Aquatic Plant Management Plan

Big and Middle McKenzie Lake

Burnett County, WI
July 2011 (Draft)

Sponsored By
McKenzie Lake Association

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Introduction

The Aquatic Plant Management Plan for Middle and Big McKenzie Lake is sponsored by the McKenzie Lakes Association. The planning phase of the project is funded, in part, by the Burnett County Land and Water Conservation Department and the McKenzie Lake Association.

Knowing that Eurasian water milfoil (*Myriophyllum spicatum*) is found in several lakes in Burnett and Washburn County, concerned members of the Middle and Big McKenzie Lake Association authorized an extensive assessment of Middle and Big McKenzie Lake aquatic macrophytes using the Wisconsin Department of Natural Resources statewide guidelines for conducting systematic point intercept macrophyte sampling. This Aquatic Plant Management Plan for Middle and Big McKenzie Lake presents a strategy for managing aquatic plants by protecting native plant populations and preventing the establishment of invasive species. The plan includes data about the plant community, watershed, and water quality, as well as other non plant species. Based on this data and public input, goals and strategies for the sound management of aquatic plants in Middle and Big McKenzie Lake are presented. This plan will guide the Middle and Big McKenzie Lake Association, Burnett County, and the Wisconsin Department of Natural Resources in aquatic plant management for Middle and Big McKenzie Lake over the next five years (from 2012 through 2017).

Public Input for Plan Development

On June 28th, 2010, members of the Middle and Big McKenzie Lake Association met to discuss the process of creating an Aquatic Plant Management (APM) Plan. At this meeting, a tentative Aquatic Plant Advisory Committee was established. Furthermore, the recommendation of additional committee members was discussed with the assumption that additional members would be added in the near future. During this meeting a date was established (July 31st, 2010) to hold a kick-off meeting. An announcement was sent to each lake home resident informing them about the meeting, including time and location. Also, an announcement was placed in the local paper three weeks prior to the event that included information pertaining to the meeting. Additionally, at the first meeting, those present reviewed aquatic plant management planning requirements and discussed initial concerns.

On July 31st, 2010, a Public meeting was held to discuss the concerns of Middle and Big McKenzie Lake and to establish those concerns as the primary focus of writing the Aquatic Plant Management Plan for the lake. Prior to the meeting date, a Public Notice was advertised for three weeks in the Spooner Advocate. A total of 30 people were present for the meeting. Minutes of the meeting were recorded. A summary of the concerns are listed below:

- Protect, prevent and control the spread of aquatic invasive species
- Control and prevent nutrient run-off/shore land preservation/restoration
- Issues concerning water flow, erosion control, septic systems/gray water
- Encouraging the growth of native plants
- Mass education on various subjects related to protecting and preserving this natural resource, including wildlife and fish species enhancement
- Boat landing inspections

A brief meeting was held immediately after the Kick-off meeting to establish a committee.

The Middle and Big McKenzie Lake Association board announced the availability of the draft Aquatic Plant Management Plan for review by September 10, 2011. Copies will be available at the following locations: Burnett County Government Center Land and Water Conservation Department Room 21, Washburn County Land and Water Conservation Department, online at the Burnett County Website, Spooner DNR Station, McKenzie Landing and from Middle and Big McKenzie Lake Aquatic Plant Management committee members. Comments and suggestions can be mailed or emailed to the address/addresses below.

Schedule for Plan Completion	October 8, 2011
Final draft for DNR and public review by	September 10,2011
Comments accepted on the plan through	September 24,2011

Send comments via mail or email to:

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Lake Information

Middle McKenzie Lake (WBIC 27065000) is a 530 acre drainage lake located on the eastern side of Burnett County. Water clarity is good, with an average Secchi visibility of 11 feet, creating a littoral zone of 21 feet, which classifies this lake as a Mesotrophic lake. Big McKenzie Lake (WBIC 2706800 is a 1185-acre, drainage lake located in eastern side of Burnett County and the Western side of Washburn County. Water clarity is fair with an average Secchi visibility of 10ft creating a littoral zone to 18ft under normal summer conditions, which classifies this lake as a Mesotrophic lake.

Table 1: Lake Information

	Middle McKenzie Lake
Size (acres)	530
Mean depth (feet)	20
Maximum depth (feet)	45
Littoral zone depth (feet)	21

A Map of both Middle and Big McKenzie can be found on the following pages in Figure 1 2.

Figure 1: Middle McKenzie Lake Map[1]

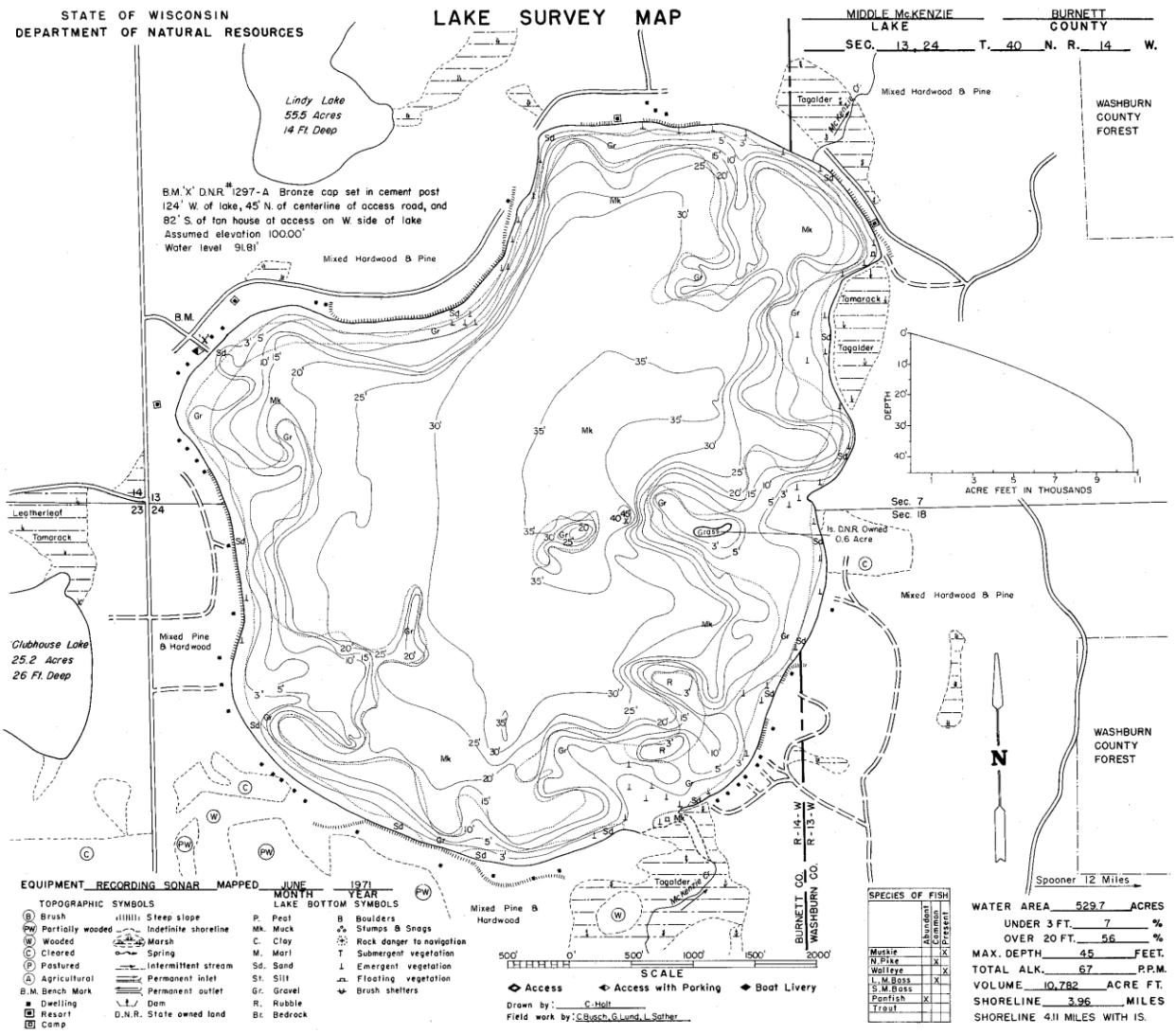
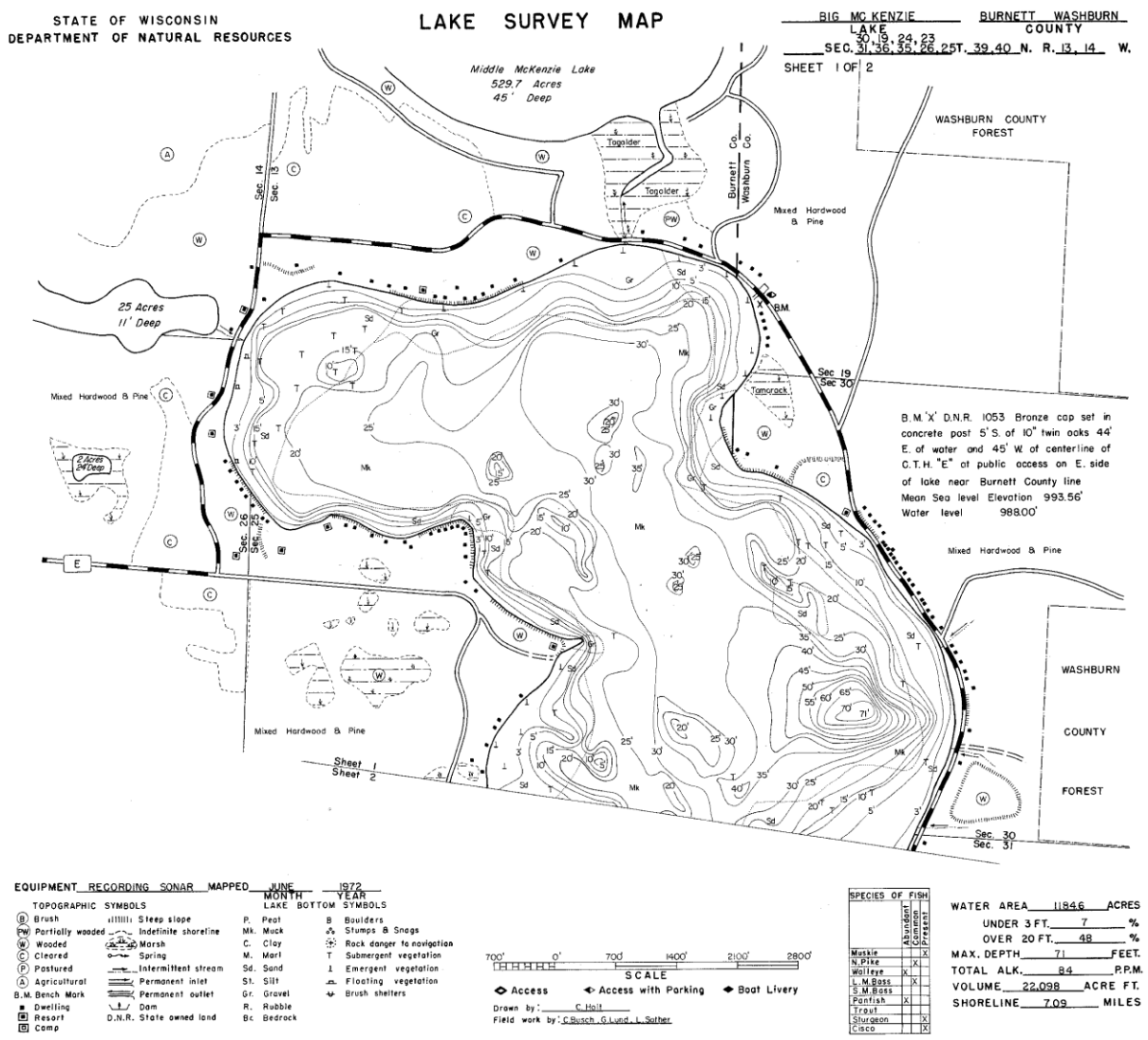


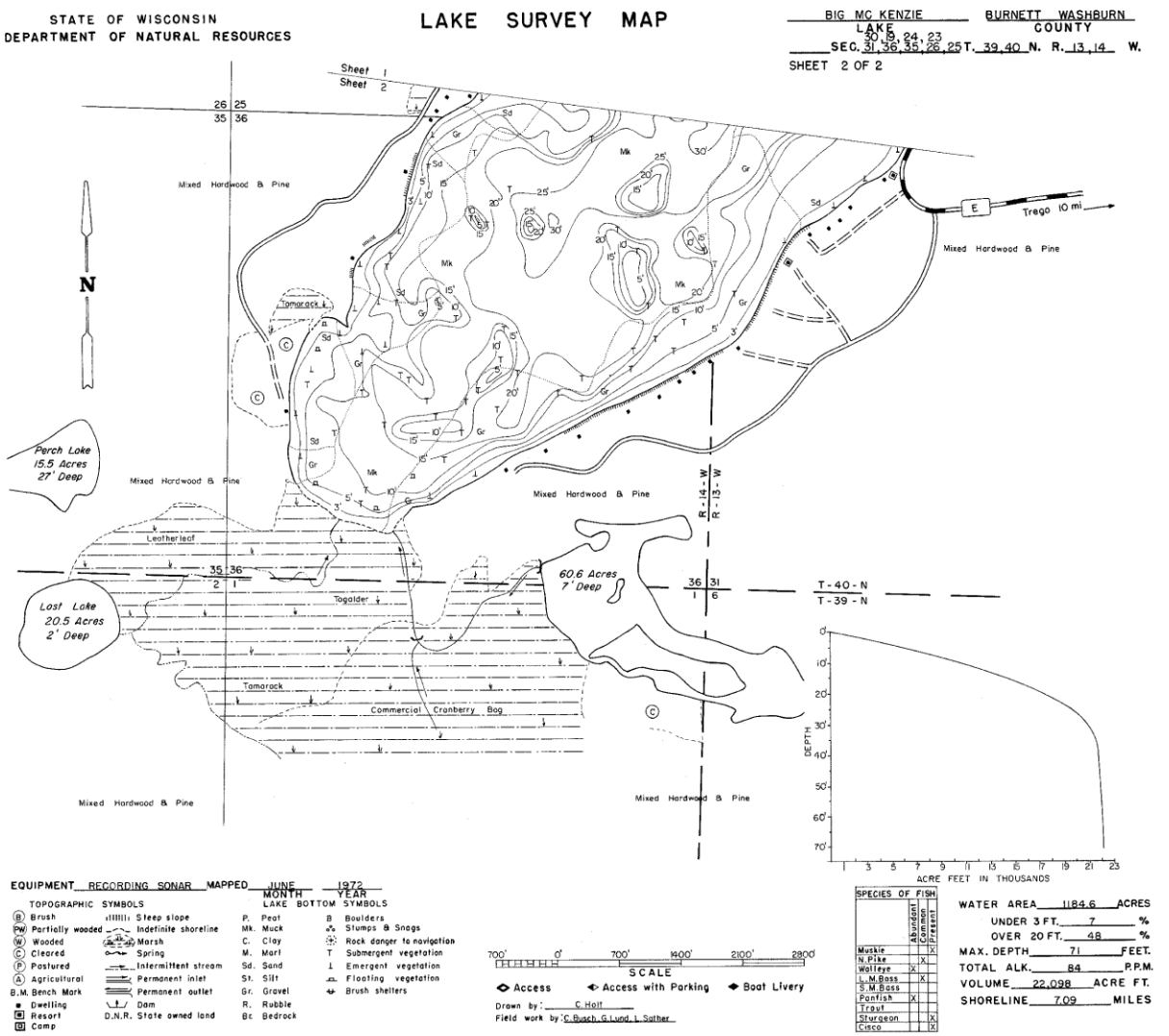
Table 2: Lake Information

	Big McKenzie Lake

Size (acres)	1185
Mean depth (feet)	19
Maximum depth (feet)	71
Littoral zone depth (feet)	18

Figure 2: Big McKenzie Lake Map[1]





Water Quality

Water quality is frequently reported by the trophic state or nutrient level of the lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.

Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes. TSI values range from 0 – 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic.

Citizen lake monitoring volunteers have collected lake data annually since 1986 on Big McKenzie. The average summer (July-Aug) secchi disk reading for Big McKenzie Lake - Deep

Hole (Washburn County, WBIC: 2706800) was 11.1 feet. The average for the Northwest Georegion was 9.8 feet.

Chemistry data was collected on Big McKenzie Lake - Deep Hole. The average summer Chlorophyll was 3.6 µg/l (compared to a Northwest Georegion summer average of 14.6 µg/l). The summer Total Phosphorus average was 20.5 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Big McKenzie Lake - Deep Hole was 44. The TSI suggests that Big McKenzie Lake - Deep Hole was **mesotrophic**. Mesotrophic lakes are characterized by moderately clear water, but have a increasing chance of low dissolved oxygen in deep water during the summer.

Data for Middle McKenzie is not as thorough as on Big McKenzie. According to the WI DNR records, Secchi readings were conducted from 1992 – 1999, except for 1996 data was not collected. Chemistry data for Middle McKenzie is not available. In 2010, Secchi readings were conducted. Chemistry data should be conducted on Middle McKenzie starting this year.

Figure 3: Secchi Readings of Middle McKenzie Lake[2]

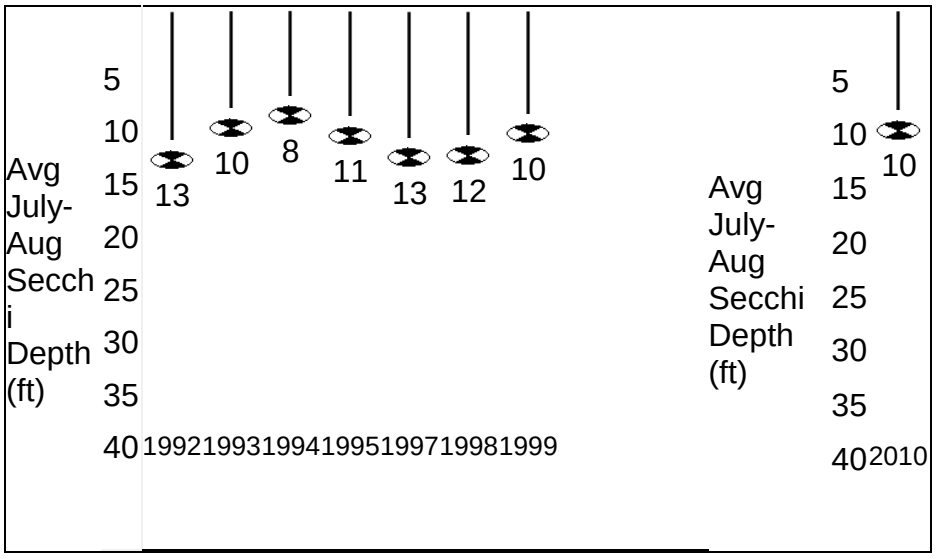


Figure 4: Trophic State Index for Middle McKenzie Deep Hole[2]

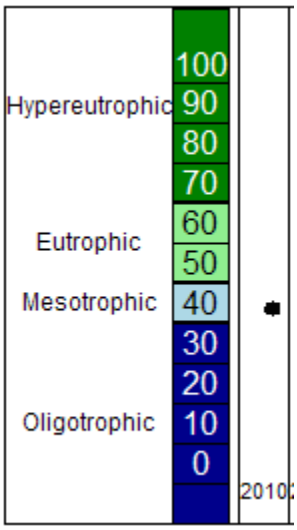


Table 3: Secchi Readings on Middle McKenzie from 1992-1998[2]

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1992	13	13	13	1
1993	9.8	8.5	11	2
1994	8.5	7	11	3
1995	10.6	7.5	13.5	4
1997	12.8	12.5	13	2
1998	12.5	12.5	12.5	1
1999	10.3	10.3	10.3	2

Table 4: Citizen Lake Monitoring[2]

	Big McKenzie Deep Hole
Number of samples, 2010	**10**
Secchi Depth (ft)	**7.15**
Total Phosphorus (µg/l)	**26.5**
Chlorophyll (µg/l)	**12.5**
Trophic State Index (TSI)	**54**
TSI Classification (based on Chl.)	**Eutrophic**

Figure 5: Secchi Readings on Big McKenzie[2]

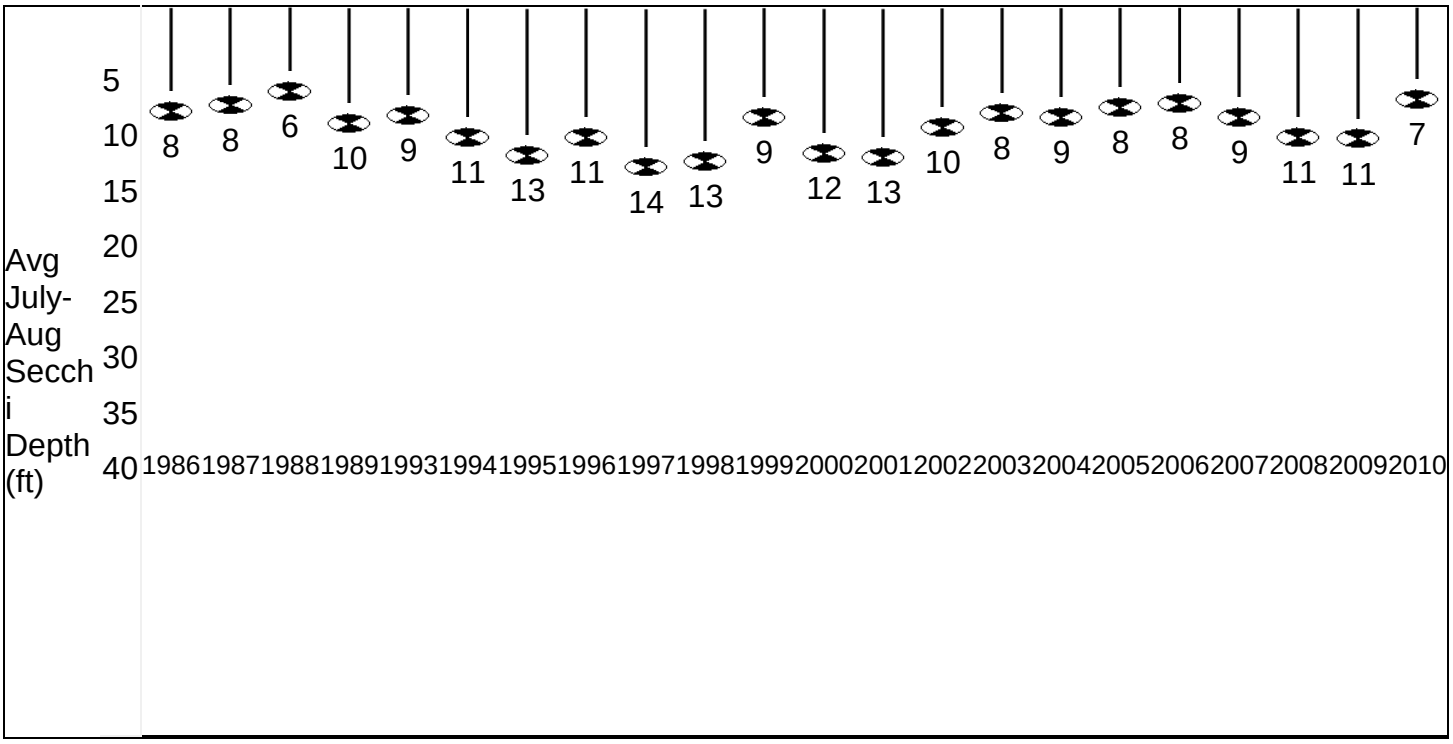
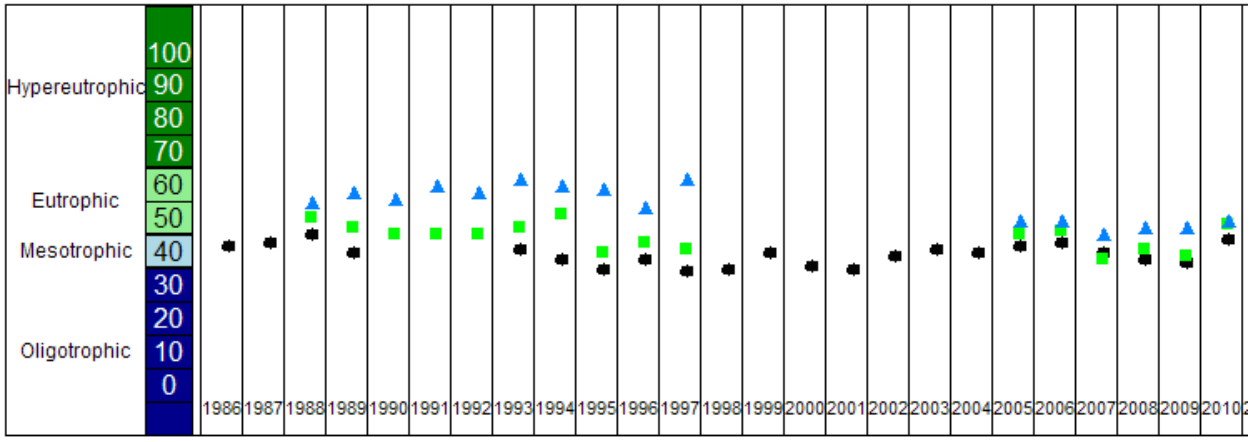


Table 5: Secchi Readings on Big McKenzie from 1986-2010[2]

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1986	8.3	6	10.5	6
1987	7.7	5	10	3
1988	6.3	4	8.5	9
1989	9.6	6.25	14	4
1993	8.8	5	13	4
1994	11	11	11	1
1995	12.8	9	15	4
1996	10.9	9.5	12.5	4
1997	14	13	15	2
1998	13.3	10	17	3
1999	9	7	12	4
2000	12.5	9	15	5
2001	13	13	13	1
2002	10	9	11	2
2003	8.5	8	9	2
2004	9	9	9	2
2005	8	5.7	11.25	3
2006	7.5	7	8	2
2007	9	9	9	1
2008	11	9.4	12.5	2
2009	11.1	10.2	12	2
2010	7.2	5	9.1	4



Monitoring Station: Big McKenzie Lake - Deep Hole, Washburn County
Past Summer (July-August) Trophic State Index (TSI) averages.

• = Secchi ■ = Chlorophyll ▲ = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI(Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI(Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI(TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI(Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

[2]

Figure 6: Trophic State Index for Big McKenzie Deep Hole[2]

Watershed

Middle and Big McKenzie Lake are part of the Lower Namekagon River Watershed (SC19). "This watershed includes the Namekagon River drainage from below the Trego Lake dam to the confluence with the St. Croix River, except for the Totagatic river drainage (SC20). Included in this area is a portion of west central Washburn County and a part of northeastern Burnett County." Big McKenzie is designated as an "outstanding resource water." Intensive water quality monitoring has been conducted on this lake since 1986 as a part of WDNR's long-term monitoring program. Middle McKenzie is also designated as an "outstanding resource water." Like Big McKenzie, Middle McKenzie also has good water quality and an excellent fishery. Figure 7 below illustrates the watershed. [4]

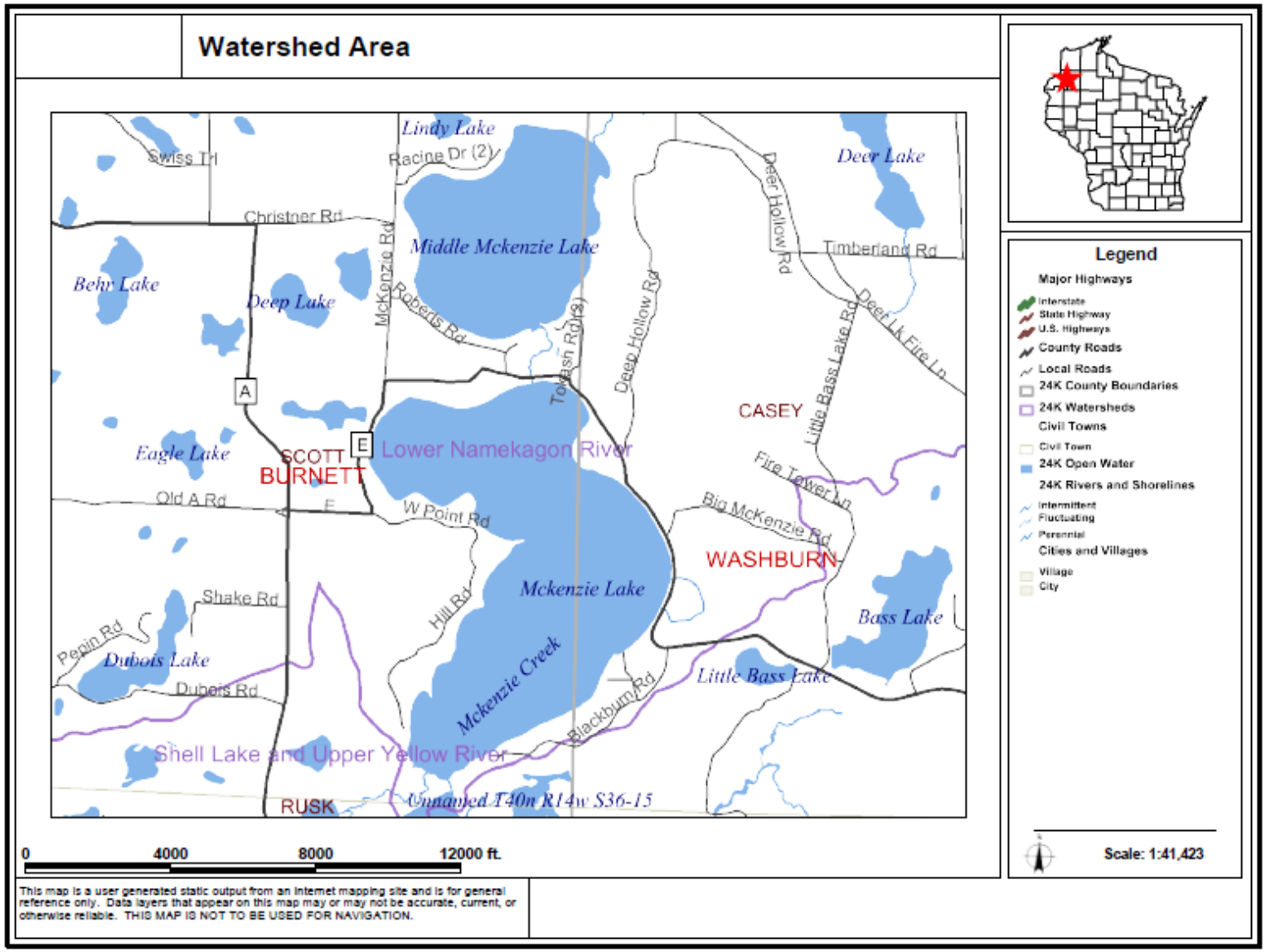


Figure 7: Lower Namekagon River Watershed[3]

3

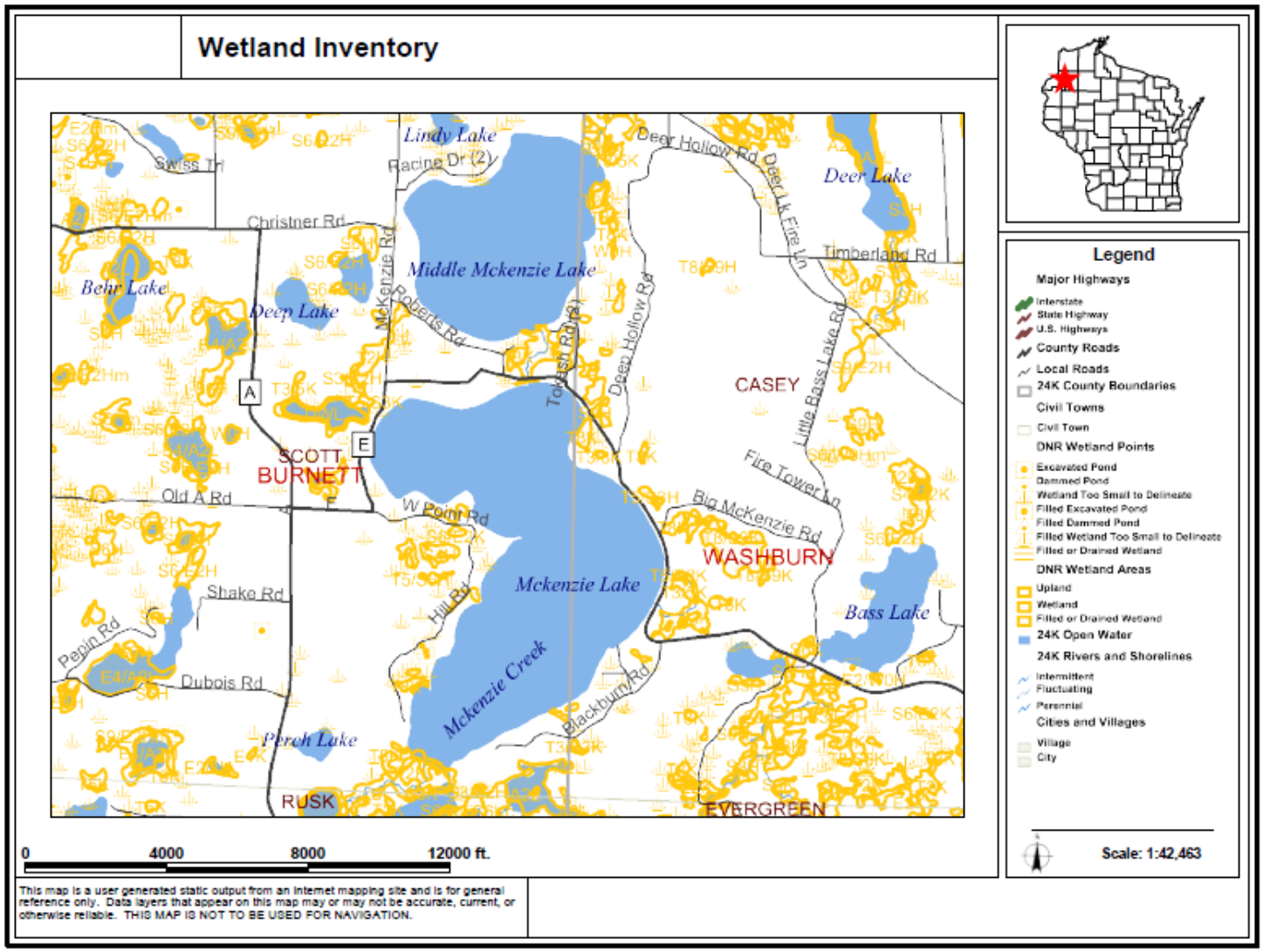


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Figure 8: DNR Designated Wetlands[3]

Watershed Runoff

Land cover plays a critical role in a watershed. The type of land cover that exists in the watershed determines the amount of phosphorus (and sediment) that runs off the land and eventually makes its way to the lake. The actual amount of pollutants (nutrients, sediment, toxins, etc.) depends greatly on how the land within the watershed is used. Vegetated areas, such as forests, grasslands, and meadows, allow the water to permeate the ground and do not produce much surface runoff. On the other hand, agricultural areas, particularly row crops, along with residential/urban areas, minimize infiltration and increase surface runoff. The increased surface runoff associated with these land cover types leads to increased phosphorus and pollutant loading; which, in turn, can lead to nuisance algal blooms, increased sedimentation, overabundant macrophyte populations, and decreased dissolved oxygen levels.[5] Land that is maintained in a natural, vegetated state is beneficial to soil and water quality.

A 2002 State of the St. Croix River Basin report, identified four key priorities for the basin, all of which are directly associated with water quality:[4]

1. Protection and restoration of shoreland habitat
2. Control of nonpoint source runoff contamination of surface waters
3. Restoration of grasslands, prairies, and wetlands to protect soil and water quality, and to enhance wildlife habitat
4. Implementation of a Northwest Sands Integrated Ecosystem Management Plan

Below is a list of Land Cover Classifications and percentages for each found in the St. Croix Basin(see St. Croix Basin Land Cover Map 2), followed by a short discussion of the major land cover types.

Table 6: Land Cover Classification found in the St. Croix Basin[4]

Forest -	48.01%
Grassland -	16.64%
Wetland -	14.02%
Agriculture-	12.85%
Water-	4.55%
Shrubland-	3.18%
Urban/Developed-	0.43%
Barrens-	0.32%

The majority of Burnett County's land cover is made up of forest, while grassland, open water and wetlands make up approximately one-third. Figure 9 below represents the land cover of the Lower Namekagon River Watershed.

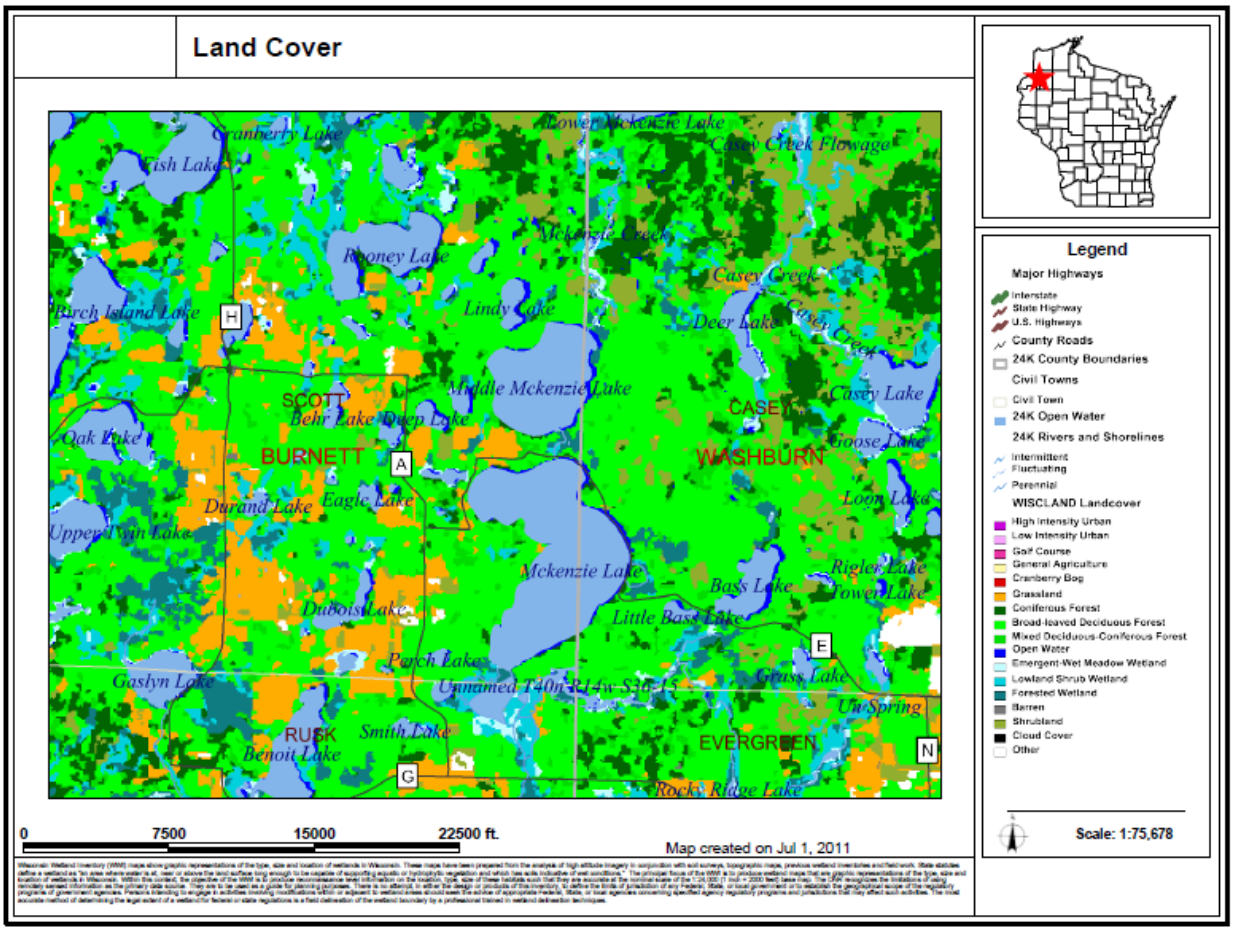


Figure 9: Lower Namekagon River Watershed Land Cover[3]

Aquatic Habitats

Primary Human Use Areas

The number of lake homes on Big McKenzie and Middle McKenzie; are,

Big McKenzie Lake, Washburn County	94
Big McKenzie Lake, Burnett County	139
Middle McKenzie Lake, Washburn County	17
Middle McKenzie Lake, Burnett County	102

There are also some "friends of the lake"; some cabins with deeded shared access to the lake not in the above count. Carson Rd on Middle McKenzie, Burnett County (Carson Estates), 7 cabins.

Hwy E on Big McKenzie, Washburn County (McKenzie Pines), only 2 cabins so far but a potential of 9.

Functions and Values of Native Aquatic Plants

Naturally occurring native plants are extremely beneficial to the lake. They provide a diversity of habitats, help maintain water quality, sustain fish populations, and support common lakeshore wildlife such as loons and frogs.

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algal growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent re-suspension of sediments from the lake bottom. Stands of emergent plants (whose stems protrude above the water surface) and floating plants help to blunt wave action and prevent erosion of the shoreline. The shoreline plant populations around Big and Middle McKenzie Lake are particularly important to reducing erosion along the shoreline, but these populations are also vulnerable to the nutrient loading and the resultant algae growth in the lakes.

Fishing

Habitat created by aquatic plants provides food and shelter for both young and adult fish. Invertebrates living on or beneath plants are a primary food source for many species of fish. Other fish such as bluegills graze directly on the plants themselves. Plant beds, such as bulrush present on both Big and Middle McKenzie Lake, provide important spawning habitat for many fish species.

Waterfowl

Plants offer food, shelter, and nesting material. Birds eat both the invertebrates that live on plants and the plants themselves.[6]

Protection against Invasive Species

Non-native invasive species threaten native plants in Northern Wisconsin. The most common are Eurasian water milfoil (EWM) and curly leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in the lake bottom where native plants have been removed. Without competition from other plants, these invasive species may successfully become established in the lake. This concept of opportunistic invasion can also be observed on land, in areas where bare soil is quickly taken over by weeds.

Removal of native vegetation not only diminishes the natural qualities of a lake, but it increases the risk of non-native species invasion and establishment. Invasive species can change many of the natural features of a lake and often lead to expensive annual control plans. Allowing native plants to grow may not guarantee protection against invasive plants, but it can discourage their establishment. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.[7]

Aquatic Invasive Species Status

Purple loostrife (Lythrum salicaria), reed canary grass (Phalaris arundinacea), and curly leaf pondweed (Potamogeton crispus) have been observed on both Big and Middle McKenzie Lake. No Eurasian water milfoil (Myriophyllum spicatum) was found on the lake, but it has been found in three nearby lakes in Burnett County: Ham Lake, Round Lake and Trade Lake. It is therefore of paramount importance that the McKenzie Lake Association takes measures to avoid the introduction of EWM into the lake.

Sensitive Areas

The Wisconsin Department of Natural Resources has completed sensitive area surveys to designate areas within aquatic plant communities that provide important habitat for game fish, forage fish, macroinvertebrates, and wildlife, as well as important shoreline stabilization functions. The Department of Natural Resources is transitioning to designations of critical habitat areas that include both sensitive areas and public rights features. The critical habitat area designation will provide a holistic approach to ecosystem assessment and protection of those areas within a lake that are most important for preserving the very character and qualities of the lake.

Two other species of interest exist in Big McKenzie Lake: Chinese mystery snails (*Bellamya chinensis*) and Banded Mystery Snails (*Viviparus georgianus*). At this time, no negative effects to the aquatic plant community have been observed. Future monitoring of these three species should continue to ensure a healthy population of native aquatic plants.

Critical habitat areas include sensitive areas that offer critical or unique fish and wildlife habitat (including seasonal or lifestage requirements) or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)). The Wisconsin Department of Natural Resources is given the authority for the identification and protection of sensitive areas of the lakes. Public rights features are areas that fulfill the right of the public for navigation, quality and quantity of water, fishing, swimming, or natural scenic beauty. Protecting these critical habitat areas requires the protection of shoreline and in-lake habitat. The critical habitat area designation will provide a framework for management decisions that impact the ecosystem of the lake.

Both Big and Middle McKenzie have been designated as having critical habitat areas (see Figure 10 below). Also, see Appendix A for a detailed summary of the Critical Habitat Designation Program Rule Summary.

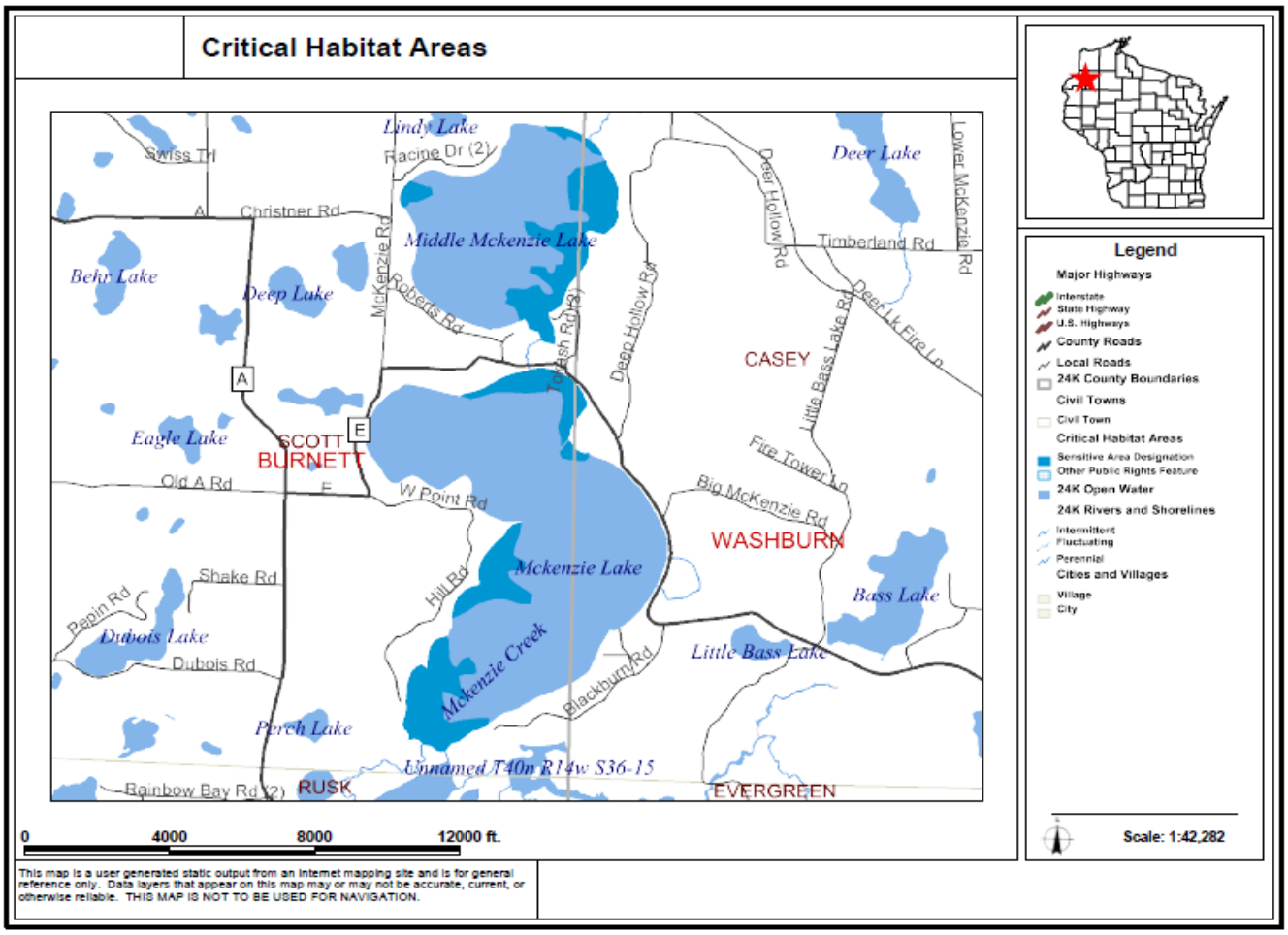


Figure 10: Critical Habitat Areas for Big and Middle McKenzie [3]

Rare and Endangered Species Habitat

Big and Middle McKenzie Lake is located in Scott Township (T.40N. – R.14W. & T.40N. – R.13W.). Within each township, the Wisconsin Natural Heritage Inventory lists species that are considered threatened, endangered, or of special concern (see Table 6 below). Due to the fact that the listing is for Scott Township in general, specific details for Big and Middle McKenzie Lake are unknown. Table 6 and 7 list the known rare and endangered species in and around Big and Middle McKenzie Lake.

Table 7: Natural Heritage Inventory (NHI) Species Found in Big McKenzie Lake Area (T.40N. – R.14W.)[8]

Common Name	Scientific Name	WI State Status
Gray Wolf	*Canis lupus*	SC/FL
Blanding's Turtle	*Emydoidea blandingii*	THR
Least Darter	*Etheostoma microperca*	SC/N
Banded Killifish	*Fundulus diaphanus*	SC/N
Bald Eagle	*Haliaeetus leucocephalus*	SC/P
Osprey	*Pandion haliaetus*	THR
Slender Bulrush	*Scirpus heterochaetus*	SC
Northeastern Bladderwort	*Utricularia resupinata*	SC

Table 8: Natural Heritage Inventory (NHI) Species Found in Middle McKenzie Lake Area (T.40N. – R.13W.)[8]

Common Name	Scientific Name	WI State Status
Elktoe	*Alasmidonta marginata*	SC/P
Gray Wolf	*Canis lupus*	SC/FL
Purple Wartyback	*Cyclonaias tuberculata*	END
Blanding's Turtle	*Emydoidea blandingii*	THR
Least Darter	*Etheostoma microperca*	SC/N
Pygmy Snaketail	*Ophiogomphus howei*	THR
Round Pigtoe	*Pleurobema sintoxia*	SC/P

WDNR and federal regulations regarding Special Concern species range from full protection to no protection. The current categories and their respective level of protection are as follows:

Key: **END** = endangered **SC/P** = fully protected
THR = threatened **SC/N** = no laws regulating use, possession, or harvesting
SC = Special Concern **SC/H** = take regulated by establishment of open /closed seasons

SC/FL = Federally protected as endangered or threatened, but not so designated by state
SC/M = fully protected by federal and state laws under the Migratory Bird Act

Big and Middle McKenzie Lake Fishery

Table 9: Middle McKenzie Lake Fish Species List

Common Name	Scientific Name	Relative Abundance
Gamefish		
Walleye	Sander vitreum	Present
Northern pike	Esox lucius	Abundant
Muskellunge	Esox masquinongy	Present
Largemouth bass	Micropterus salmoides	Abundant
Smallmouth Bass	Micropterus dolomieui	Rare
Panfish		
Bluegill	Lepomis macrochirus	Abundant
Black crappie	Pomoxis nigromaculatus	Abundant
Pumpkinseed	Lepomis gibbosus	Abundant
Rock bass	Amblopites rupestris	Common
Yellow perch	Perca flavecens	Common
Black bullhead	Ameiurus melas	Present
Brown bullhead	Ictalurus nebulosus	Present
Yellow bullhead	Ictalurus natalis	Present
Forage and other species		
Bowfin	Amia calva	Common
White sucker	Catostomus commersoni	Common
Golden shiner	Notemigonus crysoleucas	Present
Common shiner	Notropis cornutus	Common

Blacknose shiner	Notropis heterolepis	Common
Blackchin shiner	Notropis heterodon	Common
Iowa darter	Etheostoma exile	Present
Johnny darter	Etheostoma nigrum	Common
Brook silverside	Labidesthes sicculus	Abundant
Bluntnose minnow	Pimephales notatus	Abundant
Tadpole madtom	Noturus gyrinus	Present
Greater redhorse	Moxostoma valenciennesi	Present
Logperch	Percina caprodes	Common
Mimic shiner	Notropis volucellus	Common
Ozark minnow	Notropis nubilus	Present
Spottail shiner	Notropis hudsonius	Common

Table 10: Big McKenzie Lake Fish Species List

Common Name	Scientific Name	Relative Abundance
Gamefish		
Walleye	Sander vitreum	Present
Northern pike	Esox lucius	Common
Muskellunge	Esox masquinongy	Present
Largemouth bass	Micropterus salmoides	Abundant
Smallmouth bass	Micropterus dolomieui	Rare
Panfish		
Bluegill	Lepomis macrochirus	Abundant
Black crappie	Pomoxis nigromaculatus	Abundant
Pumpkinseed	Lepomis gibbosus	Common

Rock bass	Amblopites rupestris	Common
Yellow perch	Perca flavecens	Common
Black bullhead	Ameiurus melas	Present
Brown bullhead	Ictalurus nebulosus	Present
Yellow bullhead	Ictalurus natalis	Present
Forage and other species		
Bowfin	Amia calva	Common
White sucker	Catostomus commersoni	Common
Golden shiner	Notemigonus crysoleucas	Present
Common shiner	Notropis cornutus	Abundant
Blacknose shiner	Notropis heterolepis	Present
Blackchin shiner	Notropis heterodon	Abundant
Iowa darter	Etheostoma exile	Present
Johnny darter	Etheostoma nigrum	Common
Brook silverside	Labidesthes sicculus	Common
Bluntnose minnow	Pimephales notatus	Abundant
Tadpole madtom	Noturus gyrinus	Present
Spottail shiner	Notropis hudsonius	Present

Plant Community

METHODS:

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth and total lake acres, Michelle Nault (WDNR) generated a sampling grid for Middle McKenzie Lake and Big McKenzie Lake (Figure 12). In May, we conducted a Curly-leaf pondweed survey to check for the presence of this invasive species. During this survey, we went to each of the 631 points on Middle McKenzie and 1011 points on Big McKenzie. We sampled just for Curly-leaf pondweed at each site. This type of survey should result in both detection and approximate mapping of any infestation that may have occurred.

During the May survey, a general idea for the lake and plant communities was established. All plants found were identified (Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2006), and two vouchers were pressed and retained for herbarium specimens – one to be retained by the McKenzie Lake Association, and one to be sent to the state for identification confirmation. During the point intercept survey, we located each survey point using a handheld mapping GPS unit (Garmin 76CSx). At each point, we recorded a depth reading with a Hummingbird depth finder unit. Following the establishment of the littoral zone at a maximum of 21ft (middle McKenzie), and 18ft for Big McKenzie. We sampled for plants within the depth range of plant growth. At each of these points, we used a rake (either on a pole or a throw line depending on depth) to sample an approximately 2.5ft. section of the bottom. All plants on the rake, as well as any that were dislodged by the rake were identified, and assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of plants within six feet of the sample point. Substrate (lake bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

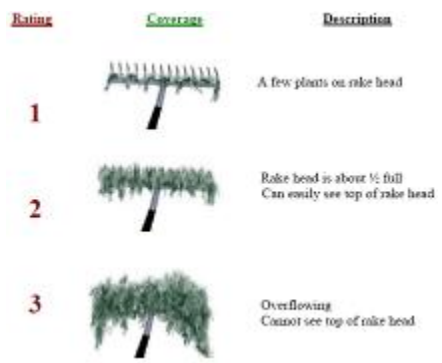


Figure 11: Rake Fullness Ratings (UWEX, 2007)

DATA ANALYSIS:

We entered all data collected into the standard APM spreadsheet (UWEX, 2007). From this, we calculated the following:

Total number of points sampled: This included the total number of points on the lake coverage that were within the littoral zone (0-maximum depth where plants are found) Initially, we continued to sample points whose depth were several feet beyond the littoral zone, but once we established this maximum depth with confidence, most points beyond this depth were not rake sampled.

Total number of sites with vegetation: These included all sites where we found vegetation after doing a rake sample. For example, if 20% of all sample sites have vegetation, it suggests that 20% of the lake has plant coverage.

Total number of sites shallower than the maximum depth of plants: This is the number of sites that are in the littoral zone. Because not all sites that are within the littoral zone actually have vegetation, we use this value to estimate how prevalent vegetation is throughout the littoral zone. For example, if 60% of the sites shallower than the maximum depth of plants have vegetation, then we estimate that 60% of the lake's littoral zone has plants.

Frequency of occurrence: The frequency of all plants (or individual species) is generally reported as a percentage of occurrences at all sample points. It can also be reported as a percentage of occurrences at sample points within the littoral zone.

Frequency of occurrence example:

Plant A is sampled at 70 out of 700 total points = 70/700 = .10 = 10%
This means that Plant A's frequency of occurrence = 10% considering the entire lake sample.

Plant A is sampled at 70 out of 350 total points in the littoral zone = 70/350 = .20 = 20%
This means that Plant A's frequency of occurrence = 20% when only considering the littoral zone.

From these frequencies, we can estimate how common each species was throughout the lake, and how common the species was at depths where plants were able to grow. Note the second value will be greater as not all the points (in this example, only ½) occur at depths shallow enough for plant growth.

Simpson's diversity index: A diversity index allows the entire plant community at one location to be compared to the entire plant community at another location. It also allows the plant community at a single location to be compared over time thus allowing a measure of community degradation or restoration at that site. With Simpson's diversity index, the index value represents the probability that two individuals (randomly selected) will be different species. The index values range from 0 -1 where 0 indicates that all the plants sampled are the same species to 1 where none of the plants sampled are the same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be **more resistant** to invasion by exotic species.

Maximum depth of plants: This indicates the deepest point that vegetation was sampled. In clear lakes, plants may be found at depths of over 20ft, while in stained or turbid locations, they may only be found in a few feet of water. While some species can tolerate very low light conditions, others are only found near the surface. In general, the diversity of the plant community decreases with increased depth.

Number of sites sampled using rope/pole rake: This indicates which rake type was used to take a sample. Protocol suggests a 15ft pole rake, and a 25ft rope rake for sampling (Wagoner personal communication).

Average number of species per site: This value is reported using four different considerations. 1) **shallower than maximum depth of plants** indicates the average number of plant species at all sites in the littoral zone. 2) **vegetative sites only** indicate the average number of plants at all sites where plants were found. 3) **native species shallower than maximum depth of plants** and 4) **native species at vegetative sites only** excludes exotic species from consideration.

Species richness: This value indicates the number of different plant species found in and directly adjacent to (on the waterline) the lake. Species richness alone only counts those plants found in the rake survey. The other two values include those seen during the point intercept survey and the initial boat survey.

Mean and median depth of plants: The mean depth of plants indicates the average depth in the water column where plants were sampled. Because a few samples in deep water can skew this data, median depth is also calculated. This tells us that half of the plants sampled were in water shallower than this value, and half were in water deeper than this value.

Relative frequency: This value shows a species' frequency relative to all other species. It is expressed as a percentage, and the total of all species' relative frequency will add up to 100%. Organizing species from highest to lowest relative frequency value (Table 2) gives us an idea of which species are most important within the macrophyte community.

Relative frequency example:

Suppose that we sample 100 points and found 5 species of plants with the following results:

Plant A was located at 70 sites. Its frequency of occurrence is thus 70/100 = 70%
Plant B was located at 50 sites. Its frequency of occurrence is thus 50/100 = 50%
Plant C was located at 20 sites. Its frequency of occurrence is thus 20/100 = 20%
Plant D was located at 10 sites. Its frequency of occurrence is thus 10/100 = 10%
To calculate an individual species' relative frequency, we divide the number of sites a plant is sampled at by the total number of times all plants were sampled. In our example that would be 150 samples (70+50+20+10).

Plant A = 70/150 = .4667 or 46.67%
Plant B = 50/150 = .3333 or 33.33%
Plant C = 20/150 = .1333 or 13.33%
Plant D = 10/150 = .0667 or 6.67%

This value tells us that 46.67% of all plants sampled were Plant A.

Floristic Quality Index (FQI): This index measures the impact of human development on a lake's aquatic plants. Species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each species found in the lake. Consequently, a higher index value indicates a healthier macrophyte community. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Middle McKenzie Lake is in the Northern Lakes and Forests Ecoregion.

RESULTS:

Aquatic Plant Survey Results for Middle McKenzie Lake

An aquatic plant survey was completed for Middle McKenzie in 2010. Prior to the whole lake monitoring, a curly leaf pondweed (CLP) survey was conducted to confirm the presence of this aquatic invasive species. Since CLP grows earlier than native species, it typically dies in early July; therefore, the CLP survey is done in early June while the plant is still robust. A general boat survey was also conducted prior to the point intercept survey to gain familiarity with the lake and the plant species found on the lake. The results discussed below are taken from these two surveys.

Using a standard formula based on a lake's shoreline shape and distance, islands, water clarity, depth, and size in acres, the Wisconsin Department of Natural Resources (WDNR) generated the sampling point grid of 1011 points for Big McKenzie and 631 points for Middle McKenzie. Figure 12 below shows the locations of these sampling points.

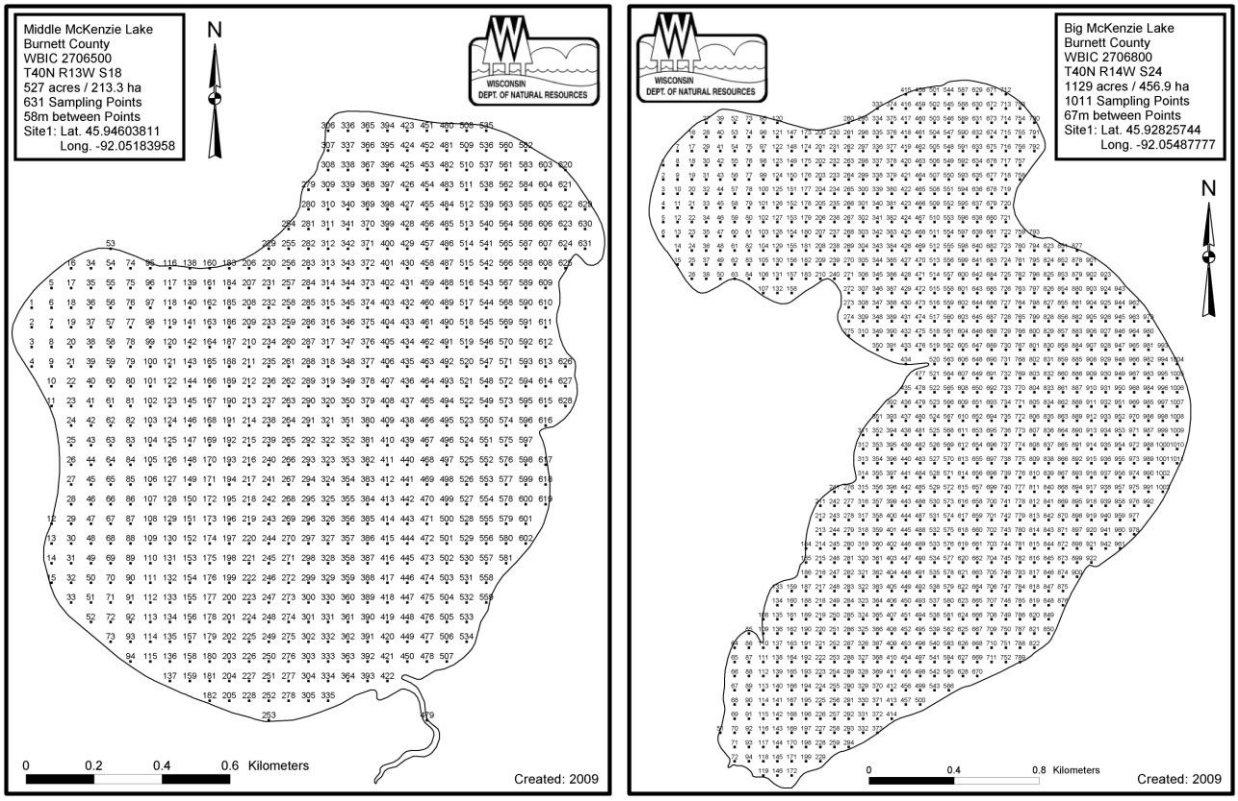


Figure 12: Big and Middle McKenzie Lake Sample Grid

Middle McKenzie survey grid comprised of 631 points. Of these points, we found plants at 271 sites in less than 21 feet of water (Figure 13: littoral zone). Areas that were shallow and had a mucky substrate supported more plants than those with sandy or rocky bottoms. Plants were found growing on approximately 33% of the entire lake bottom, and in 82.6% of the littoral zone. Diversity was very high with a Simpson Diversity Index value of 0.92. Species richness was also high with 36 total species found growing in and immediately adjacent to the lake. The majority of aquatic macrophytes were found growing in moderately deep water with an average depth of 7.06ft, and a median depth of 5.0ft. These 4-10ft areas of Middle McKenzie, especially the south bay, supported diverse weed beds that provide important underwater habitat. Tables 10, 11, and 12 summarize data from the completed survey.

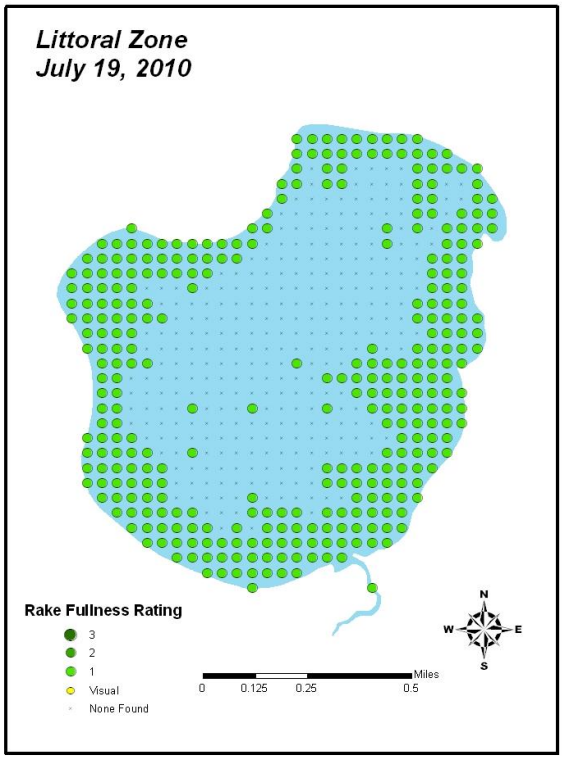
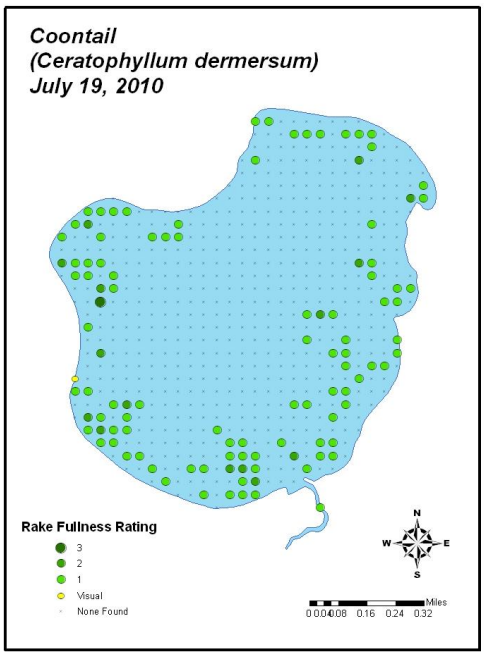
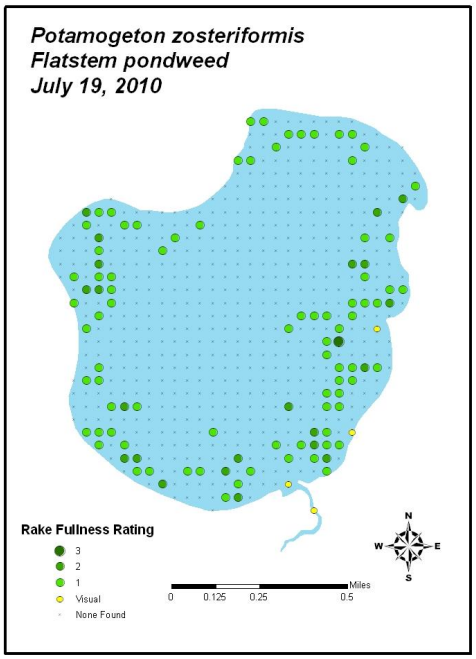
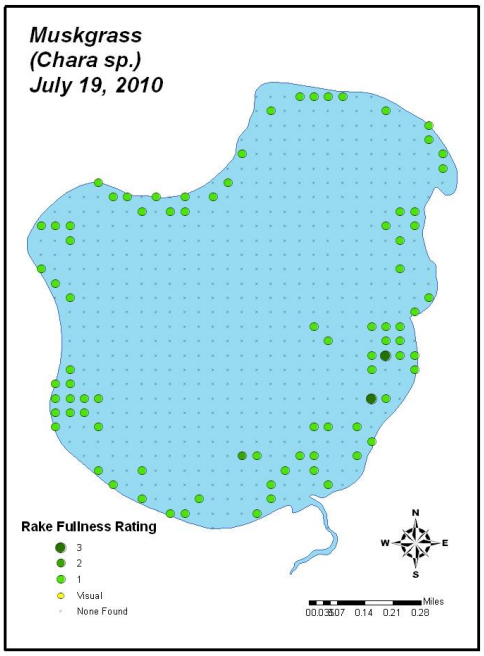


Figure 13: Middle McKenzie Littoral Zone – Region of Plant Growth

Coontail (*Ceratophyllum demersum*), Flat-stem pondweed (*Potamogeton zosteriformis*), Chara (*Chara sp.*) and Northern water-milfoil (*Myriophyllum sibiricum*) were the most common species (Table 12). We found them at 39.49, 37.68, 30.80, and 26.81% of survey points with vegetation respectively (Figure 14). All four species were widely distributed throughout the lake over muck bottoms. (Figure 14). Although many other species were widely distributed, we did not find any with a relative frequency over 13%.







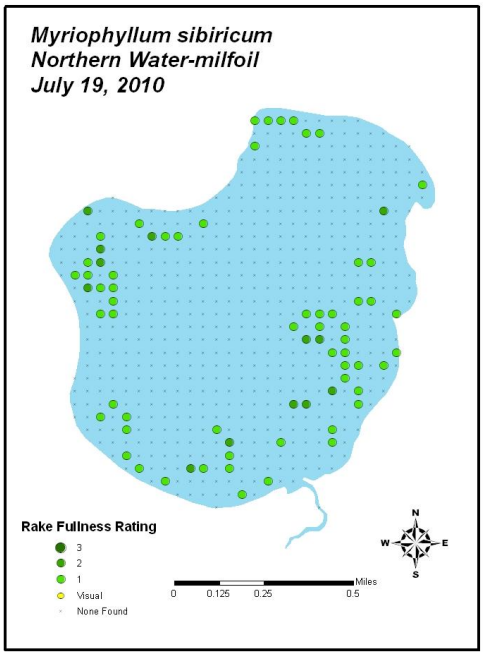


Figure 14: Middle McKenzie Most Common Species

We found Curly-leaf pondweed (CLP), an exotic invasive species; at 5 sites during the May point intercept survey (Figure 15). Plants were very sparse, and the average rake fullness rating was 1.33. During the full survey in July, we found CLP at only 3 sites and a visual spotting at the boat landing. All of the sites with Curly-leaf pondweed had a rake fullness rating of 1.00.

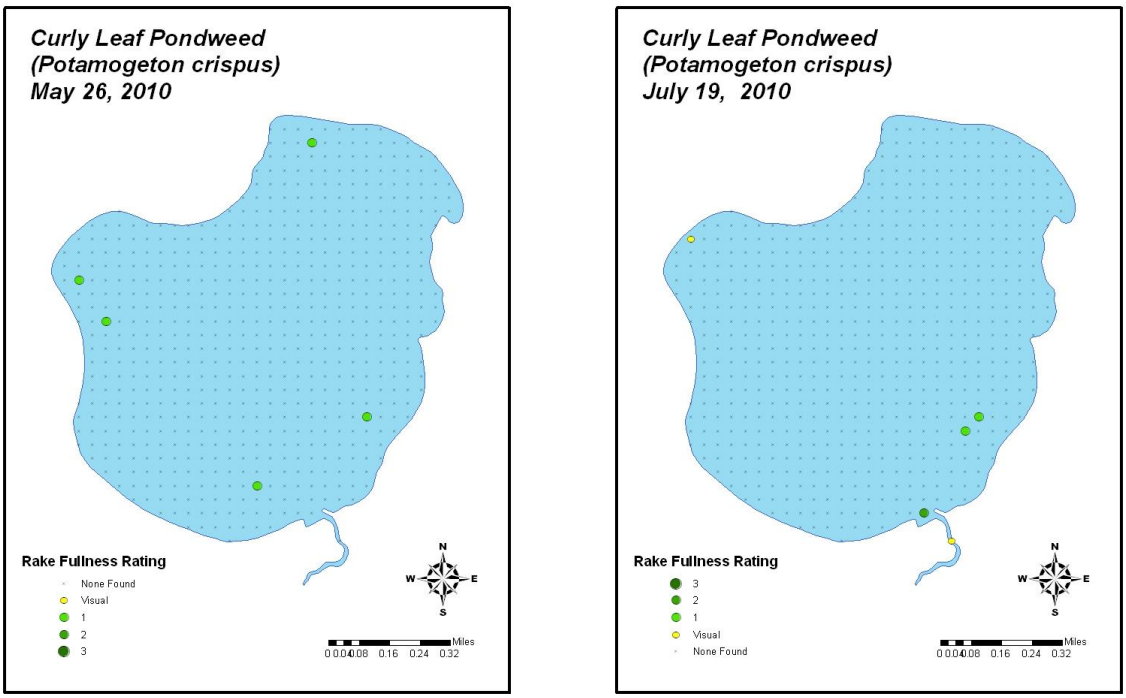


Figure 15: Curly-leaf Pondweed Distribution May and July

During the May and July survey, no Eurasian water-milfoil (*Myriophyllum sibiricum*) was detected. Several sites adjacent to the littoral zone had Reed canary grass, a common invasive species. Although we did not find any Purple loosestrife (PLS) in the littoral zone, we did find plants on Loon Island and in the creek between Middle and Big McKenzie. In the past, Galerucella beetles have been released on Loon Island and in the creek. The success of the beetles on Loon Island was limited, so in the past few years cutting and spraying efforts are being used to control PLS on the island. The amount of Purple loosestrife on the island has been greatly reduced; however, reports from this year indicate that the number of plants on the island is increasing. Last year during the survey, we had one point that we need to survey in the creek. As we navigated through the channel, we found PLS in several locations, including nearby the site we needed to sample. We discovered that there were beetles present and much damage was done to several plants. The beetles are doing their job in the creek and efforts need to be made to continue to monitor the success of the beetles. Yearly monitoring for beetles in the creek is very important.

Table 11: Middle McKenzie Lake Aquatic Macrophytes Survey Summary Statistics

Summary Statistics	
Total number of sites visited	631
Total number of sites with vegetation	271
Total number of sites shallower than maximum depth of plants	328
Frequency of occurrence at sites shallower than maximum depth of plants	82.62
Simpson Diversity Index	0.92
Maximum depth of plants (ft)**	21.00
Number of sites sampled using rake on Rope (R)	606
Number of sites sampled using rake on Pole (P)	25
Average number of all species per site (shallower than max depth)	2.42
Average number of all species per site (veg. sites only)	2.93
Average number of native species per site (shallower than max depth)	2.41
Average number of native species per site (veg. sites only)	2.93
Species Richness	30
Species Richness (including visuals)	36
Mean Depth of Plants (ft)	7.06
Median Depth of Plants (ft)	5

Table 12: Middle McKenzie Lake FQI Species and Conservatism Values

Species	Common Name	C
Bidens beckii	Water marigold	8
Ceratophyllum demersum	Coontail	3
Chara	Muskgrasses	7
Eleocharis acicularis	Needle spikerush	5
Elodea canadensis	Common waterweed	3
Isoetes sp.	Quillwort	8
Lemna minor	Small duckweed	4
Lemna trisulca	Forked duckweed	6
Littorella uniflora	Littorella	10
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum tenellum	Dwarf water-milfoil	10
Najas flexilis	Slender naiad	6
Nitella	Nitella	7
Polygonum amphibium	Water smartweed	5
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton diversifolius	Water-thread pondweed	8
Potamogeton friesii	Fries' pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton praelongus	White-stem pondweed	8
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8

Schoenoplectus acutus	Hardstem bulrush	6
Schoenoplectus pungens	Three-square bulrush	5
Schoenoplectus tabernaemontani	Softstem bulrush	4
Stuckenia pectinata	Sago pondweed	3
Vallisneria americana	Wild celery	6
N		28
mean C		6.3
FQI		33.4

Table 12: Continued

We identified a total of 28 native species in Middle McKenzie Lake. They produced a mean Coefficient of Conservation 6.3 and a Floristic Index of 33.4 (Table 11). Nichols (1999) reported an Average mean C for the Northern Lakes and Forest Region of 6.7 putting Middle McKenzie Lake slightly below average for this part of the state. However, the FQI was higher than the mean FQI of 24.3 for the Northern Lakes and Forest Region (Nichols 1999). The below average mean C is a result of having fewer than normal sensitive plants. This may be a reflection of excessive nutrients from runoff, being out competed by other more aggressive plants or good water quality and clarity are not the best conditions for plant growth (Nichols 1999). The high FQI is a result of Middle McKenzie's above average plant diversity.

Table 13: Frequencies and Mean Rake Sample of Aquatic Macrophytes Middle McKenzie Lake, Burnett County July, 2011

Scientific Name	Common Name	Total Sites	Relative Frequency (%)	Frequency of occurrence vegetated (%)	Frequency of occurrence Littoral	Mean Rake Fullness
Ceratophyllum demersum	Coontail	109	13.68	39.49	18.11	1.16
Potamogeton zosteriformis	Flat-stem pondweed	104	13.05	37.68	17.28	1.23
Chara sp.	Muskgrasses	85	10.66	30.80	14.12	1.06
Myriophyllum sibiricum	Northern water-milfoil	74	9.28	26.81	12.29	1.20
Elodea canadensis	Common waterweed	58	7.28	21.01	9.63	1.21
Potamogeton friesii	Fries' pondweed	47	5.90	17.03	7.81	1.09
Potamogeton gramineus	Variable pondweed	43	5.40	15.58	7.14	1.00
Vallisneria americana	Wild celery	42	5.27	15.22	6.98	1.00
Nitella sp.	Nitella	31	3.89	11.23	5.15	1.03
Eleocharis acicularis	Needle spikerush	30	3.76	10.87	4.98	1.00
Filamentous algae		30		10.87	4.98	1.00
Potamogeton richardsonii	Clasping-leaf pondweed	29	3.64	10.51	4.82	1.00
Potamogeton diversifolius	Water-thread pondweed	24	3.01	8.70	3.99	1.00
Najas flexilis	Slender naiad	21	2.63	7.61	3.49	1.00
Potamogeton robbinsii	Fern pondweed	21	2.63	7.61	3.49	1.05
Potamogeton amplifolius	Large-leaf pondweed	13	1.63	4.71	2.16	1.00
Bidens beckii	Water marigold	11	1.38	3.99	1.83	1.00
Potamogeton praelongus	White-stem pondweed	11	1.38	3.99	1.83	1.09
Ranunculus aquatilis	White water crowfoot	7	0.88	2.54	1.16	1.00
Stuckenia pectinata	Sago pondweed	7	0.88	2.54	1.16	1.29
Lemna trisulca	Forked duckweed	6	0.75	2.17	1.00	1.00
Isoetes sp.	Quillwort	5	0.63	1.81	0.83	1.00
Myriophyllum tenellum	Dwarf water-milfoil	5	0.63	1.81	0.83	1.00
Potamogeton crispus	Curly-leaf pondweed	3	0.38	1.09	0.50	1.33
Schoenoplectus acutus	Hardstem bulrush	3	0.38	1.09	0.50	1.00
Lemna minor	Small duckweed	2	0.25	0.72	0.33	1.00
Schoenoplectus pungens	Three-square bulrush	2	0.25	0.72	0.33	1.00
Littorella uniflora	Littorella	1	0.13	0.36	0.17	1.00
Polygonum amphibium	Water smartweed	1	0.13	0.36	0.17	1.00

Table 13: Continued

Scientific Name	Common Name	Total Sites	Relative Frequency (%)	Frequency of occurrence vegetated (%)	Frequency of occurrence Littoral	Mean Rake Fullness
Sagittaria sp.	Arrowhead	1	0.13	0.36	0.17	1.00
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.13	0.36	0.17	1.00
Bolboschoenus fluviatilis	River bulrush	**	**	**	**	**
Carex spp		**	**	**	**	**
Decodon verticillatus	Swamp loosestrife	**	**	**	**	**
Phalaris arundinacea	Reed canary grass	**	**	**	**	**
Potamogeton pusillus	Small pondweed	**	**	**	**	**
Solanum dulcamara	Nightshade	**	**	**	**	**

** Visual sighting only

Aquatic Plant Survey Results for Big McKenzie Lake

An aquatic plant survey was completed for Big McKenzie in 2010. Big McKenzie survey grid comprised of 1011 points. Of these points, we found plants at 440 sites in less than 18 feet of water (Figure 16: Littoral Zone). Areas that were shallow and had a mucky substrate supported more plants than those with sandy or rocky bottoms. Plants were found growing on approximately 34.5% of the entire lake bottom, and in 87.3% of the littoral zone. Diversity was very high with a Simpson Diversity Index value of 0.91. Species richness was also high with 40 total species found growing in and immediately adjacent to the lake. The majority of aquatic macrophytes were found growing in moderately deep water with an average depth of 8.2ft, and a median depth of 7.0ft. These 4-10ft areas of Middle McKenzie, especially the northwest and south bay, supported diverse weed beds that provide important underwater habitat. Tables 13, 14, and 15 summarize data from the completed survey.

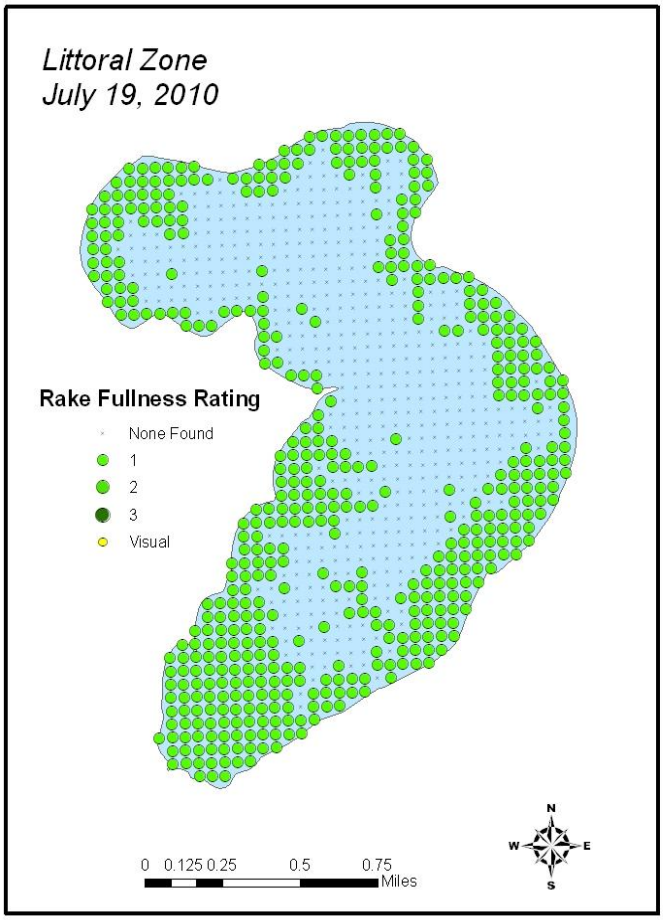


Figure 16: Littoral Zone – Region of Plant Growth

Table 14: Big McKenzie Lake Aquatic Macrophytes Survey Summary Statistics

Summary Statistics	
Total number of sites visited	**1011**
Total number of sites with vegetation	**440**
Total number of sites shallower than maximum depth of plants	**504**
Frequency of occurrence at sites shallower than maximum depth of plants	**87.30**
Simpson Diversity Index	**0.91**
Maximum depth of plants (ft)**	**18.00**
Number of sites sampled using rake on Rope (R)	**503**
Number of sites sampled using rake on Pole (P)	**1**
Average number of all species per site (shallower than max depth)	**2.44**
Average number of all species per site (veg. sites only)	**2.80**
Average number of native species per site (shallower than max depth)	**2.44**
Average number of native species per site (veg. sites only)	**2.79**
Species Richness	**29**
Species Richness (including visuals)	**40**
Mean Depth of Plants (ft)	**8.2**
Median Depth of Plants (ft)	**7**

Coontail (*Ceratophyllum demersum*), Small pondweed (*Potamogeton pusillus*), Flat-stem pondweed (*Potamogeton* zosteriformis) and Chara (*Chara sp.*) were the most common species (Table 14). We found them at 40.45, 39.09, 35.23, and 29.55% of survey points with vegetation respectively (Figure 17). All four species were widely distributed throughout the lake over muck bottoms. (Figure 17). Although many other species were widely distributed, we did not find any with a relative frequency over 14%.

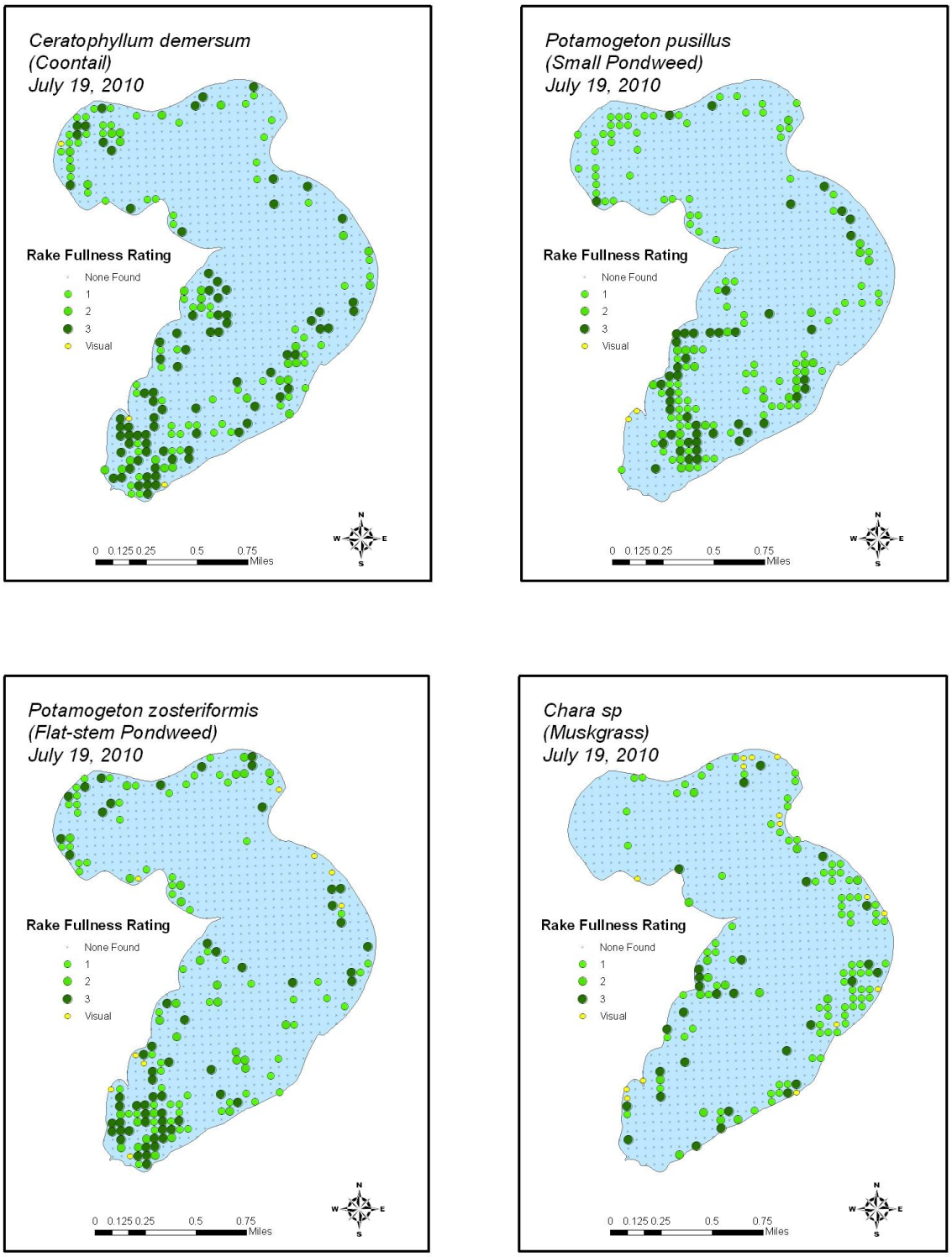


Figure 17: Big McKenzie Lake Most Common Species

Table 15: Frequencies and Mean Rake Sample of Aquatic Macrophytes Big McKenzie Lake, Burnett County July, 2011						
Scientific Name	**Common Name**	**Total Sites**	**Relative Frequency (%)**	**Frequency of occurrence vegetated (%)**	**Frequency of occurrence Littoral**	**Mean Rake Fullness**
Ceratophyllum demersum	Coontail	178	14.47	40.45	35.32	2.07
Potamogeton pusillus	Small pondweed	172	13.98	39.09	34.13	1.68
Potamogeton zosteriformis	Flat-stem pondweed	155	12.60	35.23	30.75	1.95
Chara sp.	Muskgrasses	130	10.57	29.55	25.79	1.56
Myriophyllum sibiricum	Northern water-milfoil	118	9.59	26.82	23.41	2.23
Vallisneria americana	Wildcelery	92	7.48	20.91	18.25	1.50
Elodea canadensis	Common waterweed	90	7.32	20.45	17.86	1.88
Potamogeton gramineus	Variable pondweed	50	4.07	11.36	9.92	1.14
Potamogeton illinoensis	Illinois pondweed	46	3.74	10.45	9.13	1.67
Najas flexilis	Slender naiad	43	3.50	9.77	8.53	1.12
Potamogeton richardsonii	Clasping-leaf pondweed	28	2.28	6.36	5.56	1.43
Eleocharis acicularis	Needle spikerush	27	2.20	6.14	5.36	1.41
Myriophyllum tenellum	Dwarf water-milfoil	19	1.54	4.32	3.77	1.26
	Filamentous algae	19		4.32	3.77	1.26
Nitella sp.	Nitella	15	1.22	3.41	2.98	1.20
Ranunculus aquatilis	Whitewater crowfoot	15	1.22	3.41	2.98	1.07
Lemna trisulca	Forked duckweed	12	0.98	2.73	2.38	1.25
Potamogeton robbinsii	Fern pondweed	10	0.81	2.27	1.98	1.50
Potamogeton amplifolius	Large-leaf pondweed	8	0.65	1.82	1.59	1.50
Isoetes sp.	Quillwort	4	0.33	0.91	0.79	1.25
Sagittaria sp.	Arrowhead	3	0.24	0.68	0.60	1.00
Stuckenia pectinata	Sago pondweed	3	0.24	0.68	0.60	1.00
Bidens beckii	Water marigold	2	0.16	0.45	0.40	1.50
Elatine minima	Waterwort	2	0.16	0.45	0.40	1.00
Potamogeton crispus	Curly-leaf pondweed	2	0.16	0.45	0.40	1.00
Schoenoplectus pungens	Three-square bulrush	2	0.16	0.45	0.40	1.00
Freshwater sponge		1		0.23	0.20	1.00
Nuphar variegata	Spatterdock	1	0.08	0.23	0.20	3.00

Table 15: Continued						
Scientific Name	**Common Name**	**Total Sites**	**Relative Frequency (%)**	**Frequency of occurrence vegetated (%)**	**Frequency of occurrence Littoral**	**Mean Rake Fullness**
Nymphaea odorata	Whitewater lily	1	0.08	0.23	0.20	3.00
Potamogeton praelongus	White-stem pondweed	1	0.08	0.23	0.20	3.00
Zizania sp.	Wild rice	1	0.08	0.23	0.20	2.00
Lemna minor	Small duckweed	**	**	**	**	**
Littorella uniflora	Littorella	**	**	**	**	**
Lythrum salicaria	Purple loosestrife	**	**	**	**	**
Pontederia cordata	Pickerel weed	**	**	**	**	**
Potamogeton foliosus	Leafy pondweed	**	**	**	**	**
Potamogeton natans	Floating-leaf pondweed	**	**	**	**	**
Schoenoplectus acutus	Hardstem bulrush	**	**	**	**	**
Schoenoplectus tabernaemontani	Softstem bulrush	**	**	**	**	**
Spirodela polyrhiza	Large duckweed	**	**	**	**	**
Typha angustifolia	Narrow-leaved cattail	**	**	**	**	**
Utricularia vulgaris	Common bladderwort	**	**	**	**	**
**** Visual Sighting Only**						

We found Curly-leaf pondweed (CLP), an exotic invasive species; at 114 sites during the May point intercept survey (Figure 18). Plants were very sparse in some locations and in one location a small bed was located. The bed size was approximately 1-2 acres and located near site number 112. The average rake fullness rating was 1.33. During the full survey in July, we found CLP at only 2 sites. All of the sites with Curly-leaf pondweed from the July survey had a rake fullness rating of 1.00.

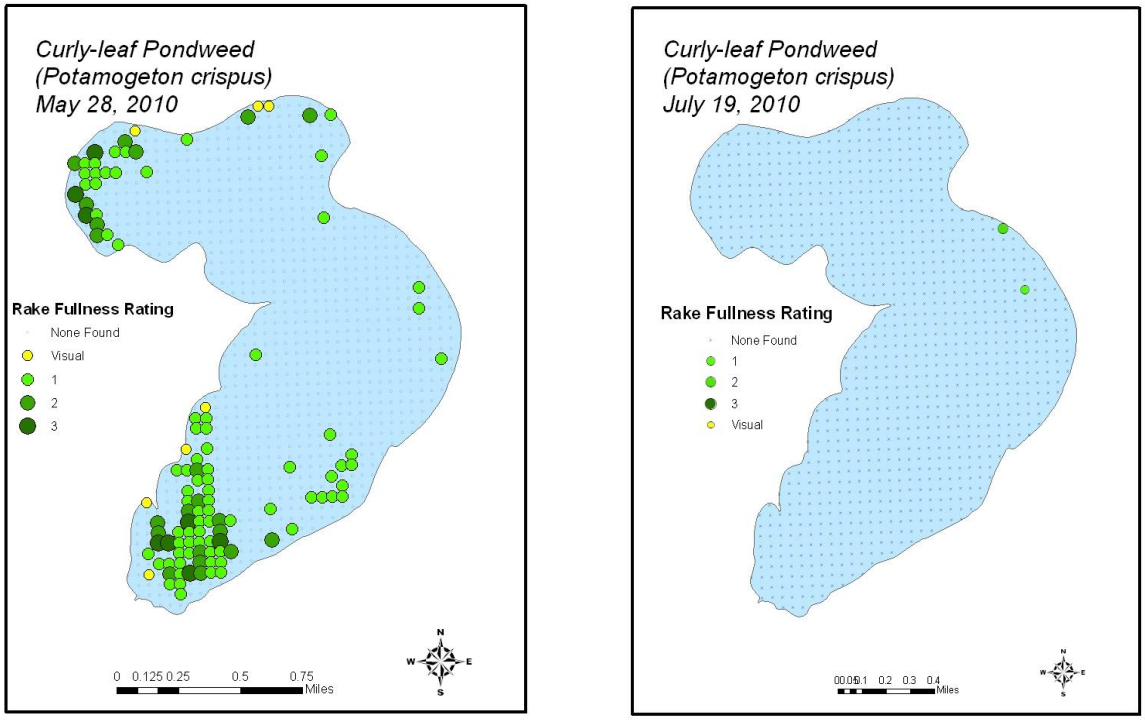


Figure 18: Curly-leaf Pondweed Distribution May and July

During the May and July survey, no Eurasian water-milfoil (*Myriophyllum sibiricum*) was detected. Several sites adjacent to the littoral zone had Reed canary grass, a common invasive species. Although we did not find any Purple loosestrife (PLS) in the littoral zone, we did find plants at several locations adjacent to the littoral zone. In the past, Galerucella beetles have been released on along Highway E from McKenzie Landing Bar and Grill to the boat landing. Also, in 2010, approximately 3,000 beetles were released in Washburn County, just east of the boat landing. The success of the beetles has been good, however this year (2011) approximately 4,000 beetles were released from the culvert, between Big and Middle McKenzie, to the public boat landing. In the past, beetles have been present along this stretch of lake; however this spring, during our annual site visits, we noticed a reduction in the amount of beetles and an increase in the number of plants. Therefore, it was decided to release more beetles at this location. We

discovered during our site visits this spring (2011) that there were beetles present and much damage was done to several plants in those areas where beetles have been released in the past. The beetles are reducing and controlling the amount of Purple loosestrife on Big McKenzie, however, efforts need to be made to continue to monitor the success of the beetles.

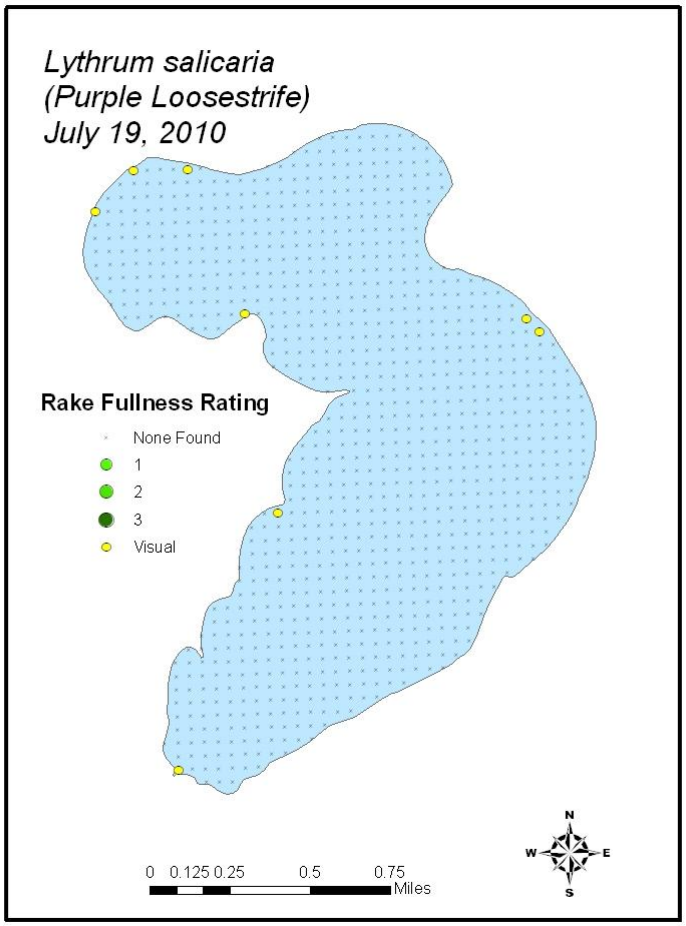


Figure 19: Purple Loosestrife Locations on Big McKenzie

We identified a total of 27 native species in Big McKenzie Lake. They produced a mean Coefficient of Conservation 6.4 and a Floristic Index of 33.49 (Table 15). Nichols (1999) reported an Average mean C for the Northern Lakes and Forest Region of 6.7 putting Big McKenzie Lake slightly below average for this part of the state. However, the FQI was higher than the mean FQI of 24.3 for the Northern Lakes and Forest Region (Nichols 1999). The below average mean C is a result of having fewer than normal sensitive plants. This may be a reflection of excessive nutrients from runoff, being out competed by other more aggressive

plants or good water quality and clarity are not the best conditions for plant growth (Nichols 1999). The high FQI is a result of Big McKenzie's above average plant diversity.

Table 16: Big McKenzie Lake FQI Species and Conservatism Values

Species	Common Name	C
Bidens beckii	Water marigold	8
Ceratophyllum demersum	Coontail	3
Chara	Muskgrasses	7
Elatine minima	Waterwort	9
Eleocharis acicularis	Needle spikerush	5
Elodea canadensis	Common waterweed	3
***Isoetes* sp.**	Quillwort	8
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum tenellum	Dwarf water-milfoil	10
Najas flexilis	Slender naiad	6
Nitella	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton gramineus	Variable pondweed	7
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Schoenoplectus pungens	Three-square bulrush	5
Stuckenia pectinata	Sago pondweed	3
Vallisneria americana	Wild celery	6
***Zizania* sp.**	Wild rice	8
N		27
mean C		6.4
FQI		33.49

Summary of Recommendations:

- Preserve and maintain McKenzie Lake's diverse native plant community.
- Continue to educate lakeshore owners and boaters about the importance of aquatic plants and the negative impacts AIS can have on the entire lake ecosystem.
- Preserve the lake's many rush/reed/rice beds and the lake's sensitive habitat areas.
- Whenever possible, refrain from removing native plants from the lake.
- Reduce and, wherever possible, eliminate fertilizer and pesticide applications near the lakeshore.
- Encourage shoreline restoration.
- Establish native vegetation buffer strips along the lakeshore.
- Consider transect monitoring for aquatic invasive species at and near the boat landing at least once a month during the summer months.
- Complete a full shoreline inspection in mid-August to locate and eliminate any beds Purple loosestrife plants where beetles are not present.
- Establish a Clean Boats/Clean Water program.
- Conduct Citizen Lake Monitoring for aquatic invasive species from May through October.

Aquatic Plant Management

This section reviews the potential management methods available, and reports recent management activities on the lakes. The application, location, timing, and combination of techniques must be considered carefully.

Discussion of Management Methods

Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, when plants are removed mechanically, and when plants are removed manually from an

area greater than thirty feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107 – Aquatic Plant Management. A permit is required for any aquatic chemical application in Wisconsin. Additional requirements exist when a lake is considered an ASNRI (Area of Special Natural Resource Interest) due, in the case of McKenzie Lake, to the presence of wild rice.

The requirements for manual and mechanical plant removal are described in NR 109 – Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations. A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline up to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal refers to the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power (WDNR).

Manual Removal[13]

Manual removal—hand pulling, cutting, or raking—will effectively remove plants from small areas. It is likely that plant removal will need to be repeated more than once during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants with rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for rapid response to a Eurasian water milfoil establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking is recommended to clear nuisance growth in riparian area corridors up to twenty feet wide.

SCUBA divers may engage in manual removal for invasive species like Eurasian water milfoil. Care must be taken to ensure that all plant fragments are removed from the lake. Manual removal with divers is recommended for shallow areas with sporadic EWM growth.

Mechanical Control
Larger-scale control efforts require more mechanization. Mechanical cutting, mechanical harvesting, diver-operated suction harvesting, and rotovating (tilling) are the most common forms of mechanical control available. WDNR permits under Chapter NR 109 are required for mechanical plant removal. (APIS, Army Corps of Engineers)

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from one to six feet. A conveyor belt on the cutter head brings the clippings onboard the machine for storage. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

The size, and consequently the harvesting capabilities, of these machines vary greatly. As they move, harvesters cut a swath of aquatic plants that is between 4 and 20 feet wide, and can be up to 10 feet deep. The on-board storage capacity of a harvester ranges from 100 to 1000 cubic feet (by volume) or 1 to 8 tons (by weight).

In some cases the plants are transported to shore by the harvester itself for disposal, while in other cases a barge is used to store and transport the plants in order to increase the efficiency of the cutting process. The plants are deposited on shore, where they can be transported to a local farm (the nutrient content of composted aquatic plants is comparable to that of cow manure) or to an upland landfill for proper disposal. Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate, and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are many environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area. This loss of plants results in a subsequent loss of the functions they perform, including sediment stabilization and wave absorption. Shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole.

While the enjoyed results of harvesting aquatic plants may be short term, the negative consequences are not so short lived. Much like mowing a lawn, harvesting must be conducted numerous times throughout the growing season. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures don't make their way back into the lake or to other lakes. The number of available

disposal sites and their distance from the targeted harvesting areas will determine the efficiency of the operation, in terms of time as well as cost.

Timing is also important. The ideal time to harvest, in order to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. For curly leaf pondweed, it should also be before the plants form turions to avoid spreading of the turions within the lake. If the harvesting is conducted too early, the plants will not be close enough to the surface, and the cutting will not do much damage to them. If too late, there may be too much plant matter on the surface of the lake for the harvester to cut effectively.

If the harvesting work is contracted, be sure to inspect the equipment before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines.

Diver dredging operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against the pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can result from this type of operation, but fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated more than once to be effective. When applied to a pioneering infestation, control can be complete. However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

Lake substrates play an important part in the effectiveness of a diver dredging operation. Soft substrates are very easy to work in. Divers can remove the plant and root crowns with little difficulty. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment.

Rotovation involves using large underwater rototillers to remove plant roots and other plant tissue. Rotovators can reach bottom sediments to depths of 20 feet. Rotovating may significantly affect non-target organisms and water quality as bottom sediments are disturbed. However, the suspended sediments and resulting turbidity produced by rotovation settles fairly rapidly once the tiller has passed. Tilling contaminated sediments could possibly release toxins into the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine the potential impacts from this type of treatment. Tillers do not

operate effectively in areas with many underwater obstructions such as trees and stumps. If operations are releasing large amounts of plant material, harvesting equipment should be on hand to collect this material and transport it to shore for disposal.

Biological Control[13]

Biological control is the purposeful introduction of parasites, predators, and/or pathogenic microorganisms to reduce or suppress populations of plant or animal pests. Biological control counteracts the problems that occur when a species is introduced into a new region of the world without a complex or assemblage of organisms that feed directly upon it, attack its seeds or progeny through predation or parasitism, or cause severe or debilitating diseases. With the introduction of native pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

Weevils[14]

Weevils have potential for use as a biological control agent against Eurasian water milfoil. There are several documented "natural" declines of EWM infestations. In these cases, EWM was not eliminated but its abundance was reduced enough so that it did not achieve dominance. These declines are attributed to an ample population of native milfoil weevils (Euhrychiopsis lecontei). Weevils feed on native milfoils but will shift preference over to EWM when it is present. Lakes where weevils can become an effective control have an abundance of native Northern water milfoil and fairly extensive natural shoreline where the weevils can over winter. Because native milfoils are susceptible to higher doses of herbicides, any control strategy for EWM that would also harm native milfoil may hinder the ability of this natural bio-control agent. Lakes with large bluegill populations are not good candidates for weevils because bluegills feed on the weevils. The presence and efficacy of stocking weevils in EWM lakes is being evaluated in Wisconsin lakes. So far, stocking does not appear to be effective.

The effectiveness of biocontrol efforts varies widely (Madsen, 2000). Beetles are commonly used to control Purple loosestrife populations in Wisconsin with good success. As mentioned above, weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations, but grass carp introduction is not allowed in Wisconsin.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, and plant-specific control. On the other hand there are several disadvantages to consider, including very long control times (years instead of weeks), a lack of available agents for particular target species, and relatively specific environmental conditions necessary for success.

Biological control is not without risks; new non-native species introduced to control a pest population may cause problems of its own. Biological control is not currently proposed for management of aquatic plants in McKenzie Lake, although it will be considered for Purple loosestrife control.

Re-vegetation with Native Plants

Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994). Re-vegetation following plant removal is probably not necessary on McKenzie Lakes because a healthy, diverse native plant population is present.

Physical Control[13]

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 DNR permit would be required.

Dredging removes accumulated bottom sediments that support plant growth. Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, need deepening, or require removal of toxic substances (Peterson 1982). Lakes that are very shallow due to sedimentation tend to have excess plant growth. Dredging can form an area of the lake too deep for plants to grow, thus creating an area for open water use (Nichols 1984). By opening more diverse habitats and creating depth gradients, dredging may also create more diversity in the plant community (Nichols 1984). Results of dredging can be very long term. However, due to the cost, environmental impacts, and the problem of disposal, dredging should not be performed for aquatic plant management alone. It is best used as a lake remediation technique. Dredging is not suggested for the McKenzie Lake as part of the aquatic plant management plan.

Benthic barriers or other bottom-covering approaches are another physical management technique. The basic idea is to cover the plants with a layer of a growth-inhibiting substance. Many materials have been used, including sheets or screens of organic, inorganic, and synthetic materials; sediments such as dredge sediment, sand, silt or clay; fly ash; and various combinations of the above materials (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984). The problem with synthetic sheeting is that the gasses evolved from plant and sediment decomposition collect underneath and lift the barrier (Gunnison and Barko 1992). Benthic barriers will typically kill the plants under them within 1 to 2 months, after which

time they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily affect benthic communities by removing fish and invertebrate habitat. A WDNR permit would be required for a benthic barrier.

Shading or light attenuation reduces the light plants need to grow. Shading has been achieved by fertilization to produce algal growth, by application of natural or synthetic dyes, shading fabric, or covers, and by establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are of only limited applicability. Physical control is not currently proposed for management of aquatic plants in McKenzie Lake.

Herbicide and Algaecide Treatments

Herbicides are chemicals used to kill plant tissue. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Thus, there are a limited number of active ingredients that are assured to be safe for aquatic use (Madsen, 2000).

An important caveat is that these products are considered safe when used according to the label. The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. WDNR permits under Chapter NR 107 are required for herbicide application.

General descriptions of herbicide classes are included below.[15]

Contact herbicides[16]

Contact herbicides act quickly and are generally lethal to all plant cells that they contact. Because of this rapid action, or other physiological reasons, they do not move extensively within the plant and are effective only where they contact plants directly. They are generally more effective on annuals (plants that complete their life cycle in a single year). Perennial plants (plants that persist from year to year) can be defoliated by contact herbicides, but they quickly resprout from unaffected plant parts. Submersed aquatic plants that are in contact with sufficient

concentrations of the herbicide in the water for long enough periods of time are affected, but regrowth occurs from unaffected plant parts, especially plant parts that are protected beneath the sediment. Because the entire plant is not killed by contact herbicides, retreatment is necessary, sometimes two or three times per year. **Endothall, diquat,** and **copper** are contact aquatic herbicides.

Systemic herbicides

Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides and those that are absorbed by leaves are referred to as foliar active herbicides. **2,4-D, dichlobenil, fluridone, and glyphosate** are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides. They must move to the part of the plant where their site of action is. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides. Systemic herbicides also generally have more selectivity than contact herbicides.

Broad spectrum herbicides

Broad spectrum (sometimes referred to as nonselective) herbicides are those that are used to control all or most species of vegetation. This type of herbicide is often used for total vegetation control in areas such as equipment yards and substations where bare ground is preferred. **Glyphosate** is an example of a broad spectrum aquatic herbicide. **Diquat, endothall, and fluridone** are used as broad spectrum aquatic herbicides, but can also be used selectively under certain circumstances.

Selective herbicides

Selective herbicides are those that are used to control certain plants but not others. Herbicide selectivity is based upon the relative susceptibility or response of a plant to an herbicide. Many related physical and biological factors can contribute to a plant's susceptibility to an herbicide. Physical factors that contribute to selectivity include herbicide placement, formulation, timing, and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

Environmental considerations

Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats and otters). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community, and in turn affect other

organisms or weed control operations. These operations can also impact water chemistry which may result in further implications for aquatic organisms.

Copper

Copper is a naturally occurring element that is essential at low concentrations for plant growth. It does not break down in the environment, but it forms insoluble compounds with other elements and is bound to charged particles in the water. It rapidly disappears from water after application as an herbicide. Because it is not broken down, it can accumulate in bottom sediments after repeated or high rates of application. Accumulation rarely reaches levels that are toxic to organisms or significantly above background concentrations in the sediment.

2,4-D

2,4-D photodegrades on leaf surfaces after being applied to leaves, and is broken down by microbial degradation in water and in sediments. Complete decomposition usually takes about 3 weeks in water but can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

Diquat

When applied to enclosed ponds for submersed weed control, diquat is rarely found longer than 10 days after application and is often below detection levels 3 days after application. The most important reason for the rapid disappearance of diquat from water is that it is rapidly taken up by aquatic vegetation and bound tightly to particles in the water and bottom sediments. When bound to certain types of clay particles, diquat is not biologically available. When diquat is bound to organic matter, it can be slowly degraded by microorganisms. When diquat is applied foliarly, it is degraded to some extent on the leaf surfaces by photodegradation. Because it is bound in the plant tissue, a proportion is probably degraded by microorganisms as the plant tissue decays.

Endothall

Like 2,4-D, endothall is rapidly and completely broken down into naturally occurring compounds by microorganisms. The by-products of endothall dissipation are carbon dioxide and water. Complete breakdown usually occurs in about 2 weeks in water and 1 week in bottom sediments.

Fluridone

Dissipation of fluridone from water occurs mainly by photodegradation. Metabolism by tolerant organisms and microbial breakdown also occurs, and microbial breakdown is probably the most important method of breakdown in bottom sediments. The rate of breakdown of fluridone is variable and may be related to time of application. Applications made in the fall or winter, when the sun's rays are less direct and days are shorter, result in longer half-lives. Fluridone usually disappears from pondwater after about 3 months but can remain up to 9 months. It may remain in bottom sediment between 4 months and 1 year.

Glyphosate

Glyphosate is not applied directly to water for weed control, but when it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive. Glyphosate is broken down into carbon dioxide, water, nitrogen, and phosphorus over a period of several months.

Copper Compounds

Copper-based compounds are generally used to treat filamentous algae. Common chemicals used are copper sulfate and Cutrine Plus, a chelated copper algaecide.

Herbicide Use to Manage Invasive Species

Eurasian water milfoil

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil: 2,4-D, diquat, endothall, All of these herbicides with the exception of diquat are available in both granular and liquid formulations. It is possible to target invasive species by using the appropriate herbicide and timing. The herbicide 2,4-D is most commonly used to treat EWM in Wisconsin. This herbicide kills dicots including native aquatic species such as northern water milfoil, coontail, water lilies, spatterdock, and watershield. Early season (April to May) treatment of Eurasian water milfoil is recommended to limit the impact on native aquatic plant populations because EWM tends to grow before native aquatic plants.

Granular herbicide formulations are more expensive than liquid formulations (per active ingredient). However, granular formulations release the active ingredient over a longer period of time. Granular formulations, therefore, may be more suited to situations where herbicide exposure time will likely be limited, as is the case in small bands or blocks. In large, shallow lakes with widespread EWM, a whole lake treatment with a low rate of liquid herbicide may be most cost effective because exposure time is greater. Factors that affect exposure time are size and configuration of treatment area, water flow, and wind.

Application rates for liquid and granular formulations are not interchangeable. A rate of 1 to 1.5 mg/L 2,4-D applied as a liquid is a middle rate that will require a contact time of 36 to 48 hours. Application rates recommended for Navigate (granular 2,4-D) are 100 pounds per acre for depths of 0 to 5 feet, 150 pounds per acre for 5 to 10 feet, and 200 pounds per acre for depths greater than 10 feet.

Curly leaf pondweed

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: diquat, endothall, and fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following

treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

Studies have demonstrated that curly leaf pondweed can be controlled with Aquathol K (a formulation of endothall) in 50 to 60 degree F water, and that treatments of CLP this early in its life cycle can prevent turion formation.[17] Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are still dormant, early season treatment selectively targets curly leaf pondweed. Staff from the Minnesota Department of Natural Resources and the U.S Army Engineer Research and Development Center is conducting trials of this method.

Because the dosage is at lower rates than the dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.[12]

Burnett County Land and Water Conservation (LWCD)[12]

Burnett County assists the McKenzie Lake Association in management of aquatic invasive species. They have individuals available to assist with the following tasks:

- Conduct watercraft inspection at public access points.
- Complete in-lake monitoring for EWM and other invasive species.
- Carry out public outreach and education events related to invasive species including lake meetings, fishing tournaments, county fairs, and local festivals.
- Post signs at boat landings and other public lake access points to inform residents of the new Burnett County "do not transport" ordinance.
- Train local lake residents and others to monitor their own boat landings as part of the WDNR "Clean Boats, Clean Waters" (CBCW) program.
- Train lake residents and others in Citizen Lake Monitoring, which includes CBCW, Secchi, Water Chemistry, and Aquatic Invasive Species identification.
- Assist in "rapid response" actions to identify and respond to new invasive species infestations reported by the public.
- Conduct integrated pest management for purple loosestrife control including beetle rearing and release, and offer assistance with clipping and herbicide application for individual infestations.

In-lake monitoring focuses on searching for potential establishment of Eurasian water milfoil and other aquatic invasive species at boat landings and other areas with high public use. Grab samples are taken at regular intervals at these high public use areas and at random locations around the littoral zone. All Burnett County boat landings are monitored each year.

Workshops and trainings include Clean Boats, Clean Waters training, plant identification, and whole lake monitoring workshops. Staff generally travels to local lakes to encourage participation and provide more focused training.

The Rapid Response Plans will involve a team of resource professionals from various agencies who can directly assist the lake organization in managing newly discovered invasive species and develop a plan to restore the native plant community. This Rapid Response SWAT team will assist with identifying appropriate management methods, coordinating and, in some instances, carrying out control measures, grant writing, and completing or hiring consultants to complete aquatic plant surveys and management plans.

Plan Goals and Strategies

Overall Purpose

The following section of the aquatic plant management plan is designed to discuss 5 major goals, objectives to accompany those goals and an action plan to meet the objectives set forth in the plan. Consideration is given to the audience and general time frame of action items.

Aquatic Plant Management Goals

1. Prevent the introduction and spread of aquatic invasive species.
2. Reduce and control the population of existing invasive species.
3. Educate the McKenzie Lakes community regarding aquatic plant management, management strategies found in the plan and appropriate plant management actions
4. Enhance and maintain the diverse populations of native aquatic plants.
5. Maintain and improve water quality.

Goal 1: Prevent the introduction and spread of aquatic invasive species

Objectives:

a. 100% of boaters inspect, clean, and drain boats, trailers and equipment.

b. 100% enforcement of Burnett and/or Washburn County's and the State's Do Not Transport Ordinance.

c. McKenzie Lake Association is monitoring regularly for AIS introduction.

d. McKenzie Lake Association is ready to rapidly respond to identified AIS in the lakes and river.

Actions

1. Train members of the MLA to conduct Clean Boats Clean Waters monitoring at public boat landings.

2. Work with the Burnett and Washburn County Sheriff's Department to encourage increased enforcement and potentially increased fines for the Do Not Transport Ordinance.

3. Hire a Consultant to conduct Clean Boats Clean Waters Surveys at the public boat landings on Big and Middle McKenzie.

4. Develop a rapid response plan for Eurasian water milfoil.

5. Train members of the MLA, using the Citizen Lake Monitoring Network, Aquatic Invasive Species training manual, to conduct whole lake monitoring on a yearly basis.

Goal 2: Reduce and control the population of excising invasive species.

Objective: Curly leaf pondweed exists in the Northwest and Southern bay of Big McKenzie and in few isolated locations in Middle McKenzie.
Action: Conduct a Curly-leaf survey on Big McKenzie every two years or more frequently as needed.
Action: Monitor each year through volunteers of CLMN AIS on Middle and Big McKenzie.

Objective: Minimize populations of purple loosestrife on Big and Middle McKenzie Lake.
Action: Control with beetles and cut and spray as needed. Before cutting and spraying, consult with either the Board members of the Lake Association or Burnett/Washburn County Land and Water Conservation Department for assistance.

Objective: Identify and remove purple loosestrife plants from any newly colonized area on both McKenzie Lakes.
Action: Provide information to McKenzie Lake community so they can identify purple loosestrife and they know who to contact if they have a suspected plant.
Action: Cut and spray individual plants where identification is confirmed by Lake association Board members or Burnett County or Washburn County Land and Water conservation Department.
Action: Note area where plant is sprayed and monitor in subsequent years.
Action: Monitor each year through volunteers of CLMN AIS.

NOTE: NEED TO GET INPUT FROM BRAD MORRIS, BURNETT COUNTY REGARDING MOST APPROPRIATE PLS
CONTROL METHODS FOR VARIOUS AREAS.

Goal 3: Educate the McKenzie Lakes community regarding aquatic plant management, management strategies found in the plan and appropriate plant management.

Audience: McKenzie Lake Community

A. All lake residents
B. Business owners
C. Lake users
D. Residents who treated waterfront with herbicides in the past

Messages

1. Summary of APM plan, notice of public meeting, and how to get full APM plan
2. List of APM dos and don’ts
3. Contact list for APM include web resources
4. Native aquatic plant values
5. Critical habitat areas/Sensitive areas
6. Limit impacts to native aquatic plants by traveling with no wake in shallow areas, using hand removal methods near docks and swimming areas, etc.
7. Explain procedure for individual corridor herbicide applications and describe conditions where herbicide treatment may be allowed.
8. Identification of PL and methods for removal (include illustrations)
9. Identification of EWM and contact if suspected (include illustrations)
10. Locations of nearby lakes with EWM
11. Describe new potential invasive species and why they are a threat
12. Native plant identification
13. Inspect, clean, and drain boats and equipment.
14. Burnett and Washburn County as well as the State of Wisconsin have an ordinance that makes it illegal to transport aquatic plants on public roads.

Methods

Summary of APM plan

AIS education workshops for all lake users

Improvements to signage at boat landings

Updates to AIS handouts

Newsletter articles

Mailings to lake residents

Web site updates

Clean boats, clean waters monitoring/education

Annual meeting/special meetings

Door-to-door distribution of information

Plastic peel-off stickers for boats and cars

Method	Audience	Message
APM plan summary	A - D	1
AIS workshops	A – C	4, 8-14
Signage	A – C	13. 14
AIS handouts	A – D	4, 6-14
Newsletter articles	A – B	1–14
Mailings	A – B	1 –14
Web site updates	A – D	1 -14
Clean Boats, Clean Waters	C	7-10, 13, 14
Annual and special meetings	A – B	1-14
Door-to-door distribution	A	4-14
Plastic peel-off stickers	A – C	13, 14

Goal 4: Enhance and maintain the diverse populations of native aquatic plants.

Objectives

A. Implement strict adherence with treatment standards and monitoring methods prior to and following herbicide treatment.
B. Prevent removal of native plants using herbicides, with special consideration to wild rice beds.
C. Increase McKenzie Lake community's understanding of the role and importance of aquatic plants and their impacts on them.

Discussion

The plant community in the McKenzie Lake is very diverse and extensive. It is important to understand that these plants play a very important role in the lake ecosystem. Aquatic plants in the lake provide habitat for a diverse fish population. They also provide protection from shoreline erosion. Removing native plants could lead to adverse effects in the lakes. Healthy native plant populations prevent colonization by invasive plants. Erosion and runoff from waterfront property may alter sediment characteristics encouraging spread of invasive plants.

Boating disturbance near the shoreline can remove aquatic plants and the valuable functions they provide. Boating disturbance near shore also creates sediment disturbance and the release of excess phosphorus, which can lead to access algal blooms.

Actions

1. Consider alternative methods for removing native plants, other than using herbicide treatment. (OBJ B)
2. Conduct a point intercept survey of the lake every five to ten years, or as needed. (OBJ C)
3. Update the aquatic plant management plan every five to ten years, or as needed. (OBJ A, B and C)
   Educational activities are detailed in the discussion for Goal 5.

Goal 5: Maintain and improve water quality conditions.

Objectives

A. Continue to sample and record both water samples and Secchi readings to ensure water quality.

B. Encourage lake residents to restore and preserve shoreline buffers of native vegetation.
   Messages

   1. Shoreline buffers protect water quality and provide fish and wildlife habitat. Describe ways to restore shoreline buffers (natural recovery, stop mowing, and plant natives).

   2. Cost sharing for restoration shoreline buffers is available from Burnett County and Washburn County.
   3. Describe the Burnett/Washburn County shoreline buffer requirements and how to report violations of these requirements.
   4. Highlight good examples of shoreline buffers on private waterfront property.

C. Reduce phosphorus and sediment loads from immediate watershed.

D. Encourage Riparian land owners to adopt and implement storm water runoff controls for existing structures and all new constructions.

Adaptive Management Approach

Big and Middle McKenzie Lake share watersheds draining into them and as a result, the impacts that are most controllable at this time originate along the lake's immediate shoreline. These sources include faulty septic systems, the use of phosphorus-containing fertilizers, shoreland areas that are maintained in an unnatural manner, and impervious surfaces. To reduce these impacts, the McKenzie Lake Association will conduct an

educational initiative aimed at raising awareness among shoreland property owners concerning their impacts on the lake. This will include news letter articles and guest speakers at Association meetings. This Management Action will be completed in conjunction with the Shoreland Restoration Action listed below.

Action Steps:

1. Recruit facilitators
2. Facilitators summarize educational material collected from WDNR, UW-Extension, and County Land and Water Conservation sources for the creation of informative materials
3. Facilitators disperse materials to stakeholders

***Actions*:**

1. Continue to monitor water quality through WDNR Citizens Lake Monitoring Network advanced water chemistry program and Secchi disk sampling and record data in the Surface Water Integrated Monitoring System (SWIMS) system. (OBJ A)
2. Incorporate the Adaptive Management Approach to reduce phosphorus and sediment loads from immediate watershed. (OBJ B, C)
3. Educate and assist McKenzie Lake community members in the restoration and preservation of shoreland buffers and shoreland vegetation. Continue implementation of shoreline owners' education program. (OBJ B, C, D)

Implementation Plan[12]

Action Items	*Timeline*	*Cost 2012*	*Cost 2013*	*Cost 2014*	*Responsible Parties*
Prevent AIS Introduction					
Identify and organize volunteer workers/employers for CBCW program	Ongoing	10 hours	10 hours	10 hours	MLA
Conduct CBCW program	Ongoing	10 hours	10 hours	10 hours	MLA president
Increase enforcement of BC/WC Do Not Transport Ordinance	Ongoing	4 hours	4 hours	4 hours	MLA, BC & WC Sheriff, BC LWCD & WC LWCD
Monitor Boat Landings	Ongoing	$1800	$1800	$1800	MLA, Burnett County LWCD
Train Volunteer monitors in CLMN	As needed	$0	$0	$0	Burnett/Washburn County LWCD
Rapid Response plan review	Ongoing	3 Hours	3 Hours	3 Hours	MLA, BC LWCD
AIS Reduction and Prevention					
Provide Identification information and encourage volunteer monitoring	May - August	20 hours	20 hours	20 hours	MLA AIS Committee, BC LWCD
Monitor Lake for PL growth	July/August	20 hours	20 hours	20 hours	MLA/community
Cut and Spray plants as needed	July/August	$100	$100	$100	MLA/community
Track and monitor previously sprayed areas in previous years	Ongoing	20 hours	20 hours	20 hours	MLA/community
Monitor & map all CLP beds every two years or more often if warranted.	Mid May-Mid June	TBD		TBD	BC LWCD

Consider if CLP control is warranted	September	TBD			MLA
Action Items	***Timeline***	***Cost 2012***	***Cost 2013***	***Cost 2014***	***Responsible Parties***
Preserve Native Plants					
Conduct a point intercept survey of the lake	2015		TBD		MLA, BC LWCD
Update APM plan	2016		TBD		MLA, BC LWCD
Educate McKenzie Lake Community					
AIS workshops	Ongoing	$0	$0	$0	BC?WC LWCD
AIS signage	Ongoing	$0	$0	$0	BC LWCD
Handouts, mailings, door-to-door distribution	As needed	$500	$500	$500	MLA
MLA newsletter articles	Ongoing	$700	$700	$700	MLA
MLA Website updates	Ongoing	$1000	$1000	$1000	MLA
Annual and special meetings	Ongoing	$1000	$1000	$1000	MLA
Water Quality					
Water chemistry and Secchi sampling	Ongoing	80 hours	80 hours	80 hours	MLA
Reduce phosphorus and sediment loads from immediate watershed	Ongoing	TBD			MLA, BC LWCD
Educate and assist McKenzie Lake community members in the restoration and preservation of shoreland buffers and shoreland vegetation	Ongoing	$500	$500	$500	MLA, BC LWCD
Continue implementation of shoreline owners' education program	Ongoing	TBD			MLA, BC LWCD

Sources

1: Source: Wisconsin Department of Natural Resources 608-266-2621
Middle McKenzie Lake – Burnett/Washburn Counties, Wisconsin DNR Lake Map
Date – Jun 1971 - Historical Lake Map - Not for Navigation

2.: Wisconsin Department of Natural Resources
http://prodoasjava.dnr.wi.gov/swims/public/reporting.do?type=33&action=post&format=html&stationNo=663115, June 15, 2011

3: WISCLAND Digital Land Cover, Wisconsin Dept. Of Natural Resources. 1998. (Converted to polygon classification by Applied Data Consultants). Agricultural land may be under-reported because idle fields and poor hay fields may classify as grassland or shrubland in the satellite image. Developed areas near water bodies are also not likely to be represented accurately. Land units smaller than 5 acres are not reflected in this classification

4: The State of the St. Croix River Basin. Wisconsin Department of Natural Resources. 2002

5: Tim Hoyman & Eddie Heath. Onterra, LLC, Pike Lake Chain of Lakes , Comprehensive Management Plan, December 2008

6. *Through the Looking Glass*. Bowman et. al. 1997

7. Taken from Aquatic Plant Management Strategy. DNR Northern Region. 1997.

8. Natural Heritage Inventory County Data by Township. Wisconsin DNR. Last revised December 2008.

9. Wisconsin Department of Natural Resources Bureau of Fisheries Management

10. Wisconsin Department of Natural Resources Critical Habitat Designation. http://dnr.wi.gov/lakes/criticalhabitat/Project.aspx?project=10419294. July 18, 2011 Appendix A

11. Wisconsin Department of Natural Resources Critical Habitat Designation. http://dnr.wi.gov/lakes/criticalhabitat/files/SummaryOfPublicRightsFeatures.pdf. July 1, 2011. Appendix A

12. Templates and other data taken from Harmony Environmental. Aquatic Plant Management Plan. Yellow and Little Yellow Lakes, Burnett County, Wisconsin. June 2009.

13. Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005 and the Aquatic plant management planning.

14. Control of Eurasian Water Milfoil & Large-scale Aquatic Herbicide Use. July 2006. Wisconsin Department of Natural Resources.

15. This discussion is taken from: Managing Lakes and Reservoirs. North American Lake Management Society.

16. Hoyer/Canfield: Aquatic Plant Management. North American Lake Management Society. 1997.
17. Research in Minnesota on Control of Curly Leaf Pondweed. Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

Appendix A: Critical Habitat Designation Program Rule Summary (Draft)

A Summary of Public Rights Features including Sensitive Areas; and their Applicable Activity-Based Laws

Public rights features are:

(a) Fish and wildlife habitat, including specific sites necessary for breeding, nesting, nursery and feeding.

Note: Physical features constituting fish and wildlife habitat include stands of aquatic plants; riffles and pools in streams; undercut banks with overhanging vegetation or that are vegetated above; areas of lake or streambed where fish nests are visible; large woody cover.

(b) Physical features of lakes and streams that ensure protection of water quality.

Note: Physical features that protect water quality include stands of aquatic plants (that protect against erosion and so minimize sedimentation), natural streambed features such as riffles or boulders (that cause turbulent stream flow and so provide aeration).

(c) Reaches of bank, shore or bed that are predominantly natural in appearance (not man−made or artificial) or that screen man−made or artificial features.

Note: Reaches include those with stands of vegetation that include intermixed trees, shrubs and grasses; stands of mature pines or other conifer species; bog fringe; bluffs rising from the water's edge; beds of emergent plants such as wild rice, wild celery, reeds, arrowhead.

(d) Navigation thoroughfares or areas traditionally used for navigation during recreational boating, angling, hunting or enjoyment of natural scenic beauty.

Note: Physical features indicative of navigation thoroughfares include shallow water areas typically used by wading anglers or areas frequently occupied by regularly repeated public uses such as water shows.

Sensitive areas are: Areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water.

Note: Public Rights Features Designations by rule always include sensitive areas (sensitive areas are one subset of Public Rights Features), however some laws specifically address only Sensitive Areas. Laws which apply only to sensitive areas are denoted by the following symbol:

Chapter NR 107- Aquatic Plant Management

Any person sponsoring or conducting chemical treatment for the management of aquatic plants or control of other aquatic organisms in waters of the state shall obtain a permit from the department. Waters of the state include those portions of Lake Michigan and Lake Superior, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other ground or surface water, natural or artificial, public or private, within the state or its jurisdiction as specified in s. 281.01 (18), Stats. The department may deny issuance of chemical treatment permits for aquatic plant management if the proposed chemical application is in locations identified by the department as **sensitive areas**, except when the applicant demonstrates to the satisfaction of the department that treatments can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

Chapter NR 109- Aquatic Plants: Introduction, Manual Removal, and Mechanical Control Regulations

The purpose of this chapter is to establish procedures and requirements for the protection and regulation of aquatic plants pursuant to ss. 23.24 and 30.715, Stats. Diverse and stable communities of native aquatic plants are recognized to be a vital and necessary component of a healthy aquatic ecosystem. This chapter establishes procedures and requirements for issuing aquatic plant management permits for introduction of aquatic plants or control of aquatic plants by manual removal, burning, use of mechanical means or plant inhibitors. The department may deny issuance of the requested permit if the department determines the proposed introduction or control is in locations identified by the department as sensitive areas, under s. NR 107.05 (3) (i) 1., except when the applicant demonstrates to the satisfaction of the department that the project can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

Chapter NR 109 also provides exemptions for permit requirements for manual removal under limited specified conditions. However, manual removal within a sensitive area is not exempt and is subject to a permit requirement. A permit is required for riparian owners who propose to manually remove aquatic plants from a body of water or use mechanical devices designed for cutting or mowing vegetation to control plants within a **sensitive area** as defined by the department under s. NR 107.05.

Chapter NR 328- Subchapter I — Shore Erosion Control Structures on Inland Lakes and Impoundments

Ch. NR 328 establishes reasonable procedures and limitations for exempt activities, general permits and individual permits for placement of shore erosion control structures in inland lakes and impoundments as regulated under s. 30.12, Stats., in order to protect the public rights and interest in the navigable, public waters of the state as defined in s. 30.10, Stats. Except as provided in s. 30.2023, Stats., this subchapter applies to construction, placement and maintenance of shore erosion control structures regulated under s. 30.12 (1), (1g) (a), (i), (j) and (k), (2m), (3) (a) 3c., 3g., 3r. and 13. and (3m), Stats. Any person who intends to construct, place or maintain a shore erosion control structure in any inland lake or impoundment shall comply with all applicable provisions of this chapter and any permit issued under this chapter.
Ch. NR 328 provides for permit exemptions under limited specific designs and locations. However, Repair or replacement of existing riprap within or adjacent to a **sensitive area** is **not** exempt and is subject to a permit requirement. Additionally, designated sensitive area is a factual consideration in the analysis of individual permit applications.

Chapter NR 103- Water Quality Standards for Wetlands

Ch. NR 103 applies to all department regulatory, planning, resource management, liaison and financial aid determinations that affect wetlands. This chapter shall only apply to specific activities which may require authorization or reauthorization after August 1, 1991 and which are subject to the requirements of statute or rules requiring a department determination concerning effects on water quality or wetlands. **(1)** Activities subject to the requirements of this chapter include, but are not limited to: (a) Permits, reviews, approvals and other actions under chs. 23 and 26 to 31, Stats.; (b) Permits and approvals under chs. 281, 283, 289 and 291, Stats., except as provided in sub. (3); (c) Water quality certification under ch. NR 299; (d) Permits and approvals under chs. NR 500 to 520; (e) Department development and management projects; and (f) Actions under ch. NR 120. **(2)** In addition to the requirements of s. NR 207.03 (5), this chapter shall apply to new or increased point source discharges to wetlands. **(3)** Wetland alterations which are directly caused by operations on a metallic mineral prospecting site or mining site shall be regulated pursuant to specific wetland standards under chs. NR 131 and 132, respectively. The department shall review all proposed activities subject to this chapter and shall determine whether the project proponent has shown, based on the factors in sub. (3), if the activities are in conformance with the provisions of this chapter. To protect all present and prospective future uses of wetlands, the following factors shall be considered by the department in making determinations under this section: (a) Wetland dependency of the proposal; (b) Practicable alternatives to the proposal which will avoid and minimize adverse impacts to wetlands and will not result in other significant adverse environmental consequences; (c) Impacts which may result from the activity on the maintenance, protection, restoration or enhancement of standards under s. NR 103.03; (d) Cumulative impacts attributable to the proposed activity which may occur, based upon past or reasonably anticipated impacts on wetland functional values of similar activities in the affected area; (e) Potential secondary impacts on wetland functional values from the proposed activity; and (f) Any potential adverse impacts to wetlands in areas of special natural resource interest as listed in s. NR 103.04. (g) Any potential adverse impact to wetlands in environmentally **sensitive areas** and environmental corridors identified in areawide water quality management plans.

Chapter NR 341- Grading on the Bank of Navigable Waterways

Ch. NR 341 establishes criteria defining those activities needing a grading permit for grading sites as required by s. 30.19 (1g) (c), Stats.; and to specify permit requirements necessary to protect public rights and interest and to protect riparian rights for grading sites regulated under this chapter. An application for a grading permit shall be filed with the department by any person who intends to grade or remove soil from the bank of any navigable waterway where the area exposed by the grading or removal will exceed 10,000 square feet on the surface of the bank as determined in s. NR 341.035. This includes areas that are part of a larger common plan of development or sale where multiple separate and distinct grading activities may be taking place at different times on different schedules, but under one plan, such that the total area exposed by grading or removal will exceed 10,000 square feet on the bank. For purposes of establishing jurisdiction

the bank of a navigable waterway is typically determined as 75 feet landward from the ordinary high water mark (there are rule exceptions for steeper slopes where jurisdiction extends more than 75 feet landward). However for banks adjacent to public rights features the bank jurisdiction is typically 300 feet landward from the ordinary high water mark (again there are rule exceptions for steeper slopes where jurisdiction extends more than 300 feet landward).

Chapter NR 323- Fish and Wildlife Habitat Structures in Navigable Waters

Ch. NR 323 establishes reasonable procedures and limitations for exempt activities, general permits and individual permits for placement of fish and wildlife habitat structures in navigable waterways in order to protect the public rights and interest in the navigable, public waters of the state. Any person who intends to construct, place or maintain a fish or wildlife habitat structure in any navigable waterway shall comply with all applicable provisions of this chapter and any permit issued under this chapter. Some fish and wildlife habitat structures are exempt from a department permit, however fish and wildlife structures located within a public rights feature are not exempt and require a state permit.

Chapter NR 329- Miscellaneous Structures in Navigable Waterways

Ch. NR 329 establishes reasonable procedures and limitations for exempt activities, general permits and individual permits for the construction and maintenance of boat landings, dry fire hydrants, fords, intake and outfall structures, pilings, pea gravel blankets and weed rakes structures placed in navigable waterways. Several miscellaneous designed structures in certain settings are exempt from a department permit. However, all miscellaneous structures identified in Ch. NR 329 and located within a public rights feature are not exempt and require a state permit. Additionally general permits are not available for fords, public boat landings, weed rakes, pea gravel blankets, or intake/outfall structures located within public rights features, but are subject to individual permit requirements.

Chapter NR 343- Ponds and Artificial Waterways

Ch. NR 343 establishes criteria defining those activities needing a permit for a pond or artificial water body and specifies permit requirements necessary to protect public health, safety, welfare, rights and interest and to protect riparian landowner's rights and property for pond sites. A permit application shall be filed with the department to construct, dredge or enlarge any part of a pond or artificial water body that either; connects with a navigable waterway, or is located within 500 feet of the ordinary high water mark of an existing navigable waterway. This includes a stormwater management pond that does not discharge into a navigable waterway except as a result of storm events. Sediment basins or stormwater management ponds where the crest of the berm of the basin is within 35 feet from the ordinary high water mark of a navigable waterway or a portion of the basin is within 100 feet of the location of any public rights feature requires a permit from the department. Additionally, permit standards for Landscape ponds require that the portion of the berm or pond may not be any closer than 35 feet from the ordinary high water mark of any navigable waterway or within 100 feet of the location of any public rights feature.

Chapter NR 320- Bridges and Culverts in or Over Navigable Waterways

Ch. NR 320 establishes reasonable procedures and limitations for exempt activities, general permits and individual permits for placement of bridges and culverts in or over navigable waterways as regulated under s. 30.123, Stats. These standards protect the public rights and interest in the navigable, public waters of the state as defined in s. 30.10, Stats. This chapter applies to construction, placement and maintenance of bridges and culverts in or over navigable waterways as regulated under s. 30.123, Stats. Any person who intends to construct, place or maintain a bridge or culvert in or over any navigable waterway shall comply with all applicable provisions of this chapter and any permit issued under this chapter. Some replacement culverts are exempt from a department permit, however replacement culverts located in a public rights feature are not exempt and do require a state permit. Additionally non-professionally engineered culvert placement on navigable streams in a public rights feature is only eligible for an individual permit.

Chapter NR 1 – Natural Resource Board Policies

Ch. NR 1.91 Public boating access standards applies to department decisions related to acquiring, developing, maintaining and improving public boating access sites, providing natural resources enhancement services and to other department decisions relating to protection and use of navigable waters. Public boating access standards are described and must be met to be eligible for natural resource enhancement services. Natural resource enhancement services may still be provided for waters that have less public boating access provided an alternative public access plan is submitted. These alternative access plans must, among other items, consider sensitive areas for fish, wildlife and aquatic plants.

Chapter NR 118- Standards for the Lower St. Croix National Scenic Riverway

Ch. NR 118 establishes rules necessary to reduce the adverse effects of overcrowding and poorly planned shoreline and bluff area development, to prevent pollution and contamination of surface waters and groundwaters and soil erosion, to provide sufficient space on lots for sanitary facilities, to minimize flood damage, to maintain property values, and to preserve and maintain the exceptional scenic, cultural and natural characteristics of the water and related land of the Lower St. Croix riverway in a manner consistent with the national wild and scenic rivers act (P.L. 90−542), the federal Lower St. Croix river act of 1972 (P.L. 92−560) and the Wisconsin Lower St. Croix river act (s. 30.27, Stats.). Ch. NR 118 establishes more restrictive vegetation management standards which aim to prevent disturbance of environmentally **sensitive areas** such as steep slopes, shorelines and blufftop areas.

Chapter NR 110- Sewerage Systems

Ch. NR 110 applies to all new or modified sewerage systems, excluding only industrial waste treatment facilities. This chapter also applies to sewerage systems employing land disposal of sewage effluent, except those systems defined as plumbing within the purview of s. 145.01 (10) (b), Stats. . The department may require the submittal of an environmental assessment meeting the requirements of s. NR 110.09 (3) for large or complex sewer projects, or large or complex lift station projects which are proposed to be constructed in environmentally **sensitive areas**.

Chapter NR 185- Solid Waste Management Planning Criteria

Ch NR 185 establishes minimum solid waste management planning criteria pursuant to chapter 377, laws of 1977, consistent with the intent of the Resource Conservation and Recovery Act of 1976 (Public Law 94–580). Ch. NR 185 governs the development of comprehensive solid waste management plans and their submittal to the department for approval. Inventory maps and narratives must address, among other items, environmentally sensitive areas.

Chapter NR 169- Dry Cleaner Environmental Response Program

Ch. NR 169 establishes rules to implement and administer a grant program to reimburse eligible applicants for a portion of their costs associated with the investigation and cleanup of soil or groundwater, or both, contaminated by a discharge and applies to all applicants for and recipients of reimbursements of costs paid to investigate and remediate soil and groundwater contaminated by a discharge of a dry cleaning product. Applicants are required to examine for potential impacts to sensitive areas in their site scoping investigation.

Chapter NR 167- Land Recycling Loan Program

Ch. NR 167 establish rules under ss. 281.59 and 281.60, Stats., for the implementation and administration of the land recycling loan program and applies to all land recycling loan program applicants and recipients. Compliance with the applicable requirements of this chapter is a prerequisite to receiving financial assistance under ss. 281.59 and 281.60, Stats. Sites that have special designated environmentally sensitive areas are assigned more weight in grant rankings.

Big McKenzie Lake Sensitive Area Survey Report (Burnett and Washburn Co)

Date of Survey: 9 September 1999 Number of Sensitive Areas: 4
Site Evaluators: Larry Damman, Fisheries Biologist
Mark Sundeen, Aquatic Plant Specialist
Jim Cahow, Water Resources Biologist – Author
Kurt Roblek, Water Resources Biologist – Interim Author

Lake Sensitive Area Survey results identified three areas that merit special protection of the aquatic plant habitat under NR 107 & NR 109 and one additional site that deserves protection as critical coarse rock rubble walleye spawning habitat covered as a Public Rights Feature (PRF) within an area designated under a newly emerging program ASNRI (Areas of Special Natural Resource Importance) designations and protection program. One additional site is under consideration or review as it was previously identified as providing critical habitat or shoreline stabilization benefits to combat shoreline erosion and was not included in the most recent survey results. If human induced impacts have resulted in a loss of functional values attempts should be made to restore full function of the area by minimizing aquatic plant removals and disturbance. If successful this area should be restored to full status as a sensitive area. A follow up field inspection should be completed in 2006/2007 with final updates integrated into the report.

During this survey there were documented occurrences of Purple Loosestrife in Sensitive Area C at the very southeast corner of the lake. The threat of Purple Loosestrife is always a concern and should be dealt with immediately. Methods for control are to remove the entire plant before it produces seeds or by cutting the flower head and spraying with an approved herbicide, also before the plant produces seed. You should contact the Department before any of these methods are implemented.

The reader should consider that any buffer that does not extend back from the waters edge at least 35' on flat ground is not providing adequate protection for water quality and should be expanded to at least 35'. Local zoning ordinances and lakes classification systems have tried to provide

better guidelines pertaining to buffer widths and set backs based on lake type. Landowners are encouraged to go beyond the minimum requirements laid out by zoning and consider extending buffer widths to beyond 35' and integrating other innovative ways to capture and reduce the runoff flowing off from their property while improving critical shoreline habitat. Berms and low head retention areas can greatly increase the effective capture rate from developed portions in addition to that portion captured within the buffer.

Site conditions may dictate that a buffer has to be much wider than 35' to be effective at capturing the sediments and nutrients running off the developed portions of the shoreline. If the shoreline is steeply sloped (>7%slope) greater widths should definitely be used.

No mowing should take place within the buffer area (with the exception of a narrow access trail and small picnic area), and trees and shrubs should not be cut down even when they become old and die; because they provide important woody debris habitat within the buffer zone as well as aquatic habitat when they fall into the lake.

The following is a brief summary of the Big McKenzie sensitive area sites and the management guidelines. Also, the "Guidelines for Protecting, Maintaining, and Understanding Sensitive Areas" provides management guidelines and considerations for different lake sensitive areas (Attached).

I. Aquatic Plant Sensitive Areas

The following sensitive areas contain aquatic plant communities, which provide important fish and wildlife habitat as well as important shoreline stabilization functional values. Sensitive areas provide enough important habitat for the Big McKenzie Lake ecosystem that conservation easements, deed restrictions, or zoning should be used to protect them. Management guidelines for aquatic plant sensitive areas are (unless otherwise specifically stated):

1. Limit aquatic vegetation removal to navigational channels no greater than 25 feet wide where necessary, the narrower the better. These channels should be kept as short in length as possible and it is recommended that people do not completely eliminate aquatic vegetation within the navigation channel; but instead only remove what is necessary to prevent fouling of propellers to provide access to open water areas. Chemical treatments should be discouraged and if a navigational channel must be cleared, pulling by hand is preferable over mechanical harvesters where practical. The maximum width that can be legally cleared with hand pulling or raking without a permit is 30' wide and must include the area in, under, and around existing dock areas and this area can not be moved to another segment of shoreline until the vegetation in the previous area is fully restored.

2. Prohibit littoral zone alterations covered by Wisconsin Statutes Chapter 30, unless there is clear evidence that such alterations would benefit the lake's ecosystem. Rock riprap permits should not be approved for areas that already have a healthy native plant community stabilizing the shoreline and property owners should not view riprap as an acceptable alternative in these situations.
3. Leave large woody debris, logs, trees, and stumps, in the littoral zone to provide habitat for fish, wildlife, and other aquatic organisms.
4. Leave an adequate shoreline buffer of un-mowed natural vegetative cover and keep access corridors as narrow as possible (preferable less than 30 feet or 30% of any developed lot which ever is less).
5. Prevent erosion, especially at construction sites. Support the development of effective county erosion control ordinances. The proper use of Best Management Practices (BMP's) will greatly reduce the potential of foreign materials entering the waterway (i.e. silt, nutrients).
6. Strictly enforce zoning ordinances and support development of new zoning regulations where needed.
7. Eliminate nutrient inputs to the lake caused by lawn fertilizers, failing septic systems, and other sources.
8. Control exotic species such as purple loosestrife. Exotics are marked with a (*)

Resource Value of Site A

Sensitive area A is located at the northeastern end of Big McKenzie Lake and covers approximately 6000 feet of shoreline extending out as far as 400' in shallower shoreline areas and is centered around the public boat access ramp on the northeast corner of the lake. This area includes a rich diversity of emergent bulrushes and spike rushes and healthy submergent vegetation including numerous large leaf pondweeds providing important shoreline erosion control benefits as well as critical habitat for fisheries and wildlife. A more detailed plant survey should be conducted to better document the unique and sensitive species which occur within this and other areas on Big McKenzie Lake.

This area provides important habitat for centrarchid (bass and panfish) species for spawning, feeding, protection and as a nursery for young. Esocid (northern pike and muskellunge) will use this area for feeding, protection and as a nursery for young. Northern pike will also use this area for spawning. This area also provides important habitat for forage species.

Wildlife are also reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, amphibians and reptiles benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area A includes: **Emergents;** soft-stem bulrush (Scirpus sp.), sedges (Carex sp.), spike rush (Eleocharis sp.), and arrowhead (Sagittaria sp.),. **Floating leafed**; yellow pond lily (Nuphar advena), and white water lily (Nymphaea odorata). **Submergents;** musk grass (Chara sp.), coontail (Ceratophyllum demersum), eel grass (Vallisneria americana), northern milfoil (Myriophyllum sibiricum), variable pondweed (P. gramineus), fern pondweed (P. robbinsii), large leaf pondweed (P. amplifolius), clasping pondweed (P. richardsonii) and narrow leaf pondweed (P. zosteriformis).

Chemical treatments and/or mechanical harvesting are strongly discouraged. Historical chemical treatments and mechanical harvesting should be limited to navigational channels only. All other interests in chemical treatments and mechanical harvesting should be scrutinized.

Resource Value of Site B

Sensitive area B is located centrally on the western shoreline and covers approximately 2800' of shoreline. This sensitive area was identified in a previous field survey as meriting protection as a sensitive area. Because past conditions are an effective measure of future potential this area should maintain the designation of a sensitive area and efforts should target reduction of removal or disturbances effecting local vegetation distribution and density in an attempt to restore critical habitat and the positive shoreline erosion reduction potential they provide.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike). These species will use the area for spawning, feeding, protection and as a nursery for young. Muskellunge will use this area for feeding and protection. This area also provides important habitat for forage species.

Wildlife are also reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, amphibians and reptiles benefit from this valuable habitat.

The emergent and submergent plant community structure of Sensitive area B includes: **Emergents;** soft stem bulrush (Scirpus validus.), hard stem bulrush (Scirpus acutus), Three square sedge (Scirpus americanus), Creeping Spikerush (Eleocharis palustris), and Bur-reed (Sparganium sp.). **Submergents;** coontail (Ceratophyllum demersum.), Dwarf Milfoil (Myriophyllum tenellum) and clasping-leaf pondweed (Potamogeton richardsonii), and wild celery or water celery or eel grass (Vallisneria Americana).

Chemical treatments and/or mechanical harvesting are strongly discouraged. Historical chemical treatments and mechanical harvesting should be limited to narrow navigational channels only. All other interests in chemical treatments and mechanical harvesting should be scrutinized. All hand pulling or raking should be scaled back to comply with the allowable 30' widths which must include the area in and around the dock and can not be moved to another segment of shoreline until the previously disturbed site is fully restored.

Resource Value of Site C

Sensitive area C is located at the southernmost end of Big McKenzie Lake and covers approximately 7,000 feet of shoreline extending out nearly 1500 feet in areas. Most of this length is dominated by a shrub/scrub and shallow or open water wetland, which have helped protect it from the negative impacts that can be associated with improperly developed shorelines.

Within sensitive area C there is an island of bulrush situated between 250 feet and 1000 feet from shore. The island is approximately 1,600 feet long x 200 feet wide. This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike). These species will use this area for spawning, feeding, protection and as a nursery for young. Muskellunge will use the area for feeding and protection. This area also provides important habitat for forage species.

Wildlife are also reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, amphibians and reptiles benefit from this valuable habitat.

Sensitive area C has a diverse community structure of emergent, floating and submergent aquatic plants including: **Emergents; ***purple loosestrife (Lythrum salicaria), sedges (Carex sp.), arrowhead (Sagittaria sp.), cattails (Typha sp.), bur-reed (Sparganium sp.), tag alder (Ulnus sp.) and giant reed grass (Phragmites sp.). **Floating leafed**; yellow pond lily (Nuphar advena) and white water lily (Nymphaea odorata). **Submergents;** musk grass (Chara sp.), elodea, coontail (Ceratophyllum demersum), eel grass (Vallisneria americana), northern milfoil (Myriophyllum sibiricum), floating leaf pondweed (Potamogeton natans), variable pondweed (P. gramineus), fern pondweed (P. robbinsii), large leaf pondweed (P. amplifolius), clasping pondweed (P. richardsonii), narrow leaf pondweed (P. zosteriformis), *****curly leaf pondweed (P. crispus) and illinois pondweed (P. illinoensis).

Purple loosestrife has been documented as occurring along the shoreline of this sensitive area. This is an invasive species, which should be dealt with immediately. Methods for control are to remove the entire plant before it

produces seeds or by cutting the flower head and spraying with an approved herbicide. You should contact the Department before any of these methods are implemented. Chemical treatments and/or mechanical harvesting are strongly discouraged. Historical chemical treatments and mechanical harvesting should be limited to narrow navigational channels only. All other interests in chemical treatments and mechanical harvesting should be scrutinized, except for treatment of purple loosestrife.

Resource Value of Site D

Sensitive area D is located along the northeastern shore of Big McKenzie Lake and covers approximately 700 feet of shoreline extending out to 500 feet. This area is considered high quality walleye spawning habitat. Consisting of rock and cobble substrate will little or no fine sediment.

Past protection efforts for coarse rock rubble walleye spawning habitat had come from an interim extension of NR107 and its coverage of critical aquatic habitats; but, this is now being more properly dealt with through protection of Public Rights Features (PRF) under a newly emerging program called ASNRI features (Areas of Special Natural Resource Importance).

No dredging, structures or deposits should occur in this area to retain the high quality spawning habitat characteristics.

Middle McKenzie Lake (Burnett Co.)
Integrated Sensitive Area Survey Report

Date of Survey: 09 September 1999 Number of Sensitive Areas: 3
Site Evaluators: Larry Damman, Fisheries Biologist
Jim Cahow, Water Resources Biologist

Lake Sensitive Area Survey results identified three areas that merit special protection of the aquatic habitat. These areas of aquatic vegetation on Middle McKenzie Lake offer critical or unique fish and wildlife habitat. These habitats provide the necessary seasonal or life stage requirements of the associated fisheries, and the aquatic vegetation offers water quality or erosion control benefits to the body of water.

During this survey there were no documented occurrences of Purple Loosestrife. However, the threat of Purple Loosestrife is always a concern and should be dealt with immediately. Methods for control are to remove the entire plant before it produces seeds or by cutting the flower head and spraying with and approved herbicide. You should contact the Department before any of these methods are implemented.

The reader should consider that any buffer that does not extend back from the waters edge at least 35' is not providing adequate protection for water quality and should be expanded to at least 35'. Local zoning ordinances and lakes classification systems have tried to provide better guidelines pertaining to buffer widths and set backs based on lake type. Landowners are encouraged to go beyond the minimum requirements laid out by zoning and consider extending buffer widths to beyond 35' and integrating other innovative ways to capture and reduce the runoff flowing off from their property while improving critical shoreline habitat. Berms and low head retention areas can greatly increase the effective capture rate from developed portions in addition to that portion captured within the buffer.

Site conditions may dictate that a buffer has to be much wider than 35' to be effective at capturing the sediments and nutrients running off the

developed portions of the shoreline. If the shoreline is steeply sloped (>7%slope) greater widths should definitely be used.

No mowing should take place within the buffer area (with the exception of a narrow access trail and small picnic area), and trees and shrubs should not be cut down even when they become old and die; because they provide important woody debris habitat within the buffer zone as well as aquatic habitat when they fall into the lake.

The following is a brief summary of the Middle McKenzie Lake sensitive area sites and the management guidelines. Also, the "Guidelines for Protecting, Maintaining, and Understanding Sensitive Areas" provides management guidelines and considerations for different lake sensitive areas (Attached).

I. Aquatic Plant Sensitive Areas

Sensitive areas contain aquatic plant communities, which provide important fish and wildlife habitat as well as important shoreline stabilization functional values. Sensitive areas provide important enough habitat for the Middle McKenzie Lake ecosystem that conservation easements, deed restrictions, or zoning should be used to protect them. Management guidelines for aquatic plant sensitive areas are (unless otherwise specifically stated):

1. Limit aquatic vegetation removal to navigational channels no greater than 25 feet wide where necessary, the narrower the better. These channels should be kept as short in length as possible and it is recommended that people do not completely eliminate aquatic vegetation within the navigation channel; but instead only remove what is necessary to prevent fouling of propellers to provide access to open water areas. Chemical treatments should be discouraged and if a navigational channel must be cleared, pulling by hand is preferable over mechanical harvesters where practical.
2. Prohibit littoral zone alterations covered by Wisconsin Statutes Chapter 30, unless there is clear evidence that such alterations would benefit the lake's ecosystem. Rock riprap permits should not be approved for areas that already have a healthy native plant

community stabilizing the shoreline and property owners should not view riprap as an acceptable alternative in these situations.

3. Leave large woody debris, logs, trees, and stumps, in the littoral zone to provide habitat for fish, wildlife, and other aquatic organisms.
4. Leave an adequate shoreline buffer of un-mowed natural vegetative cover and keep access corridors as narrow as possible (preferable less than 30 feet or 30% of any developed lot which ever is less).
5. Prevent erosion, especially at construction sites. Support the development of effective county erosion control ordinances. The proper use of Best Management Practices (BMP's) will greatly reduce the potential of foreign materials entering the waterway (i.e. silt, nutrients).
6. Strictly enforce zoning ordinances and support development of new zoning regulations where needed.
7. Eliminate nutrient inputs to the lake caused by lawn fertilizers, failing septic systems, and other sources.
8. Control exotic species such as purple loosestrife.

Resource Value of Site A

Sensitive area A consists of a small area along the northwestern shore of Middle McKenzie Lake, immediately south of the public boat launch. This area covers approximately 500 feet of shoreline.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent and submergent plant community structure of Sensitive area A includes:
Emergents; brown fruited rush (Juncus peleocarpus) and arrowhead (Sagittaria sp.).
Submergents; wild celery (Vallisneria americana), coontail (Ceratophyllum demersum), muskgrass (Chara sp.), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), large leaf pondweed (Potamogeton amplifolius),

variable pondweed (P. gramineus), floating leaf pondweed (P. natans), white stem pondweed (P. praelongus), clasping leaf pondweed (P. richardsonii) and flat stem pondweed (P. zosteriformis).

Chemical treatments and mechanical removal efforts should be limited to navigation channels only.

Resource Value of Site B

Sensitive area B consists of the entire eastern shoreline of Middle McKenzie Lake. It starts near the inflowing channel of McKenzie Creek and extends northward approximately 5,000 feet of shoreline ending at the north end of a large riparianTamarack and Tag Alder swamp,. This area includes several large shallow flats that extend several hundred feet out into the lake providing critically diverse shallow water aquatic plant habitat.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area B includes: **Emergents;** bur reed (Sparganium eurycarpum), brown fruited rush (Juncus peleocarpus), creeping spikerush (Eleocharis palustris), pickerelweed (Pontederia cordata), water willow (Decon sp.), hardstem bulrush (Scirpus acutus), three-square sedge (Scirpus americanus) and narrow leaf cattail (Typha angustifolia). **Floating leafed**; spatterdock (Nuphar variegata) and white water lily (Nymphaea odorata). **Submergents;** wild celery (Vallisneria americana), coontail (Ceratophyllum demersum), muskgrass (Chara sp.), water stargrass (Zosterella dubia), water marigold (Bidens beckii), northern milfoil (Myriophyllum sibiricum), bushy pondweed (Najas flexilis), large leaf pondweed (Potamogeton amplifolius), curly leaf pondweed (P. crispus), variable pondweed (P. gramineus), clasping leaf pondweed (P. richardsonii) and flat stem pondweed (P. zosteriformis).

Chemical treatments and mechanical removal efforts should be limited to navigational channels only.

Resource Value of Site C

Sensitive area C consists of 1600' of shoreline including the shallow bulrush beds in the northestern corner of Middle McKenzie Lake surrounding the outflowing channel for McKenzie Creek.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area C includes: **Emergents;** bur reed (Sparganium eurycarpum), creeping spikerush (Eleocharis palustris), hardstem bulrush (Scirpus acutus), **Submergents;** wild celery (Vallisneria americana), coontail (Ceratophyllum demersum), northern milfoil (Myriophyllum sibiricum), clasping leaf pondweed (P. richardsonii) and flat stem pondweed (P. zosteriformis).

Chemical treatments and mechanical removal efforts should be limited to navigational channels only.

Appendix B. Invasive Species Information

Curly Leaf Pondweed

Curly leaf pondweed is specifically designated as an invasive aquatic plant (along with Eurasian water milfoil and Purple loosestrife) to be the focus of a statewide program to control invasive species in Wisconsin. Invasive species are defined as a "non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (23.22(c)."

The Wisconsin Comprehensive Management Plan for Aquatic Invasive Species describes curly leaf pondweed impacts as follows:

> It is widely distributed throughout Wisconsin lakes, but the actual number of waters infested is not known. Curly-leaf pondweed is native to northern Europe and Asia where it is especially well adapted to surviving in low temperature waters. It can actively grow under the ice while most plants are dormant, giving it a competitive advantage over native aquatic plant species. By June, curly-leaf pondweed can form dense surface mats that interfere with aquatic recreation. By mid-summer, when other aquatic plants are just reaching their peak growth for the year, it dies off. Curly-leaf pondweed provides habitat for fish and invertebrates in the winter and spring when most other plants are reduced to rhizomes and buds, but the mid-summer decay creates a sudden loss of habitat. The die-off of curly-leaf pondweed also releases a surge of nutrients into the water column that can trigger algal blooms and create turbid water conditions. In lakes where curly-leaf pondweed is the dominant plant, the summer die-off can lead to habitat disturbance and degraded water quality. In other waters where there is a diversity of aquatic plants, the breakdown of curly-leaf may not cause a problem.[40]

The state of Minnesota DNR web site explains that curly leaf pondweed often causes problems due to excessive growth. At the same time, the plant provides some cover for fish and some waterfowl species feed on the seeds and winter buds.[41]

The following description is taken from a Great Lakes Indian Fish and Wildlife Commission handout.

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[40] Wisconsin's Comprehensive Management Plant to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species. Prepared by Wisconsin DNR. September 2003.

[41] Information from Minnesota DNR (www.dnr.state.mn.us/aquatic_plants).

Curly Leaf Pondweed (*Potamogeton crispus*)[42]

Identification

Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters one to three meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as two meters. The stems are dark reddish-green to reddish-brown, with the mid-vein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa, and Australia and is now spread throughout most of the United States and southern Canada.

Characteristics

New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

Reproduction and Dispersal

Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 – 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer, and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, turions germinate in the fall, over-wintering as a small plant. The next summer plants mature, producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

Ecological Impacts

Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

[42] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).

In late spring, curly leaf pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish populations. The foliage of curly leaf pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

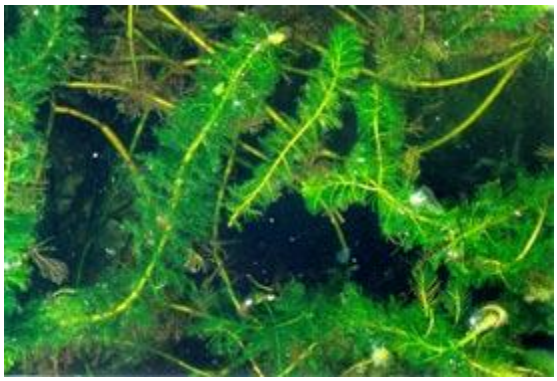
Control

Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments, to keep them from re-establishing.

Control of large populations requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed bank over time. It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants may aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

Eurasian Water Milfoil *(Myriophyllum spicatum)*

Introduction



Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian water milfoil is nearly impossible to distinguish from Northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

Distribution and Habitat
Eurasian milfoil first arrived in Wisconsin in the 1960's. During the 1980's, it began to move from several counties in southern Wisconsin to lakes and waterways in the northern half of the state. As of 1993, Eurasian milfoil was common in 39 Wisconsin counties (54%) and at least 75 of its lakes, including shallow bays in Lakes Michigan and Superior and Mississippi River pools.

Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

Life History and Effects of Invasion
Unlike many other plants, Eurasian water milfoil does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian milfoil provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways: For example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes. [43]

[43] Taken in its entirety from WDNR, 2008 http://www.dnr.state.wi.us/invasives/fact/milfoil.htm

Reed Canary Grass (*Phalaris arundinacea*)

Description

Reed canary grass is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. Blades are flat and have a rough texture on both surfaces. The lead ligule is membranous and long. The compact panicles are erect or slightly spreading (depending on the plant's reproductive stage), and range from 3 to 16 inches long with branches 2 to 12 inches in length. Single flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.

Both Eurasian and native ecotypes of reed canary grass are thought to exist in the U.S. The Eurasian variety is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype. Agricultural cultivars of the grass are widely planted.

Reed canary grass also resembles non-native orchard grass (*Dactylis glomerata*), but can be distinguished by its wider blades, narrower, more pointed inflorescence, and the lack of hairs on glumes and lemmas (the spikelet scales). Additionally, bluejoint grass (*Calamagrostis canadensis*) may be mistaken for reed canary in areas where orchard grass is rare, especially in the spring. The highly transparent ligule on reed canary grass is helpful in distinguishing it from the others. Ensure positive identification before attempting control. The ligule is a transparent membrane found at the intersection of the leaf stem and leaf.

Distribution and Habitat

Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America. The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800's for forage and erosion control. It has become naturalized in much of the northern half of the U.S., and is still being planted on steep slopes and banks of ponds and created wetlands.

Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas.

Life History and Effects of Invasion

Reed canary grass reproduces by seed or creeping rhizomes. It spreads aggressively. The plant produces leaves and flower stalks for 5 to 7 weeks after germination in early spring, then spreads laterally. Growth peaks in mid-June and declines in mid-July. A second growth spurt occurs in the fall. The shoots coMLApse in mid to late summer, forming a dense, impenetrable mat of

stems and leaves. The seeds ripen in late June and shatter when ripe. Seeds may be dispersed from one wetland to another by waterways, animals, humans, or machines.

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites.[44]

Purple Loosestrife (*Lythrum salicaria*)[45]

Description

Purple loosestrife is a non-native plant common in Wisconsin. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes (underground stems) that form a dense mat.

Characteristics

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators,

[44] Taken in its entirety from WDNR, 2008 http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm
[45] Wisconsin DNR invasive species factsheets from http:/dnr.wi.gov/invasives.

like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. This plant's optimal habitat includes marshes, stream margins, river flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

Reproduction and Dispersal

Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local disturbance is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland.

Ecological Impacts

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

Mechanical Control

Purple loosestrife (PL) can be controlled by cutting, pulling, digging and drowning. Cutting is best done just before plants begin flowering. Cutting too early encourages more flower stems to grow than before. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are still blooming, check for seed. If none, simply bag all cuttings (to prevent them from rooting). If there is seed, cut off each top while carefully holding it upright, then bend it over into a bag to catch any dropping seeds. Dispose of plants/seeds in a capped landfill, or dry and burn them. Composting will not kill the seeds. Keep clothing and equipment seed-free to prevent its spread. Rinse all equipment used in infested areas before moving into uninfested areas, including boats, trailers, clothing, and footwear.

Pulling and digging can be effective, but can also create disturbed bare spots, which are good sites for PL seeds to germinate, or leave behind root fragments that grow into new plants. Use these methods primarily with small plants in loose soils, since they do not usually leave behind large gaps, nor root tips while large plants with multiple stems and brittle roots often do. Dispose of plants as described above.

Mowing has not been effective with loosestrife unless the plants can be mowed to a height where the remaining stems will be covered with water for a full twelve months. Burning has also proven largely ineffective. Mowing and flooding are not encouraged because they can contribute to further dispersal of the species by disseminating seeds and stems.

Follow-up treatments are recommended for at least three years after removal.

Chemical Control

This is usually the best way to eliminate PL quickly, especially with mature plants. The chemicals used have a short soil life. Timing is important. Treat in late July or August, but before flowering to prevent seed set. Always back away from sprayed areas as you go, to prevent getting herbicide on your clothes. Generally, the formula designed for use on wet sites should be used. The best method is to cut stems and paint the stump tops with herbicide. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Try to cover the entire cut portion of the stem, but not let the herbicide drip onto other plants since it is non-selective and can kill any plant it touches.

Glyphosate herbicides: Roundup and Glyfos are typically used, but if there is any open water in the area use Rodeo, a glyphosate formulated and listed for use over water. Currently, glyphosate is the most commonly used chemical for killing loosestrife. Glyphosate must be applied in late July or August to be most effective. Since you must treat at least some stems of each plant and they often grow together in a clump, all stems in the clump should be treated to be sure all plants are treated.

Another method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with very high densities of PL, since the work should be easier and there will be few other plant species to hit accidentally. Use a glyphosate formulated for use over water. A weak solution of around 1% active ingredient can be used and it is generally necessary to wet only 25% of the foliage to kill the plant.

You must obtain a permit from WDNR before applying any herbicide over water. The process has been streamlined for control of purple loosestrife and there is no cost. Contact your regional Aquatic Plant Management Coordinator permit information.

Biological Control

Conventional control methods like hand pulling, cutting, flooding, herbicides, and plant competition have only been moderately effective in controlling purple loosestrife. Biocontrol is now considered the most viable option for more complete control for heavy infestations. The DNR, in cooperation with the U.S. Fish and Wildlife Service, is introducing several natural insect enemies of purple loosestrife from Europe. A species of weevil (*Hylobius transversovittatus*) has been identified that lays eggs in the stem and upper root system of the plant; as larvae develop, they feed on root tissue. In addition, two species of leaf eating beetles (*GaleruceMLA calmariensis* and *G. pusiMLA*) are being raised and released in the state, and another weevil that feeds on flowers (*Nanophyes marmoratu*s) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

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Appendix D

Rapid Response for Early Detection of Eurasian Water Milfoil

1. The McKenzie Lake Association (MLA) community will be directed to contact the EWM identification (ID) lead Tom Mehring and Swany Swanson, if they see a plant in the lakes they suspect might be Eurasian water milfoil (EWM). Signs at the public boat landings, web pages, and newsletter articles will provide contact information and instructions.

2. If the plant is likely to be EWM, the AIS ID lead will confirm identification with WDNR and inform the rest of the MLA board.

3. Mark the location of suspected EWM (AIS ID Lead). Use GPS points, if available, or mark the location with a small float.

4. Confirm identification of EWM (or other AIS) with the WDNR (within 72 hours) (AIS ID Lead). Two entire intact rooted adult specimens of the suspect plants will be collected and bagged and delivered to the WDNR. WDNR may confirm identification with the herbarium at the University of Wisconsin – Stevens Point or the University of Wisconsin – Madison.

5. If the suspect plants are determined to be EWM, the location of EWM will be marked with a more permanent marker. (AIS ID Lead).

6. If identification is positive, inform the board, Burnett County LWCD, herbicide applicator, the person who reported the EWM, lake management consultant, and all lake residents. (AIS ID Lead).

7. If identification is positive, post a notice at the public landing and include a notice in the next newsletter. These notices will inform residents and visitors of the approximate location of EWM and provide appropriate means to avoid spread. (MLA board)

8. Contact Burnett County LWCD to seek assistance in EWM control efforts. The county has a rapid response plan in place that includes assisting lakes where EWM is discovered. Request that the county determine the extent of the EWM introduction and conduct initial removal efforts. If unavailable to assist within two weeks, proceed to step 9.

9. Hire a consultant to determine the extent of the EWM introduction. A diver may be used. If small amounts of EWM are found during this assessment, the consultant will be directed to identify locations with GPS points and hand pull plants found. All plant fragments will be removed from the lake when hand pulling.

10. Select a control plan in cooperation with Burnett County AIS Coordinator and WDNR (board of directors). Additional guidance regarding EWM treatment is found in DNR's *Response for Early Detection of Eurasian Water Milfoil Field Protocol*.

Control methods may include hand pulling, use of divers to manually or mechanically remove the EWM from the lake bottom, application of herbicides, and/or other effective and approved control methods.

The goal of the control plan will be eradication of the EWM.

11. Implement the selected control plan including applying for the necessary permits. Regardless of the control plan selected, it will be implemented by persons who are qualified and experienced in the technique(s) selected.

12. MLA funds may be used to pay for any reasonable expense incurred in implementing the selected control plan, and implementation will not be delayed by waiting for WDNR to approve or fund a grant application.

13. The President of the MLA will work with the WDNR to confirm, as soon as possible, a start date for an Early Detection and Rapid Response AIS Control Grant. Thereafter, the MLA shall formally apply for the grant.

14. MLA shall have the authority to accept donations or borrow money for the purpose of paying for control of EWM.

15. Frequently inspect the area of the EWM to determine the effectiveness of the treatment and whether additional treatment is necessary.

16. Contract for professional monitoring to supplement volunteer monitoring in years following EWM discovery.

EXHIBIT A[2]

McKenzie Lake Association

President	Lisa Kiener-Barnett
EWM ID Lead	Tom Mehring Swany Swanson

Burnett County Land and Water Conservation Department – 715-349-2186

Brad Morris, AIS Coordinator

Dave Ferris, County Conservationist

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Grants	Pamela Toshner: 715-635-4073
Permits	Mark Sundeen: 715-635-4074
EWM Notice	Kathy Bartilson: 715-635-4053

LAKE MANAGEMENT CONSULTANT

Endangered Resource Services	Matt Berg: 715-483-2847

DIVERS

Endangered Resource Services	Matt Berg: 715-483-2847

[2] This list will be reviewed and updated each year.

Appendix E

Management Options for Aquatic Plants

Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
No Management	N	Do not actively manage plants	Minimizing disturbance can protect native species that provide habitat for aquatic fauna; protecting natives may limit spread of invasive species; aquatic plants reduce shoreline erosion and may improve water clarity	May allow small population of invasive plants to become larger, more difficult to control later
			No immediate financial cost	Excessive plant growth can hamper navigation and recreational lake use
			No system disturbance	May require modification of lake users' behavior and perception
			No unintended effects of chemicals	
			Permit not required	
Mechanical Control	May be required under NR 109	Plants reduced by mechanical means	Flexible control	Must be repeated, often more than once per season
		Wide range of techniques, from manual to highly mechanized	Can balance habitat and recreational needs	Can suspend sediments and increase turbidity and nutrient release
a. Handpulling/Manual raking	Y/N	SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake	Little to no damage done to lake or to native plant species	Very labor intensive
		Works best in soft sediments	Can be highly selective	Needs to be carefully monitored
			Can be done by shoreline property owners without permits within an area <30 ft wide OR where selectively removing exotics	Roots, runners, and even fragments of some species, particularly Eurasian watermilfoil (EWM) will start new plants, so all of plant must be removed
			Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species	Small-scale control only

Management Options for Aquatic Plants

Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
b. Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore	Immediate results	Not selective in species removed
		Harvest invasives only if invasive is already present throughout the lake	EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting	Fragments of vegetation can re-root
			Minimal impact to lake ecology	Can remove some small fish and reptiles from lake
			Harvested lanes through dense weed beds can increase growth and survival of some fish	Initial cost of harvester expensive
			Can remove some nutrients from lake	
Biological Control	Y	Living organisms (e.g. insects or fungi) eat or infect plants	Self-sustaining; organism will over-winter, resume eating its host the next year	Effectiveness will vary as control agent's population fluctates
			Lowers density of problem plant to allow growth of natives	Provides moderate control - complete control unlikely
				Control response may be slow
				Must have enough control agent to be effective
a. Weevils on EWM	Y	Native weevil prefers EWM to other native water-milfoil	Native to Wisconsin: weevil cannot "escape" and become a problem	Need to stock large numbers, even if some already present
			Selective control of target species	Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines
			Longer-term control with limited management	Bluegill populations decrease densities through predation

Management Options for Aquatic Plants

Draft updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
b.	Pathogens	Y	Fungal/bacterial/viral pathogen introduced to target species to induce mortalitiy	May be species specific	Largely experimental; effectiveness and longevity unknown
				May provide long-term control	Possible side effects not understood
				Few dangers to humans or animals	
c.	Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long-term, maintenance-free control	Initial transplanting slow and labor-intensive
				Spikerushes (*Eleocharis* spp.) appear to inhibit Eurasian watermilfoil growth	Spikerushes native to WI, and have not effectively limited EWM growth
					Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d.	Planting native plants	Y	Diverse native plant community established to repel invasive species	Native plants provide food and habitat for aquatic fauna	Initial transplanting slow and labor-intensive
				Diverse native community may be "resistant" to invasive species	Nuisance invasive plants may outcompete plantings
				Supplements removal techniques	Largely experimental; few well-documented cases
					If transplants from external sources (another lake or nursury), may include additional invasive species or "hitchhikers"

Management Options for Aquatic Plants

Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
Physical Control	Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Fabrics/ Bottom Barriers	Y	Prevents light from getting to lake bottom	Reduces turbidity in soft-substrate areas	Eliminates all plants, including native plants important for a healthy lake ecosystem
			Useful for small areas	May inhibit spawning by some fish
				Need maintenance or will become covered in sediment and ineffective
				Gas accumulation under blankets can cause them to dislodge from the bottom
				Affects benthic invertebrates
				Anaerobic environment forms that can release excessive nutrients from sediment
b. Drawdown	Y, May require Environmental Assessment	Lake water lowered with siphon or water level control device; plants killed when sediment dries, compacts or freezes	Winter drawdown can be effective at restoration, provided drying and freezing occur. Sediment compaction is possible over winter	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling
		Season or duration of drawdown can change effects	Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction	May impact attached wetlands and shallow wells near shore
			Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality	Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced
			Success demonstrated for reducing EWM, variable success for curly-leaf pondweed (CLP)	Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning
			Restores natural water fluctuation important for all aquatic ecosystems	Winter drawdawn must start in early fall or will kill hibernating reptiles and amphibians
				Navigation and use of lake is limited during drawdown

Management Options for Aquatic Plants

Draft updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
c.	Dredging	Y	Plants are removed along with sediment	Increases water depth	Severe impact on lake ecosystem
			Most effective when soft sediments overlay harder substrate	Removes nutrient rich sediments	Increases turbidity and releases nutrients
			For extremely impacted systems	Removes soft bottom sediments that may have high oxygen demand	Exposed sediments may be recolonized by invasive species
			Extensive planning required		Sediment testing may be necessary
					Removes benthic organisms
					Dredged materials must be disposed of
d.	Dyes	Y	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity	Appropriate for very small water bodies
				Usually non-toxic, degrades naturally over a few weeks	Should not be used in pond or lake with outflow
					Impairs aesthetics
					Effects to microscopic organisms unknown
e.	Non-point source nutrient control	N	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use) thereby providing fewer nutrients available for plant growth	Attempts to correct source of problem, not treat symptoms	Results can take years to be evident due to internal recycling of already-present lake nutrients
				Could improve water clarity and reduce occurrences of algal blooms	Requires landowner cooperation and regulation
				Native plants may be able to better compete with invasive species in low-nutrient conditions	Improved water clarity may increase plant growth

Management Options for Aquatic Plants

Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
Chemical Control	Y, Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae	Some flexibility for different situations	Possible toxicity to aquatic animals or humans, especially applicators
		Results usually within 10 days of treatment, but repeat treatments usually needed	Some can be selective if applied correctly	May kill desirable plant species, e.g. native water-milfoil or native pondweeds; maintaining healthy native plants important for lake ecology and minimizing spread of invasives
		Chemicals must be used in accordance with label guidelines and restrictions	Can be used for restoration activities	Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration
				May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape
				Often controversial
a. 2,4-D	Y	Systemic[1] herbicide selective to broadleaf[2] plants that inhibits cell division in new tissue	Moderately to highly effective, especially on EWM	May cause oxygen depletion after plants die and decompose
		Applied as liquid or granules during early growth phase	Monocots, such as pondweeds (e.g. CLP) and many other native species not affected	May kill native dicots such as pond lilies and other submerged species (e.g. coontail)
			Can be selective depending on concentration and seasonal timing	Cannot be used in combination with copper herbicides (used for algae)
			Can be used in synergy with endotholl for early season CLP and EWM treatments	Toxic to fish
			Widely used aquatic herbicide	

Management Options for Aquatic Plants

Draft updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
b.	Endothall	Y	Broad-spectrum[3], contact[4] herbicide that inhibits protein synthesis	Especially effective on CLP and also effective on EWM	Kills many native pondweeds
			Applied as liquid or granules	May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring	Not as effective in dense plant beds; heavy vegetation requires multiple treatments
				Can be selective depending on concentration and seasonal timing	Not to be used in water supplies; post-treatment restriction on irrigation
				Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds	Toxic to aquatic fauna (to varying degrees)
				Limited off-site drift	
c.	Diquat	Y	Broad-spectrum, contact herbicide that disrupts cellular functioning	Mostly used for water-milfoil and duckweed	May impact non-target plants, especially native pondweeds, coontail, elodea, naiads
			Applied as liquid, can be combined with copper treatment	Rapid action	Toxic to aquatic invertebrates
				Limited direct toxicity on fish and other animals	Must be reapplied several years in a row
					Ineffective in muddy or cold water (<50°F)
d.	Fluridone	Y; special permit and Environmental Assessment may be required	Broad-spectrum, systemic herbicide that inhibits photosynthesis	Effective on EWM for 1 to 4 years with aggressive follow-up treatments	Affects non-target plants, particularly native milfoils, coontails, elodea, and naiads, even at low concentrations
			Must be applied during early growth stage	Some reduction in non-target effects can be achieved by lowering dosage	Requires long contact time at low doses: 60-90 days
			Available with a special permit only; chemical applications beyond 150 ft from shore not allowed under NR 107	Slow decomposition of plants may limit decreases in dissolved oxygen	Demonstrated herbicide resistance in hydrilla subjected to repeat treatments
			Applied at very low concentration at whole lake scale	Low toxicity to aquatic animals	In shallow eutrophic systems, may result in decreased water clarity
					Unknown effect of repeat whole-lake treatments on lake ecology

Management Options for Aquatic Plants

Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
e. Glyphosate	Y	Broad-spectrum, systemic herbicide that disrupts enzyme formation and function	Effective on floating and emergent plants such as purple loosestrife	RoundUp is often incorrectly substituted for Rodeo - Associated surfactants of RoundUp believed to be toxic to reptiles and amphibians
		Usually used for purple loosestrife stems or cattails	Selective if carefully applied to individual plants	Cannot be used near potable water intakes
		Applied as liquid spray or painted on loosetrife stems	Non-toxic to most aquatic animals at recommended dosages	Ineffective in muddy water
			Effective control for 1-5 years	No control of submerged plants
f. Triclopyr	Y	Systemic herbicide selective to broadleaf plants that disrupts enzyme function	Effective on many emergent and floating plants	Impacts may occur to some native plants at higher doses (e.g. coontail)
		Applied as liquid spray or liquid	More effective on dicots, such as purple loosestrife; may be more effective than glyphosate	May be toxic to sensitive invertebrates at higher concentrations
			Control of target plants occurs in 3-5 weeks	Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)
			Low toxicity to aquatic animals	Sensitive to UV light; sunlight can break herbicide down prematurely
			No recreational use restrictions following treatment	Relatively new management option for aquatic plants (since 2003)
g. Copper compounds	Y	Broad-spectrum, systemic herbicide that prevents photosynthesis	Reduces algal growth and increases water clarity	Elemental copper accumulates and persists in sediments
		Used to control planktonic and filamentous algae	No recreational or agricultural restrictions on water use following treatment	Short-term results
		Wisconsin allows small-scale control only	Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Long-term effects of repeat treatments to benthic organisms unknown
				Toxic to invertebrates, trout and other fish, depending on the hardness of the water
				Clear water may increase plant growth

[1]Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.
[2]Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.
[3]Broad-spectrum herbicide - Affects both monocots and dicots.
[4]Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.
Specific effects of herbicide treatments dependent on timing, dosage, duration of treatment, and location.
References to registered products are for your convenience and not intended as an endorsement or criticism of that product versus other similar products.
This document is intended to be a guide to available aquatic plant control techniques, and is not necessarily an exhaustive list.
Please contact your local Aquatic Plant Management Specialist when considering a permit.

Appendix F

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR
Summer, 2007

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote "whole lake" management plans
- Limit the number of permits to control native aquatic plants.

BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality*, helps *sustain the fishing* quality known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the "up-north" appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is

because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these "invaders" benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, it *may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

GOALS OF STRATEGY:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a" whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE

State Statute 23.24 (2)(c) states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic plants that are removed or controlled under an aquatic plant management permit.
7. The requirements for plans that the department may require under sub. (3) (b). "

State Statute 23.24(3)(b) states:

"The department may require that an application for an aquatic plant management permit contain a plan for the department's approval as to how the aquatic plants will be introduced, removed, or controlled."

Wisconsin Administrative Code NR 109.04(3)(a) states:

"The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long-term sustainability of beneficial water use activities."

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents "impairment of navigation" and/or "nuisance conditions". Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of "impairment of navigation" and/or "nuisance conditions". No new individual permits will be issued during the interim.

2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.

3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
   a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR's Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WNDR review and approval.
   b. Individuals holding past permits for control of *invasive* aquatic plants and/or "mixed stands" of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if "impairment of navigation" and/or "nuisance conditions" is adequately documented, unless there is an approved lake management plan for the lake in question.

4. Control of invasive species or "mixed stands" of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).

5. Manual removal (see attached definition) is allowed (Admin. Code NR 109.06).

** Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.

- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

Documentation of *impairment of navigation* by native plants must include:

a. Specific locations of navigation routes (preferably with GPS coordinates)
b. Specific dimensions in length, width, and depth
c. Specific times when plants cause the problem and how long the problem persists
d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
e. The species of plant or plants creating the nuisance (documented with samples or from a Site inspection)

Documentation of the *nuisance* must include:

a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DEFINITIONS

Manual removal: Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver.

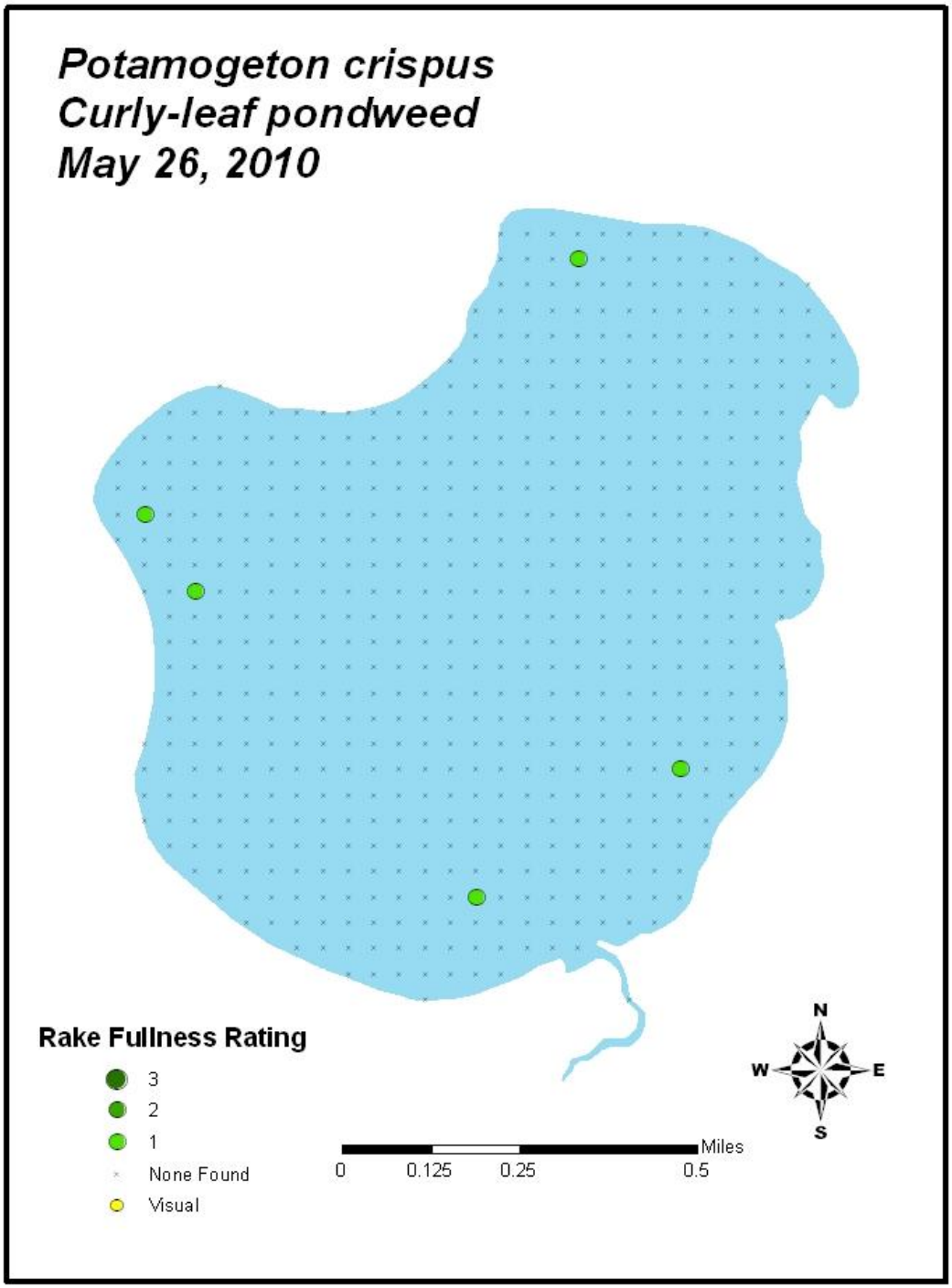
Native aquatic plants: Aquatic plants that are indigenous to the waters of this state.

Invasive aquatic plants: Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Sensitive area: Defined under s. NR 107.05(3)(i) (sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water).

Rapid Response protocol: This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established.

Appendix G: Middle and Big McKenzie Aquatic Plant Distribution Maps


Potamogeton crispus
Curly-leaf pondweed
May 26, 2010
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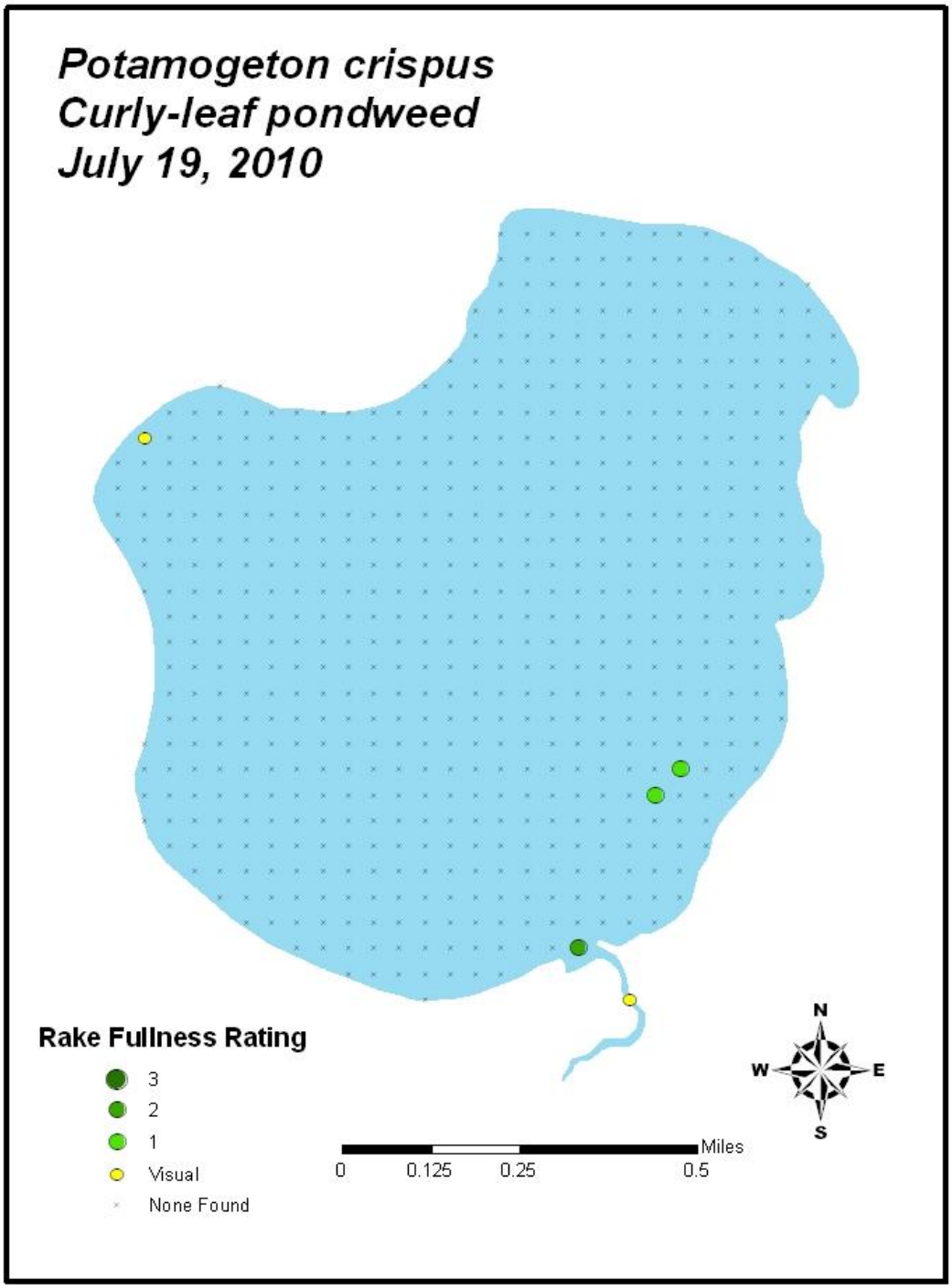
Potamogeton crispus
Curly-leaf pondweed
July 19, 2010
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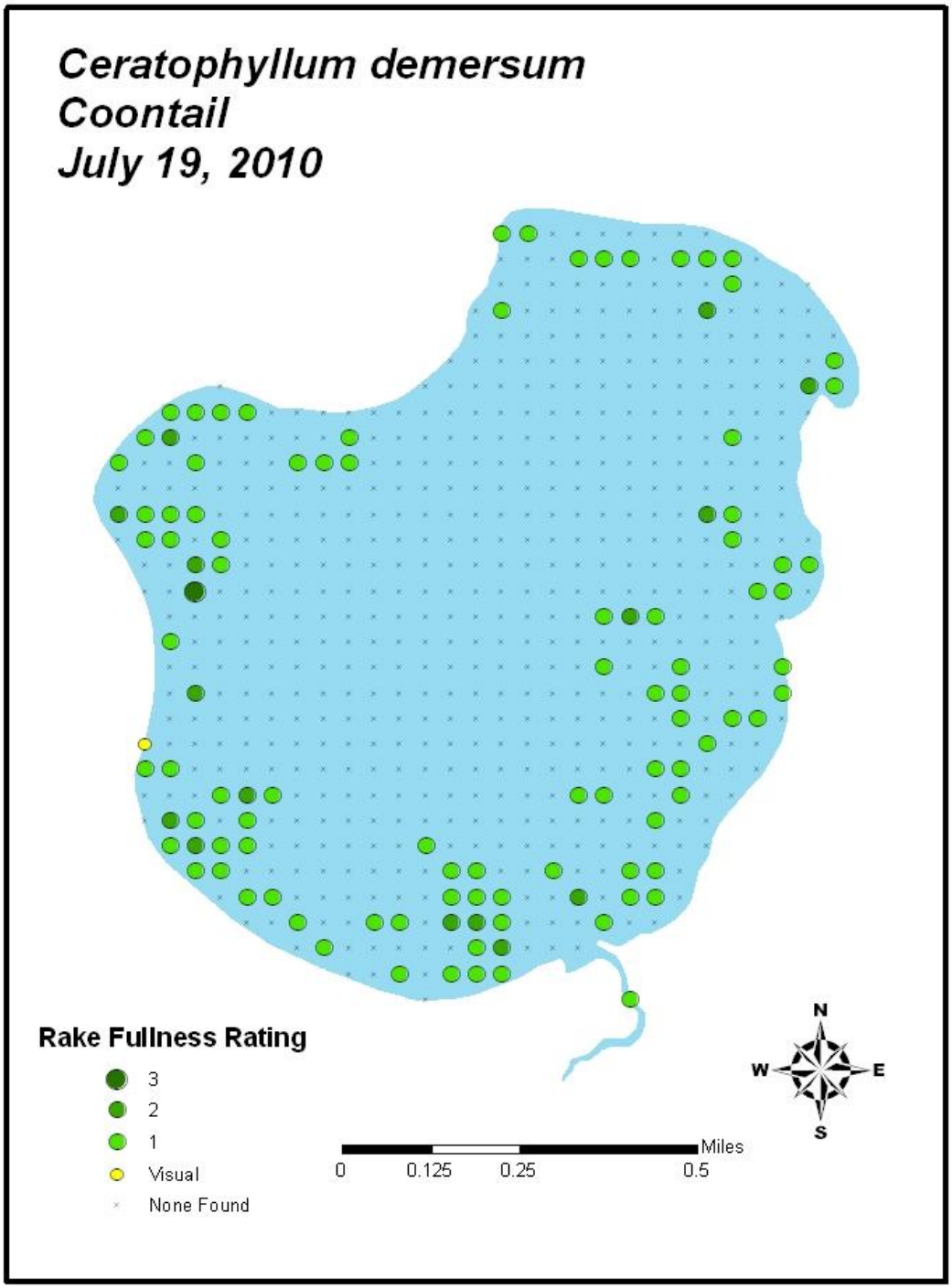
Ceratophyllum demersum
Coontail
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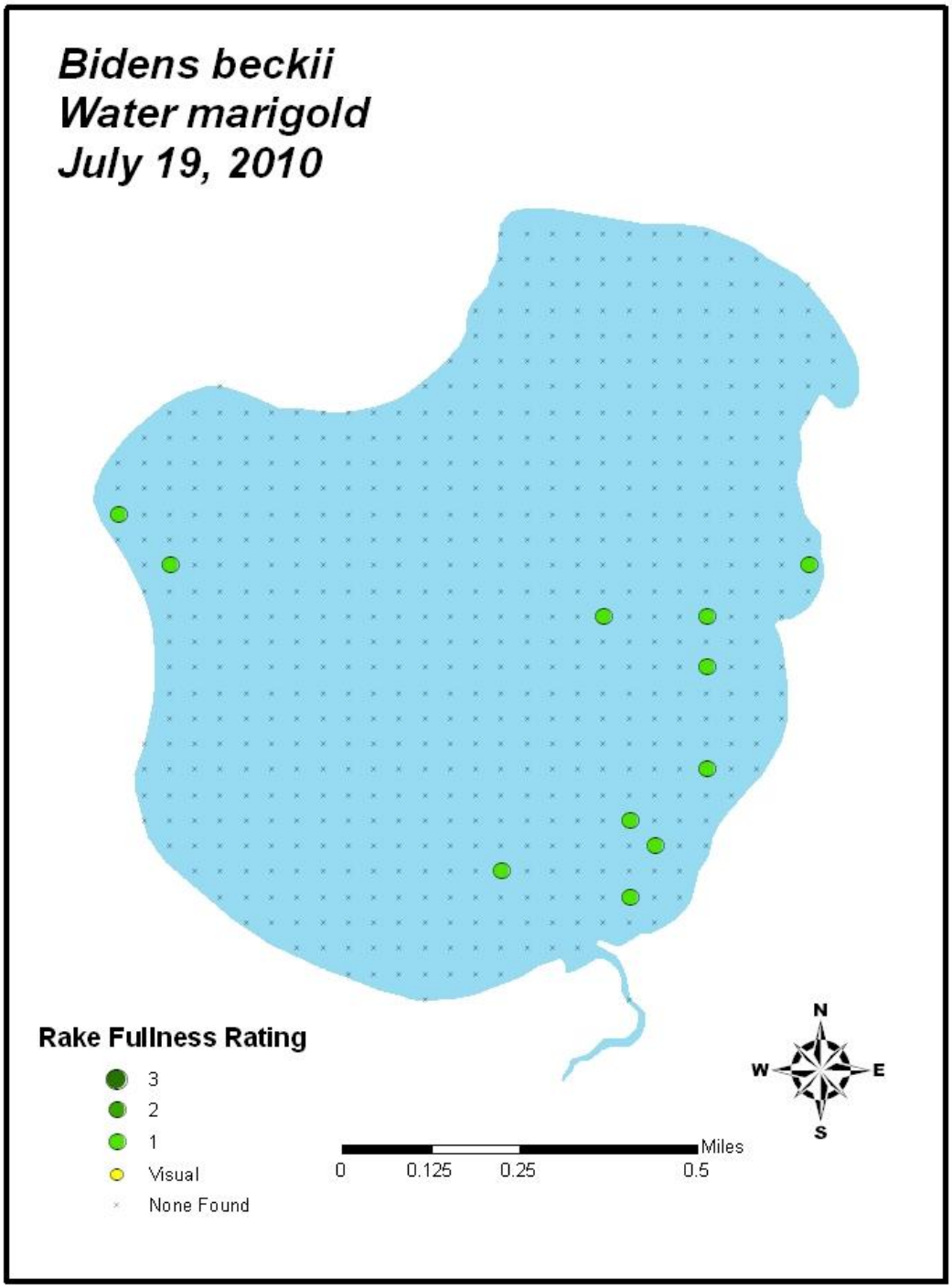
Bidens beckii
Water marigold
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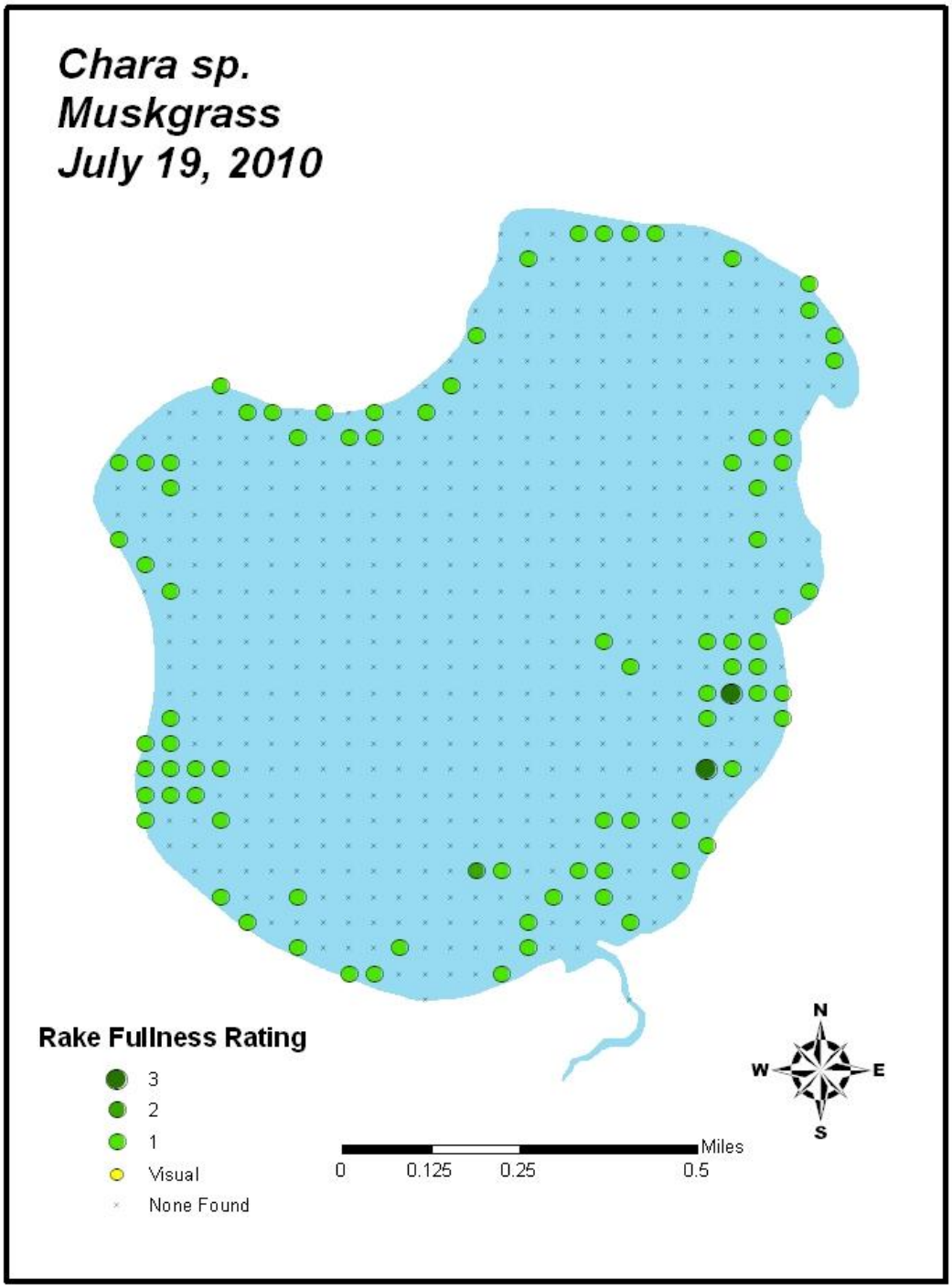
Chara sp.
Muskgrass
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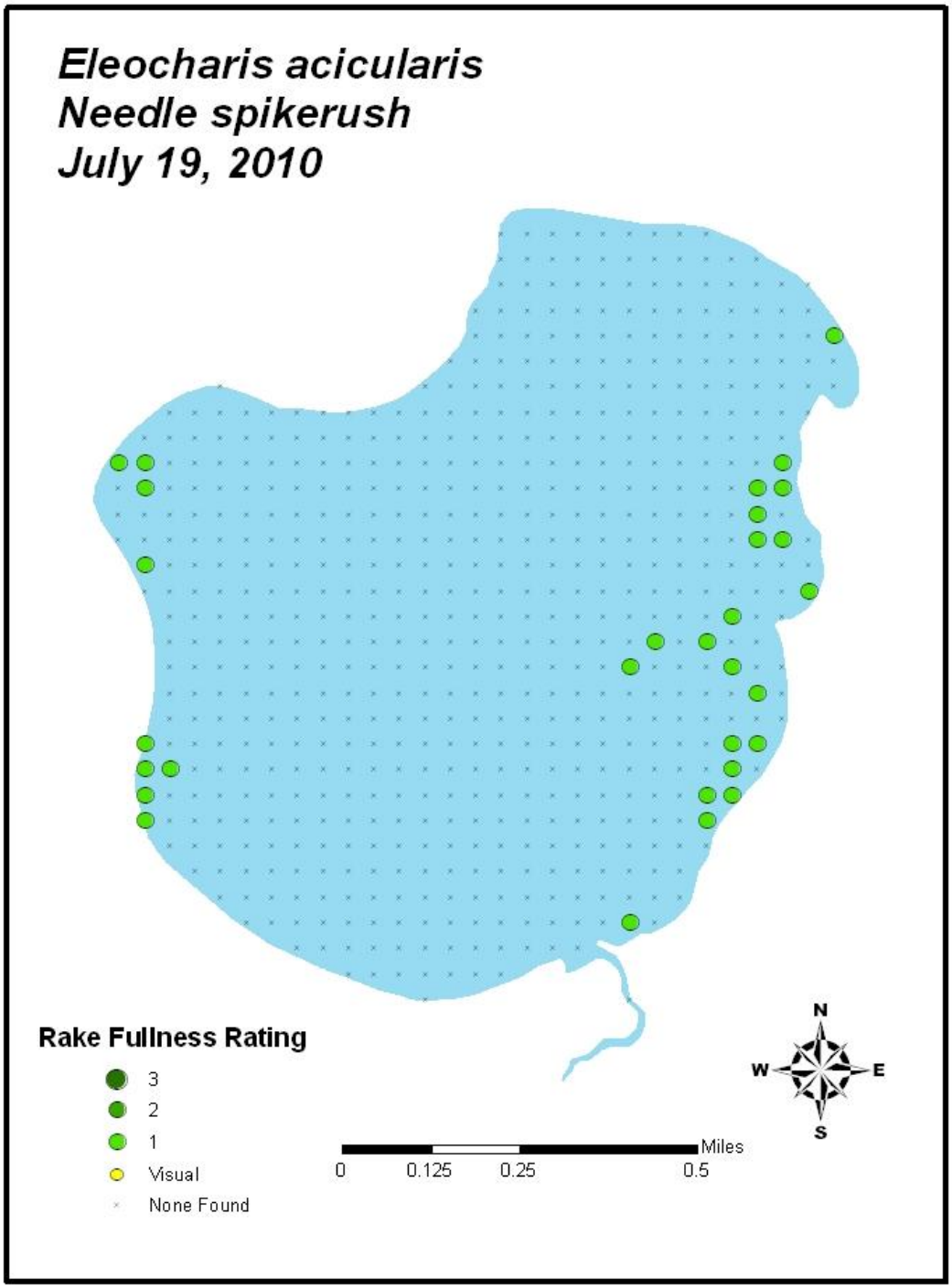
Eleocharis acicularis
Needle spikerush
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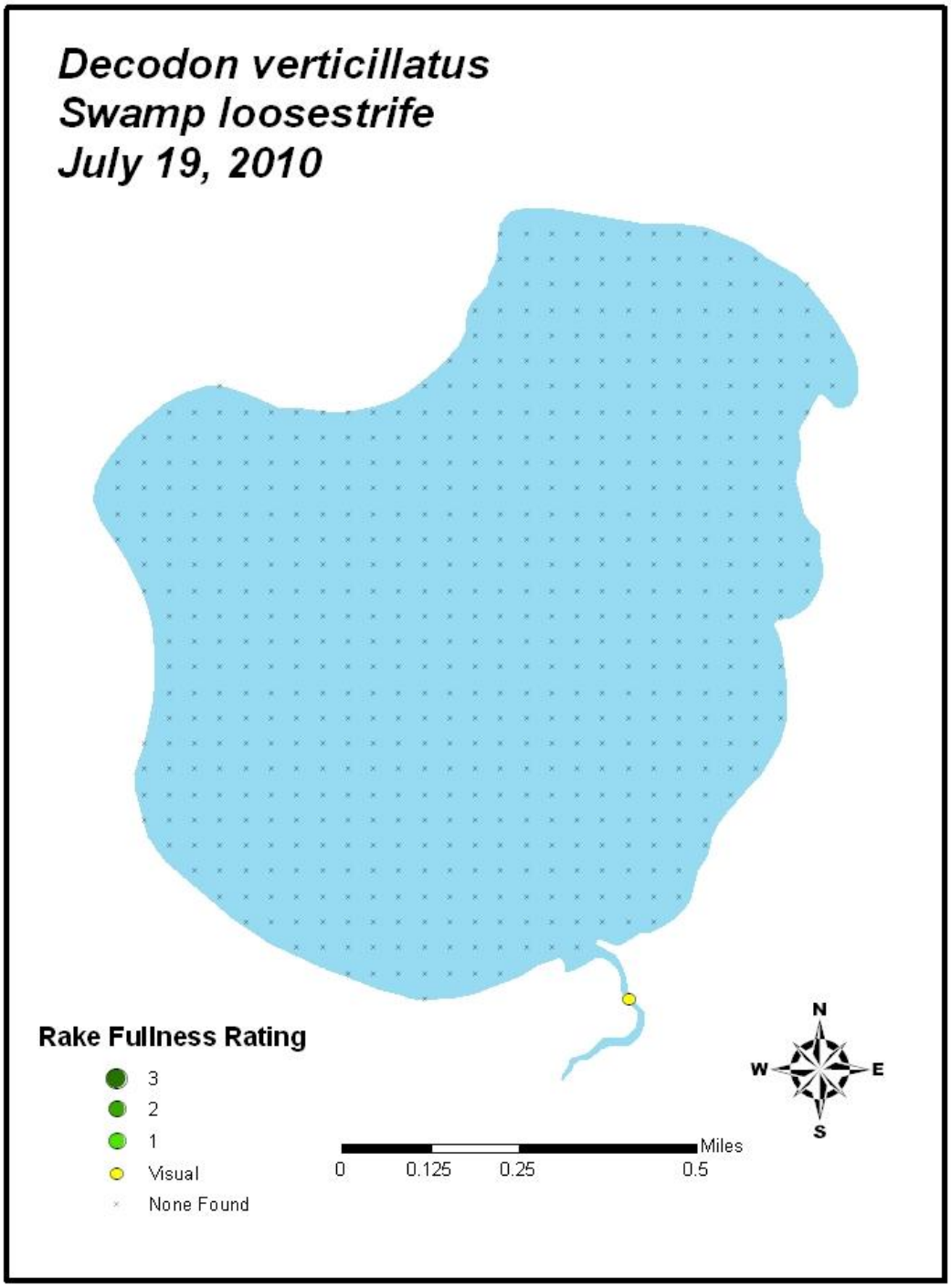
Decodon verticillatus
Swamp loosestrife
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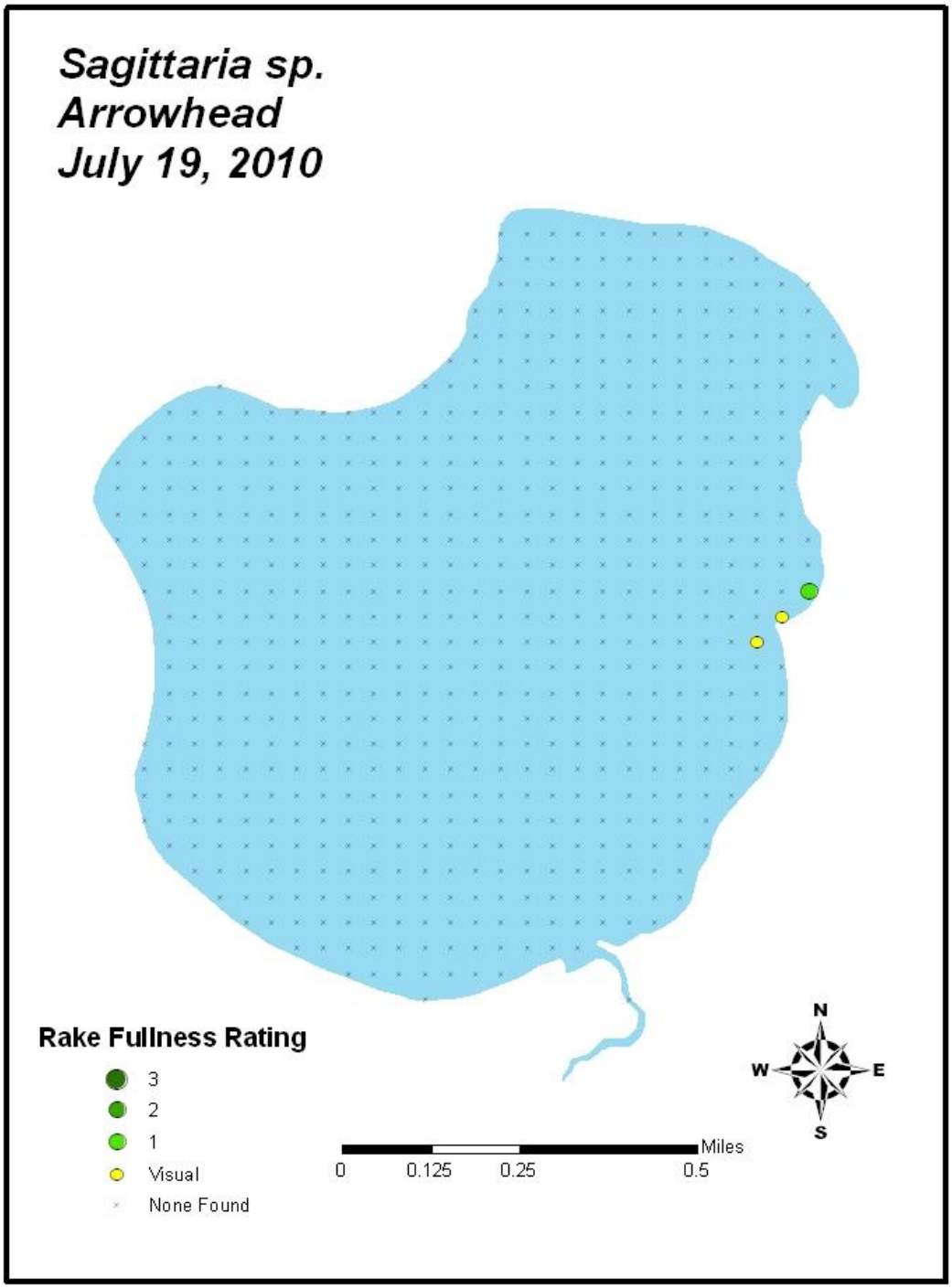
Sagittaria sp.
Arrowhead
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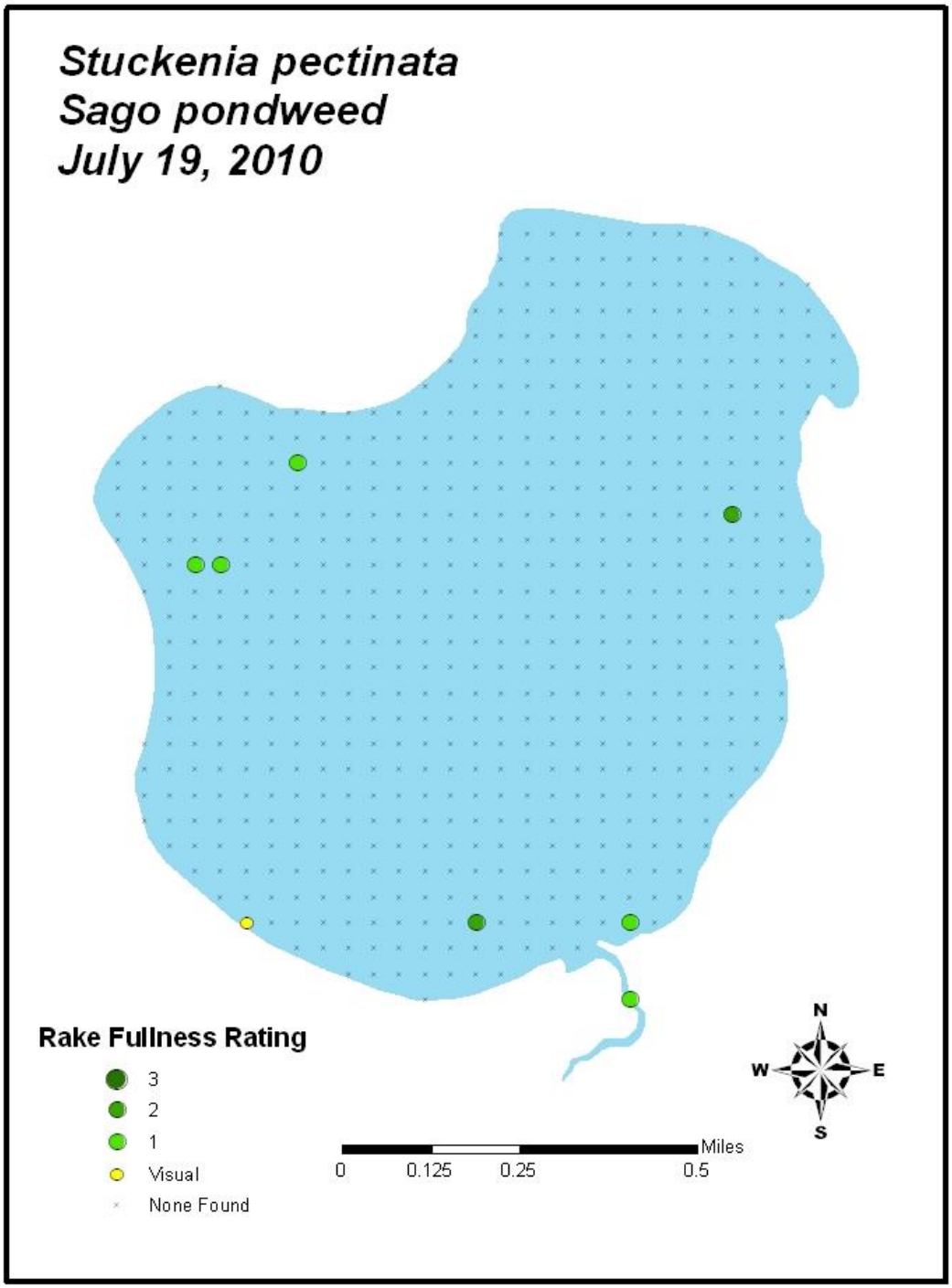
Stuckenia pectinata
Sago pondweed
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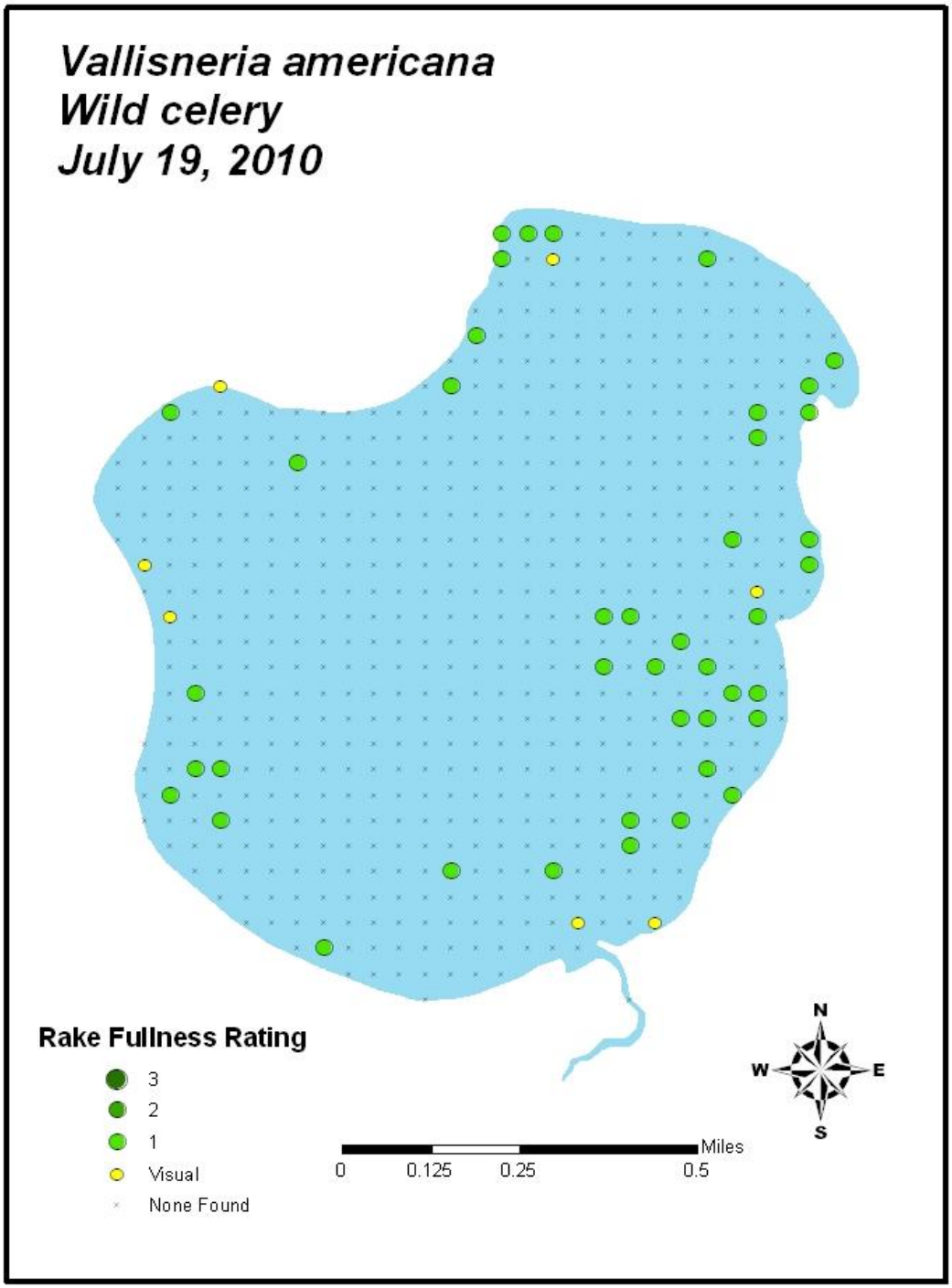
Vallisneria americana
Wild celery
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Carex sp.
July 19, 2010
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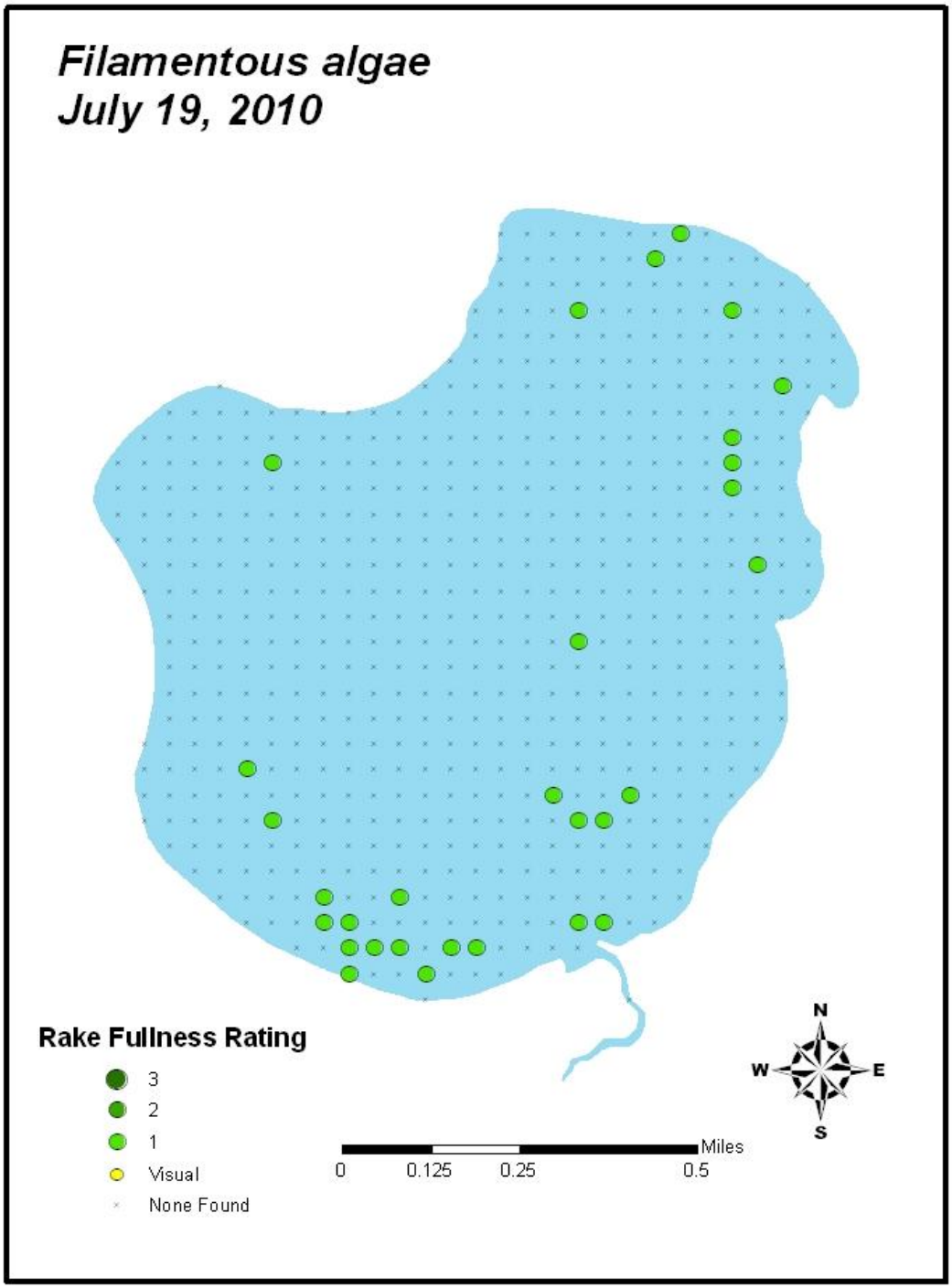
Filamentous algae
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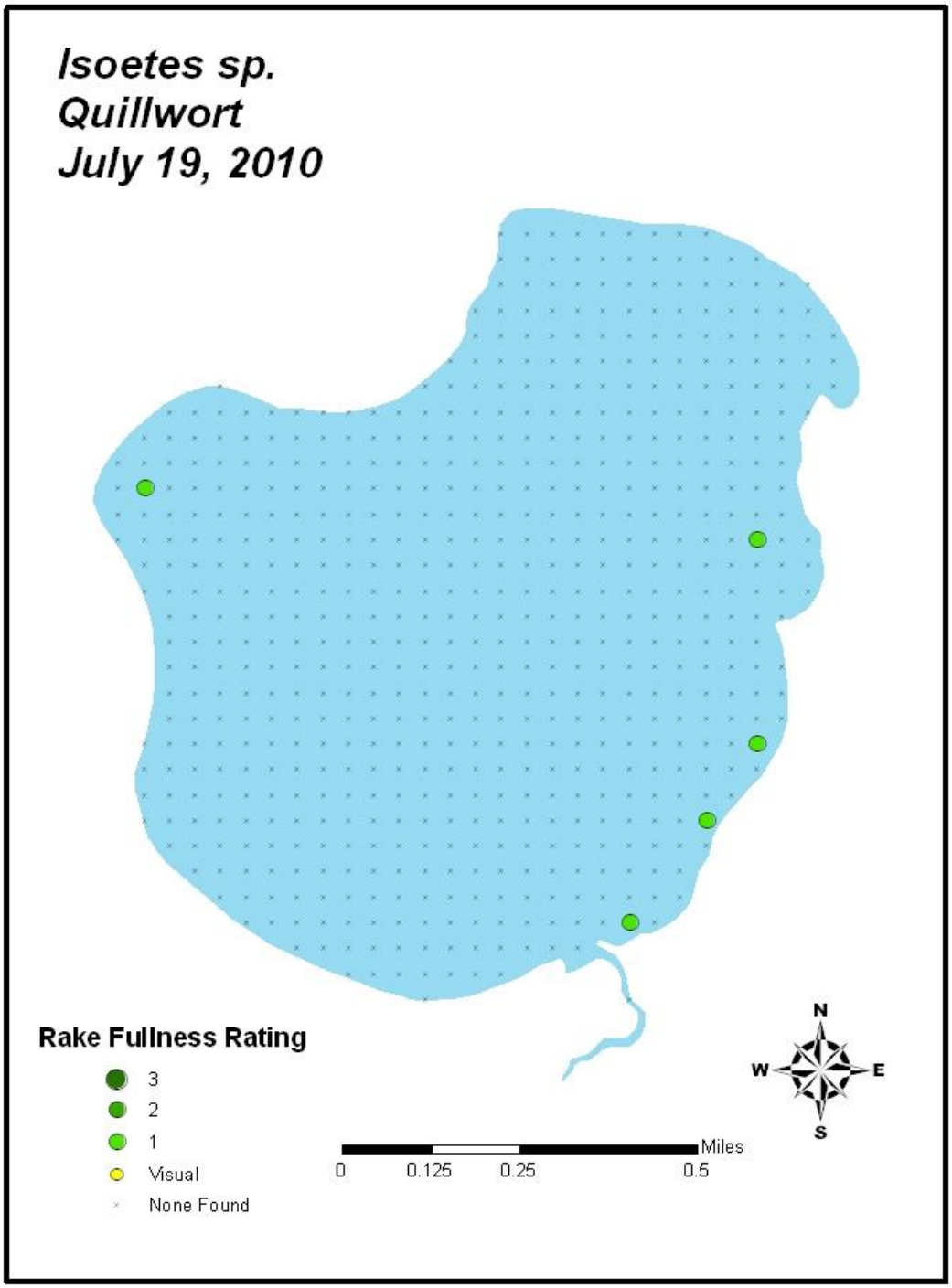
Isoetes sp.
Quillwort
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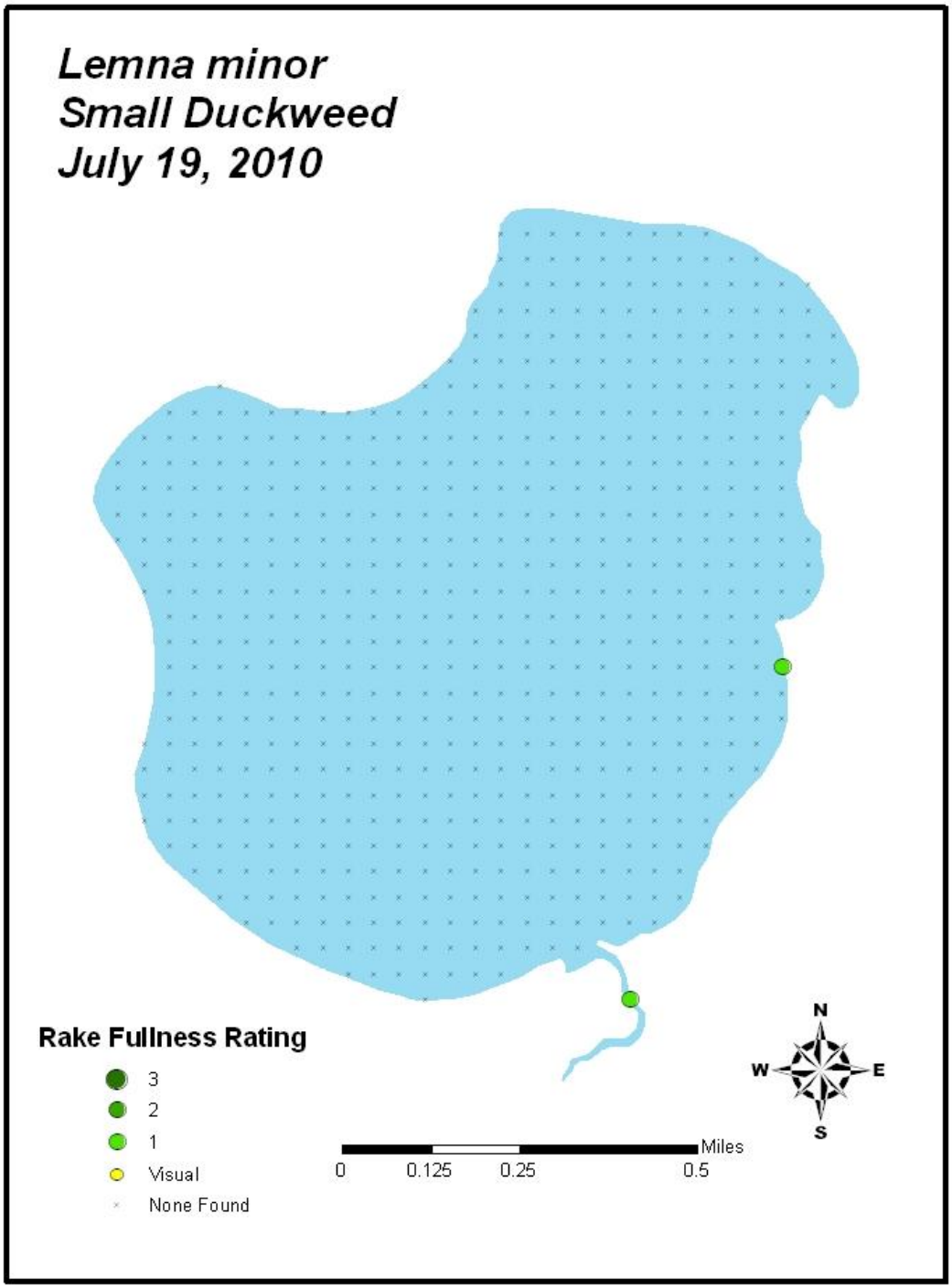
Lemna minor
Small Duckweed
July 19, 2010
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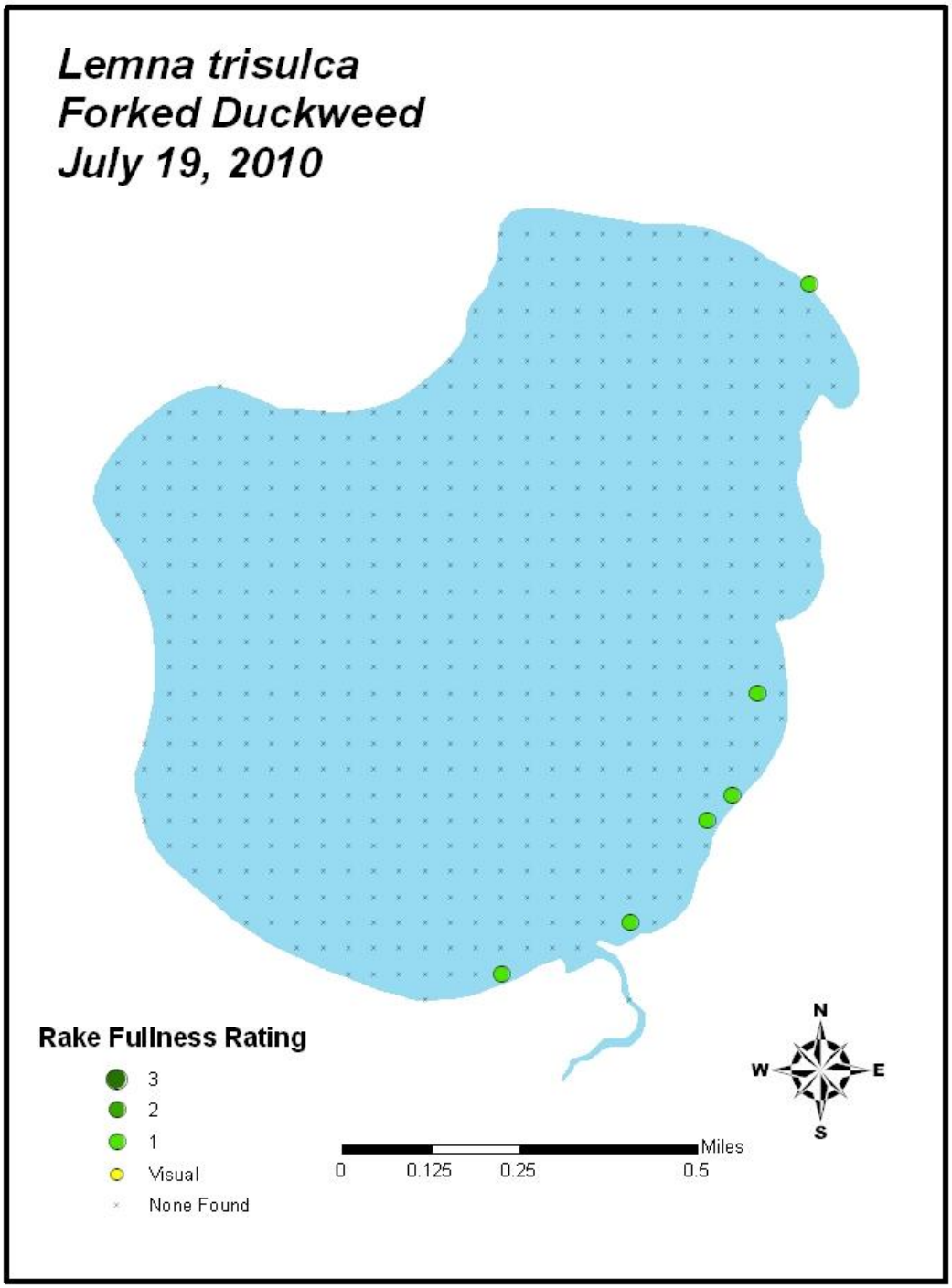
Lemna trisulca
Forked Duckweed
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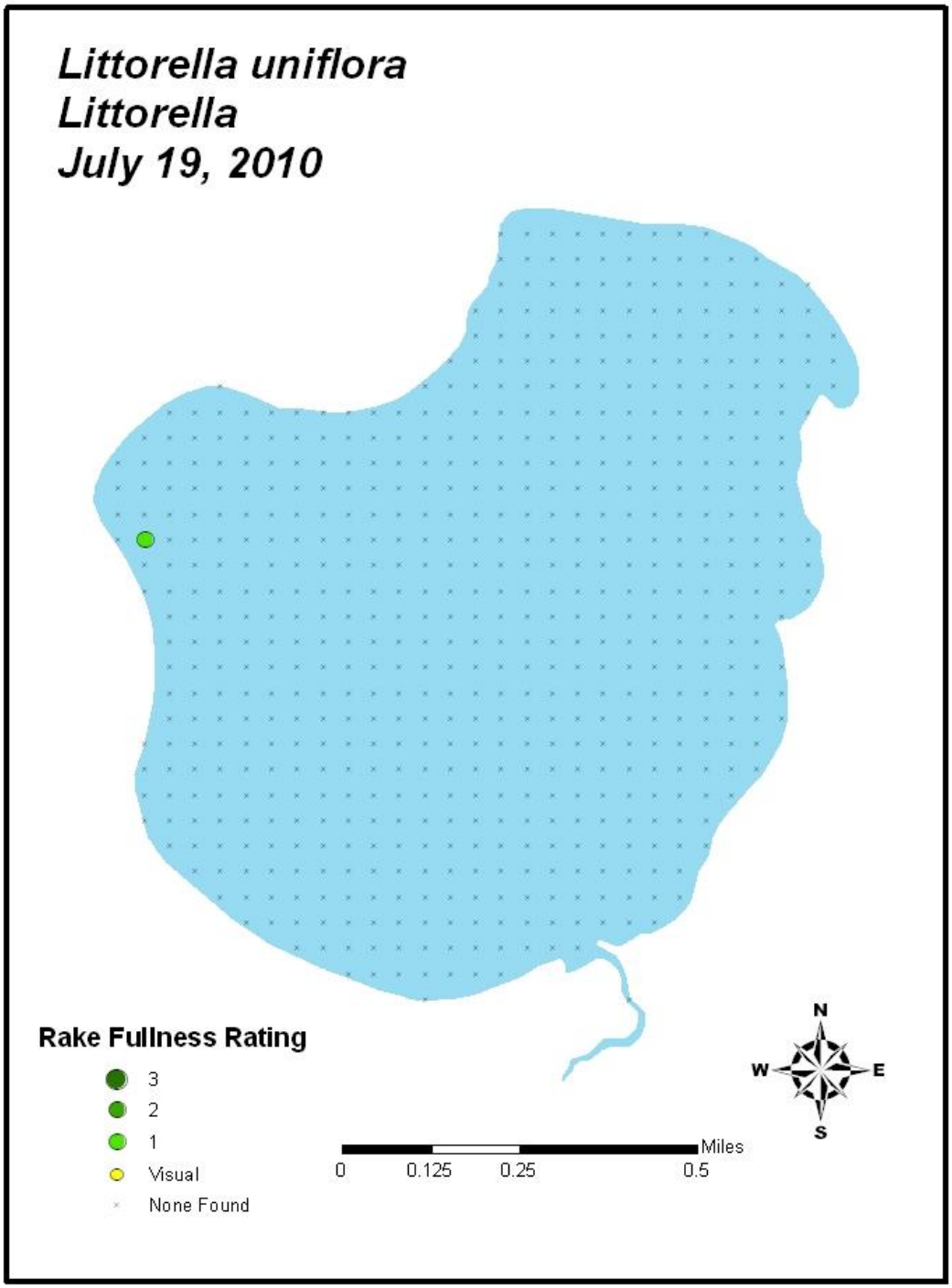
Littorella uniflora
Littorella
July 19, 2010
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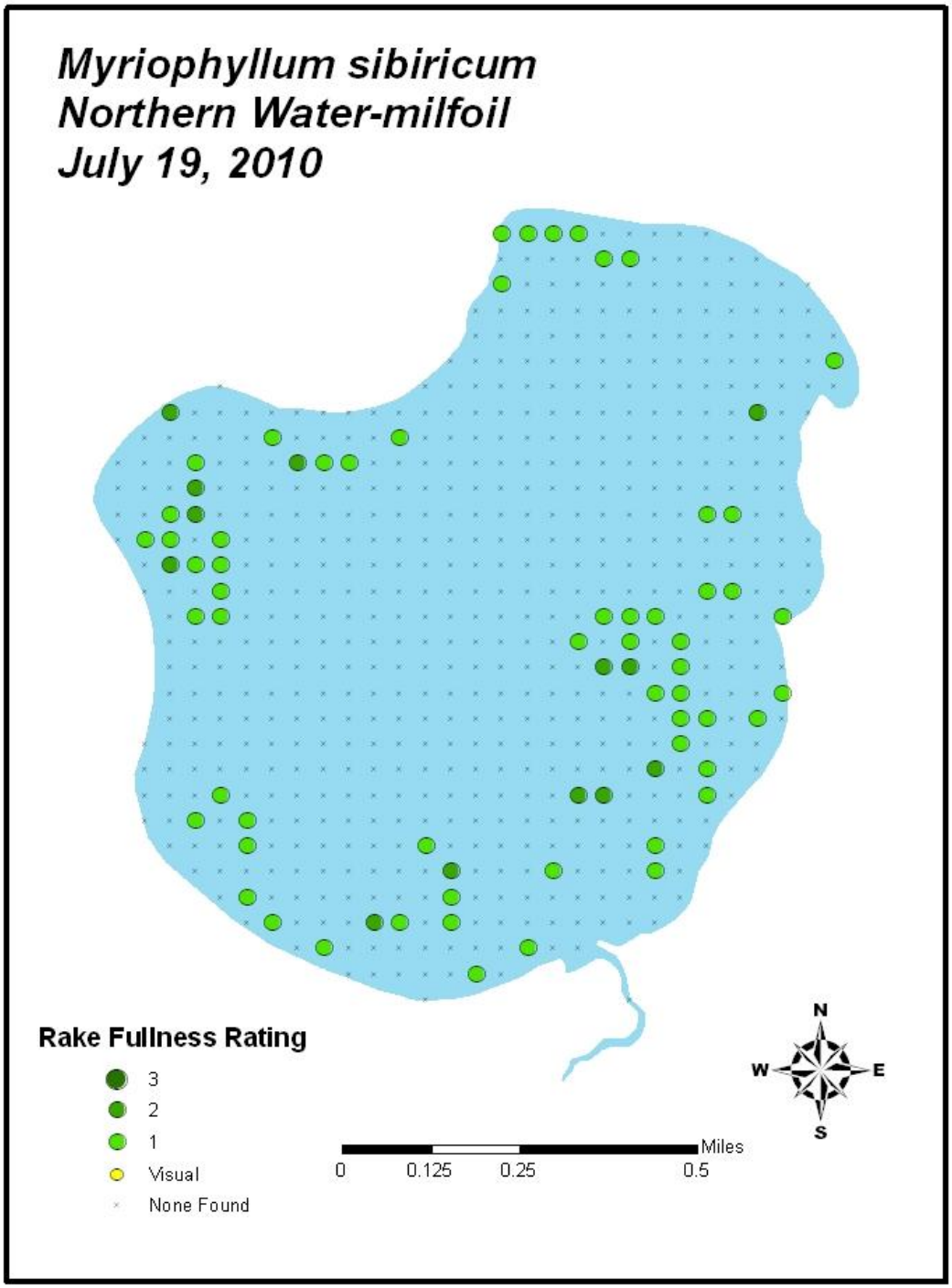
Myriophyllum sibiricum
Northern Water-milfoil
July 19, 2010
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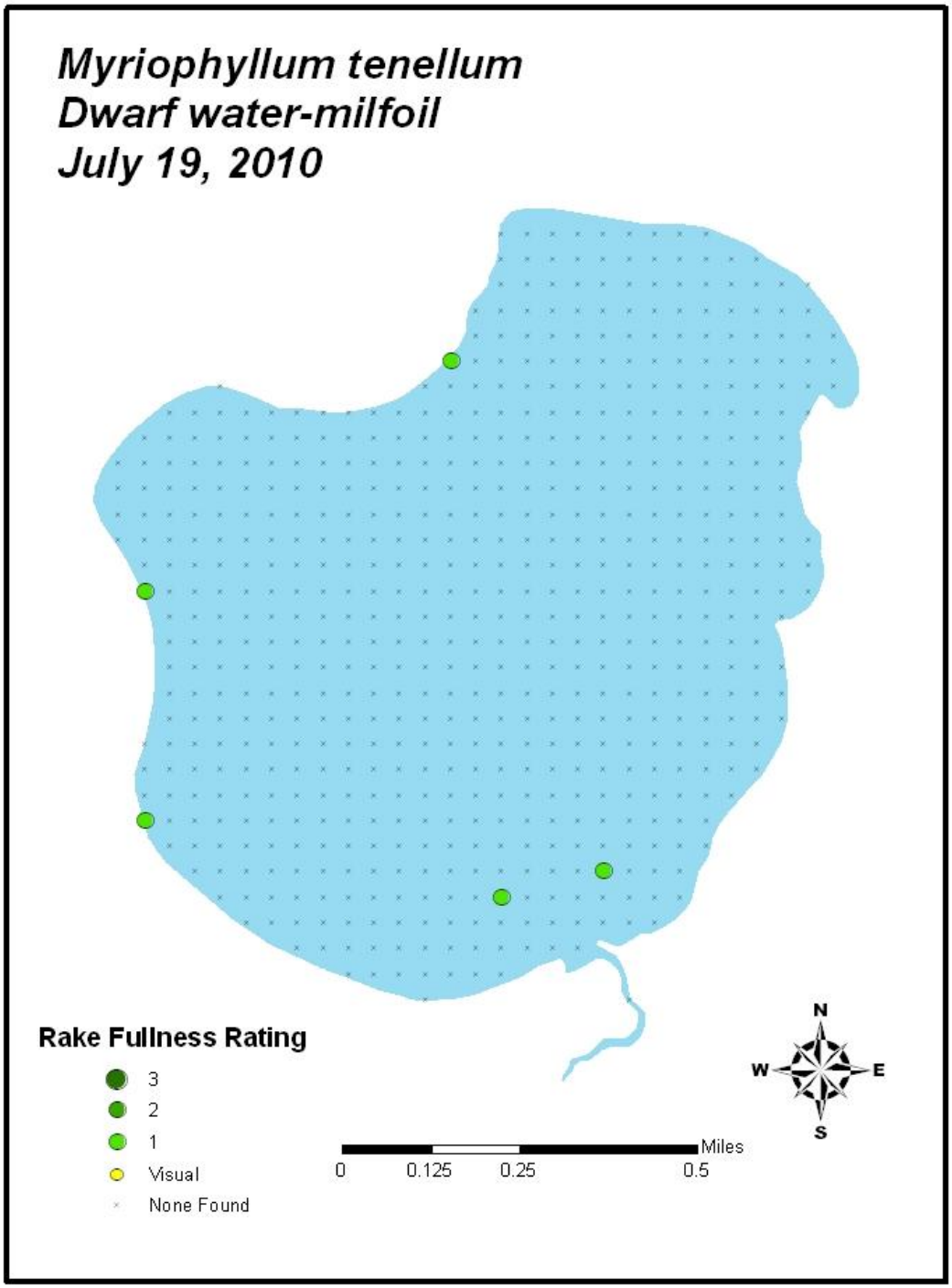
Myriophyllum tenellum
Dwarf water-milfoil
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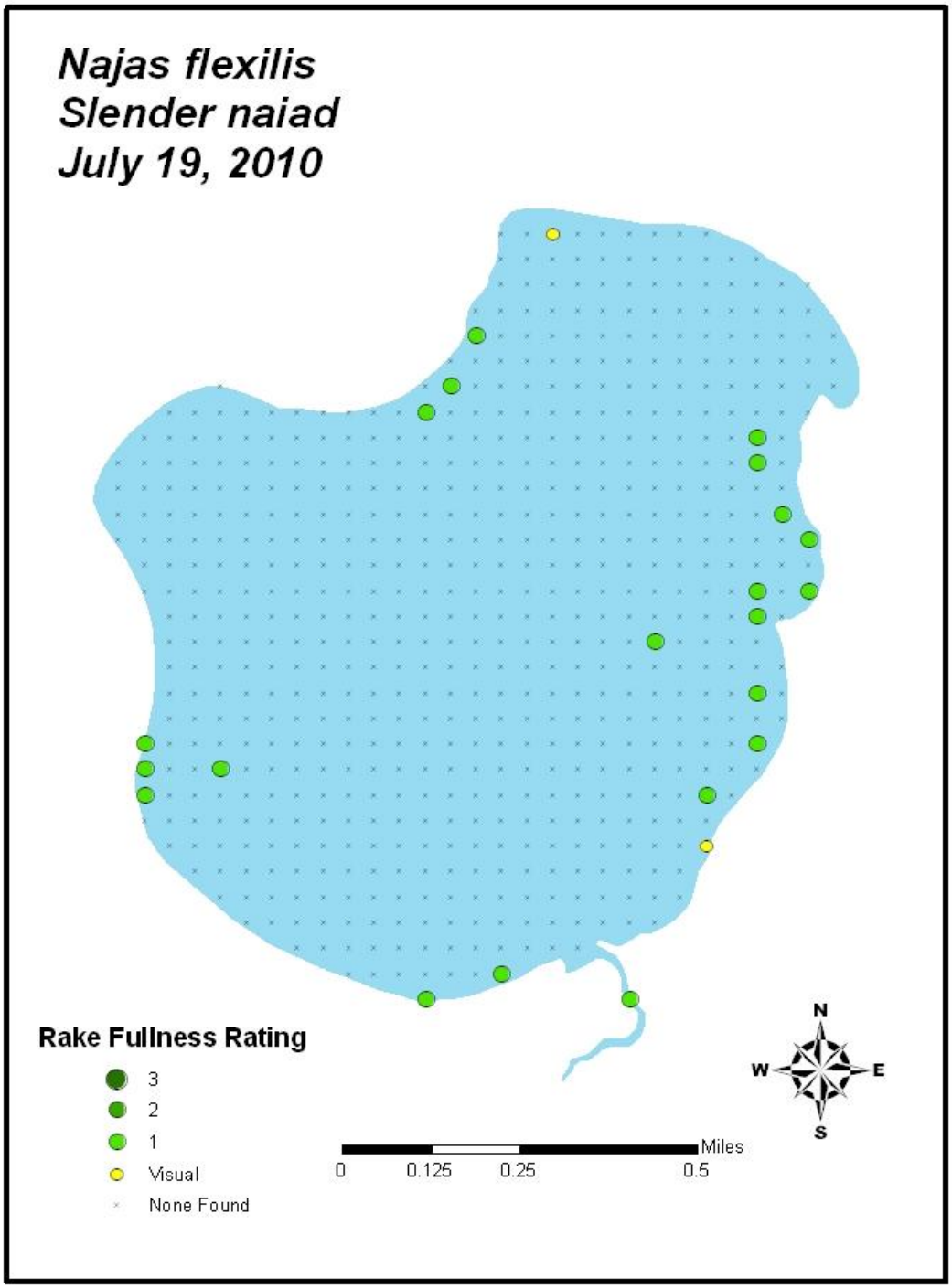
Najas flexilis
Slender naiad
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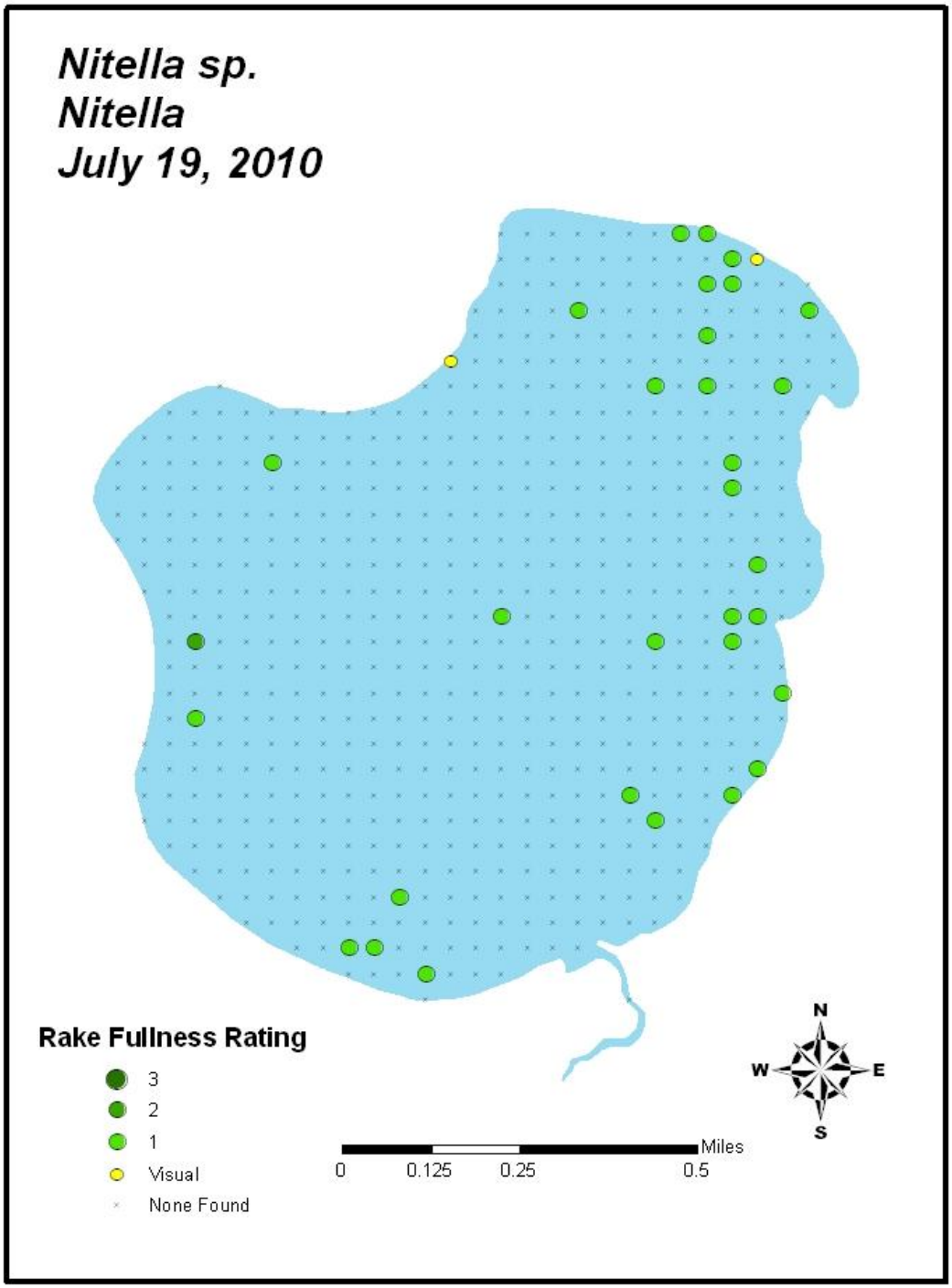
Nitella sp.
Nitella
July 19, 2010
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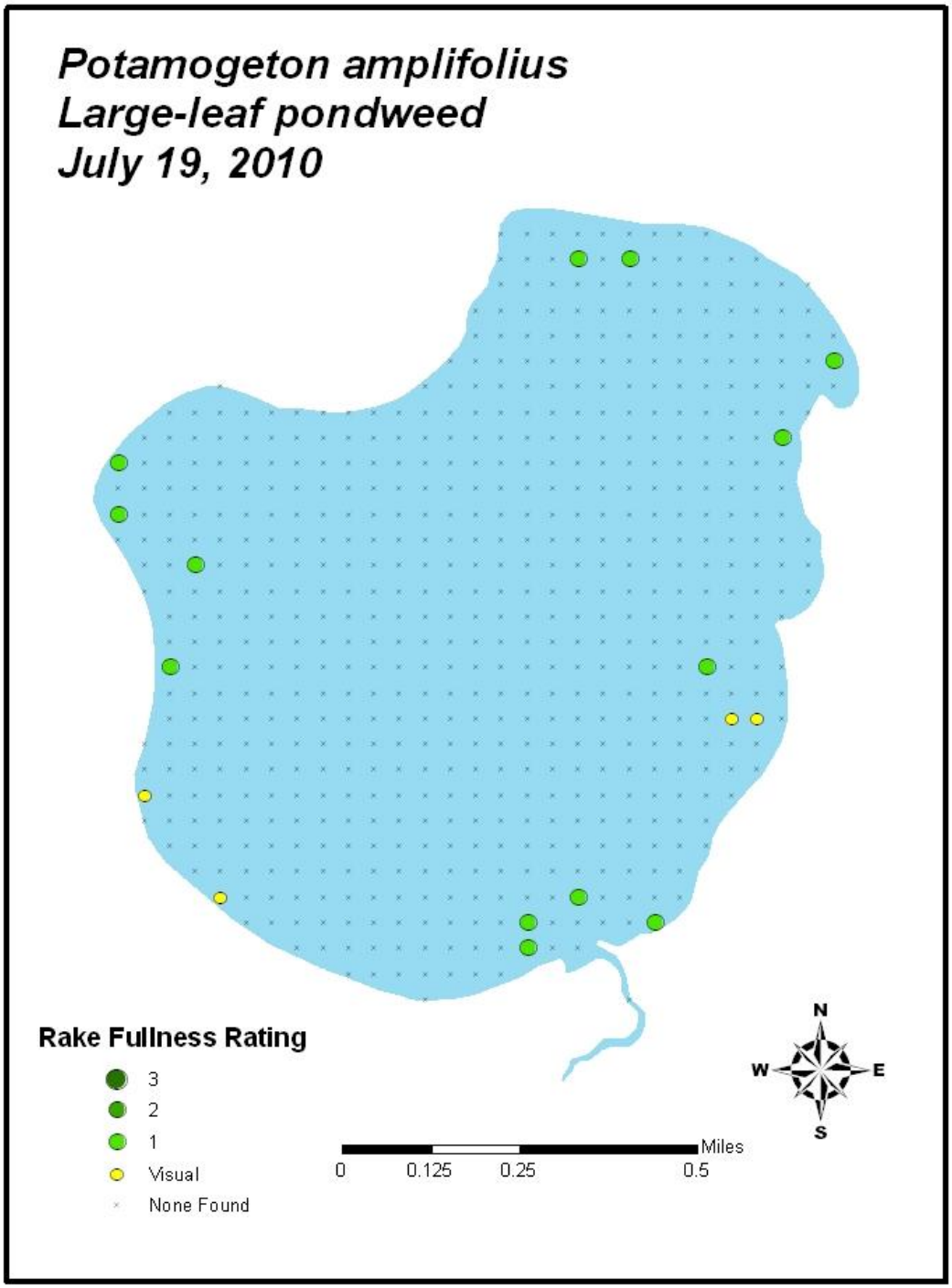
Potamogeton amplifolius
Large-leaf pondweed
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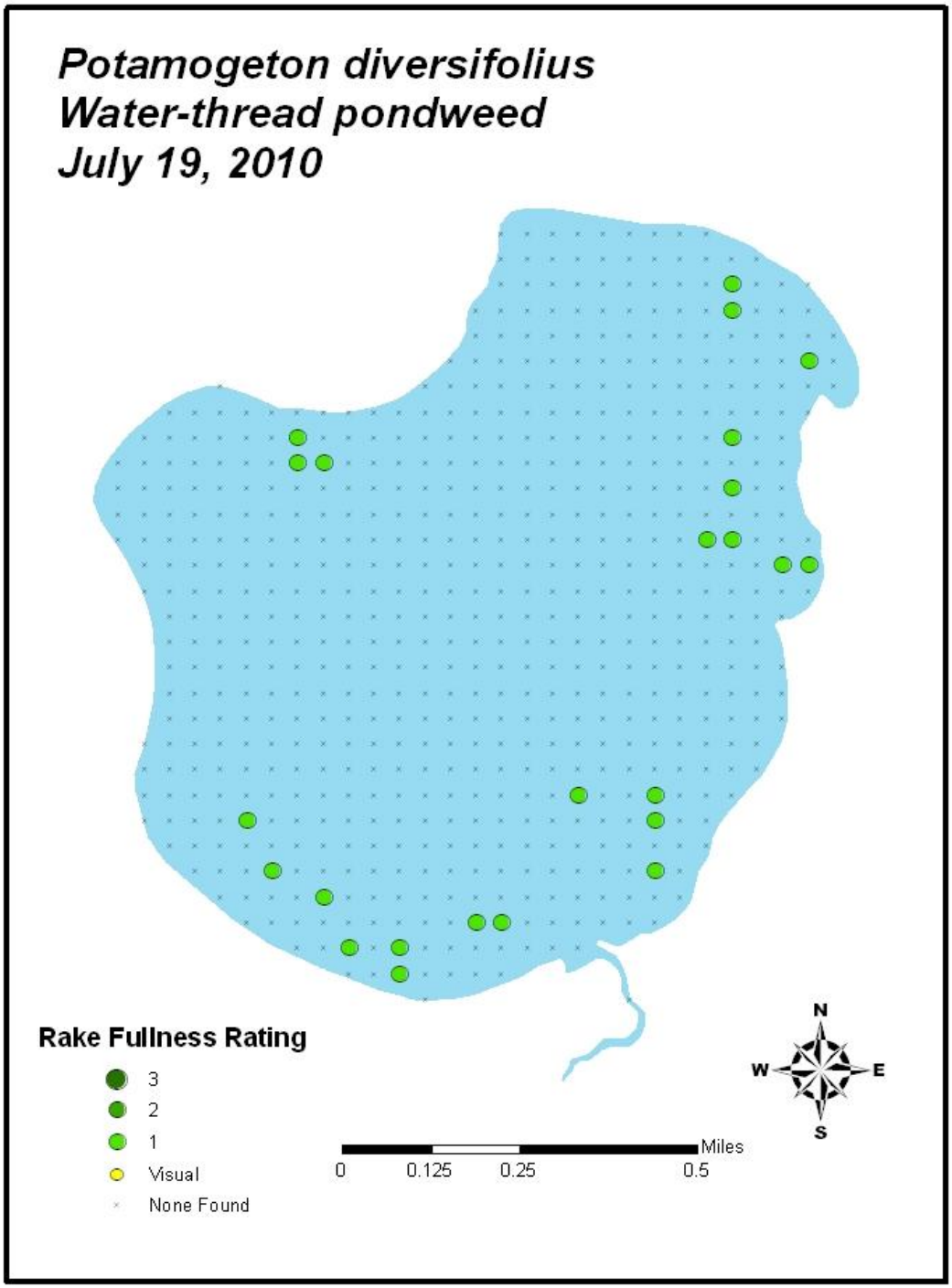
Potamogeton diversifolius
Water-thread pondweed
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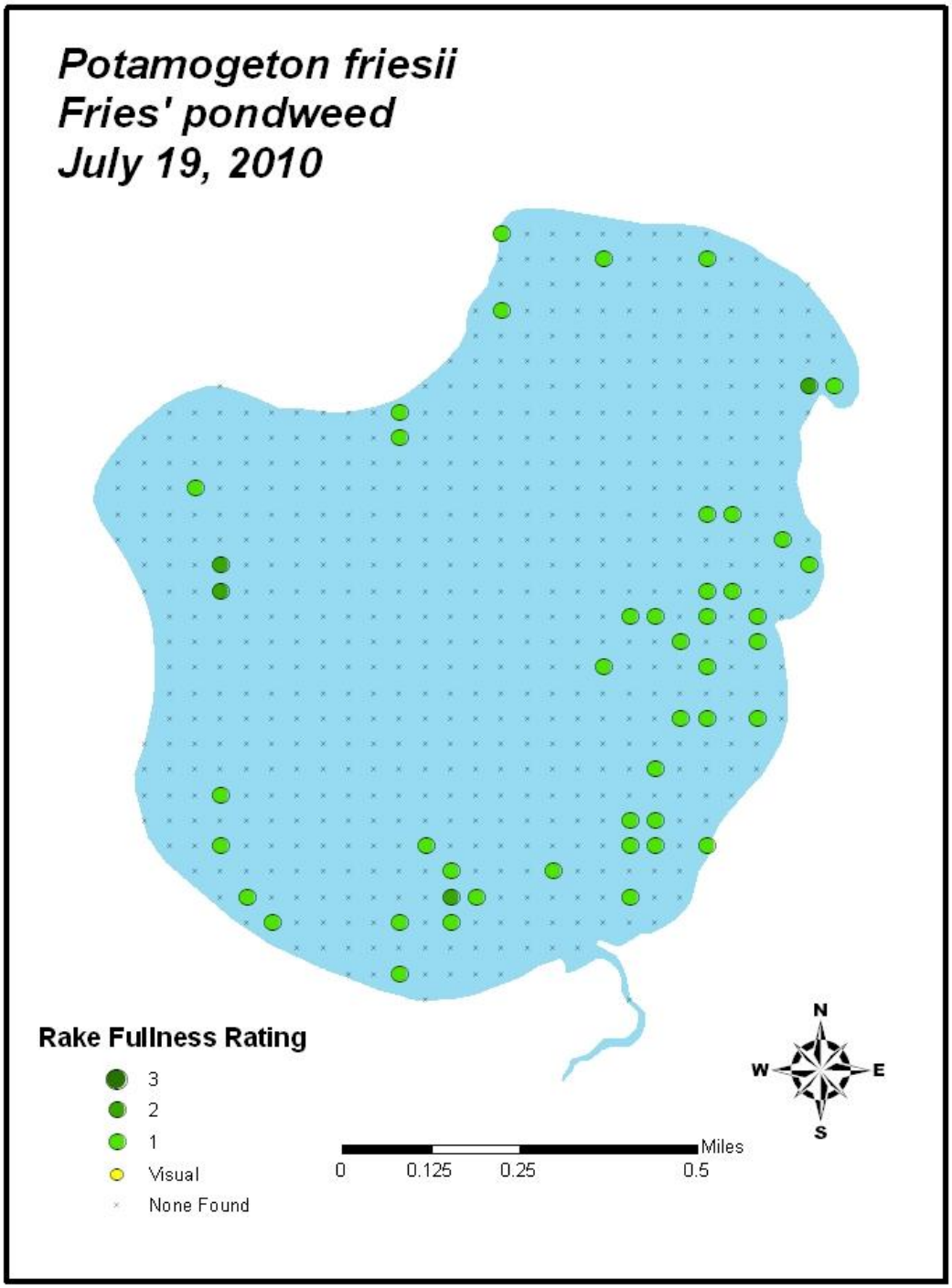
Potamogeton friesii
Fries' pondweed
July 19, 2010
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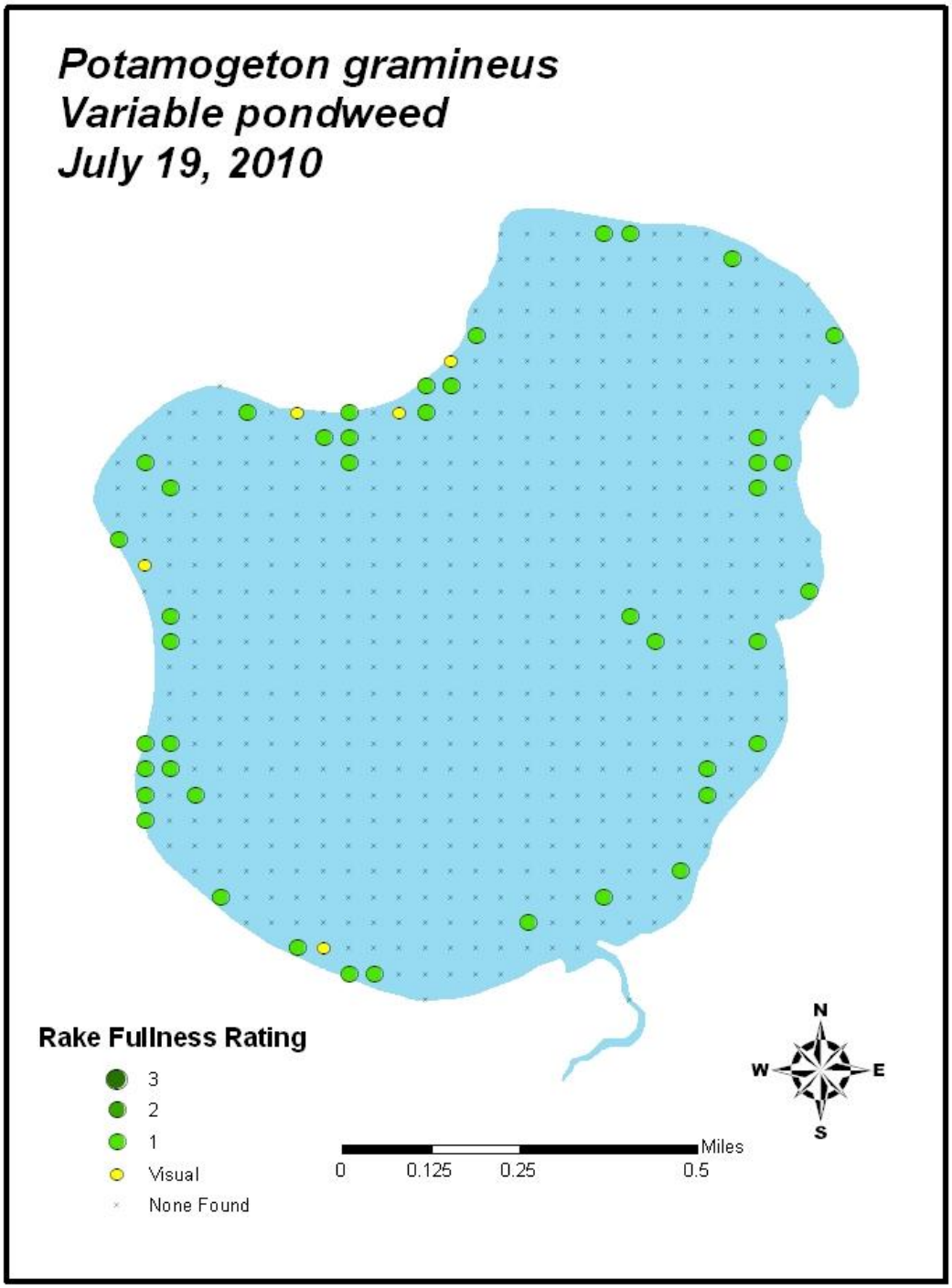
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July 19, 2010
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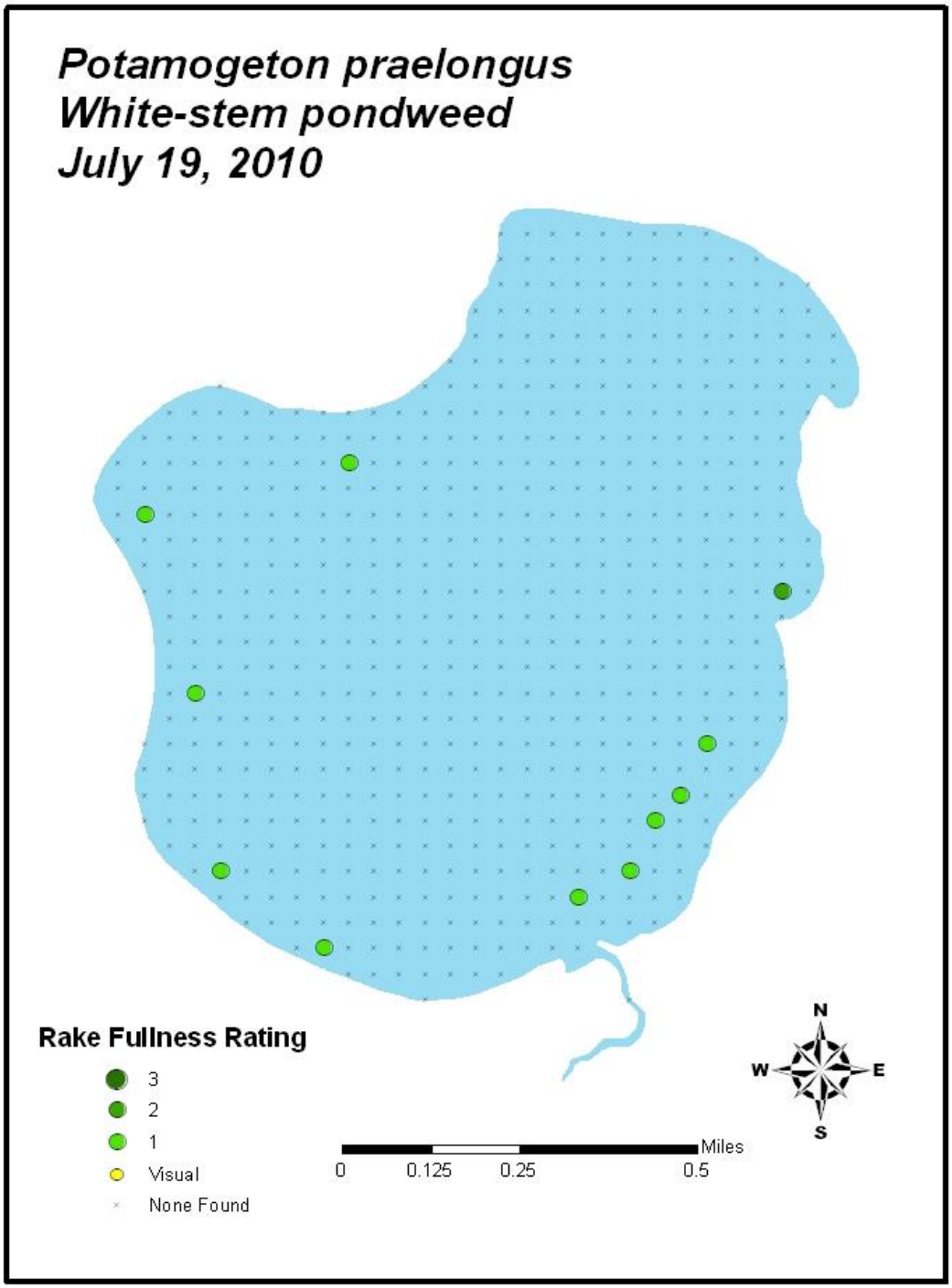
Potamogeton praelongus
White-stem pondweed
July 19, 2010
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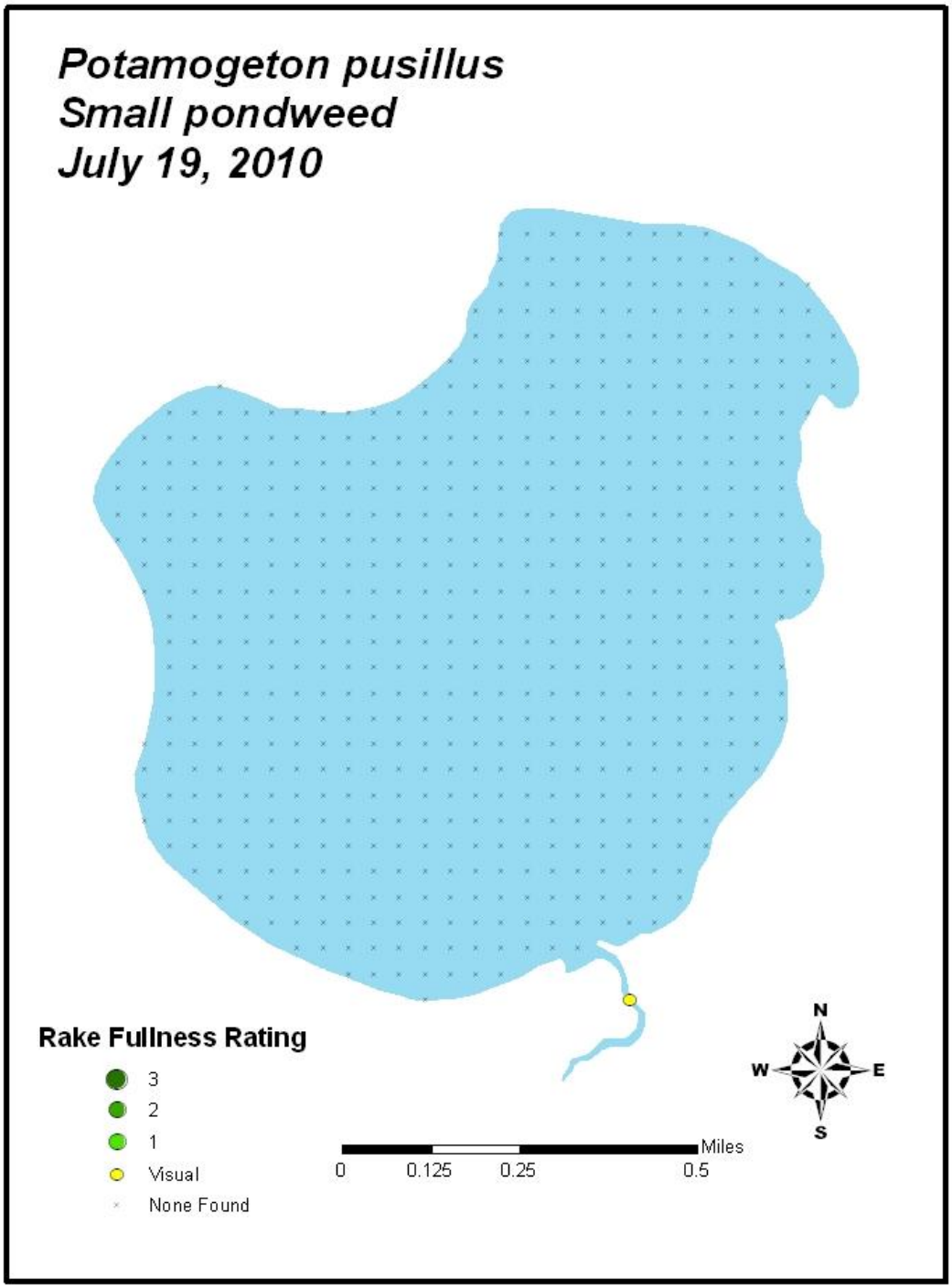
Potamogeton pusillus
Small pondweed
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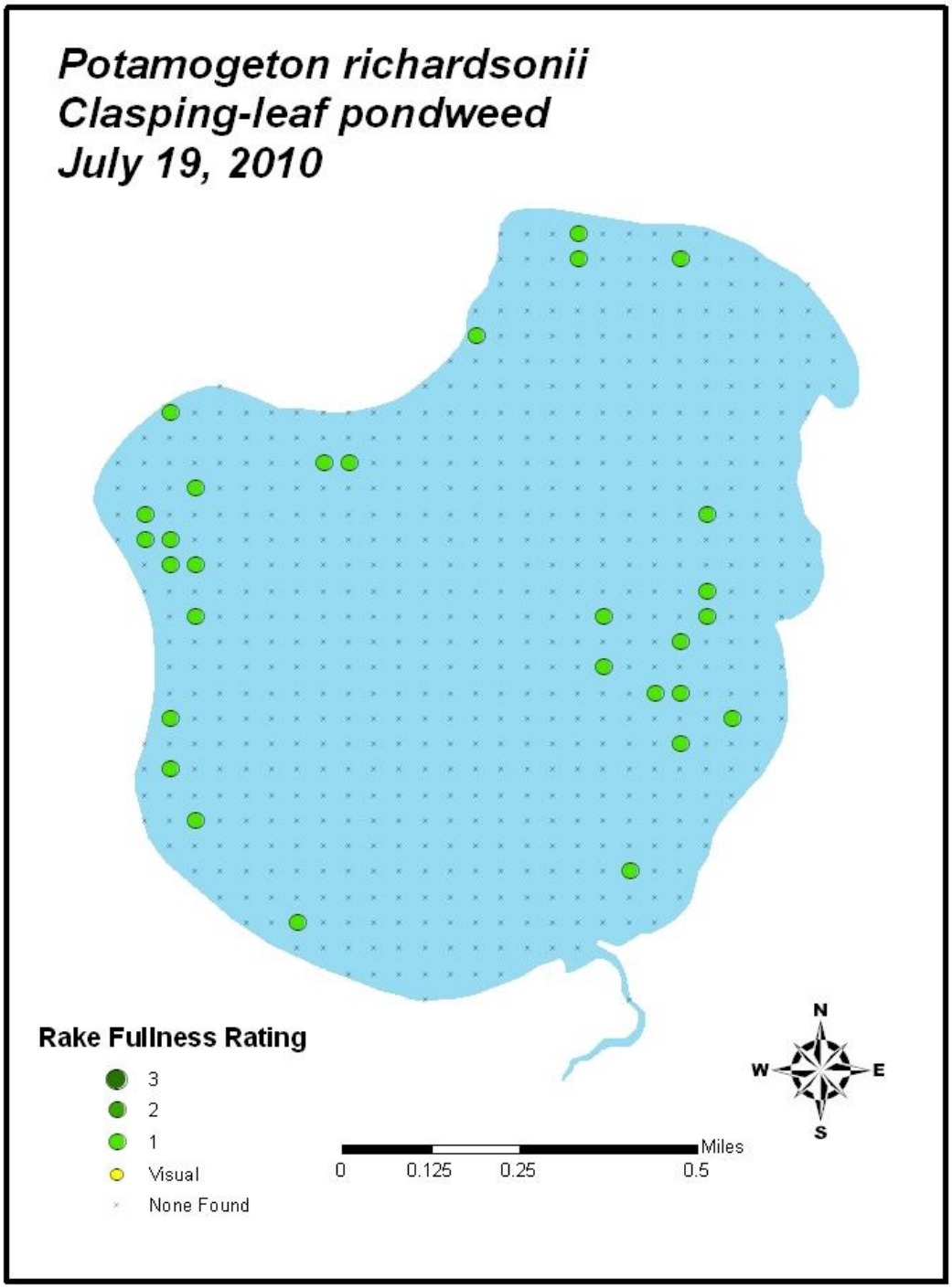
Potamogeton richardsonii
Clasping-leaf pondweed
July 19, 2010
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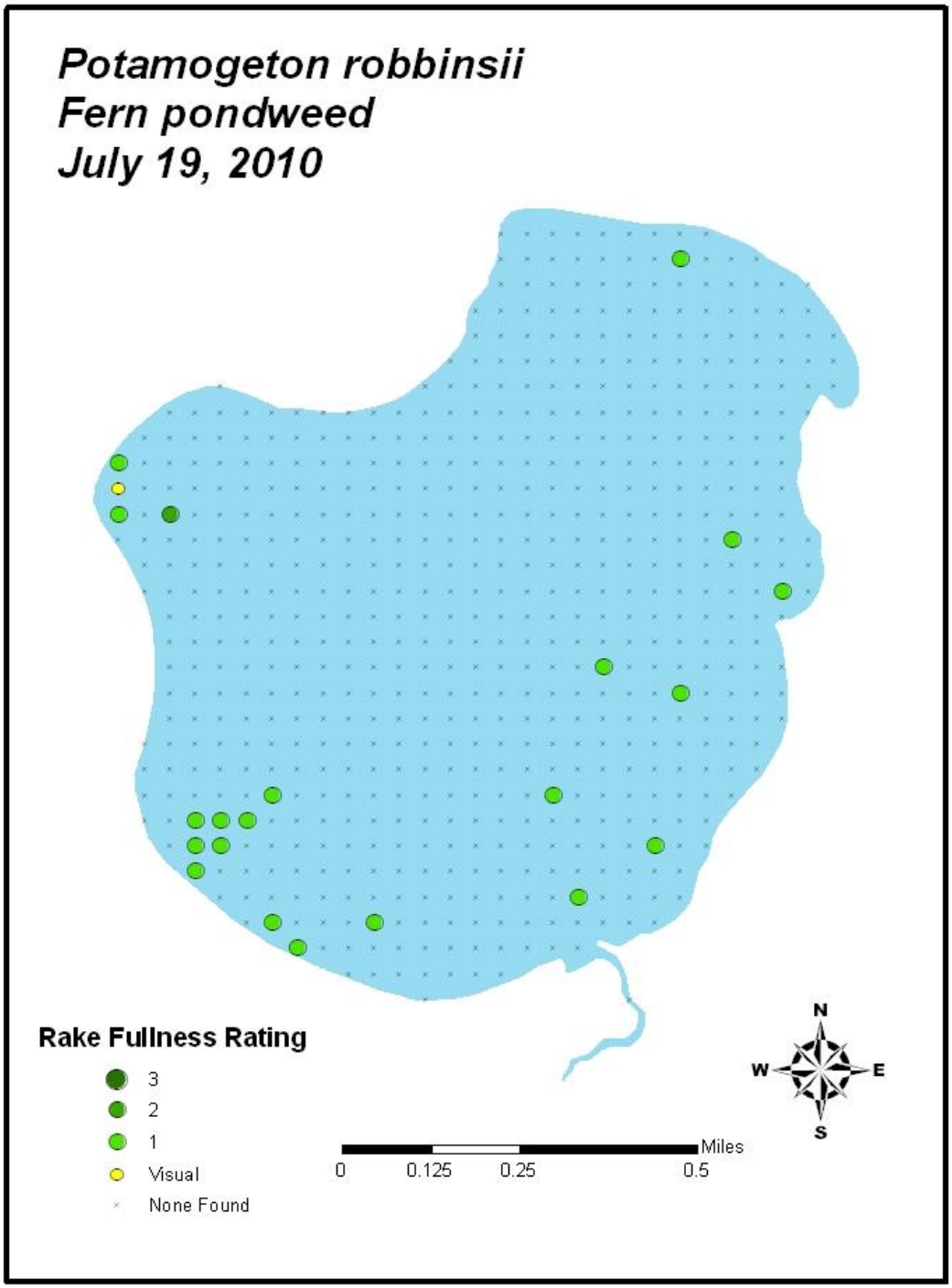
Potamogeton robbinsii
Fern pondweed
July 19, 2010
Rake Fullness Rating
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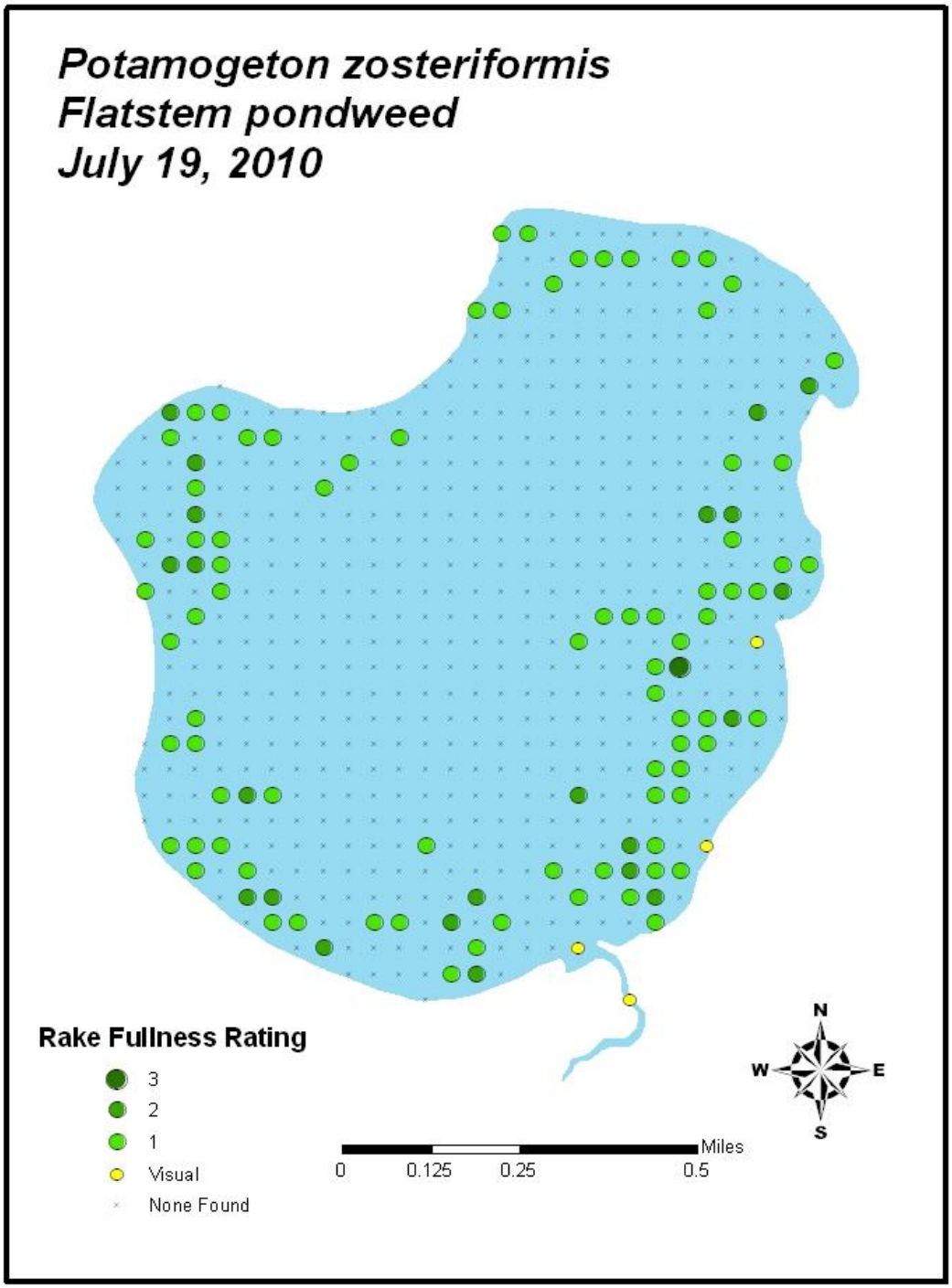
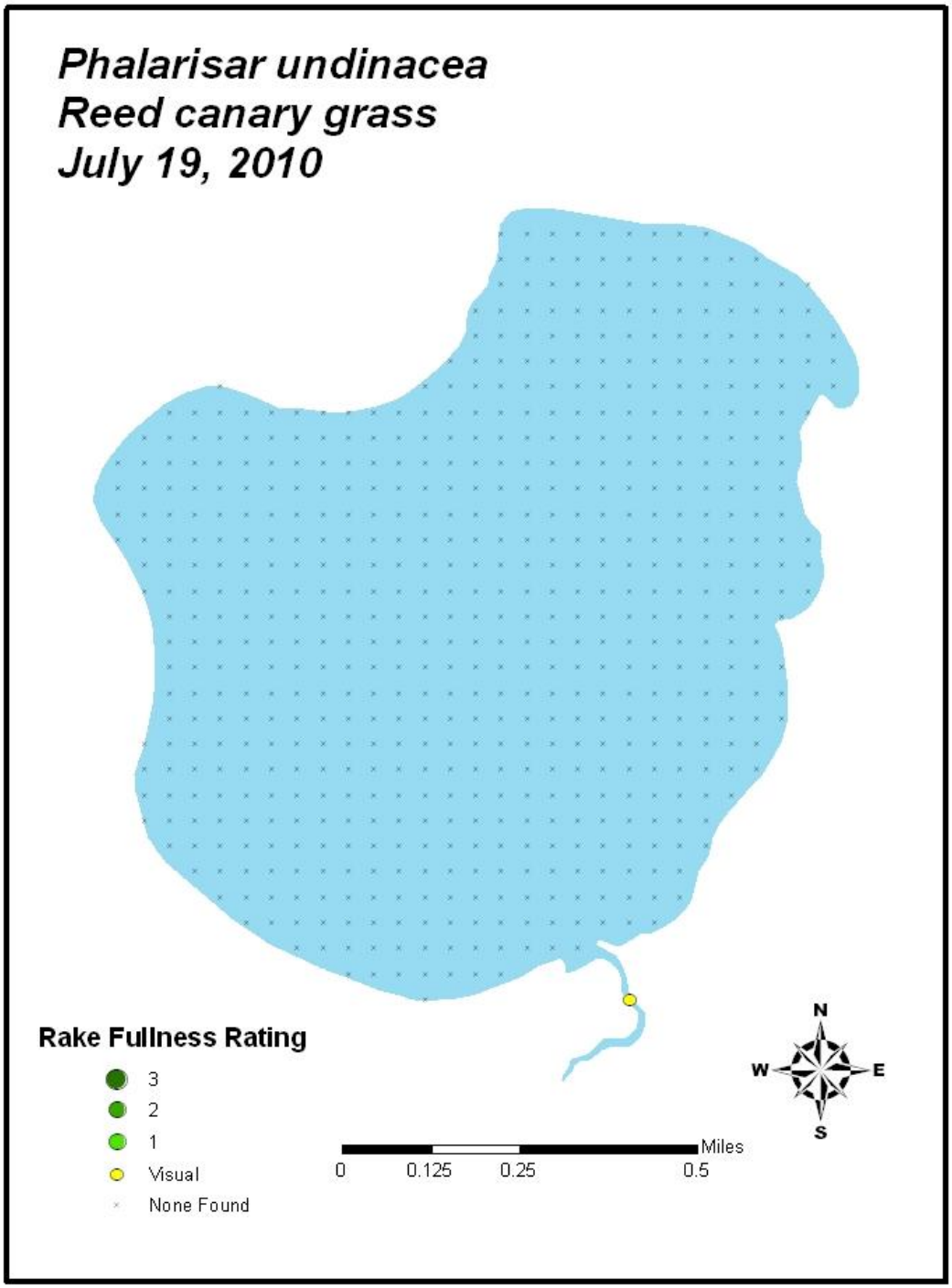
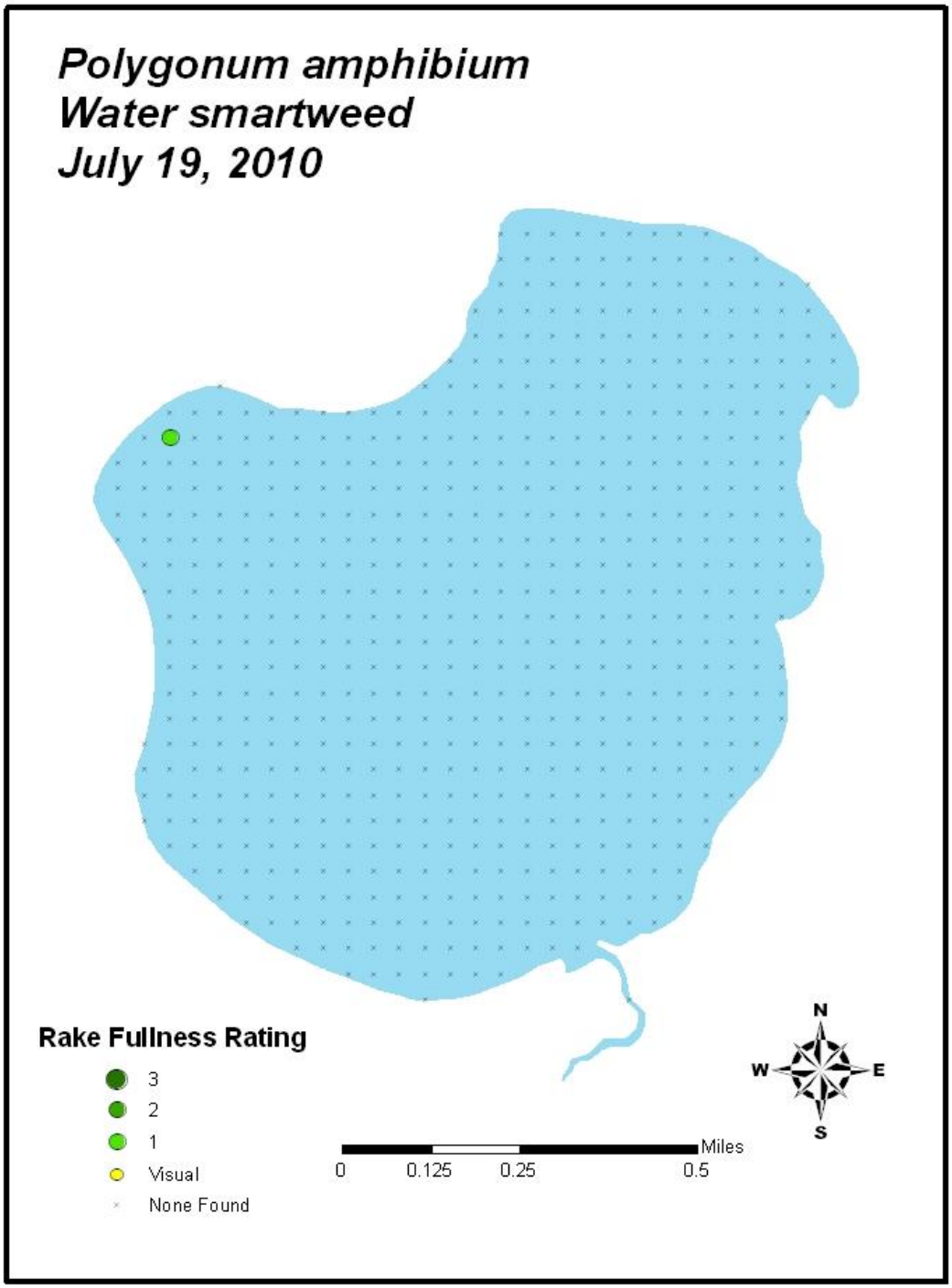
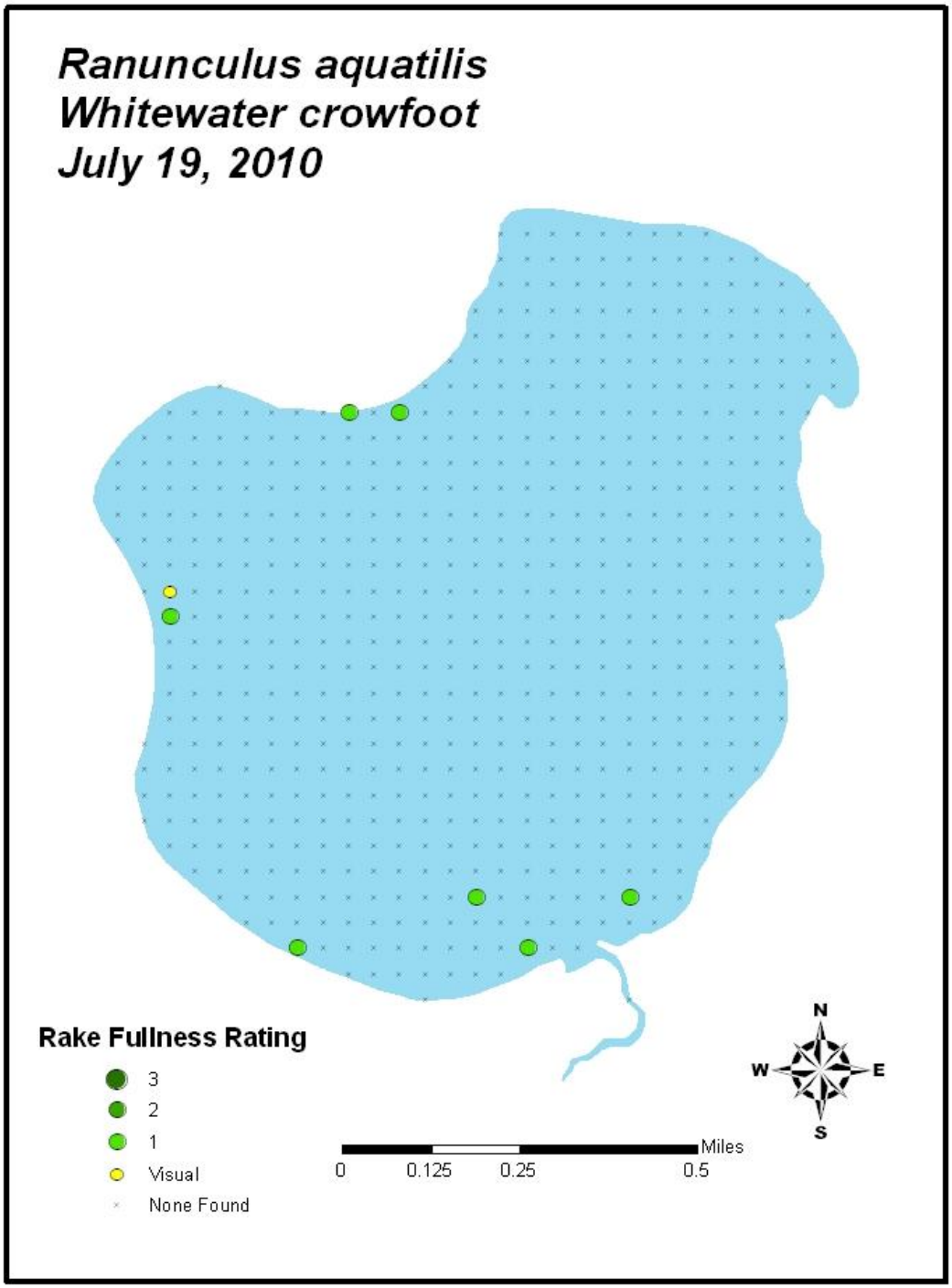
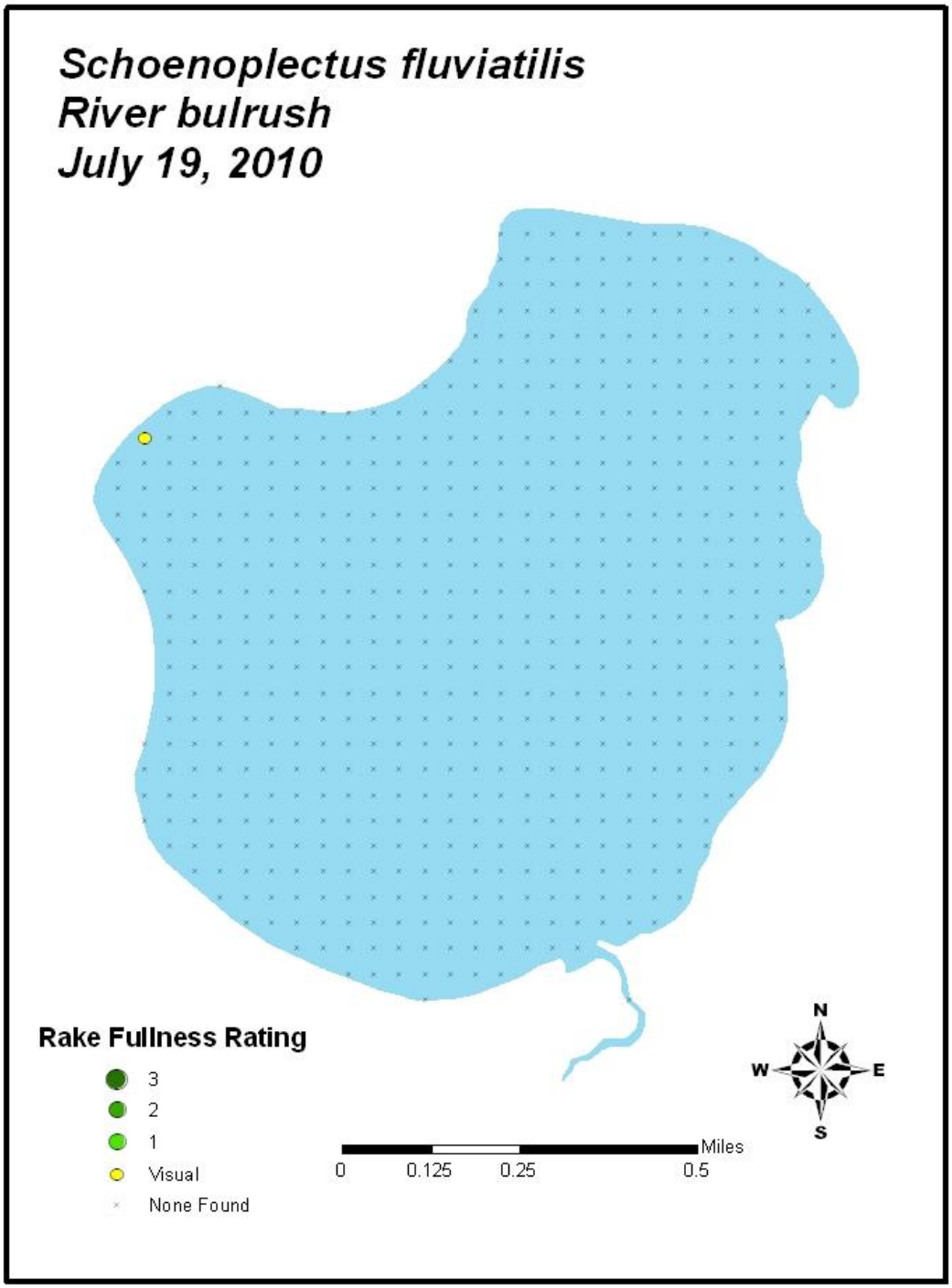
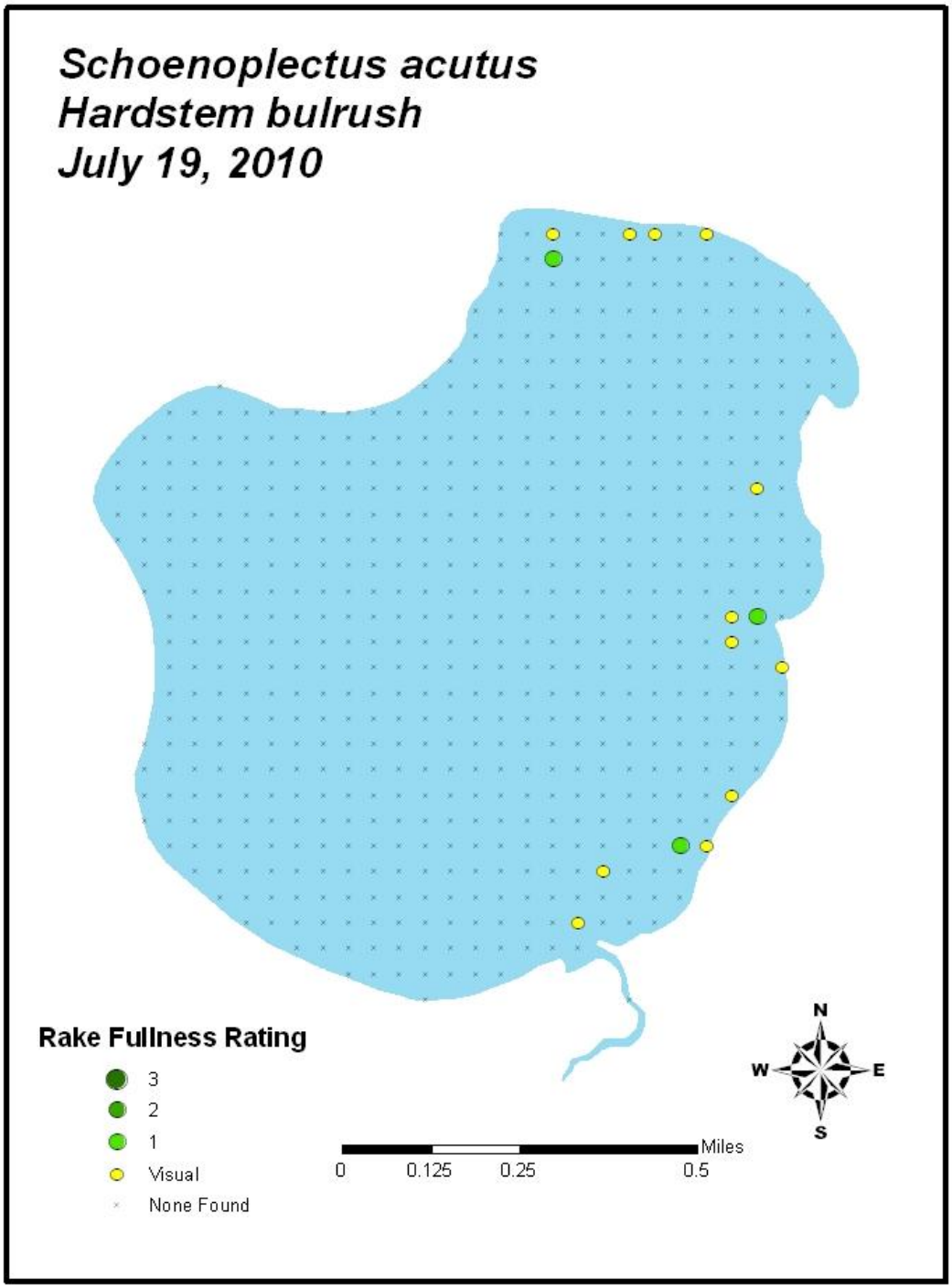

Potamogeton zosteriformis
Flatstem pondweed
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

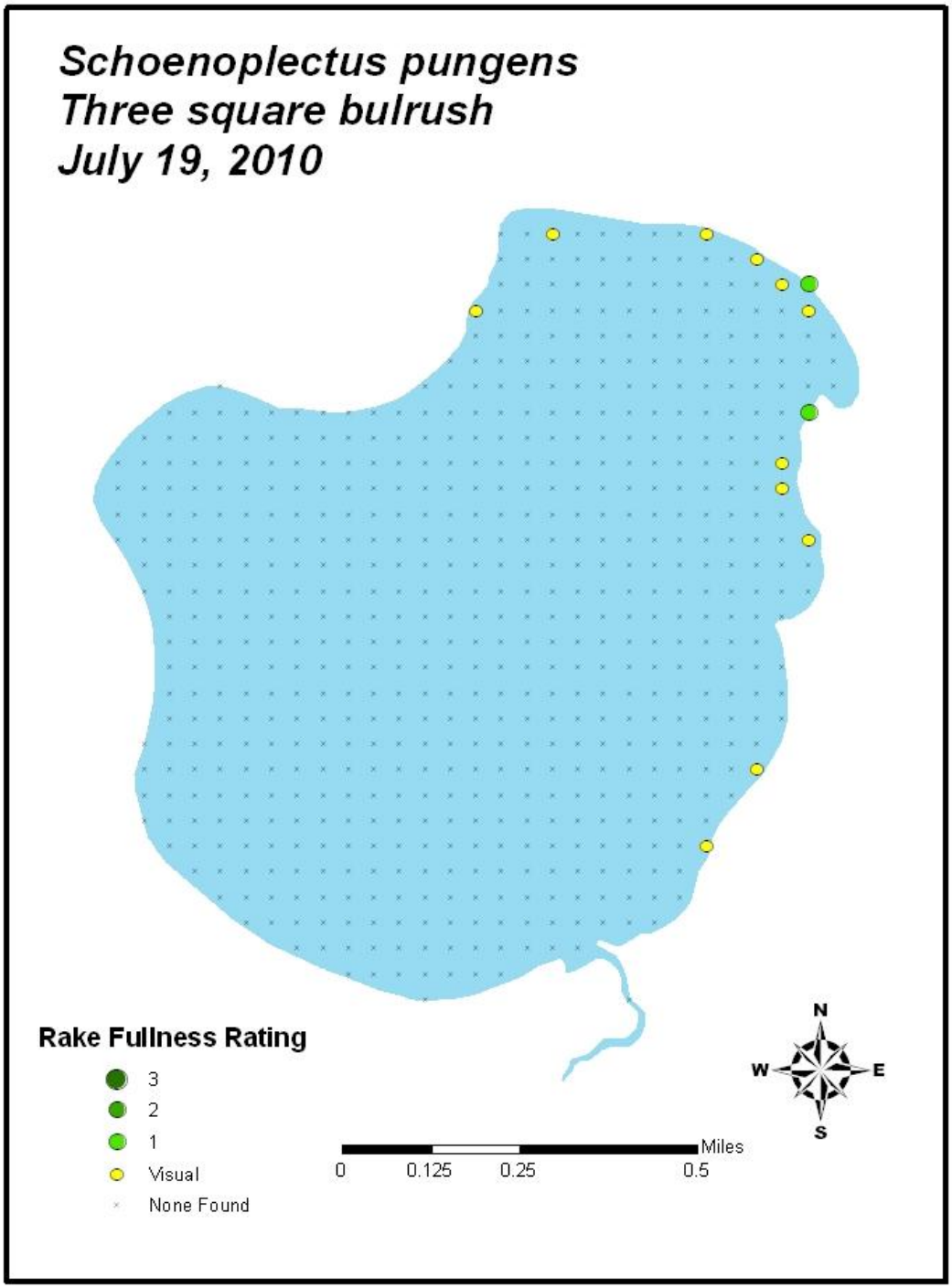

Phalarisar undinacea
Reed canary grass
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

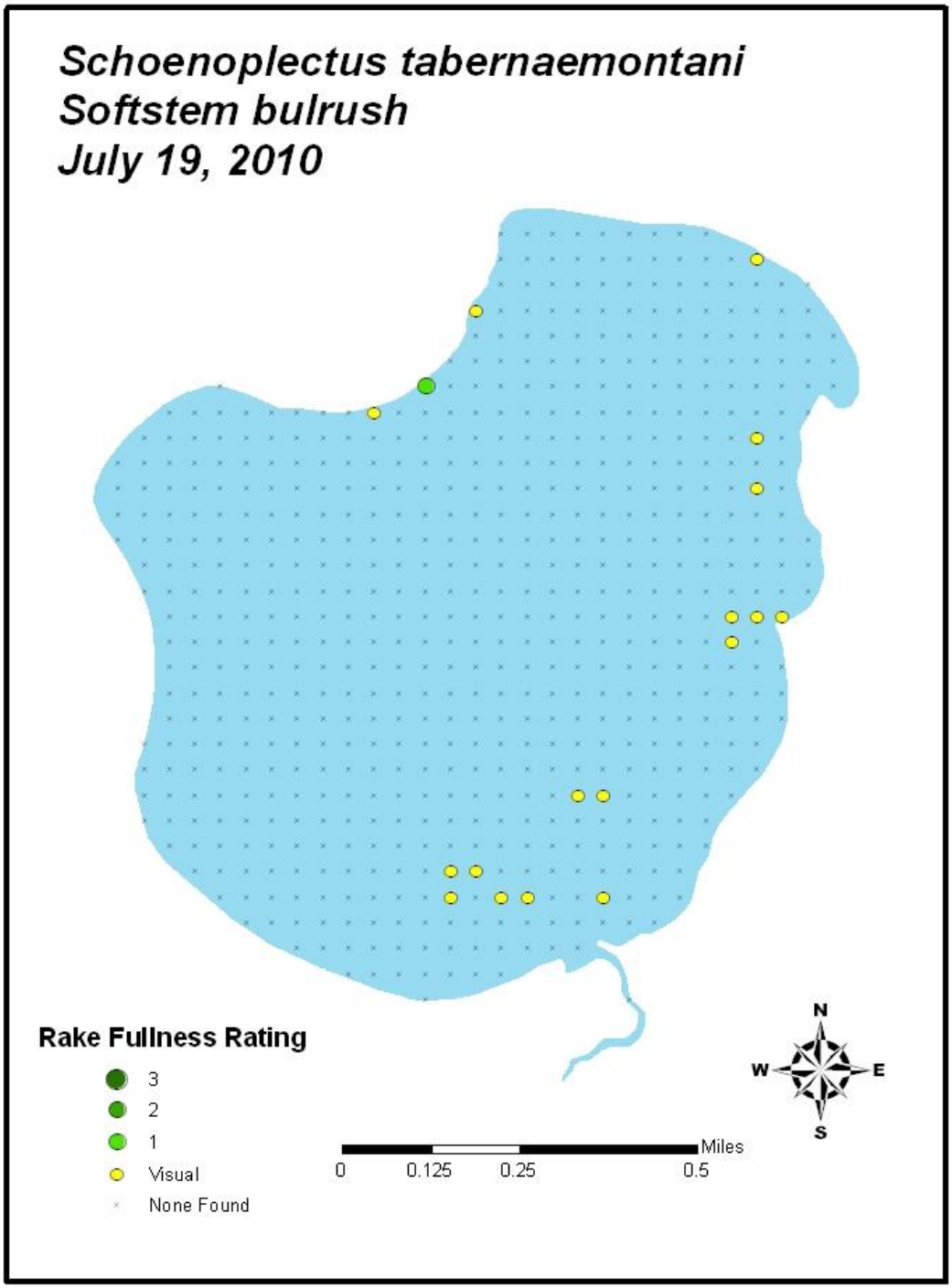

Polygonum amphibium
Water smartweed
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

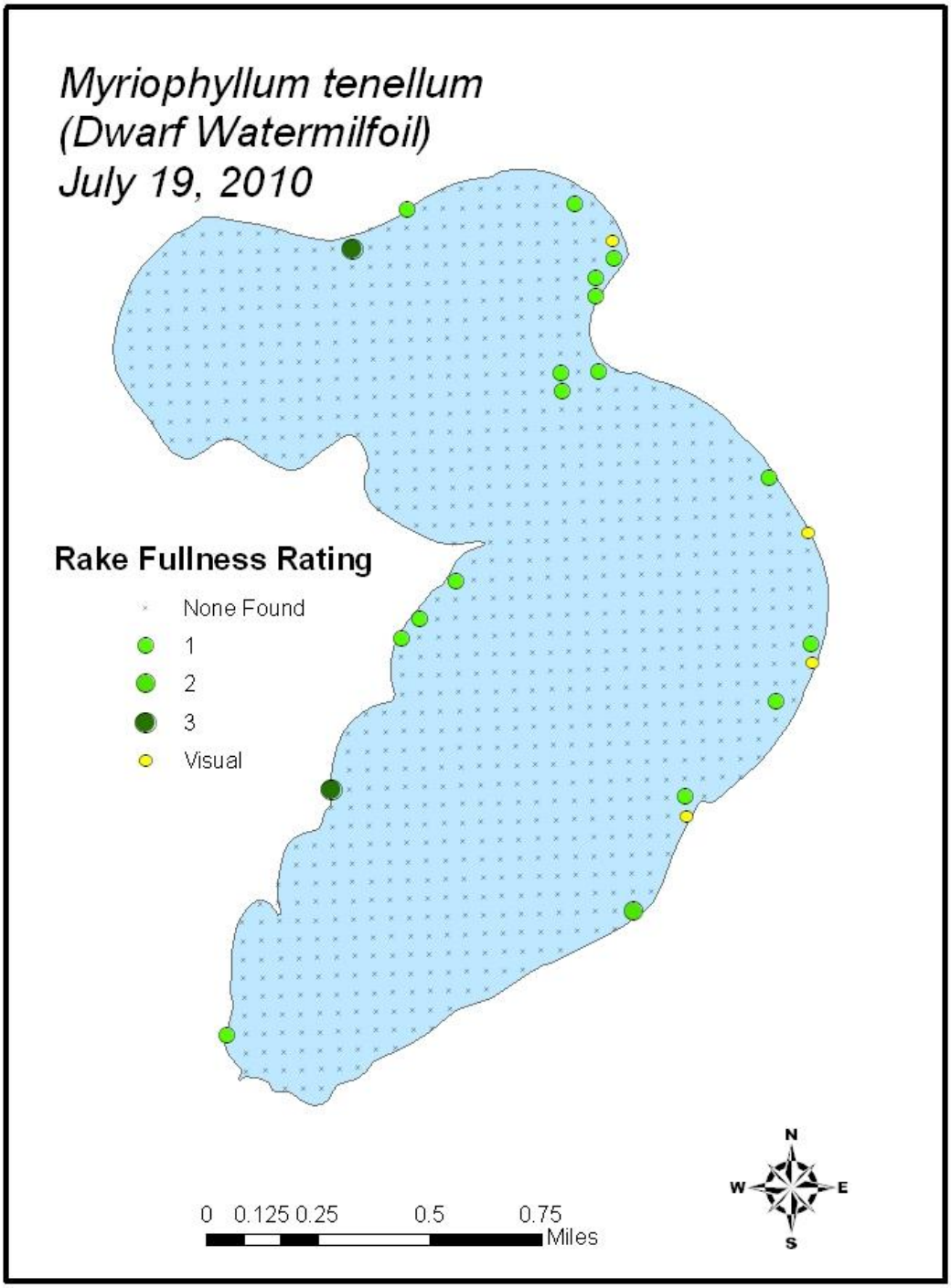

Ranunculus aquatilis
Whitewater crowfoot
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

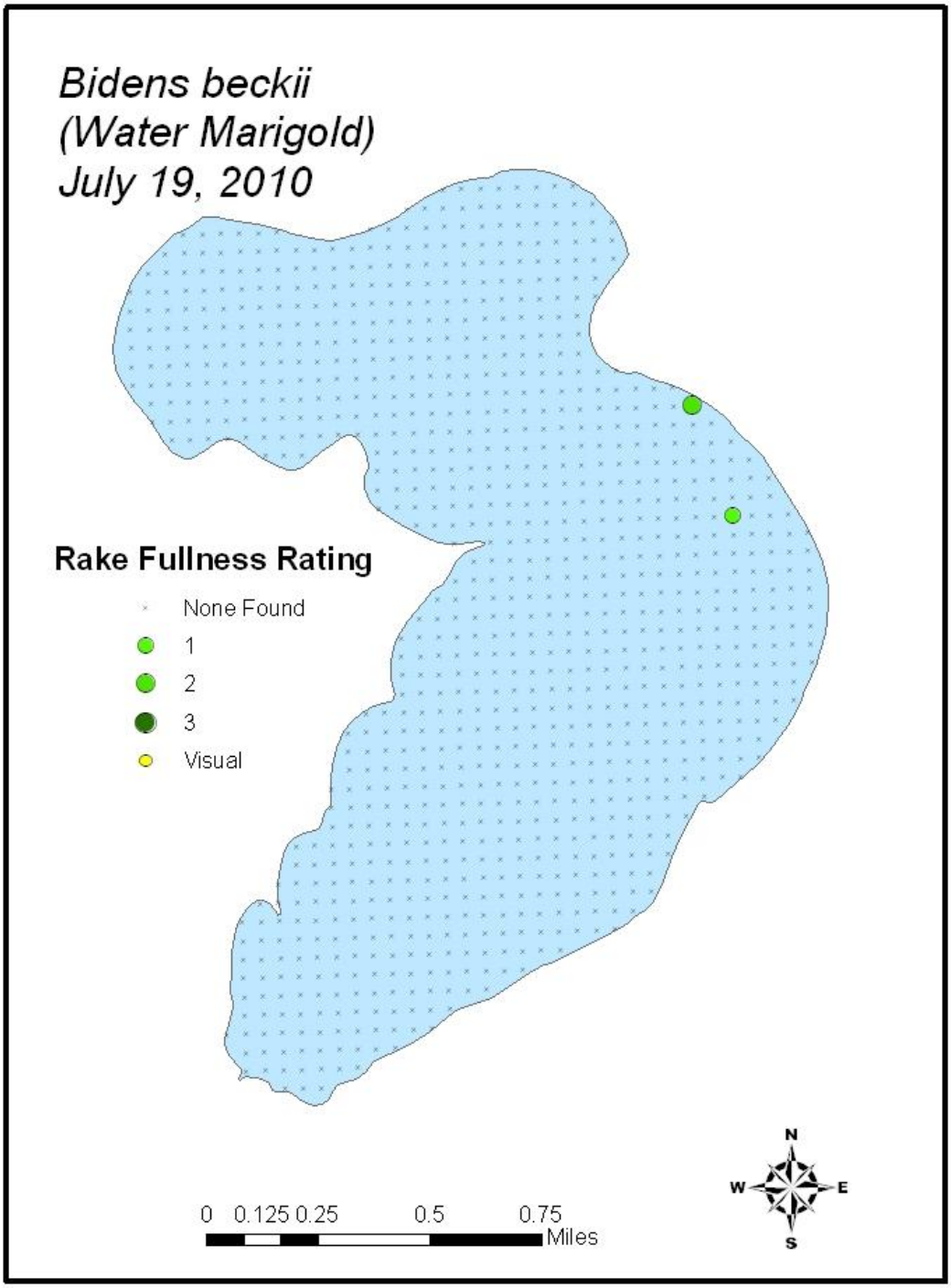

Schoenoplectus fluviatilis
River bulrush
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

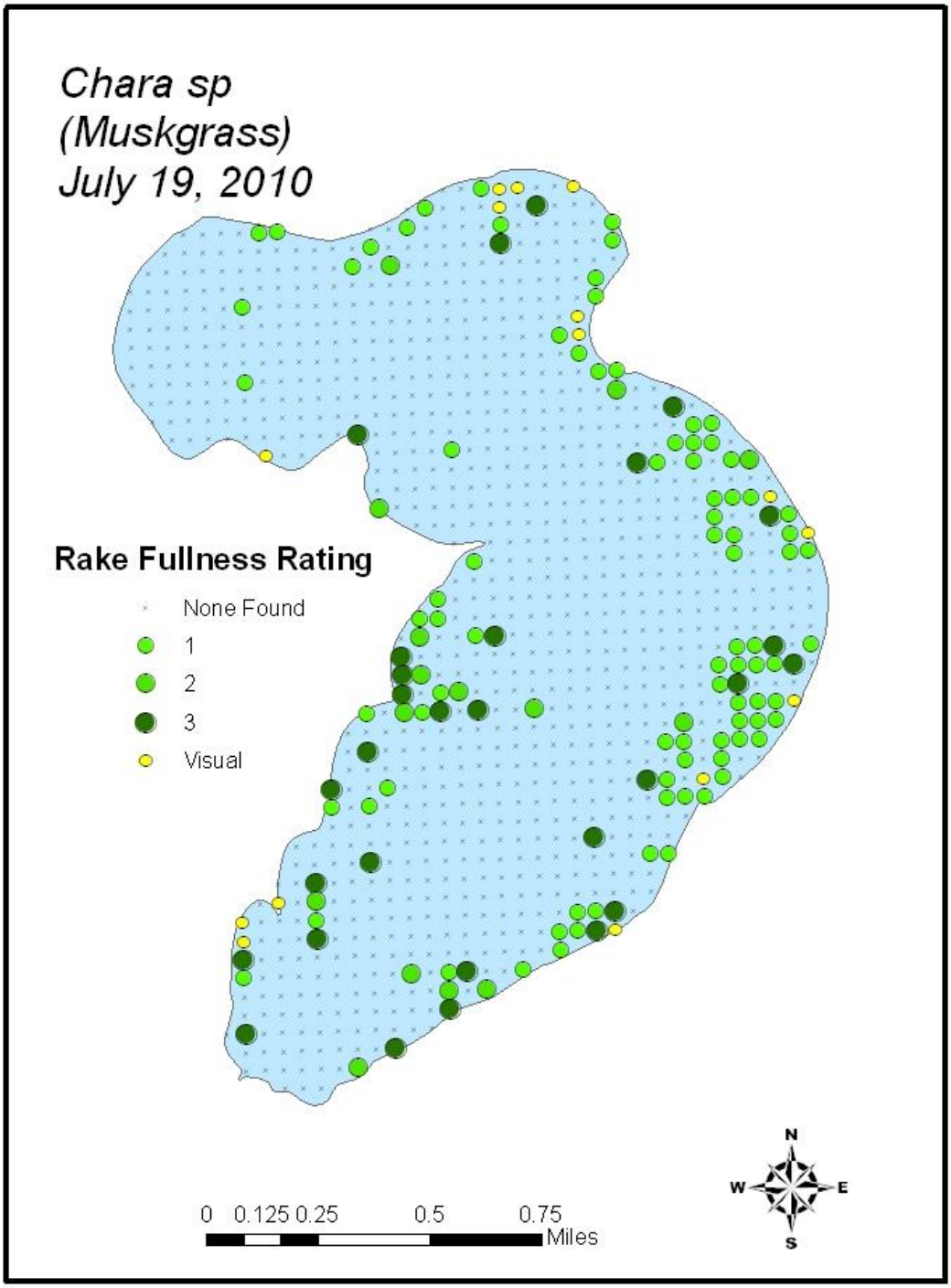

Schoenoplectus acutus
Hardstem bulrush
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

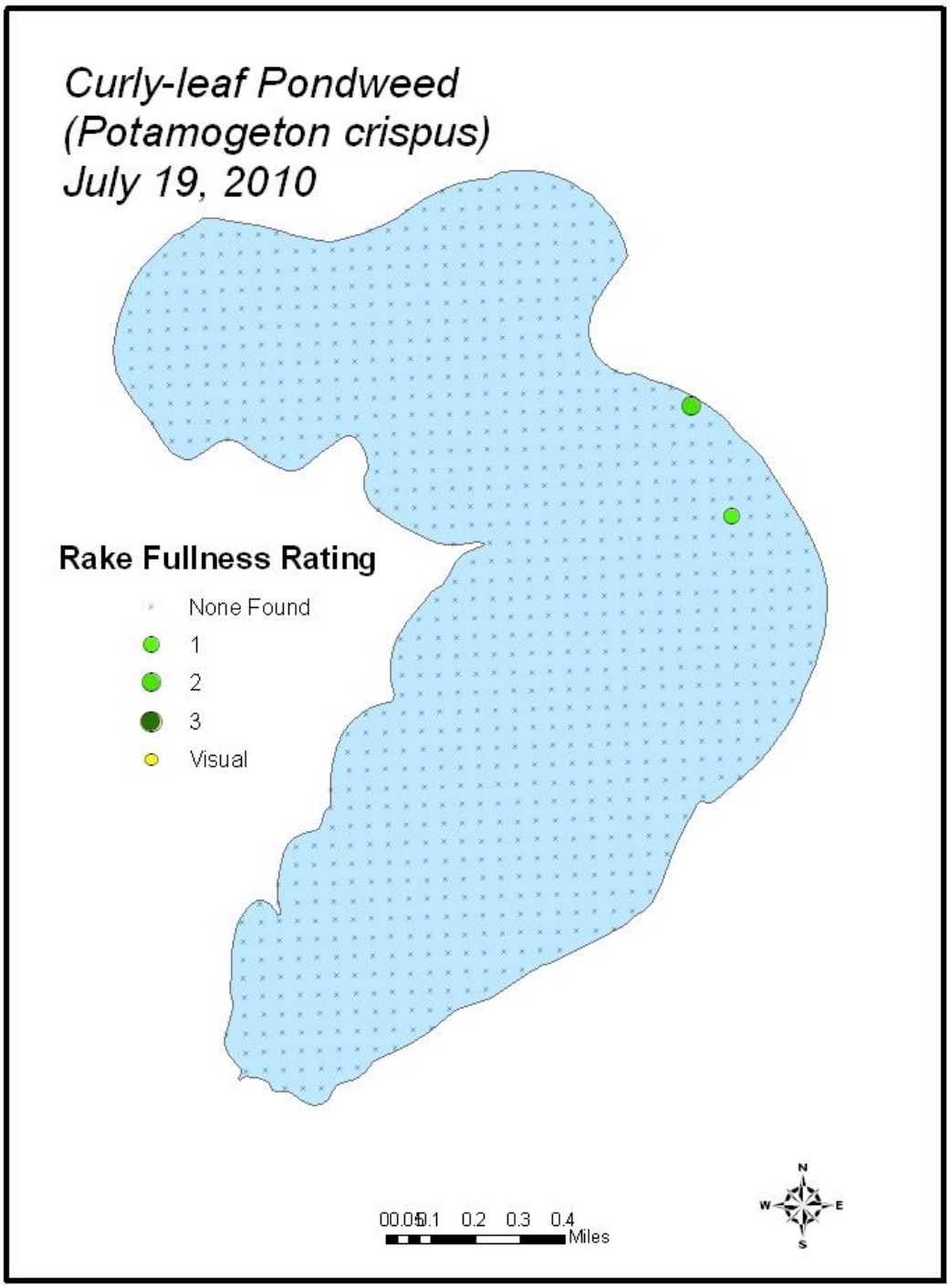

Schoenoplectus pungens
Three square bulrush
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

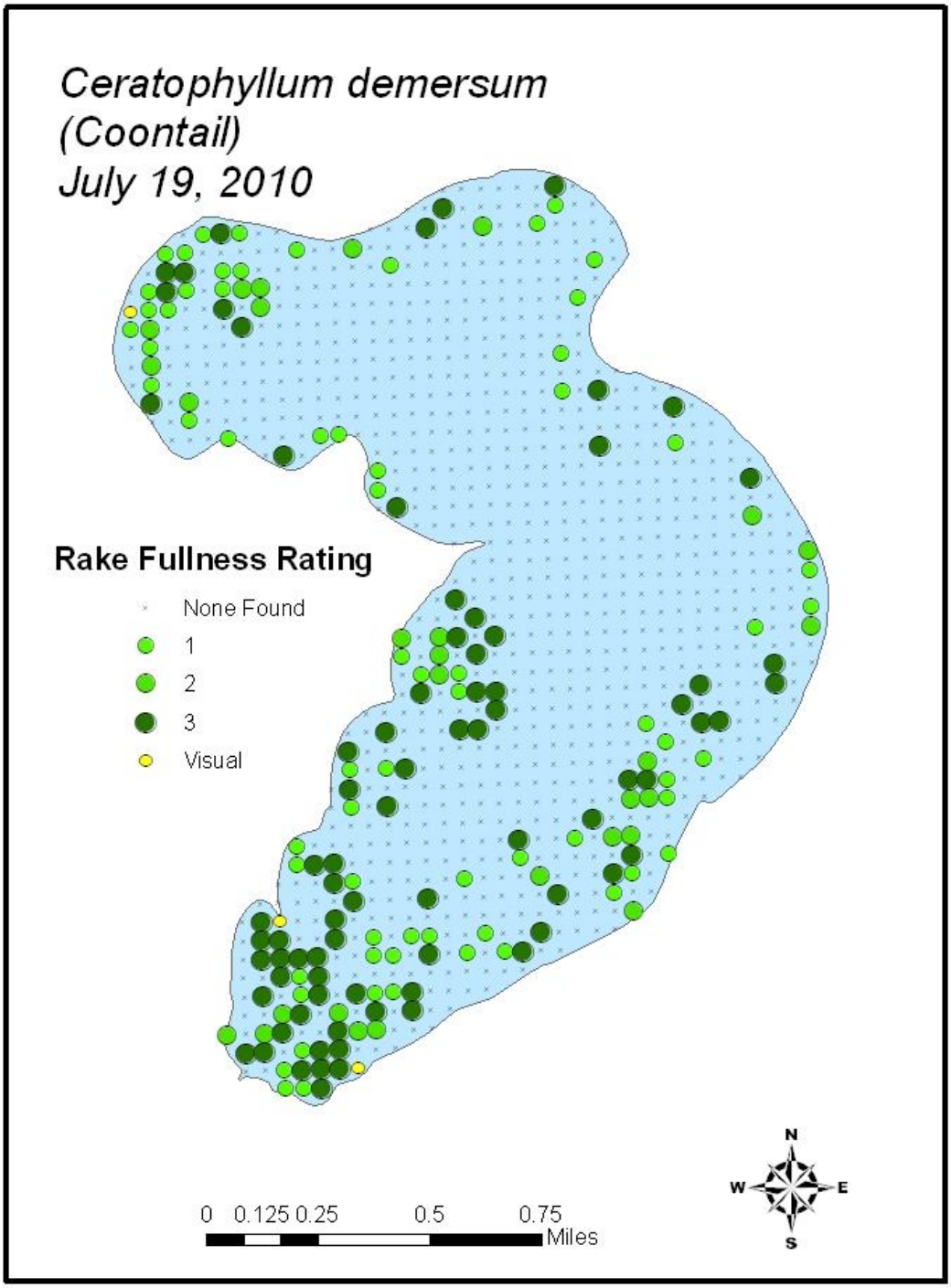

Schoenoplectus tabernaemontani
Softstem bulrush
July 19, 2010
Rake Fullness Rating
3
2
1
Visual
None Found
Miles
0
0.125
0.25
0.5
N
W
E
S

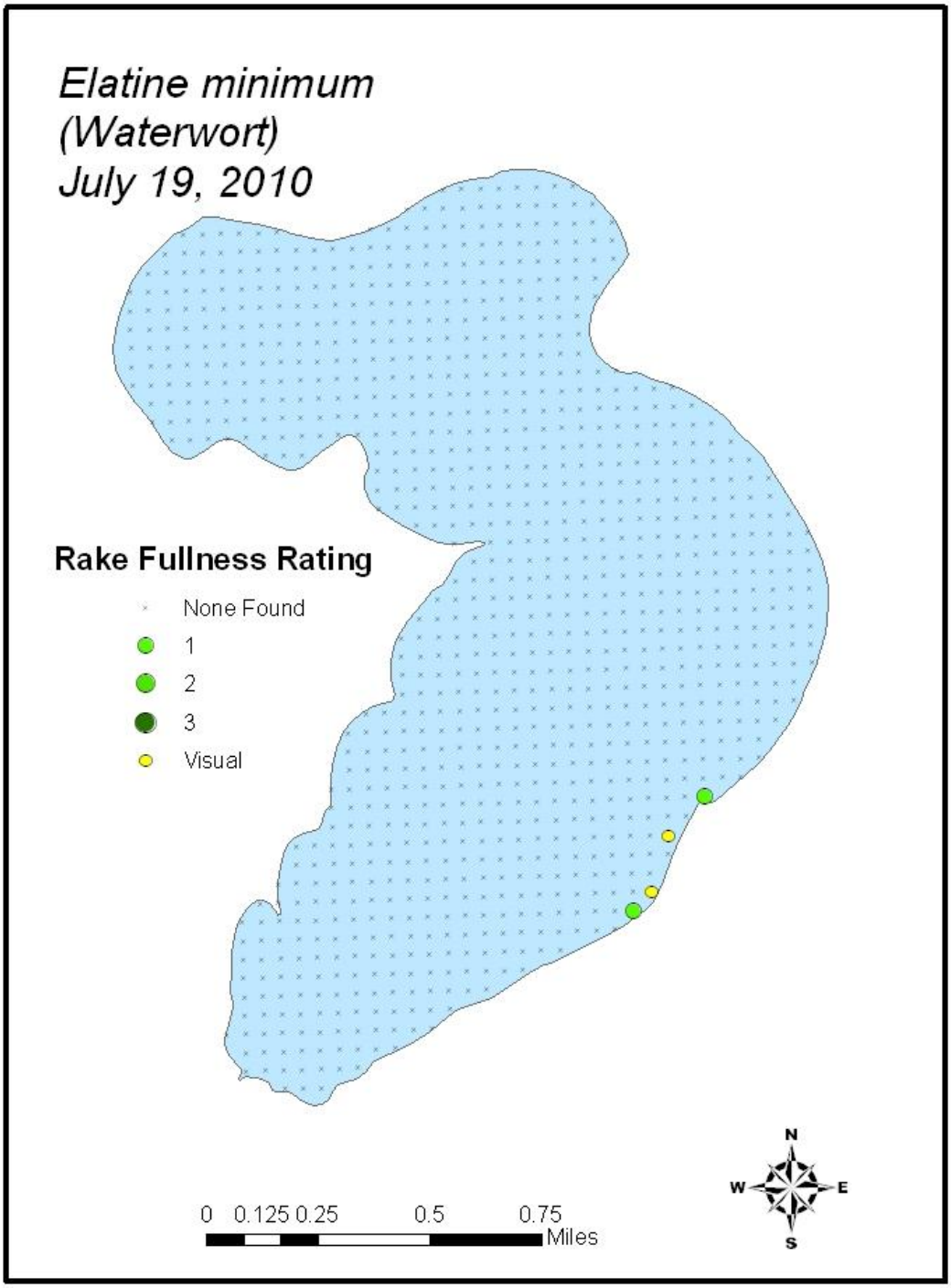

Myriophyllum tenellum
(Dwarf Watermilfoil)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

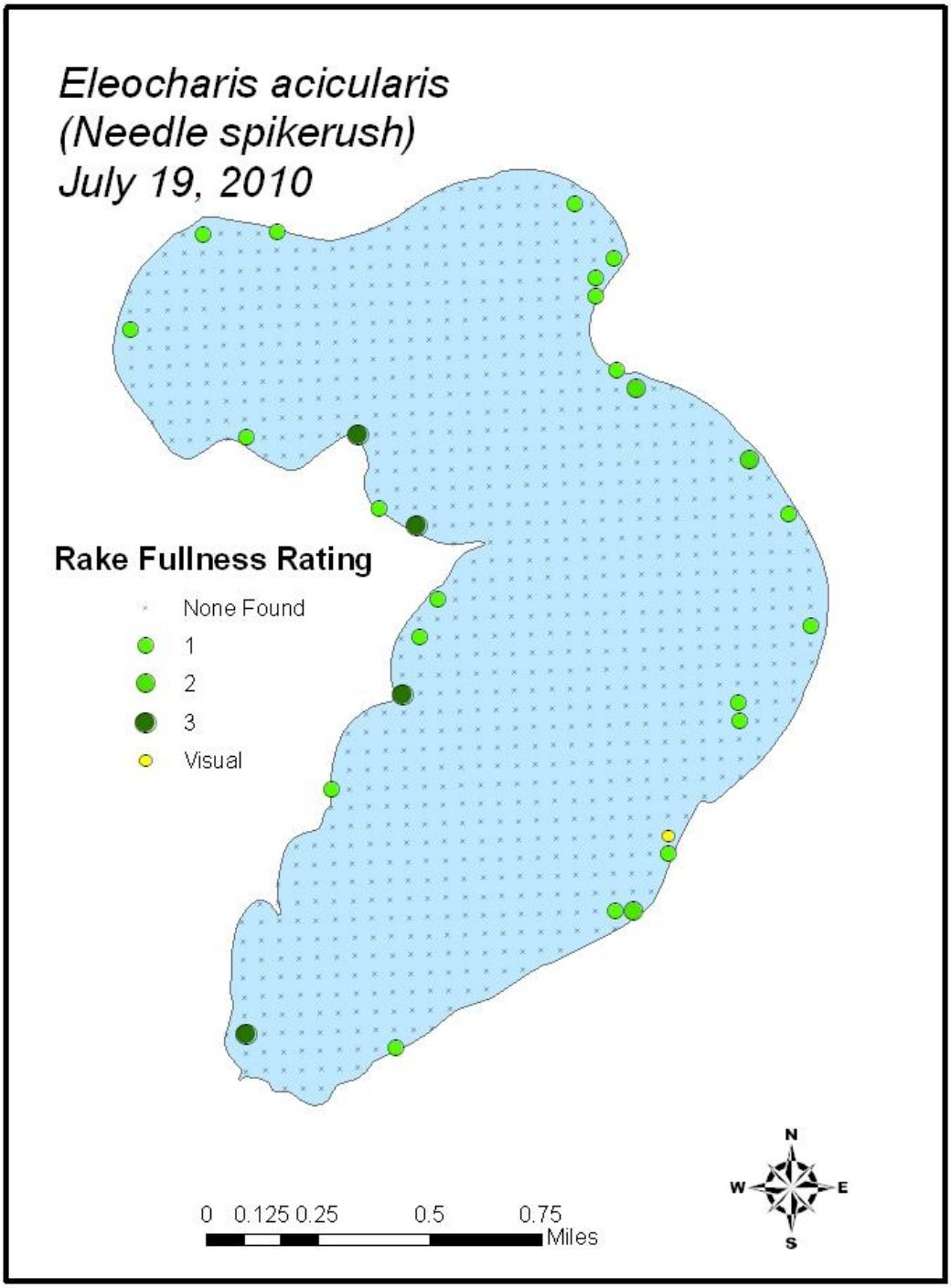

Bidens beckii
(Water Marigold)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

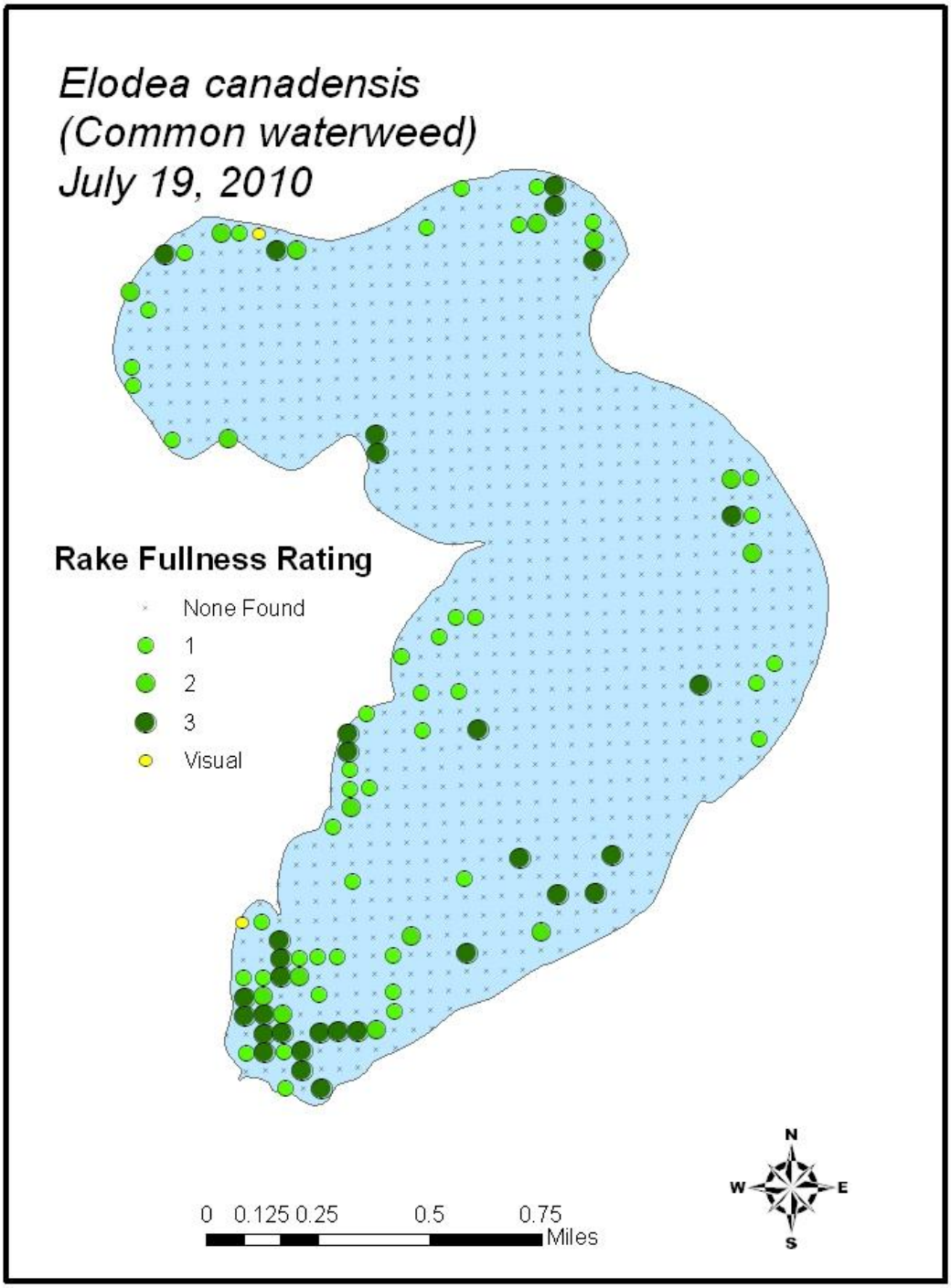

Chara sp
(Muskgrass)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

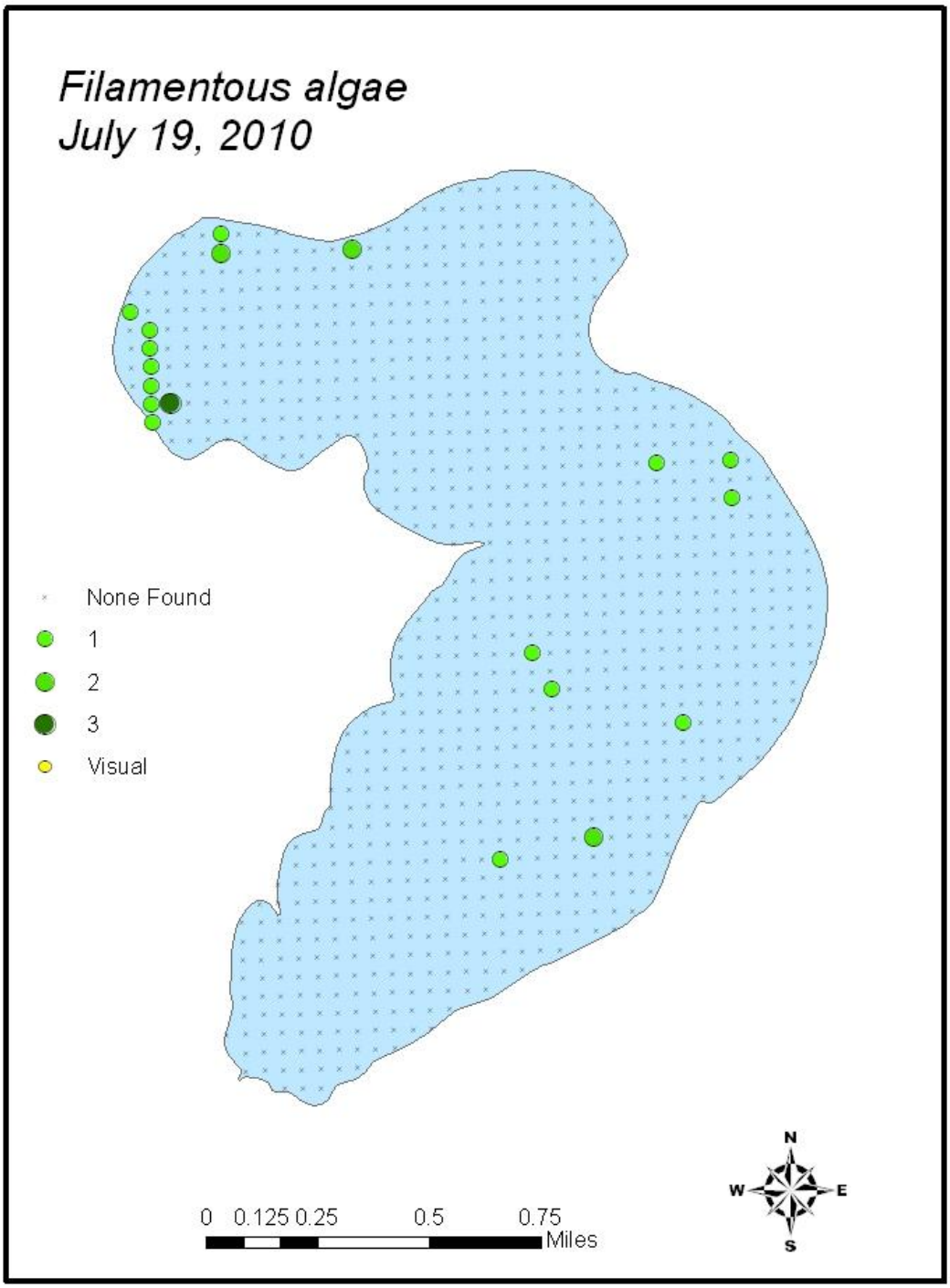

Curly-leaf Pondweed
(Potamogeton crispus)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.05 0.1 0.2 0.3 0.4
Miles
N
W
E
S

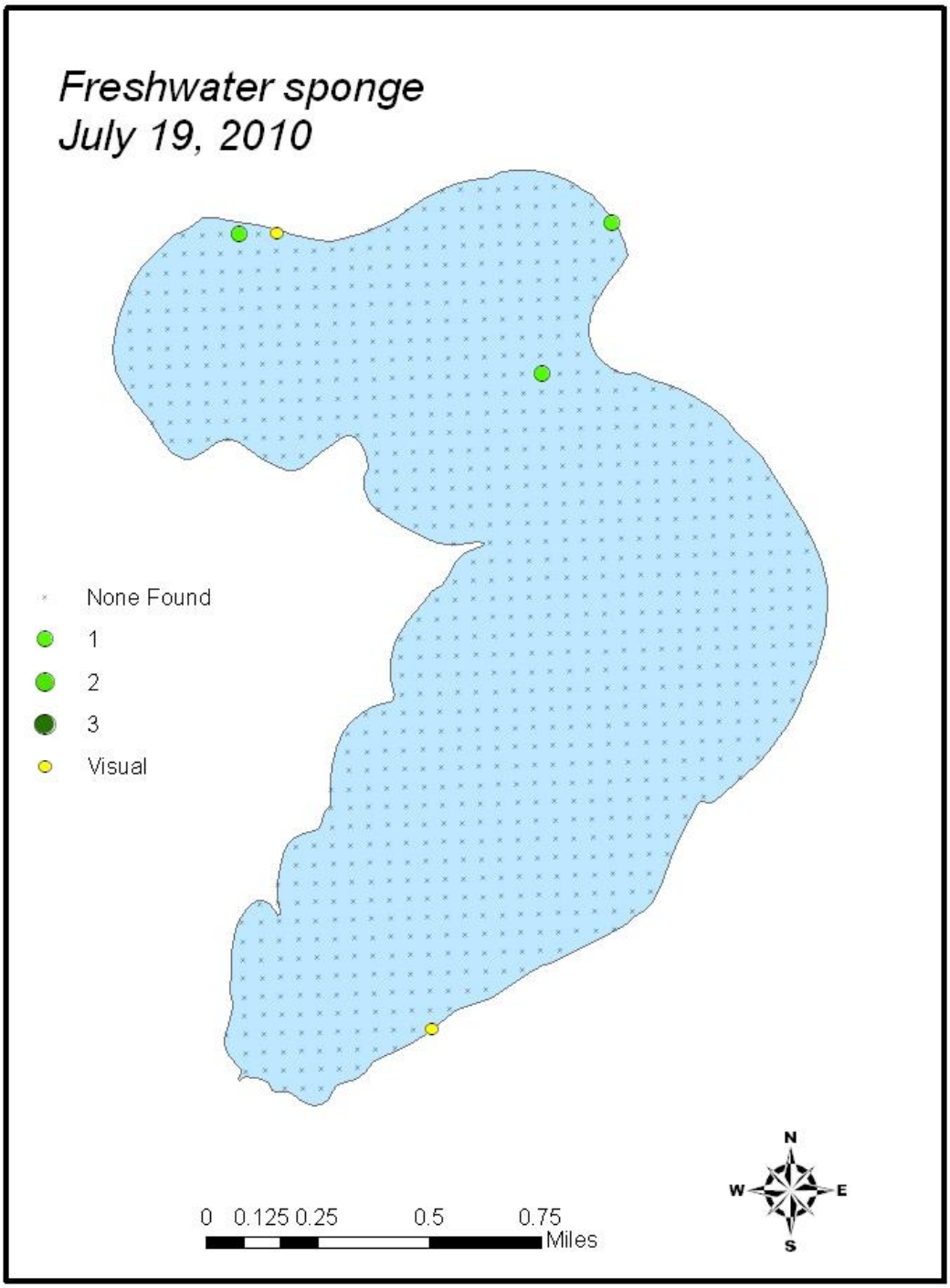

Ceratophyllum demersum
(Coontail)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

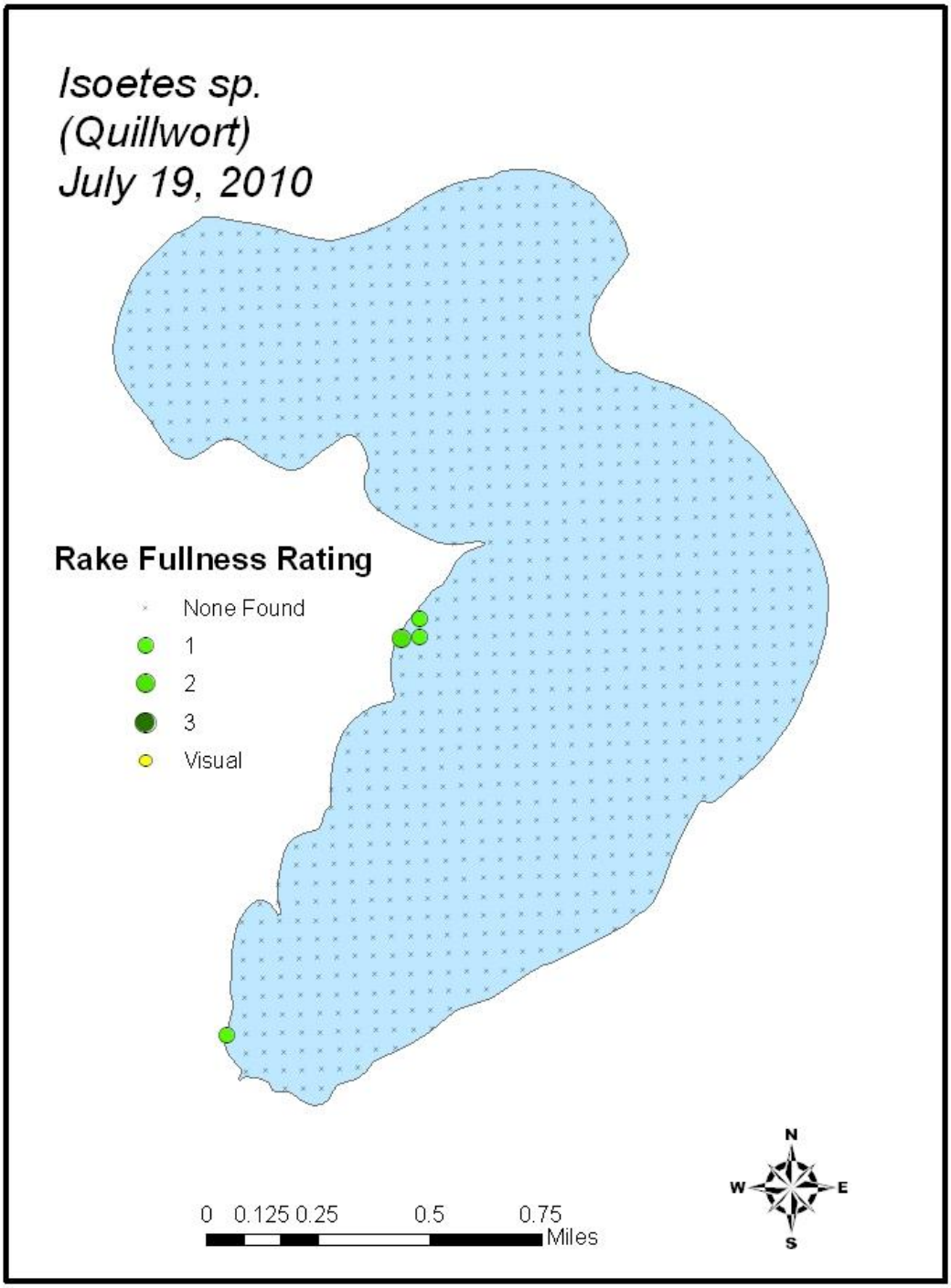

Elatine minimum
(Waterwort)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

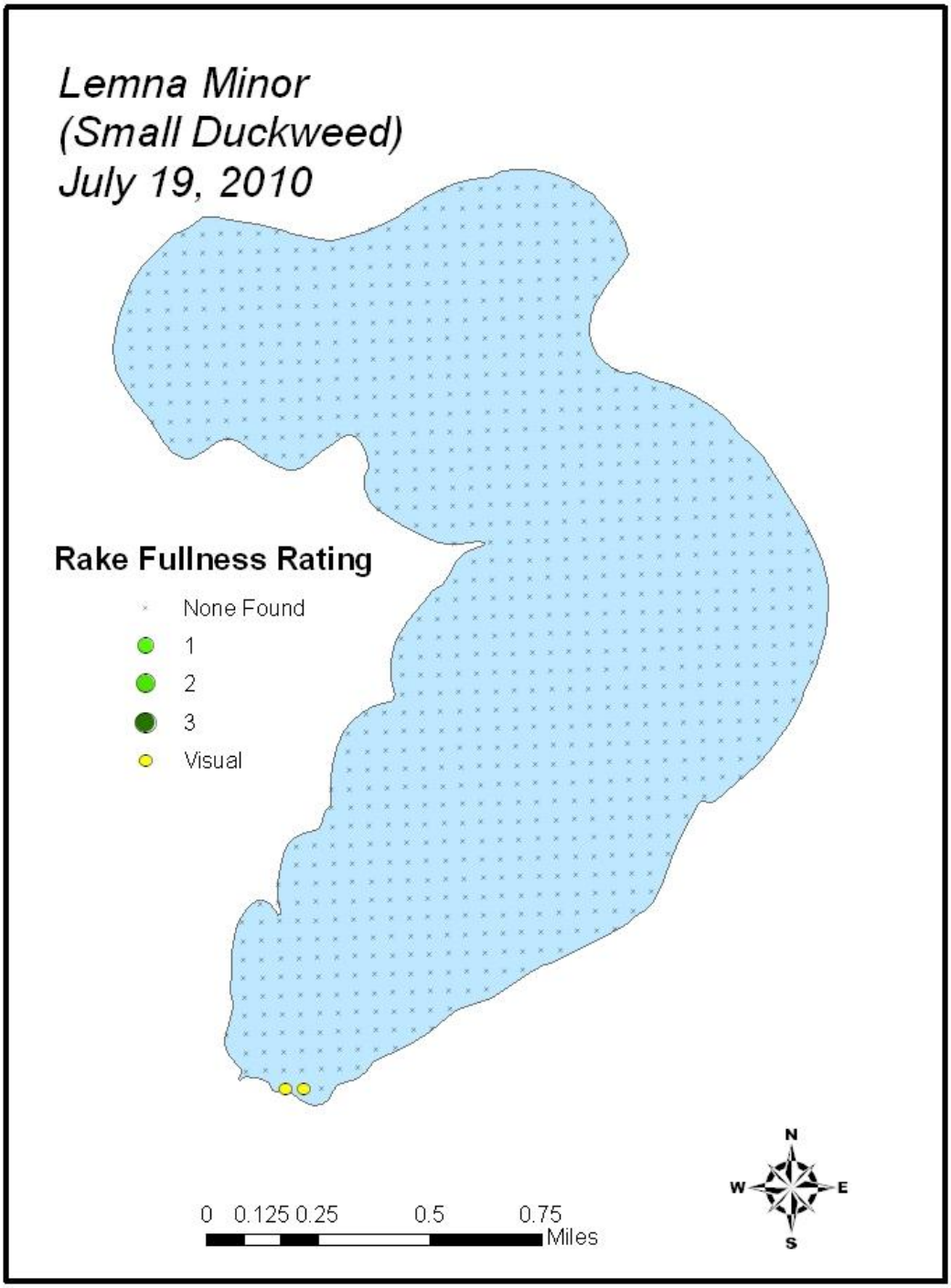

Eleocharis acicularis
(Needle spikerush)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

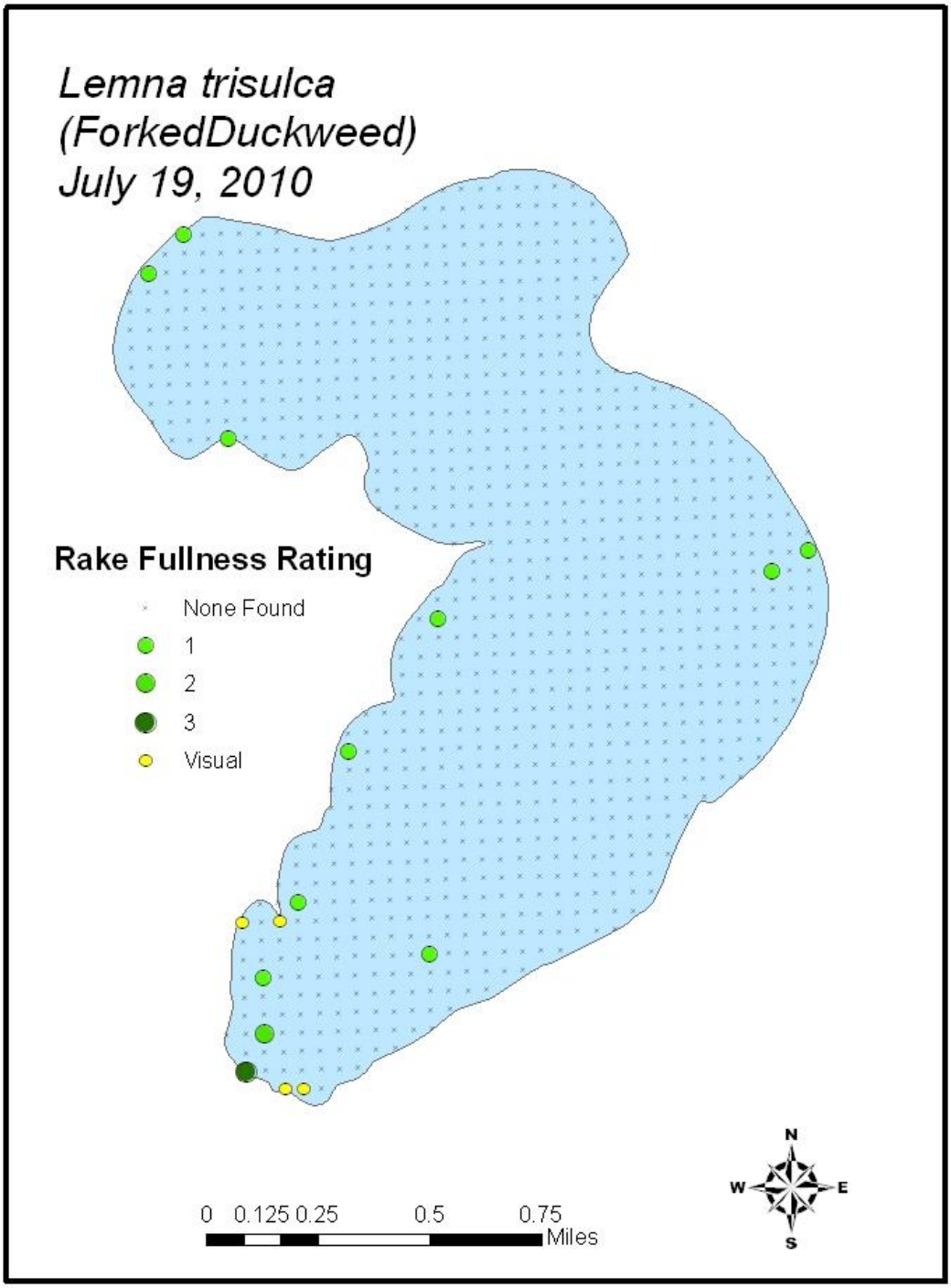

Elodea canadensis
(Common waterweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

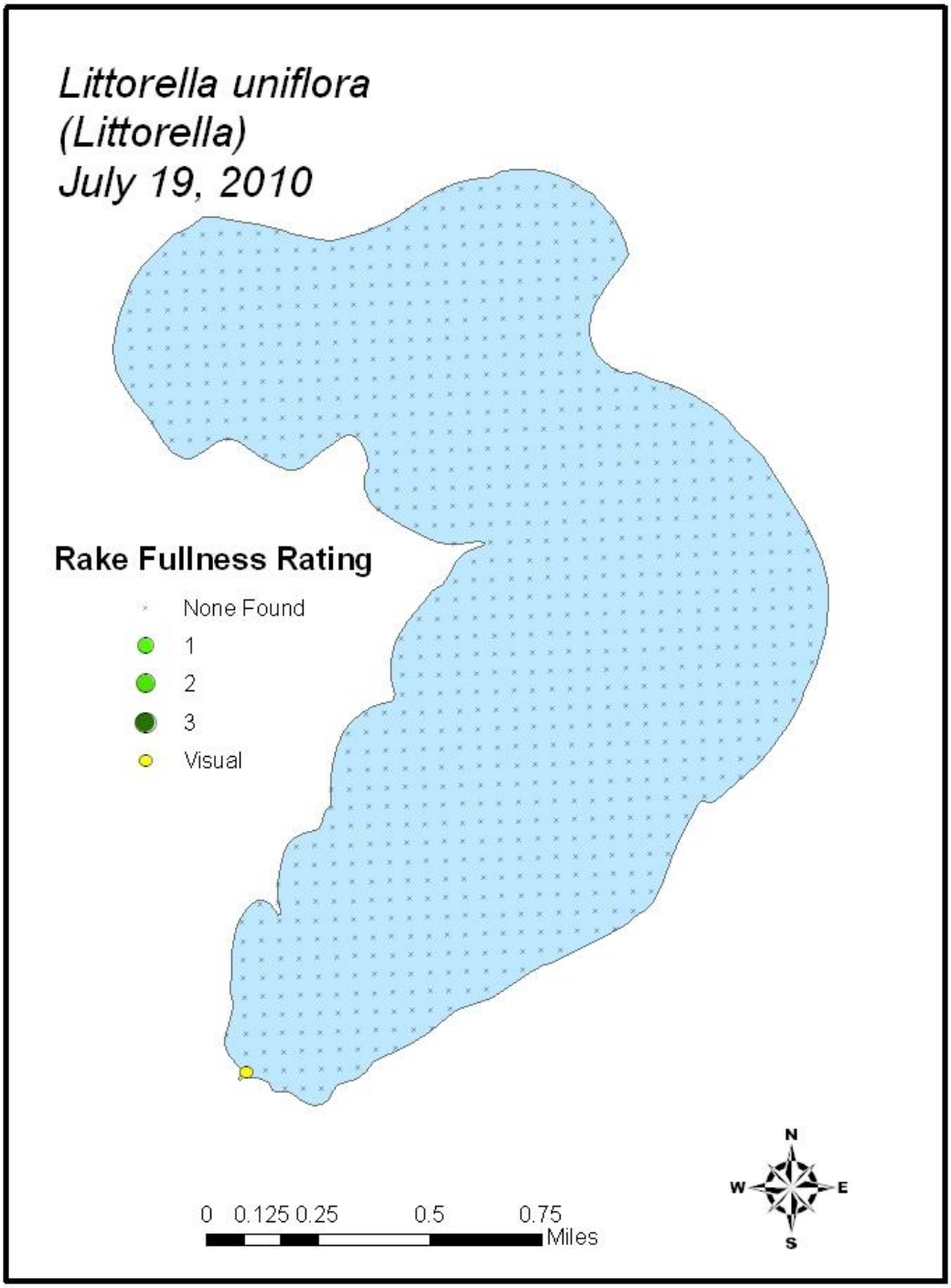

Filamentous algae
July 19, 2010
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

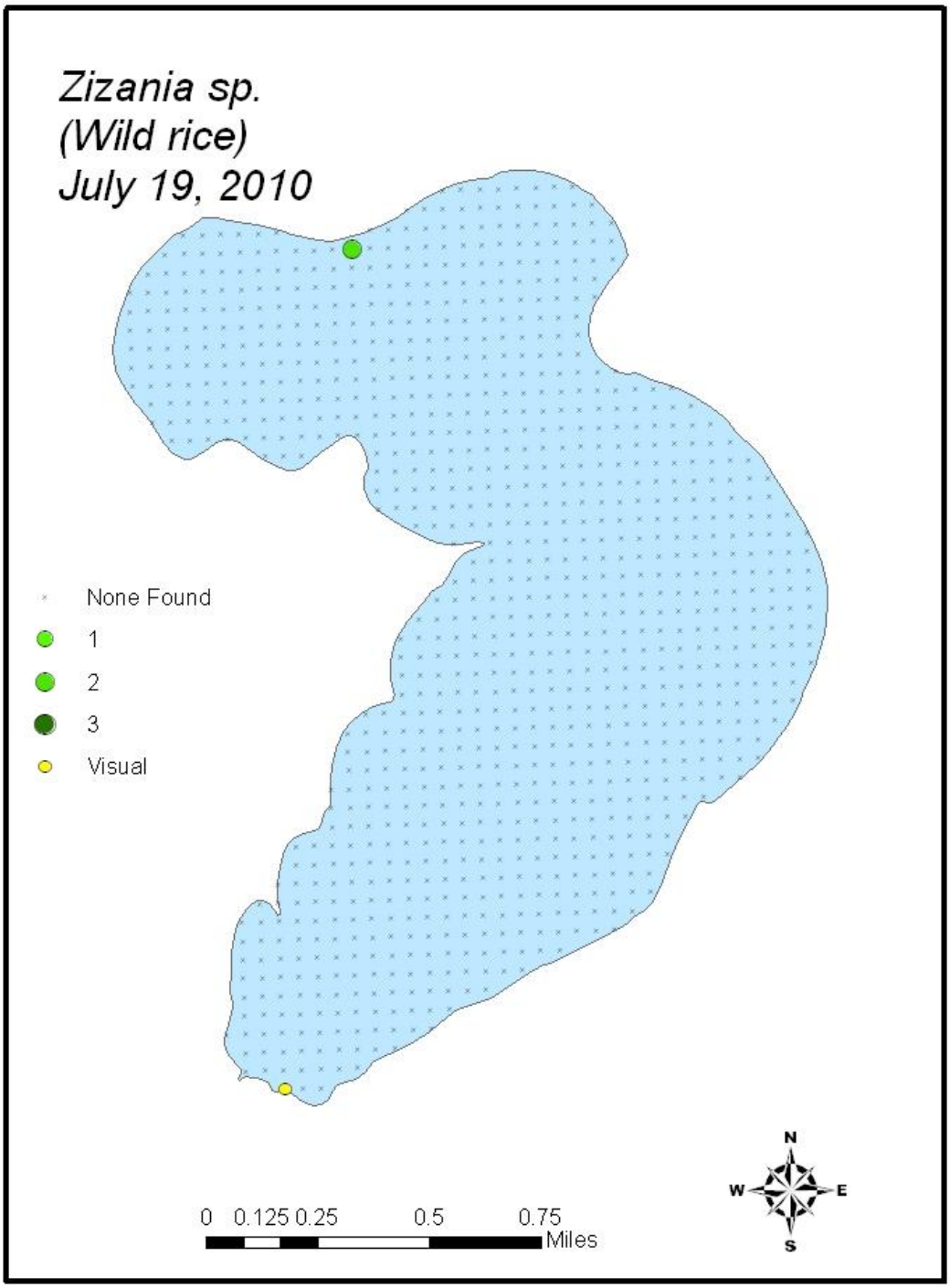

Freshwater sponge
July 19, 2010
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

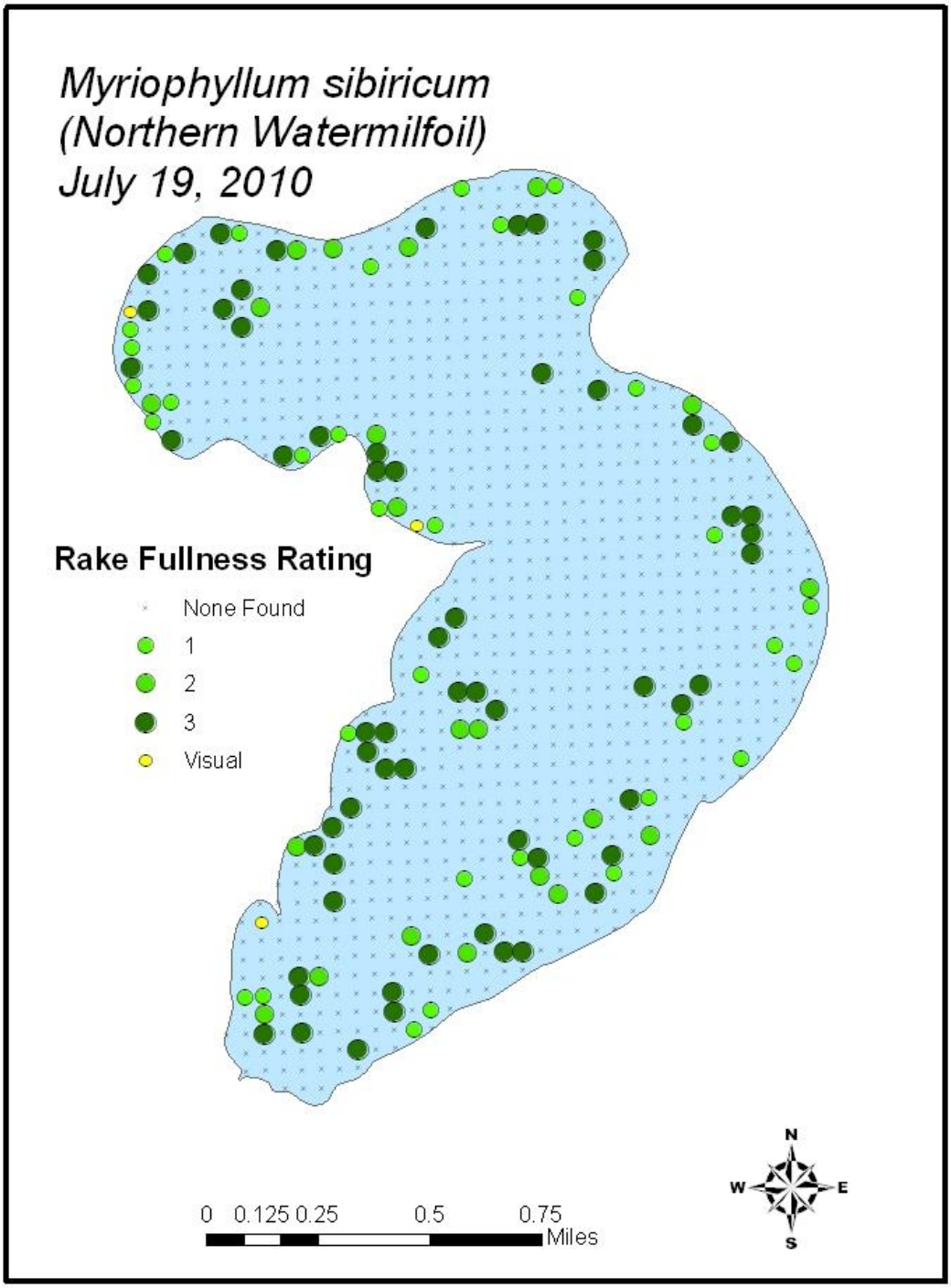

Isoetes sp.
(Quillwort)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

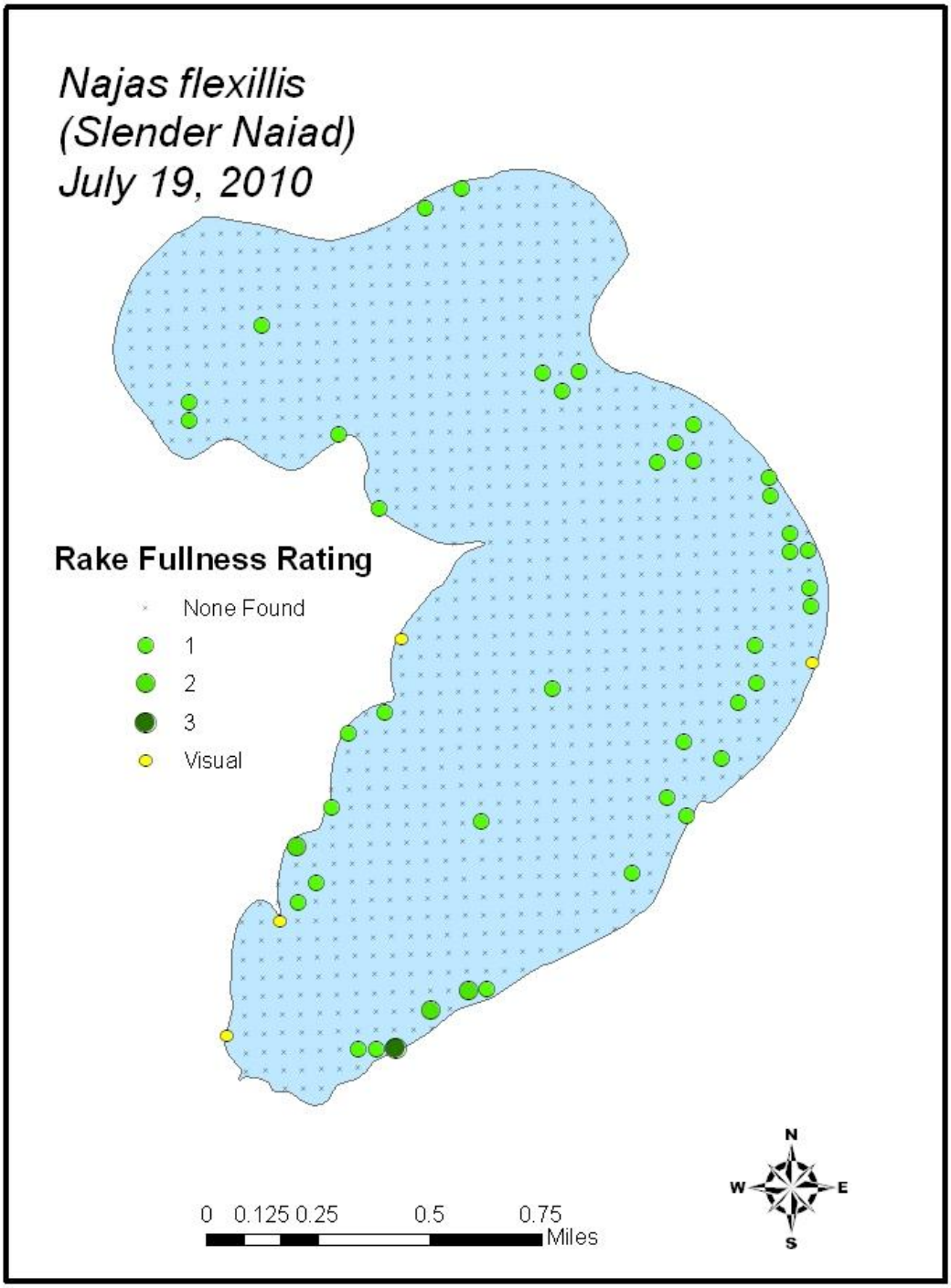

Lemna Minor
(Small Duckweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

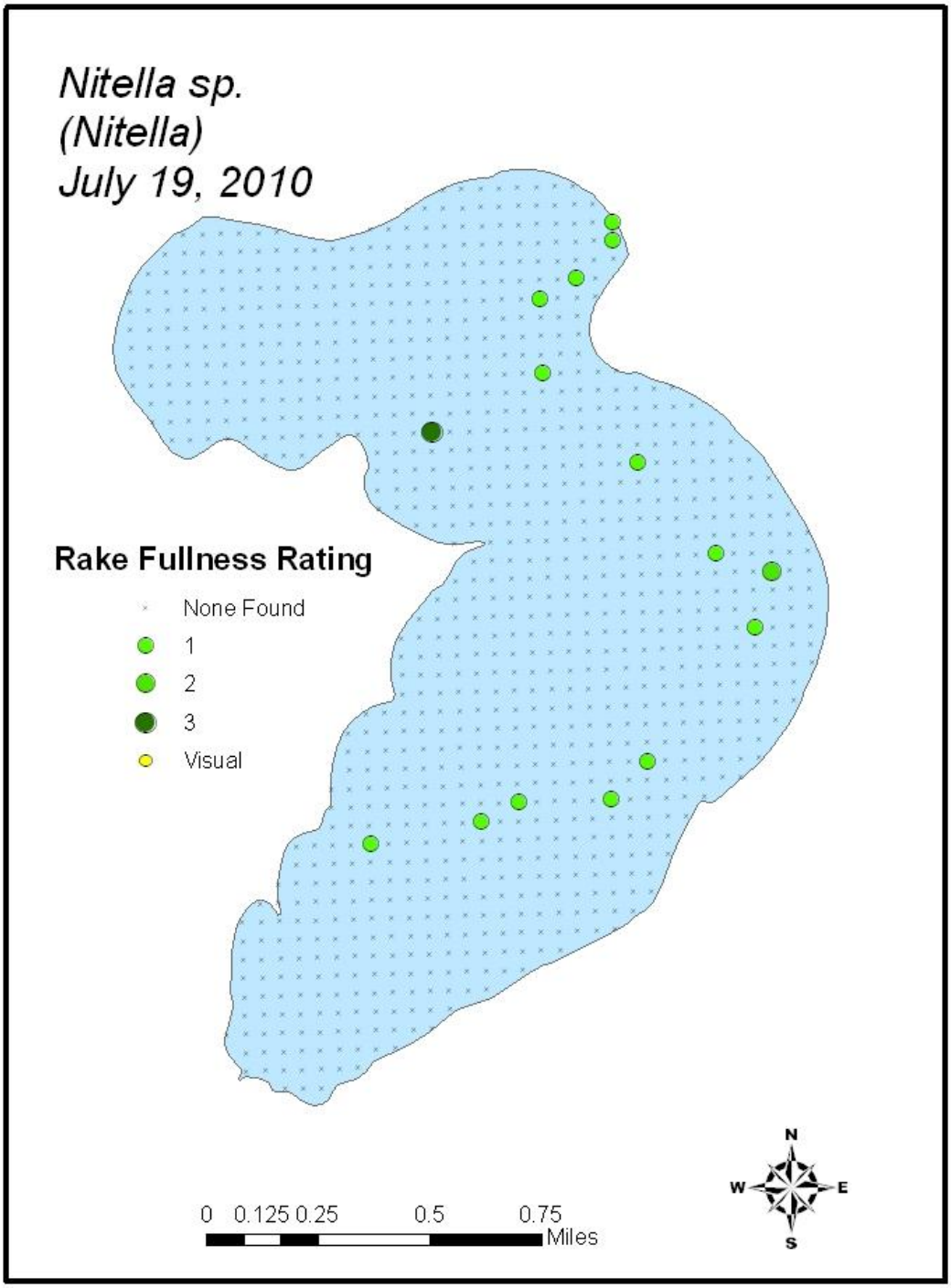

Lemna trisulca
(ForkedDuckweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

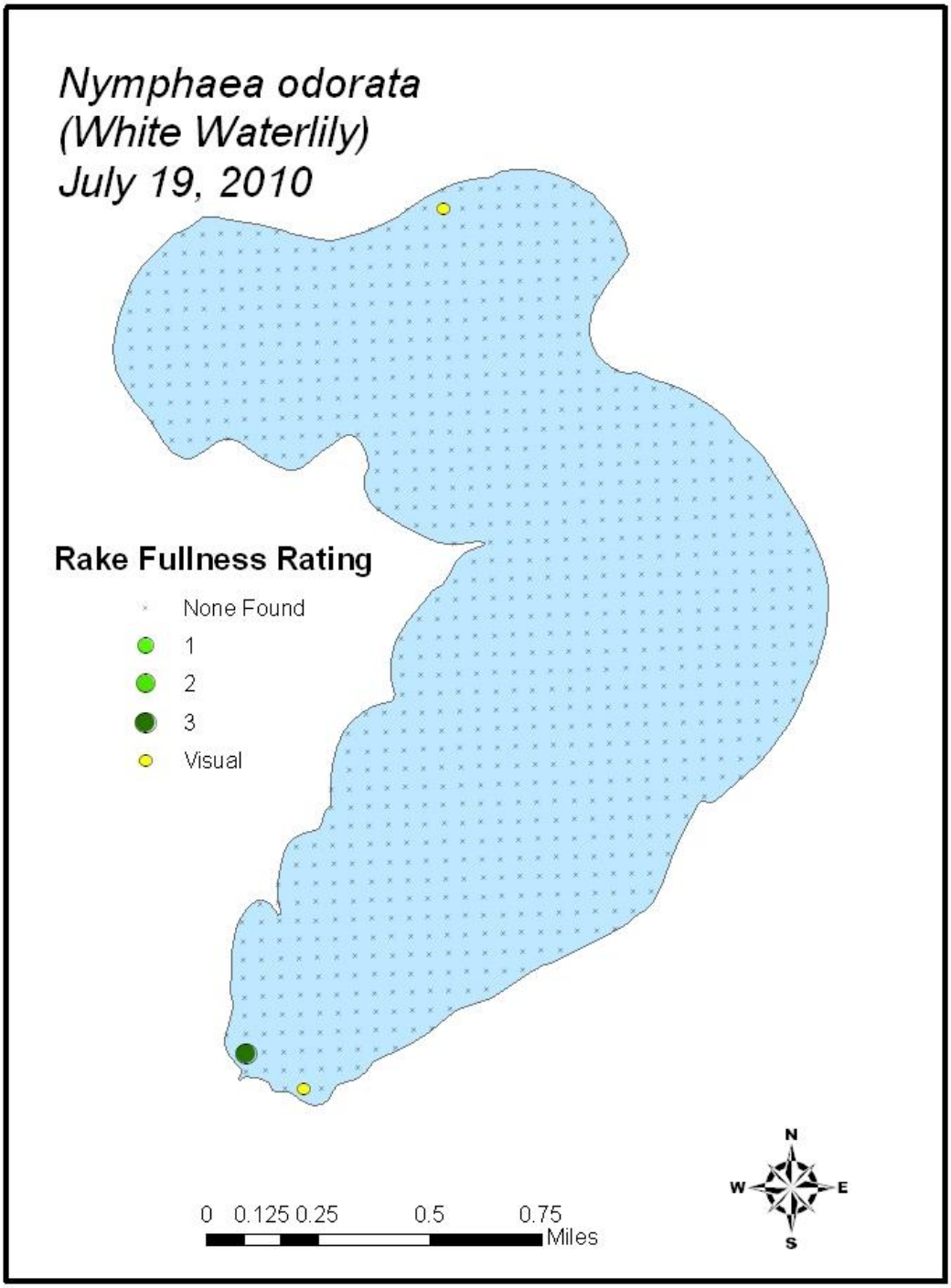

Littorella uniflora
(Littorella)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

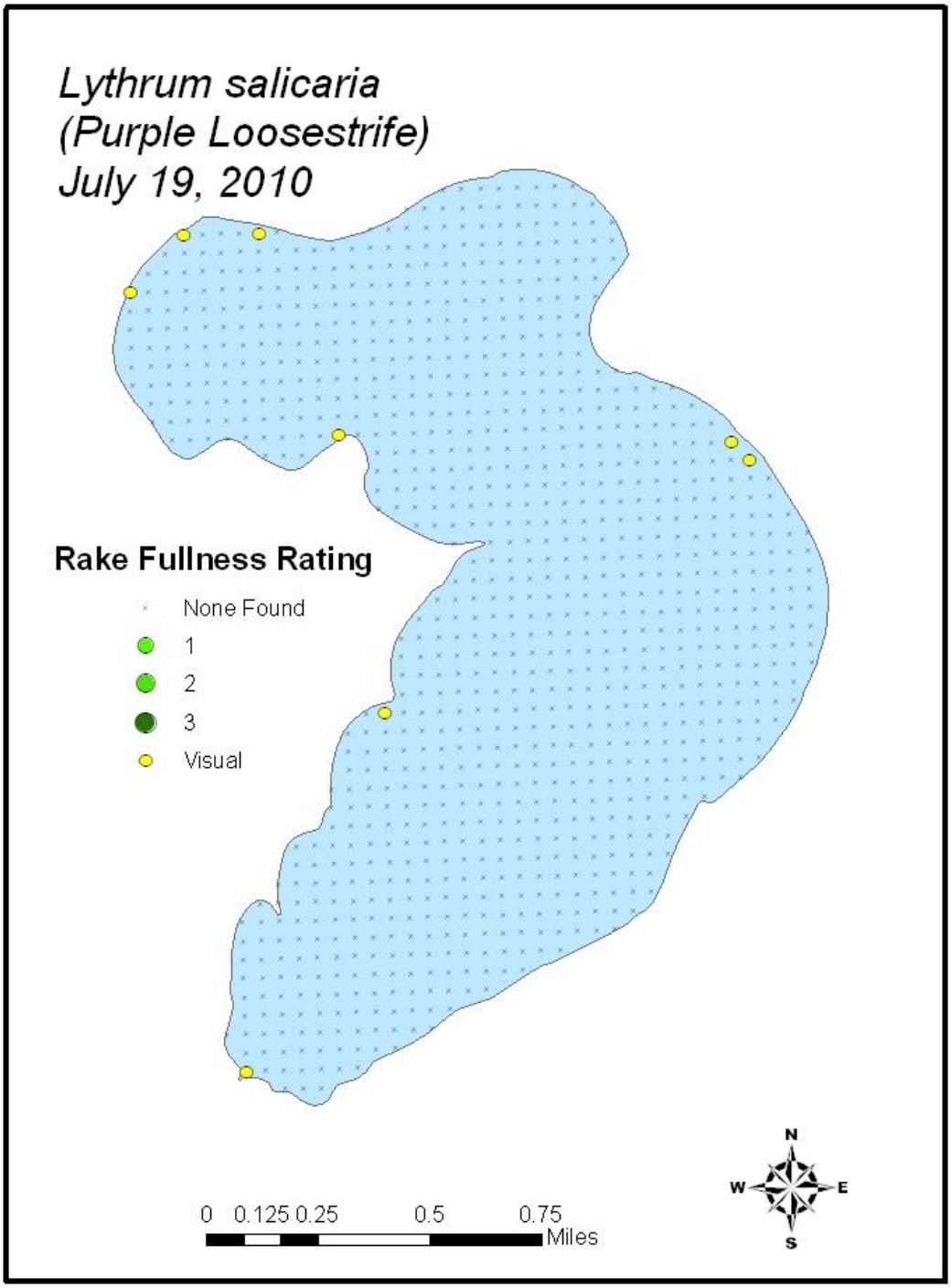

Zizania sp.
(Wild rice)
July 19, 2010
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

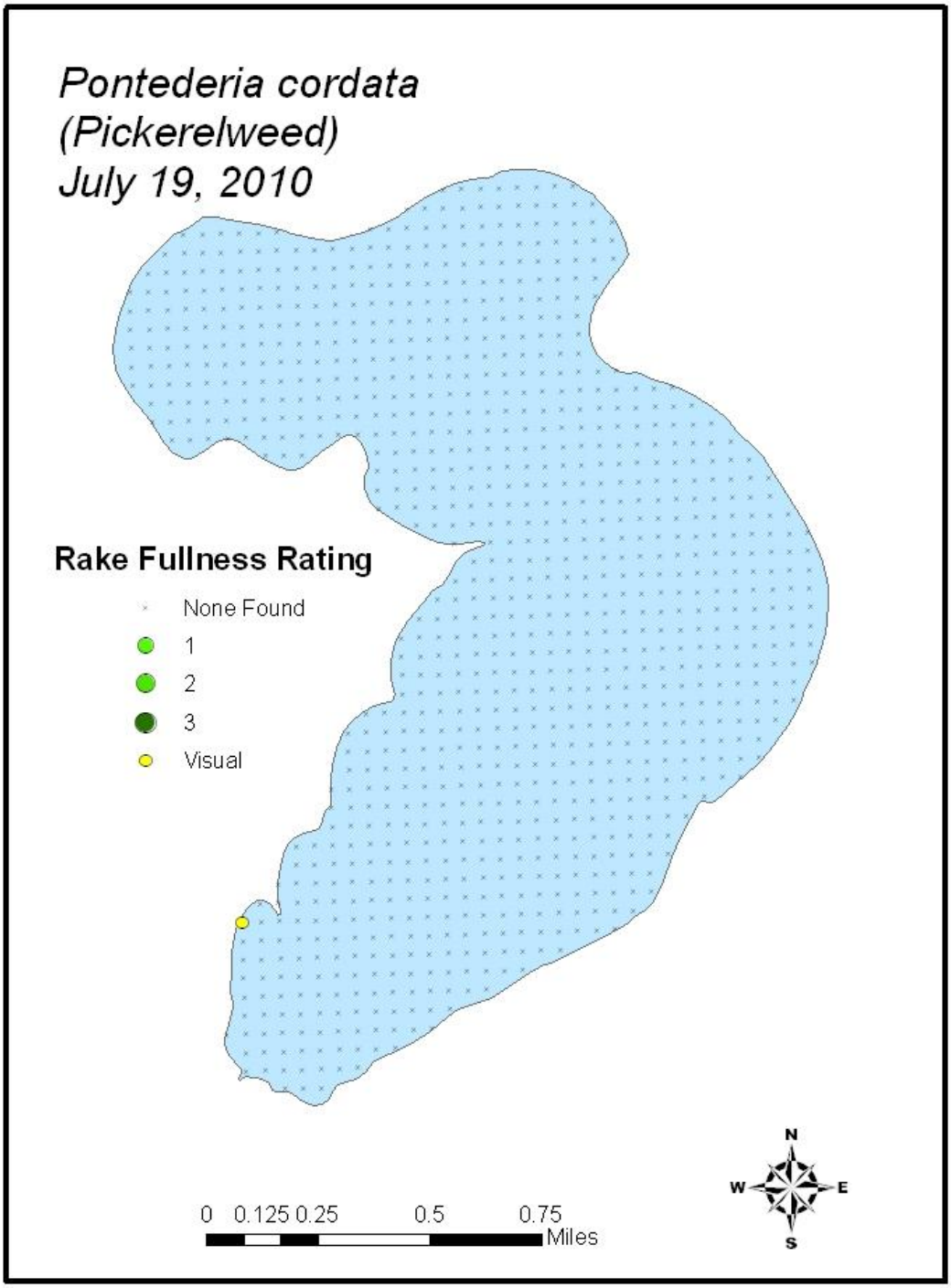

Myriophyllum sibiricum
(Northern Watermilfoil)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

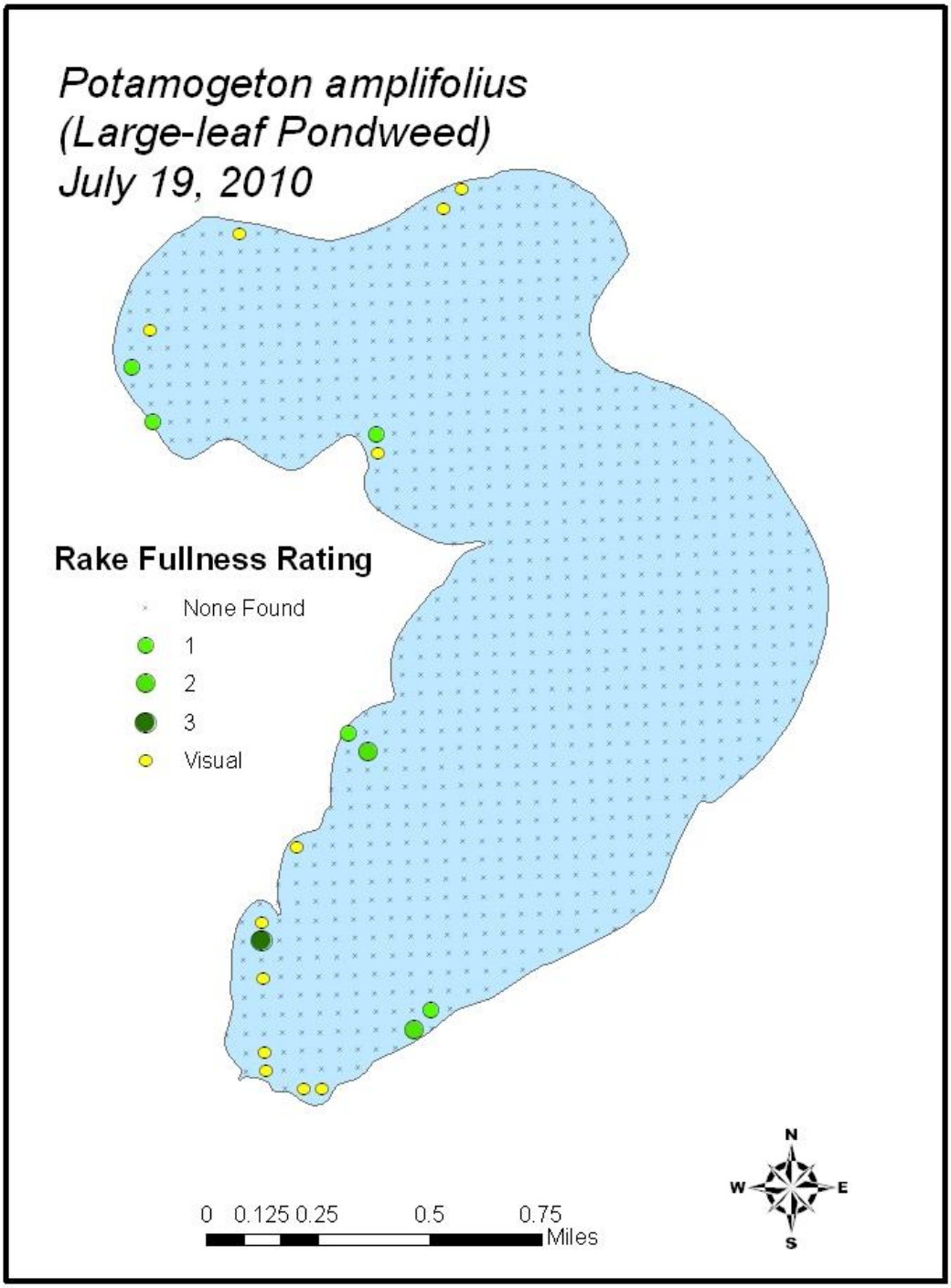

Najas flexillis
(Slender Naiad)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

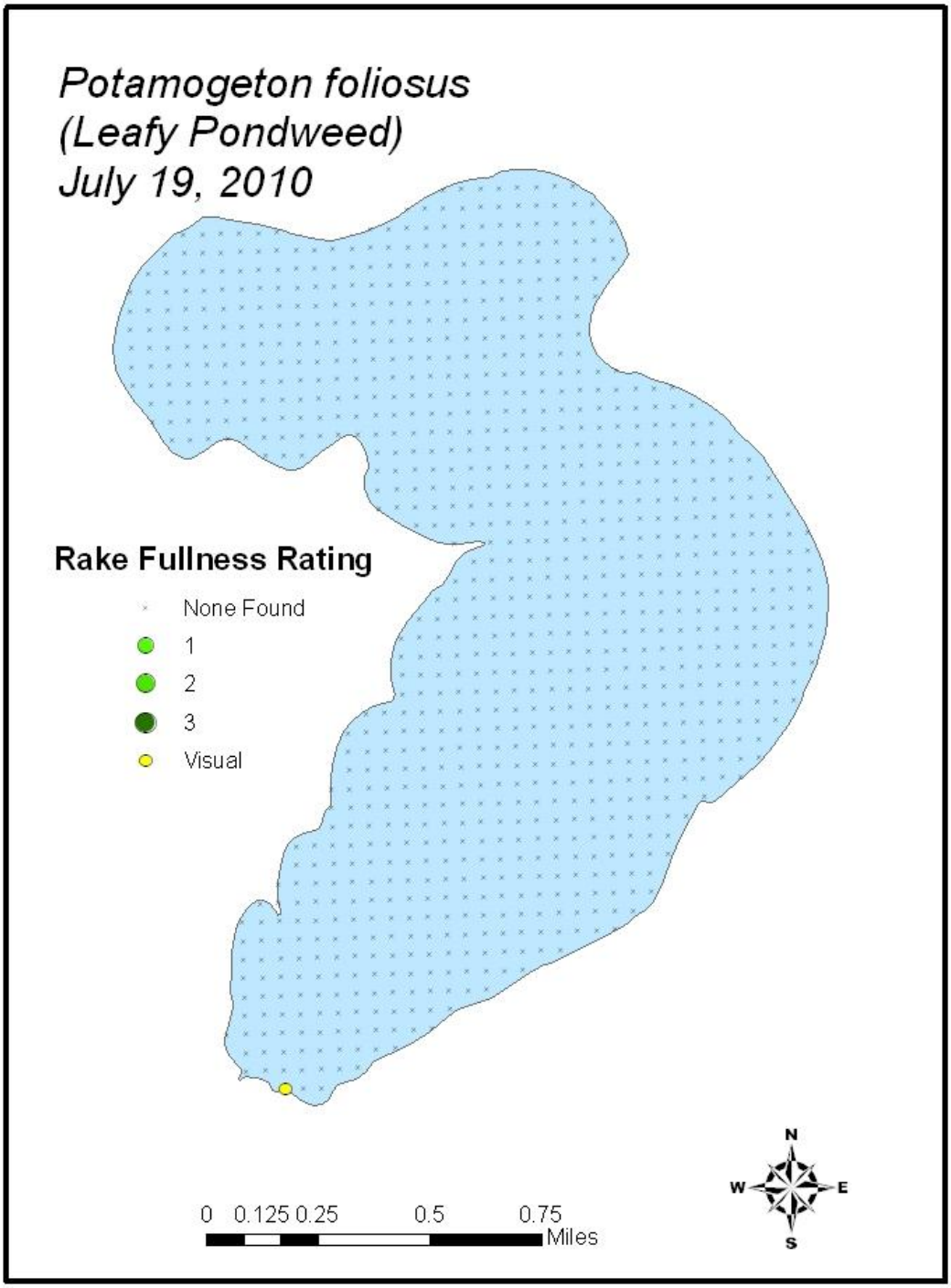

Nitella sp.
(Nitella)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

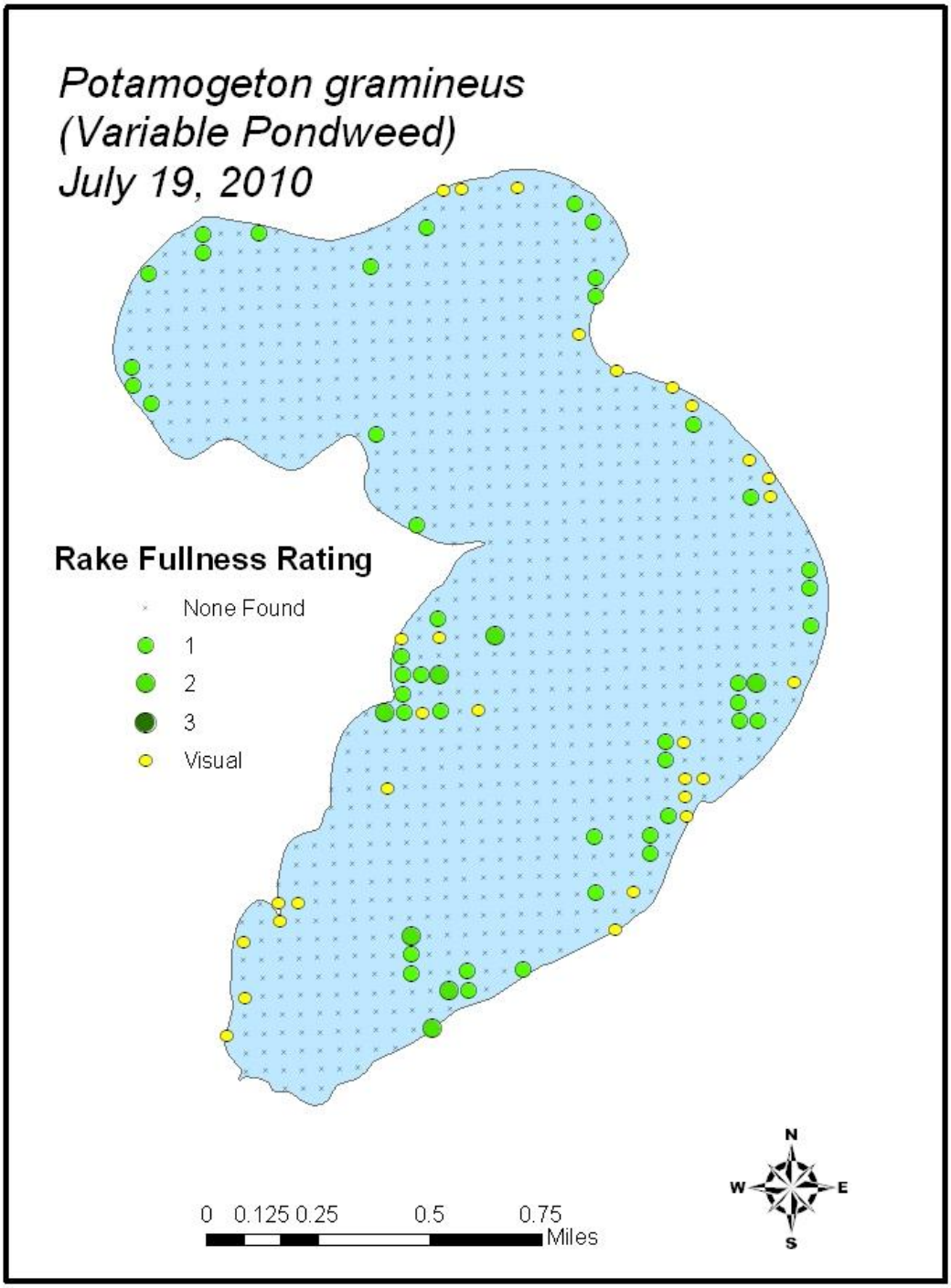

Nymphaea odorata
(White Waterlily)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

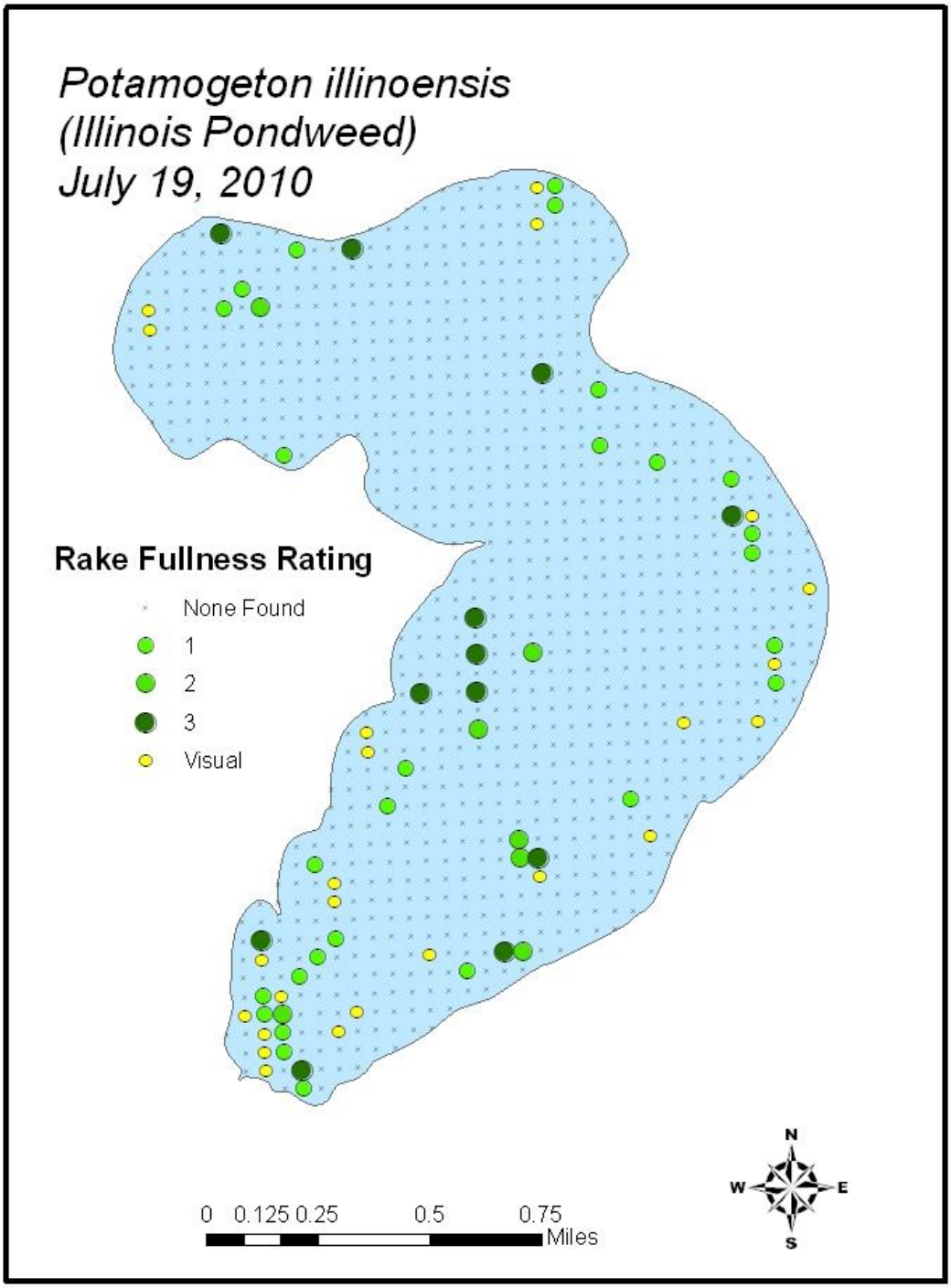

Lythrum salicaria
(Purple Loosestrife)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

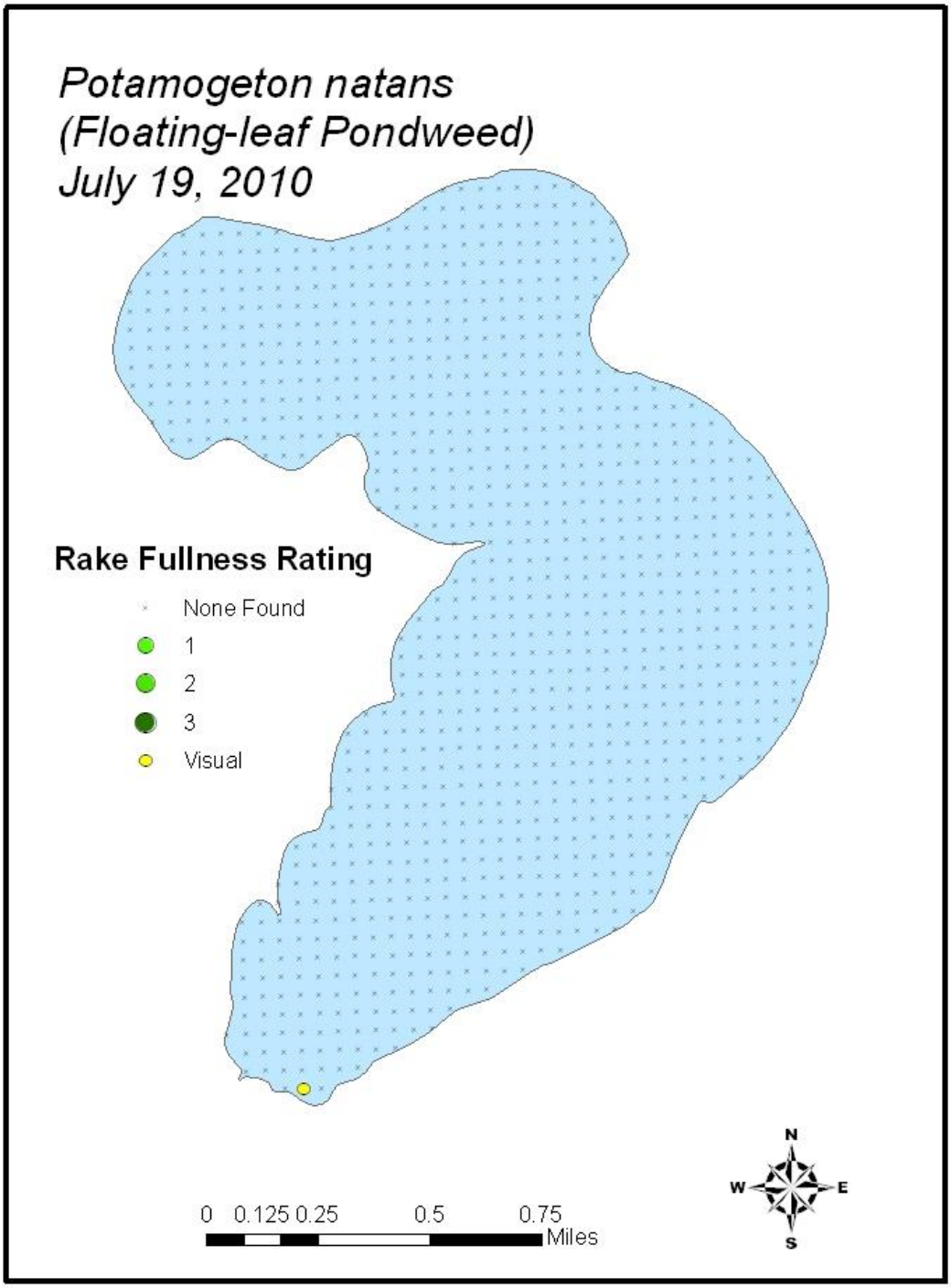

Pontederia cordata
(Pickerelweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

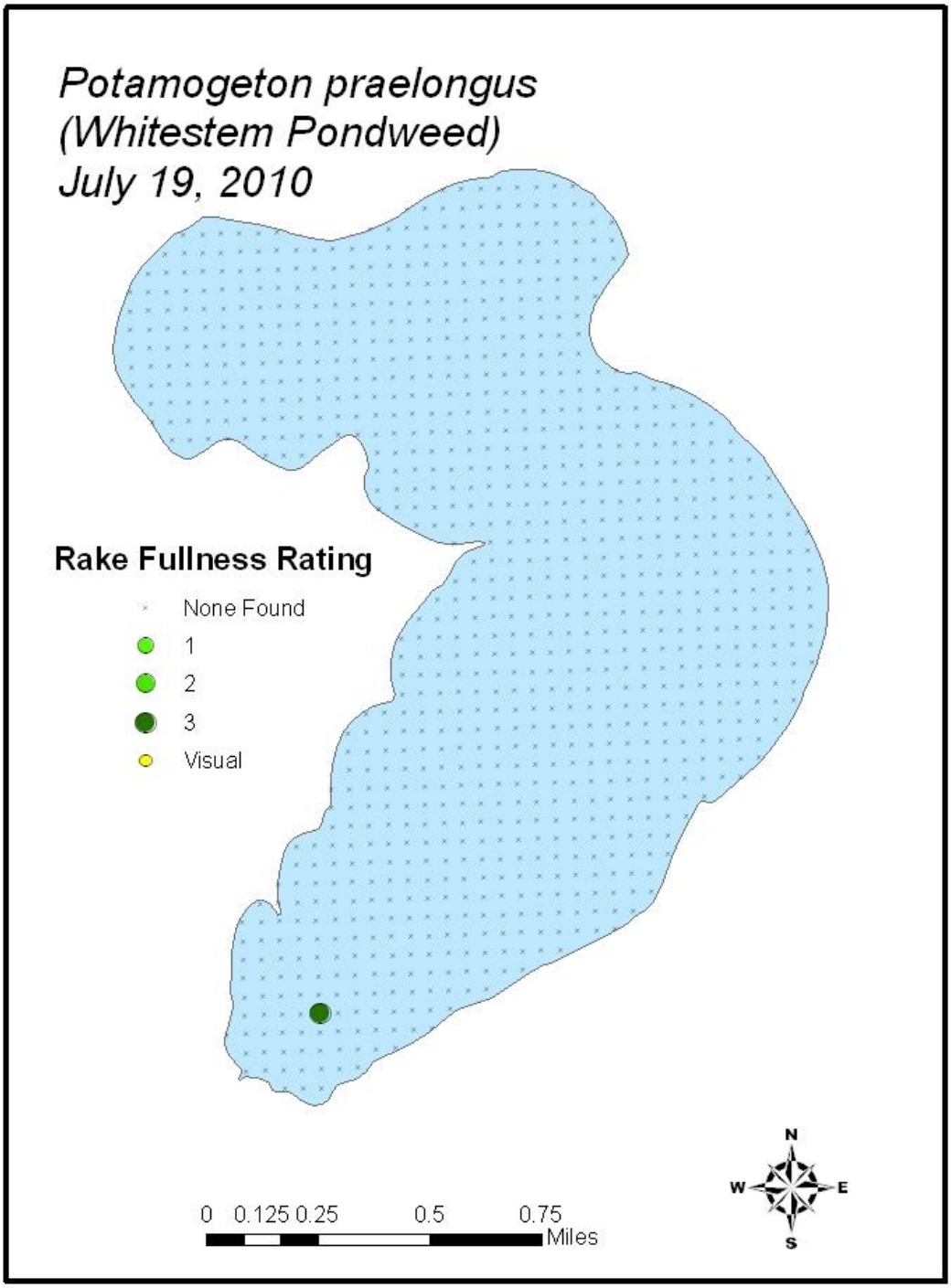

Potamogeton amplifolius
(Large-leaf Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

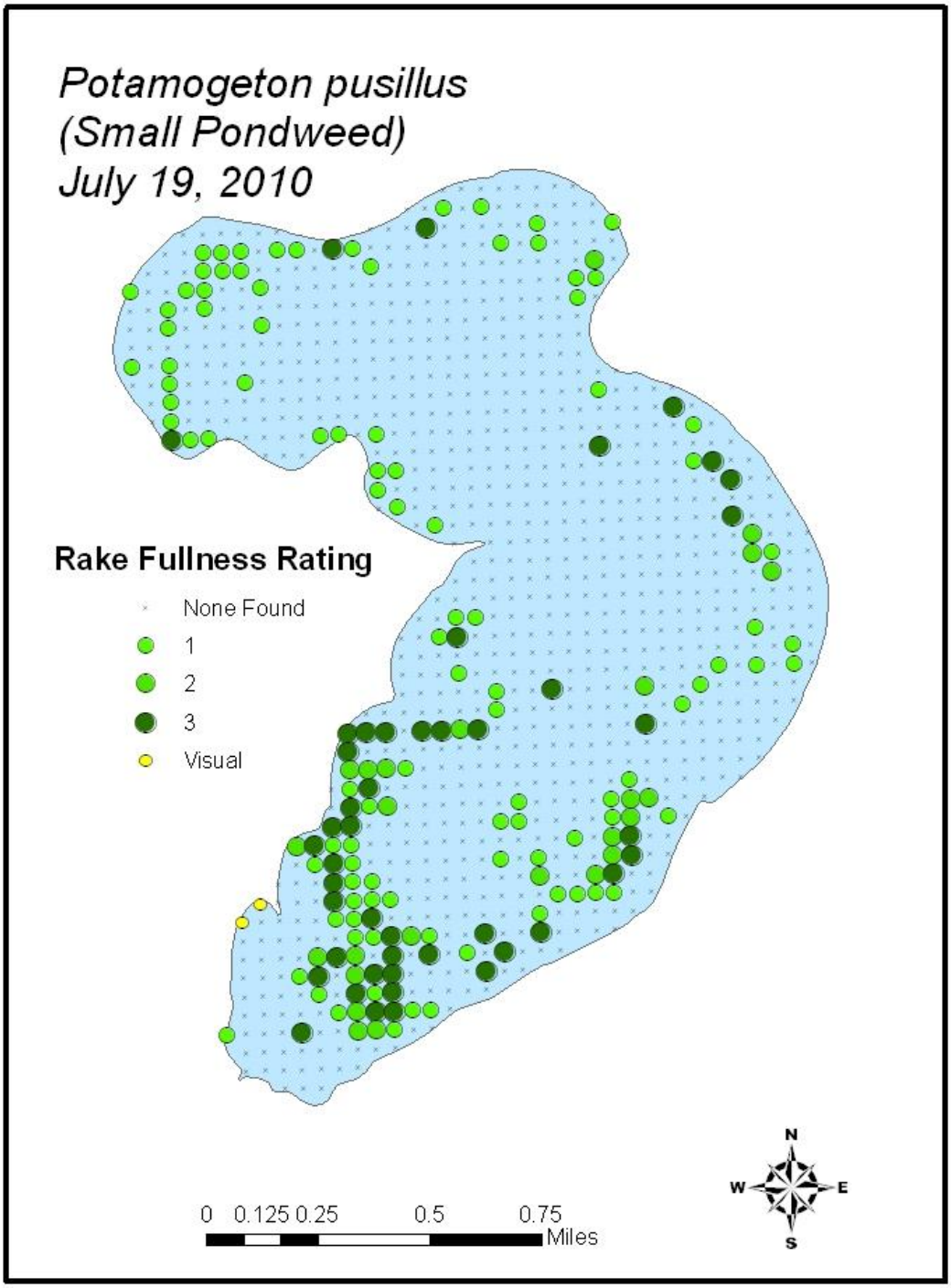

Potamogeton foliosus
(Leafy Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

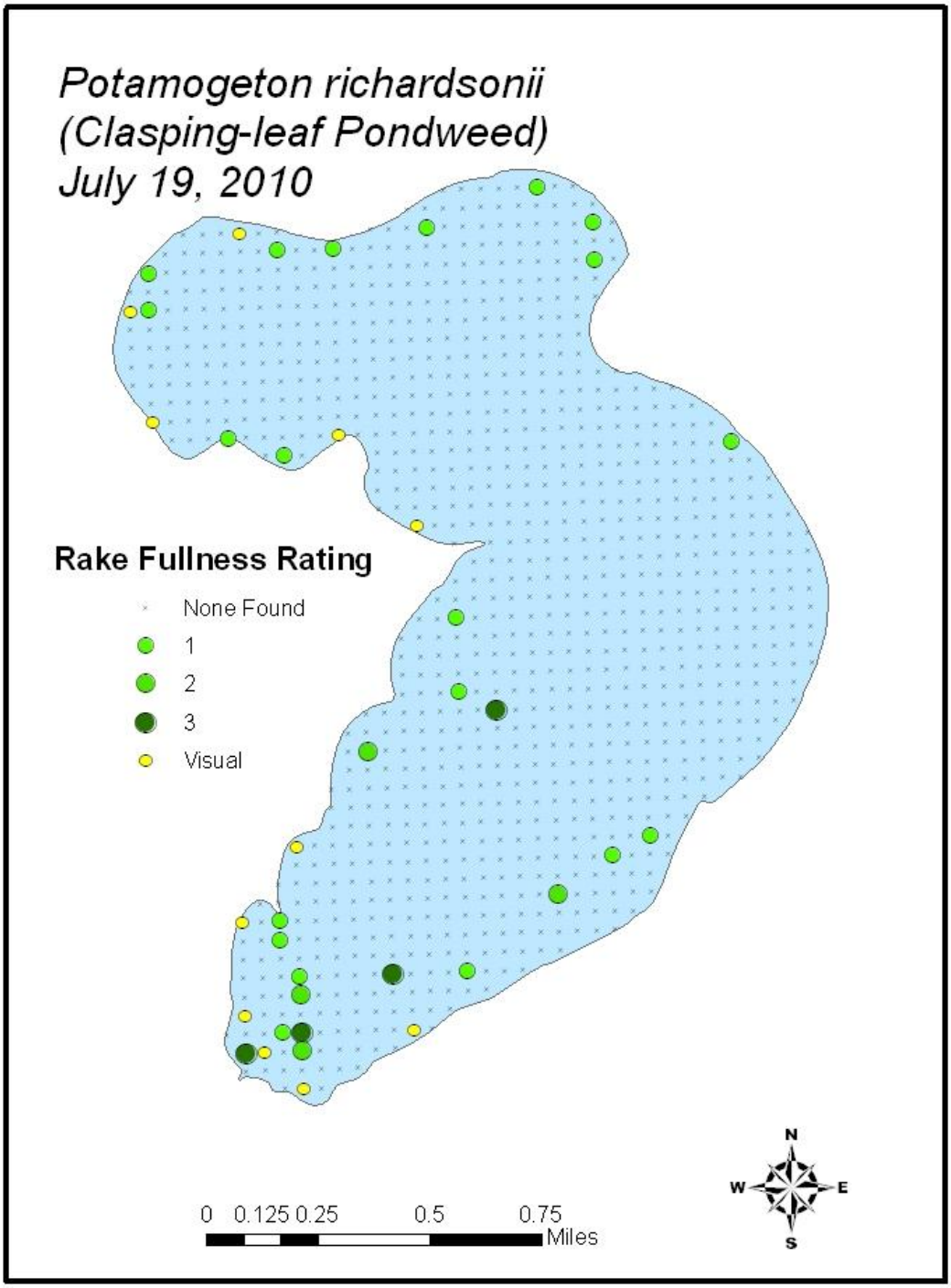

Potamogeton gramineus
(Variable Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

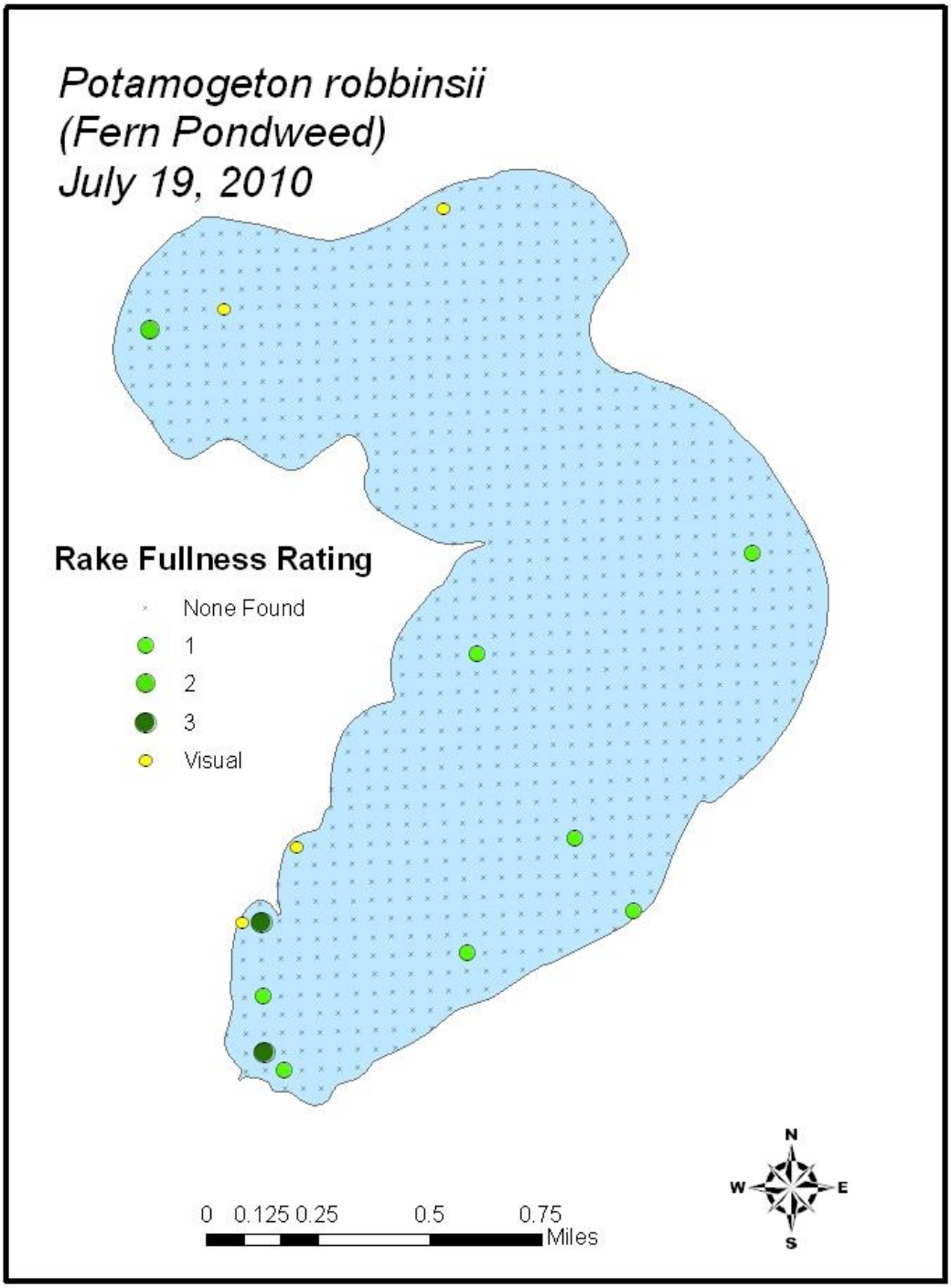

Potamogeton illinoensis
(Illinois Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

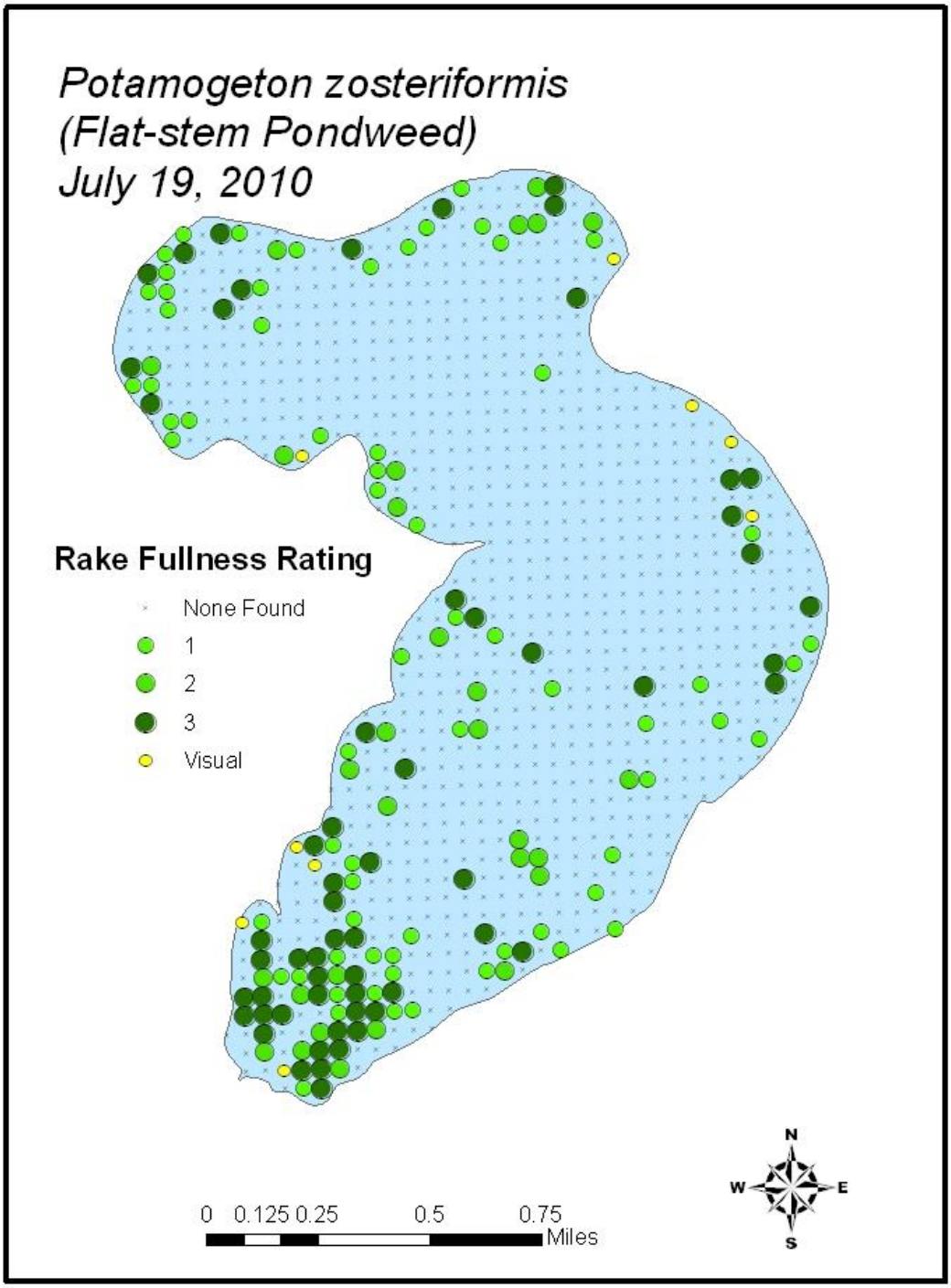

Potamogeton natans
(Floating-leaf Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

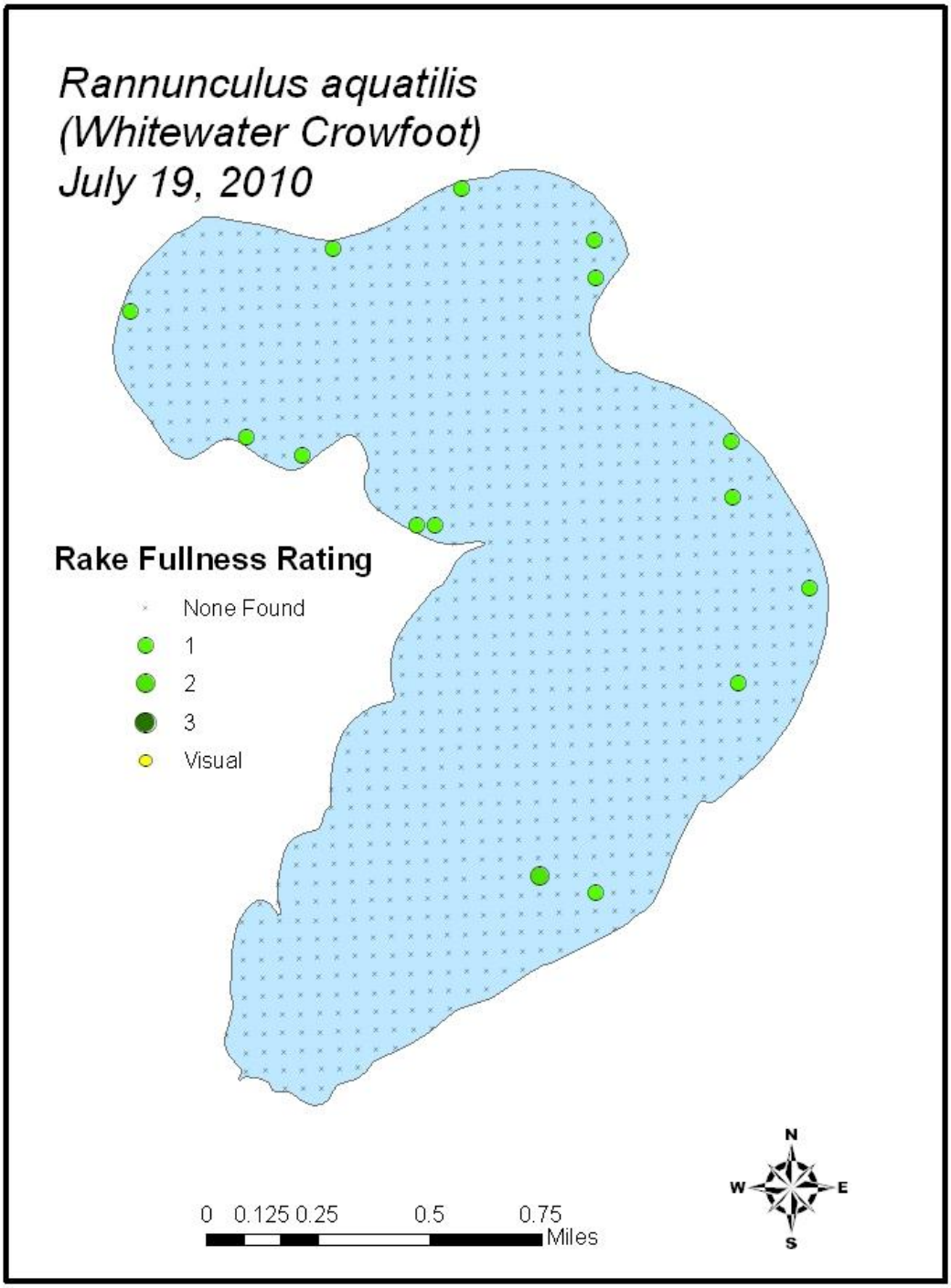

Potamogeton praelongus
(Whitestem Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

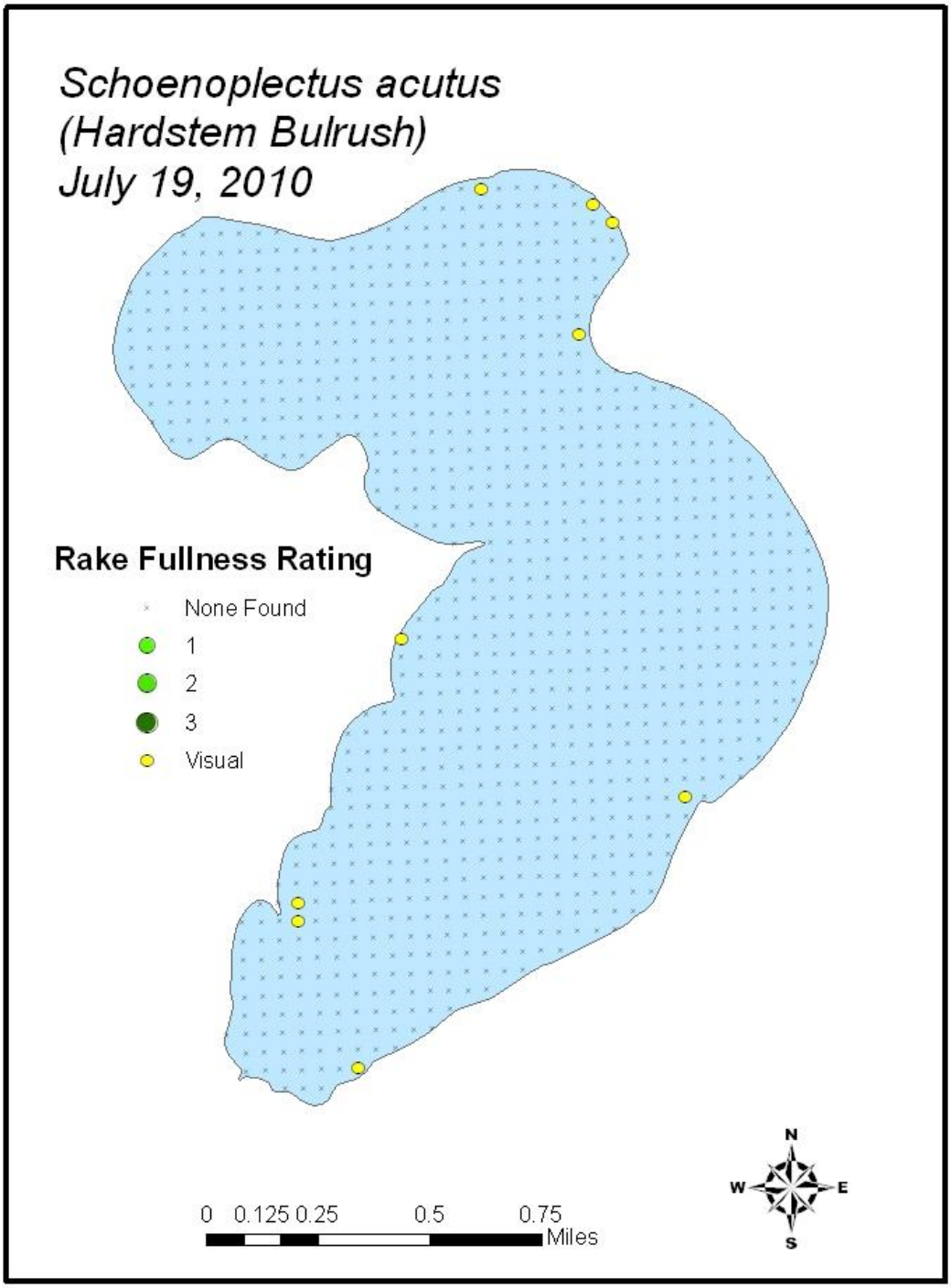

Potamogeton pusillus
(Small Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

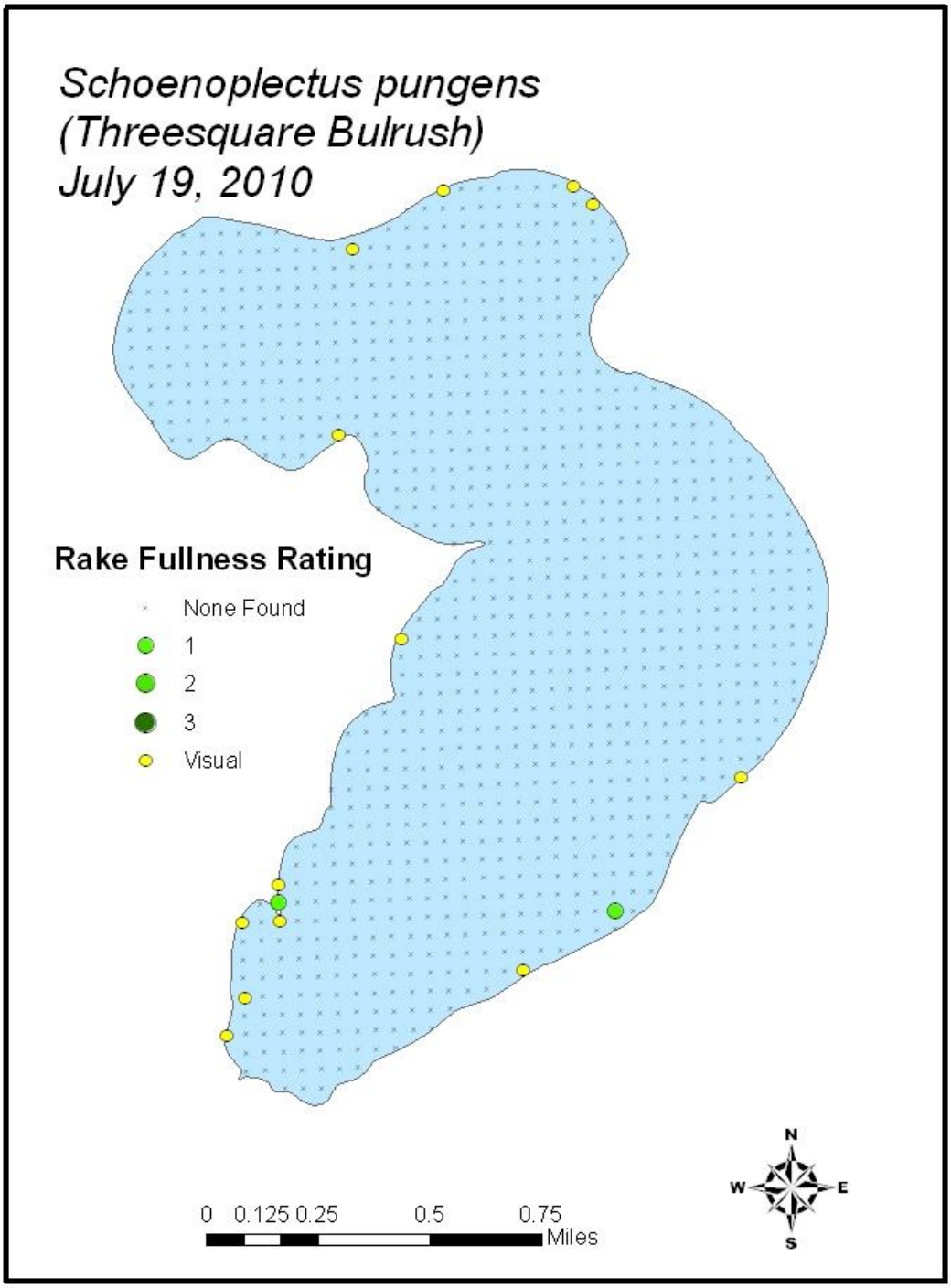

Potamogeton richardsonii
(Clasping-leaf Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

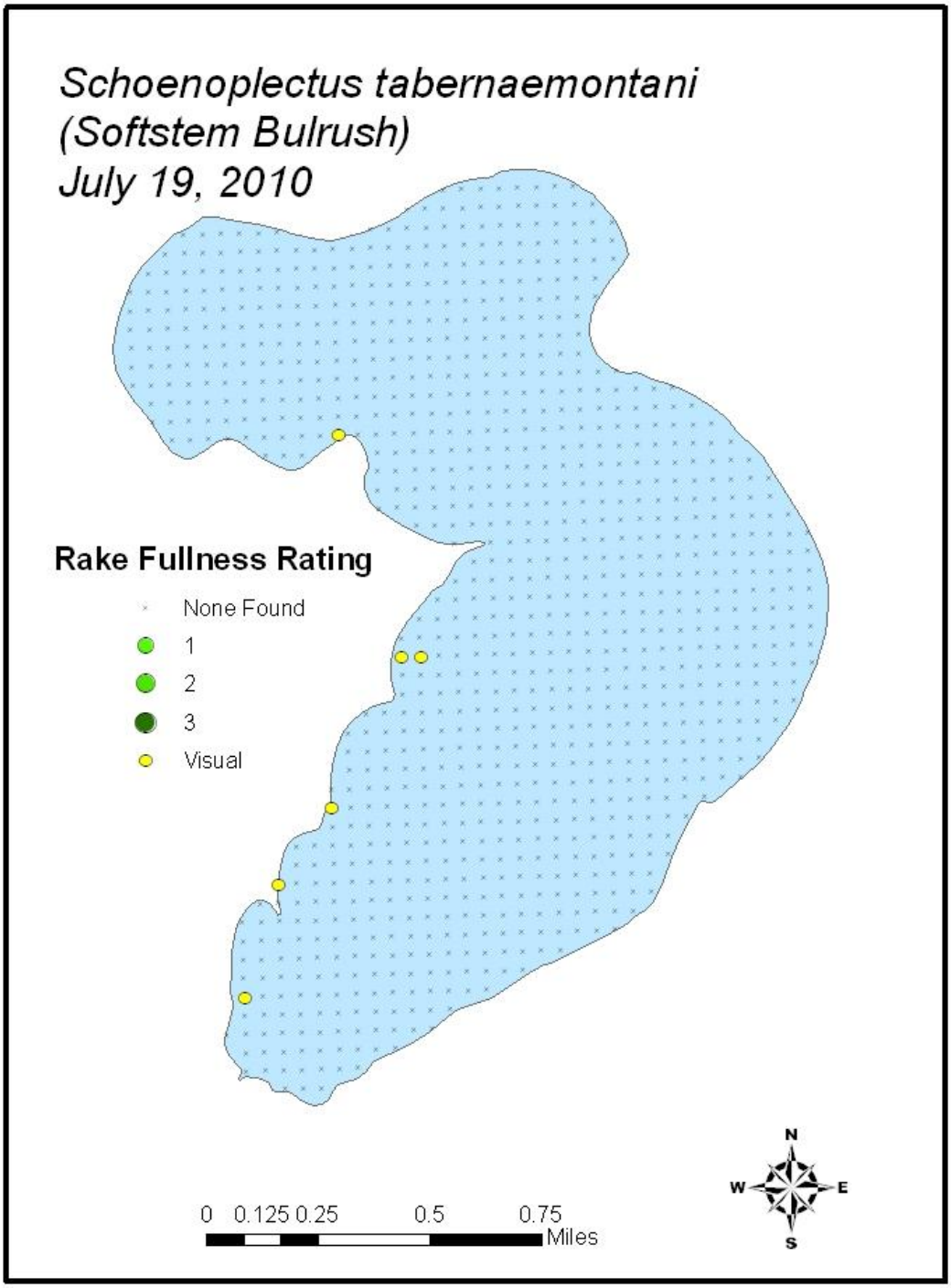

Potamogeton robbinsii
(Fern Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

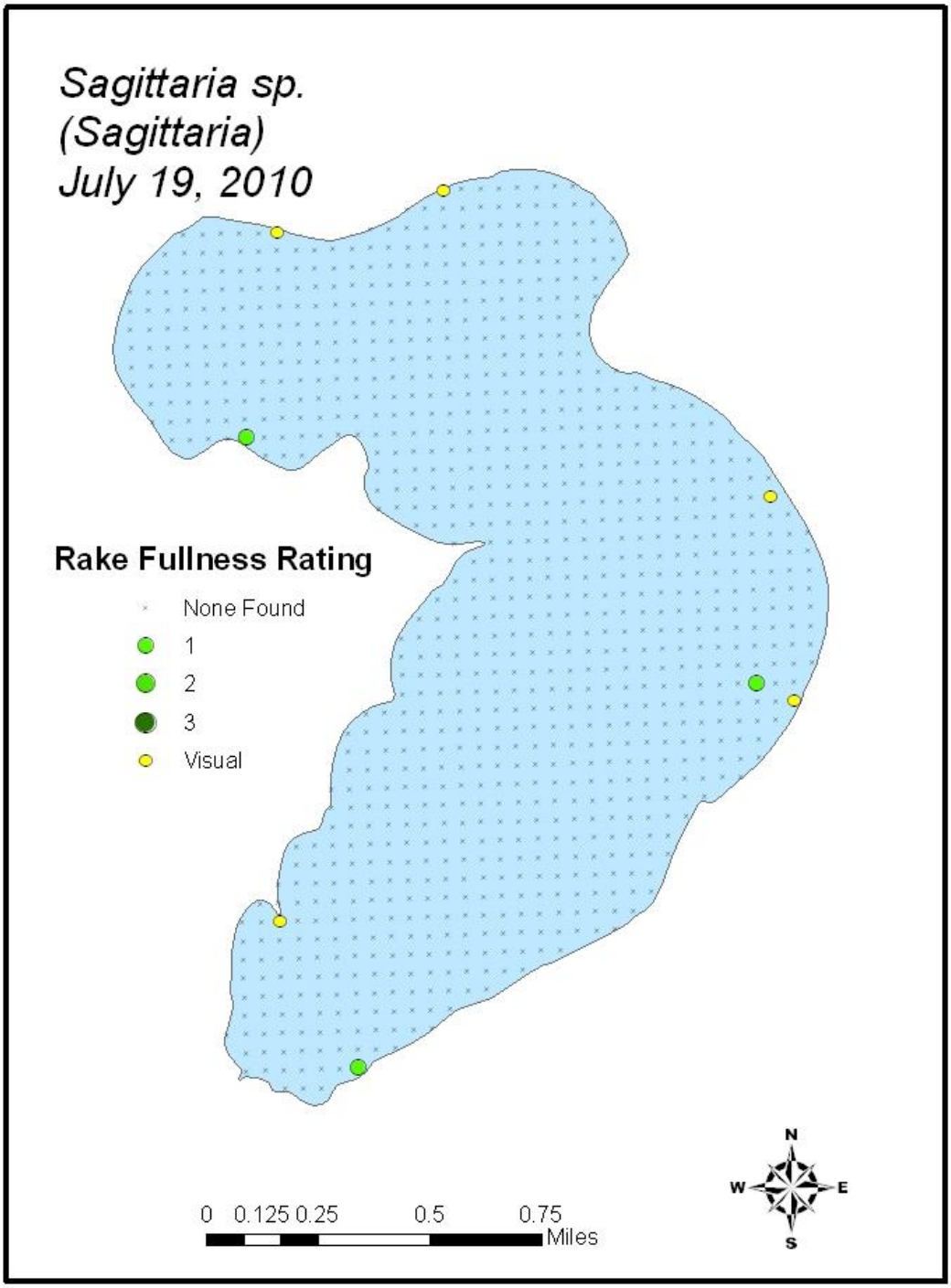

Potamogeton zosteriformis
(Flat-stem Pondweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

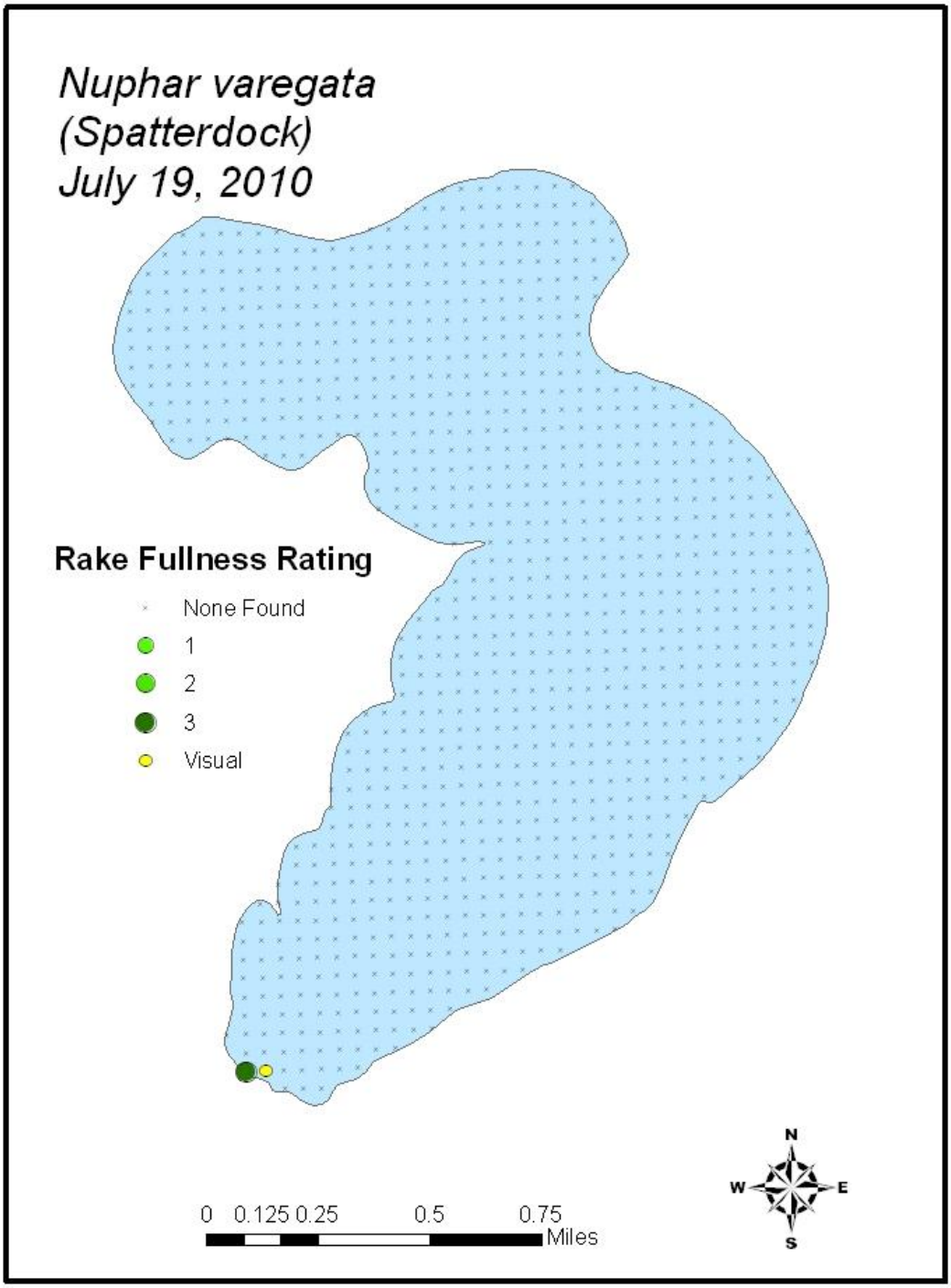

Rannunculus aquatilis
(Whitewater Crowfoot)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

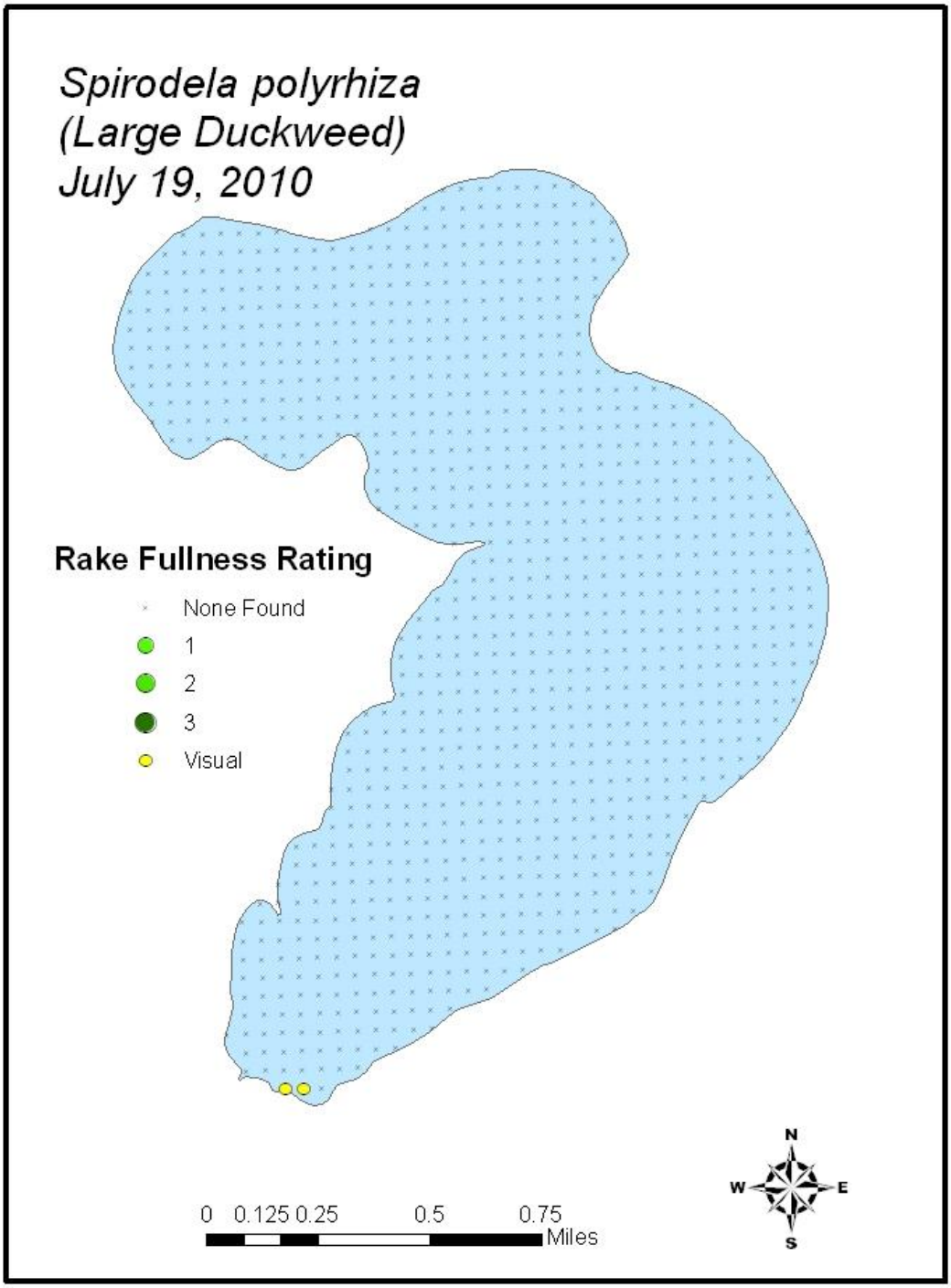

Schoenoplectus acutus
(Hardstem Bulrush)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

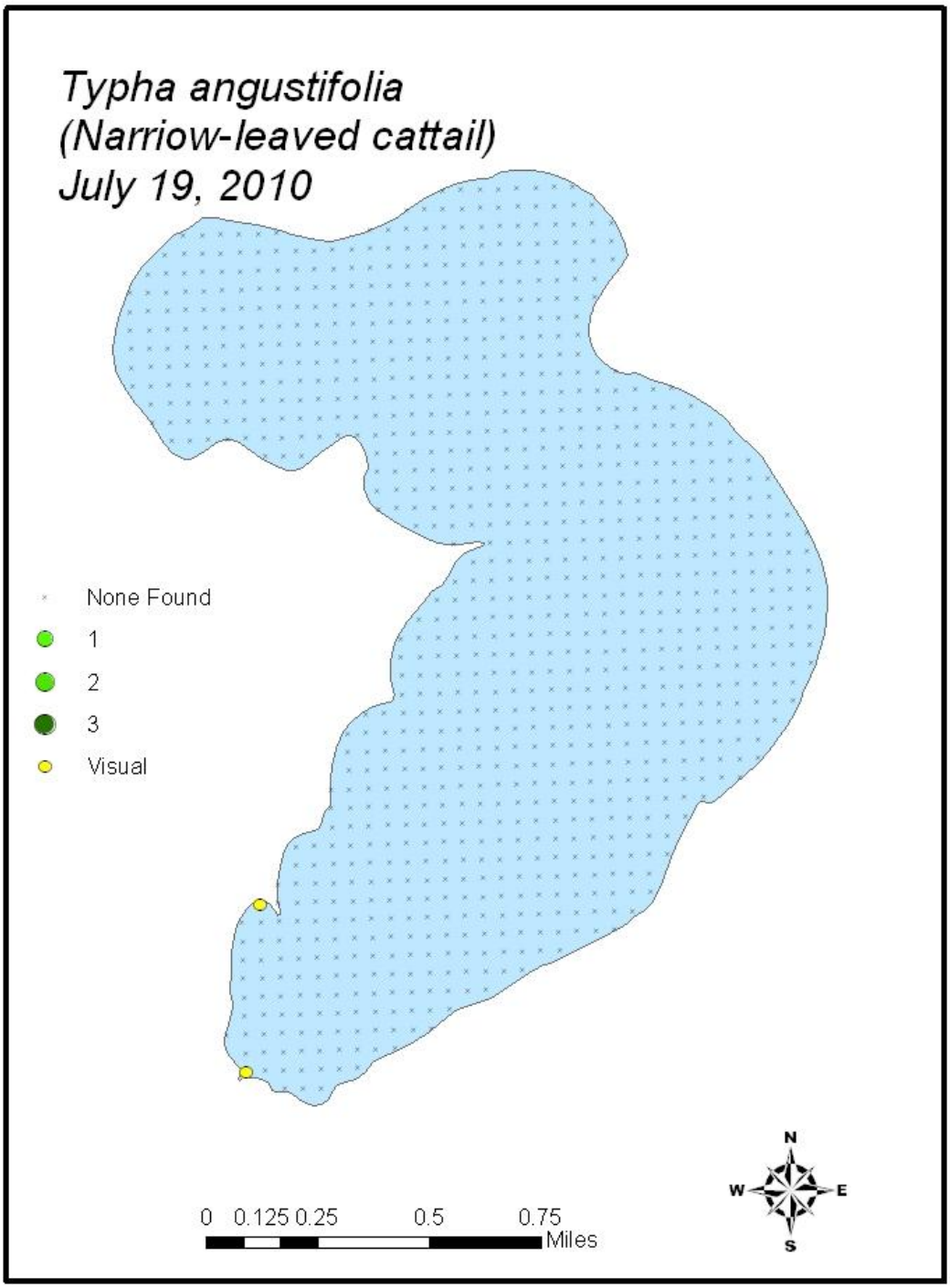

Schoenoplectus pungens
(Threesquare Bulrush)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

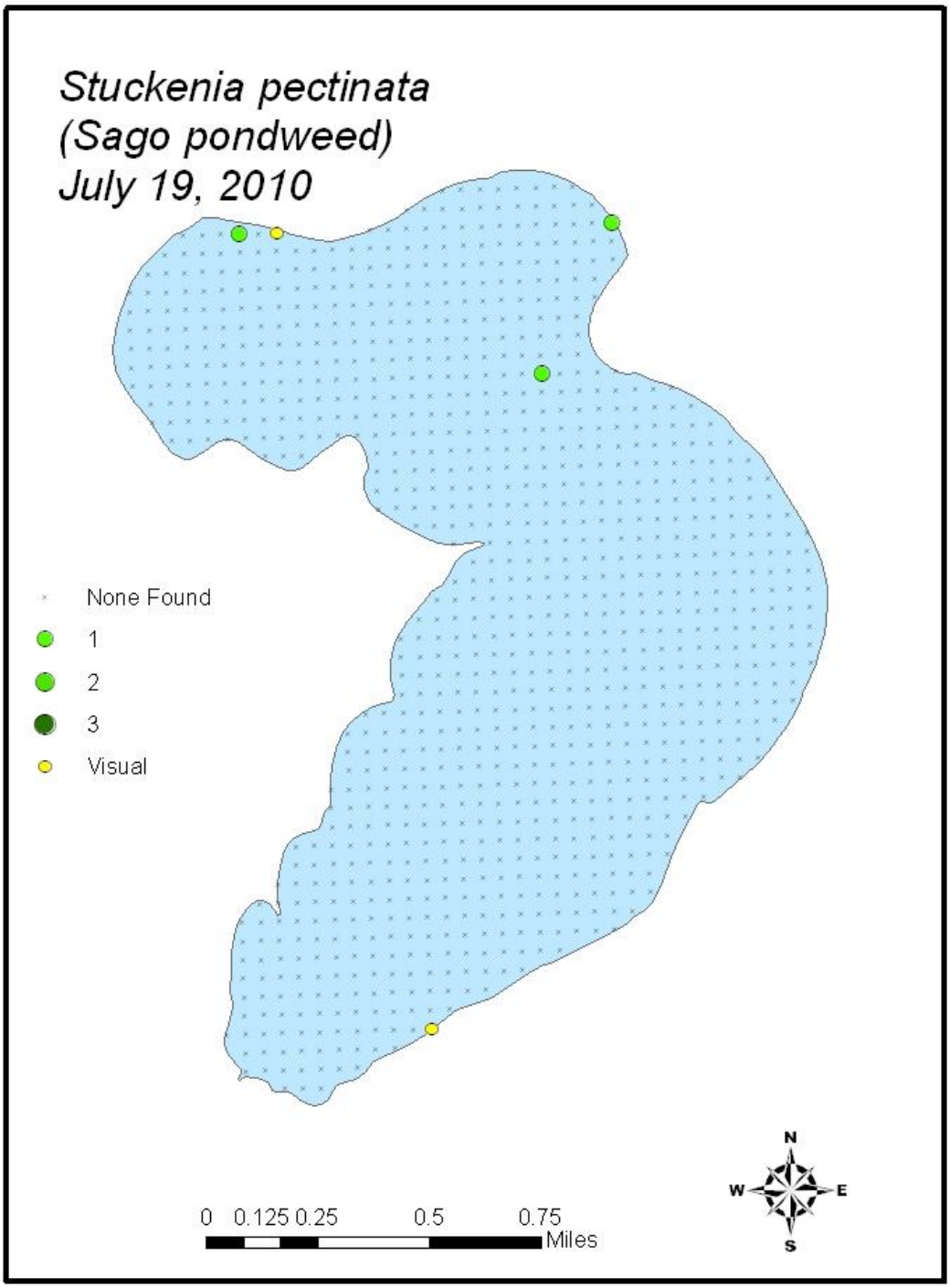

Schoenoplectus tabernaemontani
(Softstem Bulrush)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

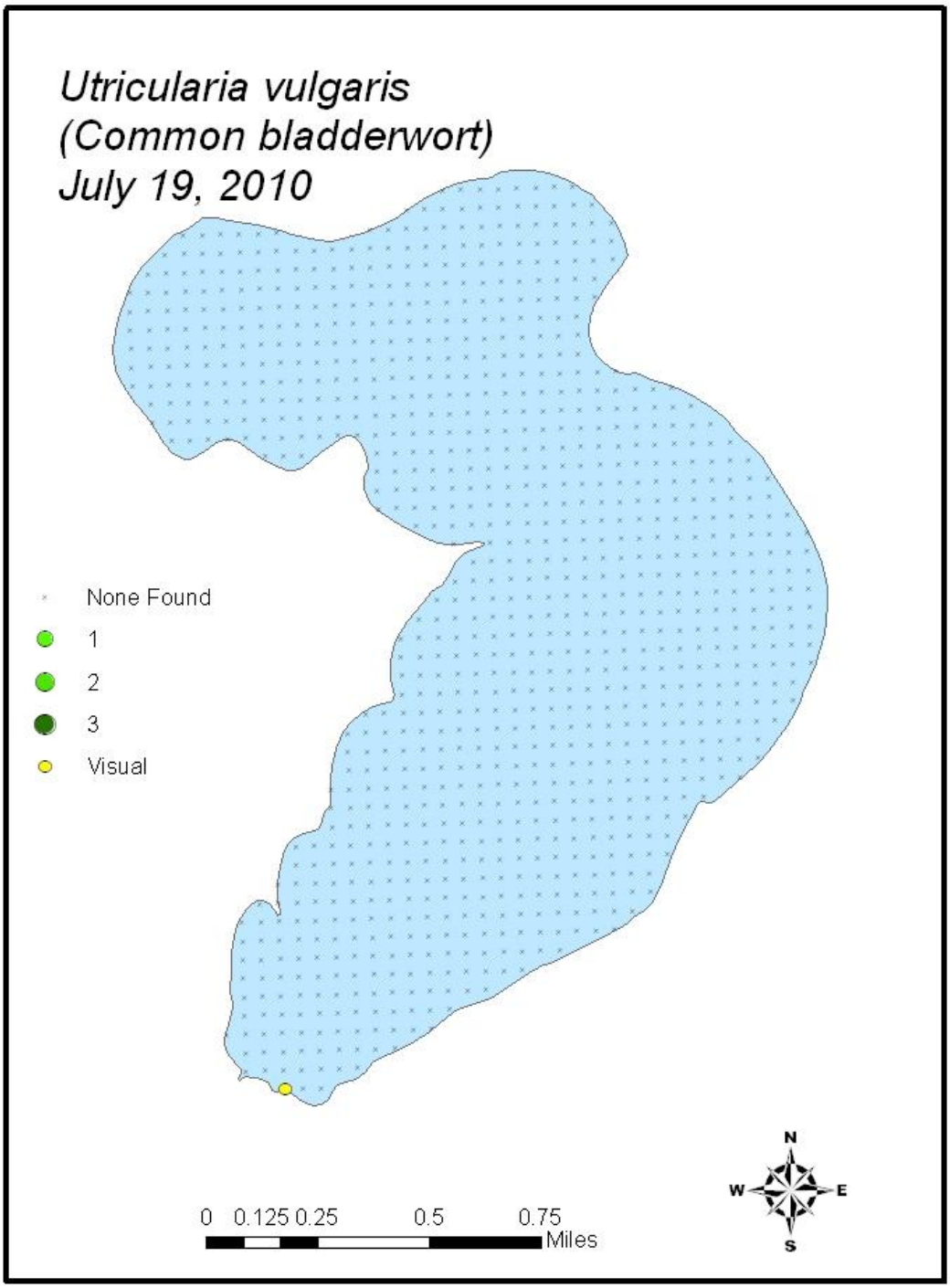

Sagittaria sp.
(Sagittaria)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S

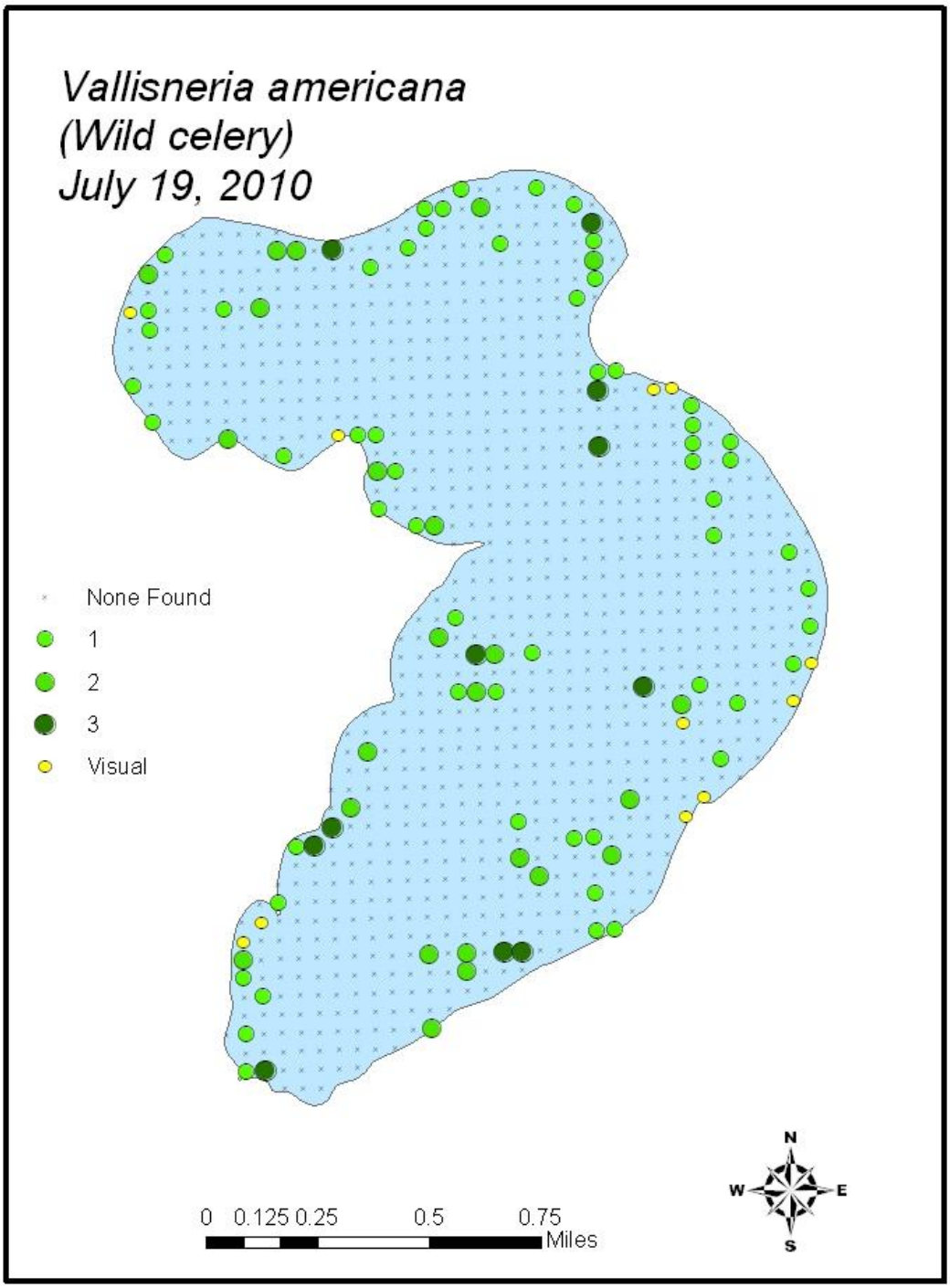

Nuphar varegata
(Spatterdock)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S


Spirodela polyrhiza
(Large Duckweed)
July 19, 2010
Rake Fullness Rating
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S


Typha angustifolia
(Narriow-leaved cattail)
July 19, 2010
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S


Stuckenia pectinata
(Sago pondweed)
July 19, 2010
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S


Utricularia vulgaris
(Common bladderwort)
July 19, 2010
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S


Vallisneria americana
(Wild celery)
July 19, 2010
None Found
1
2
3
Visual
0 0.125 0.25 0.5 0.75
Miles
N
W
E
S