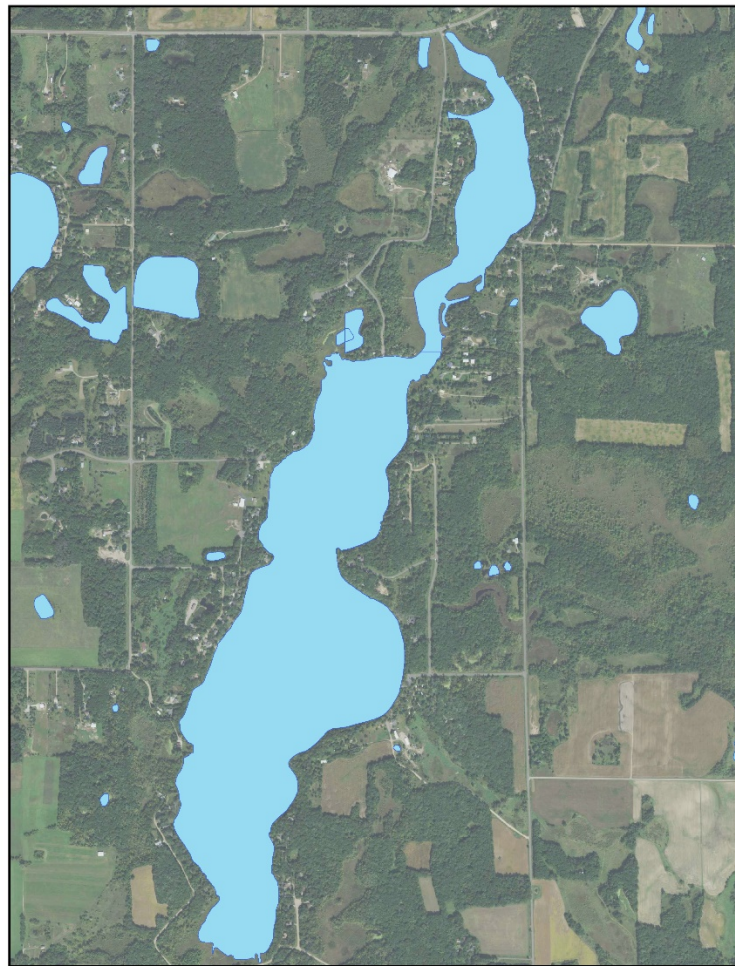

BLUE LAKE, ISANTI COUNTY: 2021 AQUATIC VEGETATION MANAGEMENT REPORT

Report by the Invasive Species Program- Division of Ecological and Water Resources
Minnesota Department of Natural Resources



Prepared by:

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Minnesota Department of Natural Resources
January 10, 2022

Project Details

Lake: Blue (DOW# 30010700)

Lake Surface Area: 296 acres

Littoral Area: 134 acres

County: Isanti County

Survey Type: Point-intercept

Date of Survey (most recent): May 21, 2021

Observer[s]: MN DNR Surveyors

Invasive Species Program (ISP) 2021: Emelia Hauck Jacobs and Chris Jurek

MN DNR Lake Habitat Program (LHP) 2013: Donna Perleberg and Stephanie Simon

MN DNR Fisheries (FSH) 2010: Deb Sewell and Nate Painovich

MN DNR (ISP) 2007: Wendy Crowell

MN DNR (ISP) 2006: Wendy Crowell and Mitch Travis

MN DNR (ISP) 2005: Wendy Crowell and Nick Proulx

MN DNR (ISP) 2004: Wendy Crowell and Rich Rezanka.

Report Updated: January 7, 2021

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Report Details

C. Jurek and E. Hauck Jacobs. 2021. Blue Lake, Isanti County: 2021 MN DNR Aquatic Vegetation Report. Minnesota Department of Natural Resources, Division of Ecological and Water Resources, Invasive Species Program, 1035 South Benton Drive, Sauk Rapids, MN 56379. 17 pp.

Summary

The most recent aquatic vegetation point-intercept survey of Blue Lake (DOW #30010700) occurred on May 21, 2021. Plants were present throughout the lake to a depth of 15 feet. Within the littoral zone (zone in lake from the 0-15 foot depth range), 47% of the points had native submersed taxa. The average number of native submersed taxa per sample point was 0.57. In total, ten native submersed taxa, one invasive taxa, and four floating-leaf taxa were observed during the 2021 survey.

Lake Description

Blue Lake is a 296- acre lake located 6.5 miles northeast of Zimmerman, MN in Isanti County. The lake has two invasive plant species: curly-leaf pondweed (*Potamogeton crispus*) and purple loosestrife (*Lythrum salicaria*). The maximum depth of water in Blue Lake is 31 feet, and 45.3% of the lake is classified as littoral (areas of water depth between 0 to 15 feet, where aquatic plants are most likely to grow). According to the water quality data collected by Isanti Soil and Water Conservation District, the mean total phosphorus concentration had averaged 41 µg/L between 2014 and 2019, while the mean growing season chlorophyll-a concentration averaged 20 µg/L and the mean Secchi depth averaged 1.7 meters between 2013 and 2019. Blue Lake is classified as a eutrophic lake, based on its Trophic State Index (TSI), which indicates a lake with high nutrients and excessive algae. More information regarding the water quality of Blue Lake can be found on the [Isanti County SWCD webpage](https://www.isantiswcd.org/studies-plans.html) at <https://www.isantiswcd.org/studies-plans.html> or [Blue Lake water quality](https://webapp.pca.state.mn.us/surface-water/station/30-0107-02-101) on the MPCA website <https://webapp.pca.state.mn.us/surface-water/station/30-0107-02-101>.

Management History

Based on a historic MN DNR Fisheries lake survey, curly- leaf pondweed was first documented in Blue Lake in 1973. Between the years of 2004 and 2008, management of curly-leaf pondweed was greater than 15% of the littoral area. Since 2010, invasive aquatic plant management in Blue Lake has continued with spot herbicide treatments of curly-leaf pondweed

ranging from 5.7 to 16.0 acres, with the most recent treatment in 2021 for 16.0 acres organized by the Blue Lake Improvement Association (Figure 1, Table 1).

Table 1 - Invasive Plant Management Summary. Characteristics and history of partial lake invasive plant treatments for Blue Lake, Isanti County (DOW#30010700). Total acres: 296, Littoral acres: 134, 15% of Littoral acres: 20.1). Abbreviations are as followed: curly-leaf pondweed (CLP). Note: Total acres permitted does not reflect the actual treatment or known acreage of the taxa in the lake.

Date	Target Species	Total Acres Permitted	Herbicide	Licensed Commercial Applicator
2003	CLP	18.0	Endothall	Lake Management
2004	CLP	45.0	Endothall	Lake Management
2005	CLP	45.0	Endothall	Lake Management
2006	CLP	45.0	Endothall	Lake Management
2007	CLP	45.0	Endothall	Lake Management
2008	CLP	45.0	Endothall	Lake Management
2009	CLP	11.0*	Endothall	Lake Management
2010	CLP	11.0	Endothall	Lake Management
2011	CLP	10.7	Endothall	Lake Management
2012	CLP	15.8	Endothall	Lake Management
2013	CLP	15.6	Endothall	Lake Management
2014	CLP	15.6	Endothall	Lake Management
2015	CLP	15.6	Endothall	NA
2016	CLP	13.1	Endothall	Lake Restoration
2017	CLP	5.7	Endothall	Clarke
2018	CLP	9.0	Endothall	Jacobson Environmental
2018	CLP	12.0	Mechanical	Jacobson Environmental
2019	CLP	15.8	Endothall	Lake Management
2020	CLP	16.0	Endothall	Lake Management
2021	CLP	16.0	Diquat	Lake Management

*Records indicate no treatment in 2009.

Survey Objectives

Point-intercept surveys were used to assess the distribution of aquatic plants in Blue Lake. The primary purpose for this type of survey is to 1) develop baseline knowledge of the current plant community in a lake, and over time, 2) compare year to year plant variation (in plant presence and spatial location). Moreover, this survey will help the DNR and our partners to monitor native plant communities and evaluate possible responses to invasive aquatic plant management via herbicide control. It is important to note that distributions of aquatic plants may vary from year to year due to effects such as differences in weather, as well as the effects from management efforts.

Survey Methods

In 2021, MN DNR surveyors used a point-intercept survey method developed by John Madsen in “Aquatic Plant Control Technical Note MI-02, 1999”. Sampling points were placed 75 meters apart using a Geographic Information System. A total of 160 points within 15 feet were established on a grid and all were sampled (Figure 1). Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point. Frequencies of occurrence percentages (i.e., how often a plant species was sampled in the lake) were calculated based on the littoral zone.

Survey Observations

In 2021, submerged aquatic plants in Blue Lake ranged in water depths between 1 to 15 feet, while most plants grew in depths between 1 and 9 feet. In the littoral zone, 47% of the surveyed points had submersed native vegetation (Table 2). In total, we found ten submersed taxa and four floating-leaf species during the survey (Table 3). Coontail (*Ceratophyllum demersum*) was the most commonly occurring plant at 40% of all sites in the littoral zone (Figure 2), followed by star duckweed (*Lemna trisulca*, Figure 3), and white waterlily (*Nymphaea odorata*, Figure 4). Curly- leaf pondweed was the only invasive species found during the survey with a frequency of occurrence of 10% (Figure 5). Blue Lake has a low diversity of aquatic plants with an average of 0.6 species per a sampling site (Figure 6).

Comparison among years

Over time, the diversity of aquatic plants in Blue Lake has declined. According to point-intercept surveys, Canadian waterweed (*Elodea Canadensis*), water star-grass (*Heteranthera dubia*), northern watermilfoil (*Myriophyllum sibiricum*) and northern naiad (*Najas flexilis*) were more prevalent in the mid- 2000's, but have shown recent declines during the last two decades.

Additional historic aquatic plant data collected by MN DNR Fisheries can be found in the Appendix (Tables A- 1 and A-2), as well as, a more comprehensive plant species list collected by the [Minnesota Biological Survey](#) located on our website:

https://files.dnr.state.mn.us/natural_resources/water/lakes/aquatic_plant_reports/30010700_1850.pdf.

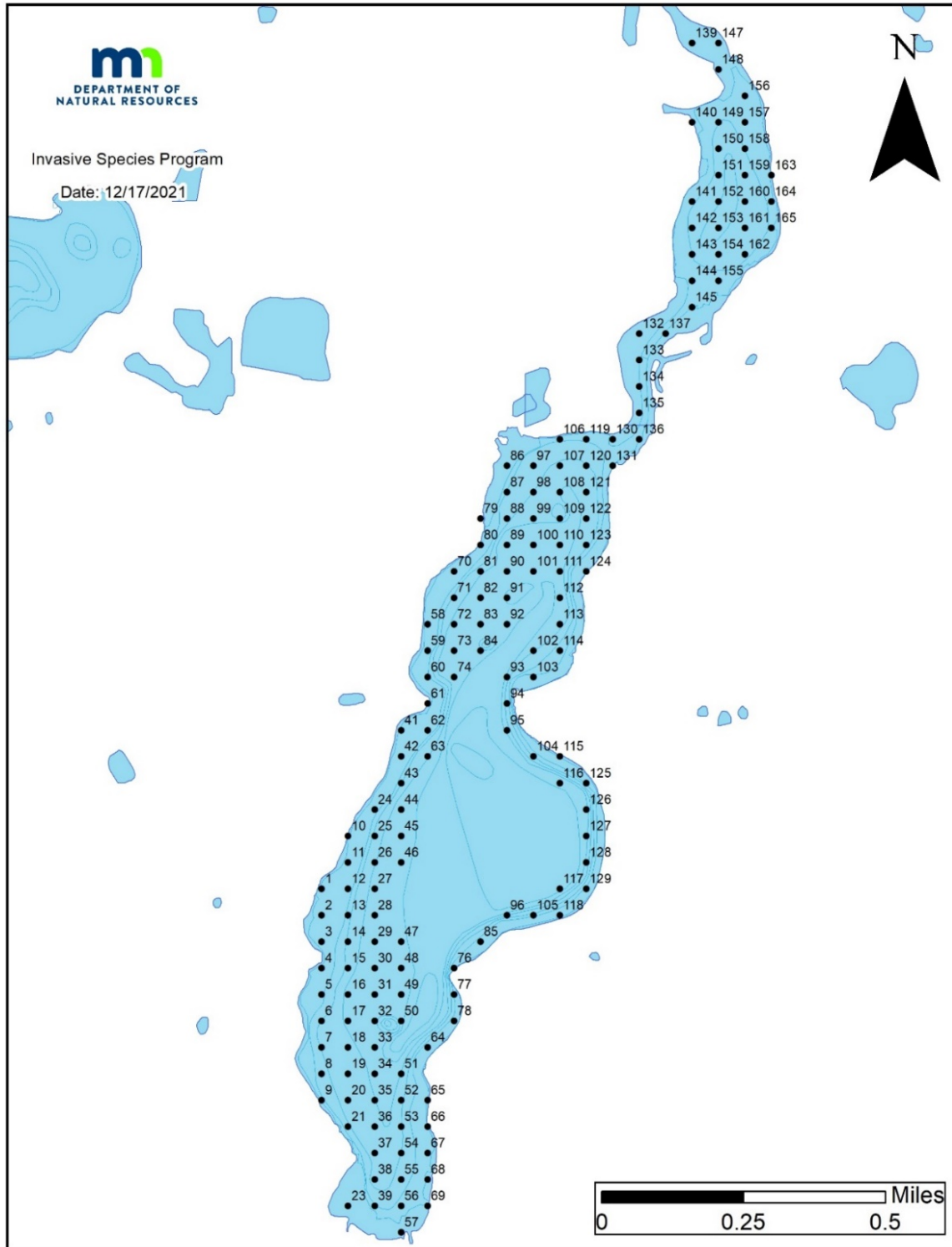


Figure 1 – Point-intercept Survey Grid. Point-intercept survey grid for Blue Lake, Isanti County (DOW#30010700). Point-intercept survey included 160 points, 75 meters apart.

Table 2 - Point-intercept Metrics. Summary of point-intercept metrics for Blue Lake, Isanti County (DOW#30010700). Shaded values were calculated from littoral depth range (0-15 feet).

Metric	2013	2021
Surveyor	MN DNR	MN DNR
Total # Points Sampled	182	160
Depth Range of Rooted Veg (ft.)	0.25 - 15	1 - 15
# Point in Max Depth Range	100	89
# Points in Littoral (0-15 feet)	152	134
% Points w/ Submersed Native Taxa	67	47
Mean Submersed Native Taxa/ Point	1.0	0.6
# Submersed Native Taxa	12	10
# Submersed Non-Native Taxa	1	1
% Points w/ Submersed Non- native Taxa	8	10

Table 3 - Plant Frequency of Occurrence. Percent frequency of occurrence for observed plant species within the littoral zone (0-15 feet) in Blue Lake, Isanti County (DOW#30010700).

Taxonomic Name	Common Name	MAY 2004	SEPT 2004	MAY 2005	MAY 2006	AUG 2006	AUG 2007	APRIL 2010	JULY 2013	MAY 2021
SUBMERSED NON-NATIVE										
<i>Potamogeton crispus</i>	Curly-leaf pondweed	32	25	40	43	12	13	17	8	10
SUBMERSED NATIVE										
<i>Bidens beckii</i>	Marigold	0	0	0	0	0	0	0	0	2
<i>Ceratophyllum demersum</i>	Coontail	29	76	42	56	88	52	59	57	40
<i>Chara</i> sp.	Muskgrass	0	2	3	3	0	0	1	0	0
<i>Elodea canadensis</i>	Canadian waterweed	1	9	11	14	13	2	1	0	<1
<i>Heteranthera dubia</i>	Water star-grass	7	34	12	2	13	3	8	5	<1
<i>Myriophyllum sibiricum</i>	Northern watermilfoil	0	12	6	11	25	0	1	2	<1
<i>Najas flexilis</i>	Northern naiad	0	22	0	0	14	0	0	2	0
<i>Potamogeton freizii</i>	Freis' pondweed	0	0	0	0	0	0	0	<1	0
<i>Potamogeton praelongus</i>	Whitestem pondweed	0	0	0	1	0	0	0	1	<1
<i>Potamogeton richardsonii</i>	Clasping-leaved pondweed	2	13	0	0	4	0	1	3	<1
<i>Potamogeton strictifolius</i>		0	1	0	0	0	0	0	0	0
<i>Potamogeton</i> sp.	Narrowleaf pondweed	0	0	0	0	2	0	0	21	7
<i>Stuckenia pectinata</i>	Sago pondweed	0	3	0	0	5	0	0	1	2
<i>Potamogeton pusillus</i>	Small pondweed	0	0	0	1	0	0	0	0	0
<i>Potamogeton strictifolius</i>	Straight-leaved pondweed	0	0	0	1	0	0	0	0	0
<i>Potamogeton zosteriformis</i>	Flat-stemmed pondweed	0	4	0	2	7	0	0	7	4
<i>Ranunculus</i> sp.	Buttercup species	0	0	0	0	0	0	0	0	<1

Taxonomic Name	Common Name	MAY 2004	SEPT 2004	MAY 2005	MAY 2006	AUG 2006	AUG 2007	APRIL 2010	JULY 2013	MAY 2021
<i>Utricularia vulgaris</i>	Greater bladderwort	0	2	0	0	2	0	0	1	0
<i>Valisneria americana</i>	Water celery	0	18	0	0	20	0	0	4	0
FLOATING LEAF										
<i>Lemna minor</i>	Minor duckweed	2	21	0	5	25	5	0	12	<1
<i>Spirodela polyrhiza</i>	Greater duckweed	0	5	0	0	2	0	0	18	0
<i>Lemna trisulca</i>	Star duckweed	9	32	32	27	18	7	17	29	27
<i>Nymphaea odorata</i>	White waterlily	6	27	13	21	24	3	17	11	19
<i>Nuphar variegata</i>	Yellow waterlily	1	4	0	0	3	0	0	5	3
<i>Wolffia</i> sp.	Watermeal species	0	19	0	0	23	0	0	15	0

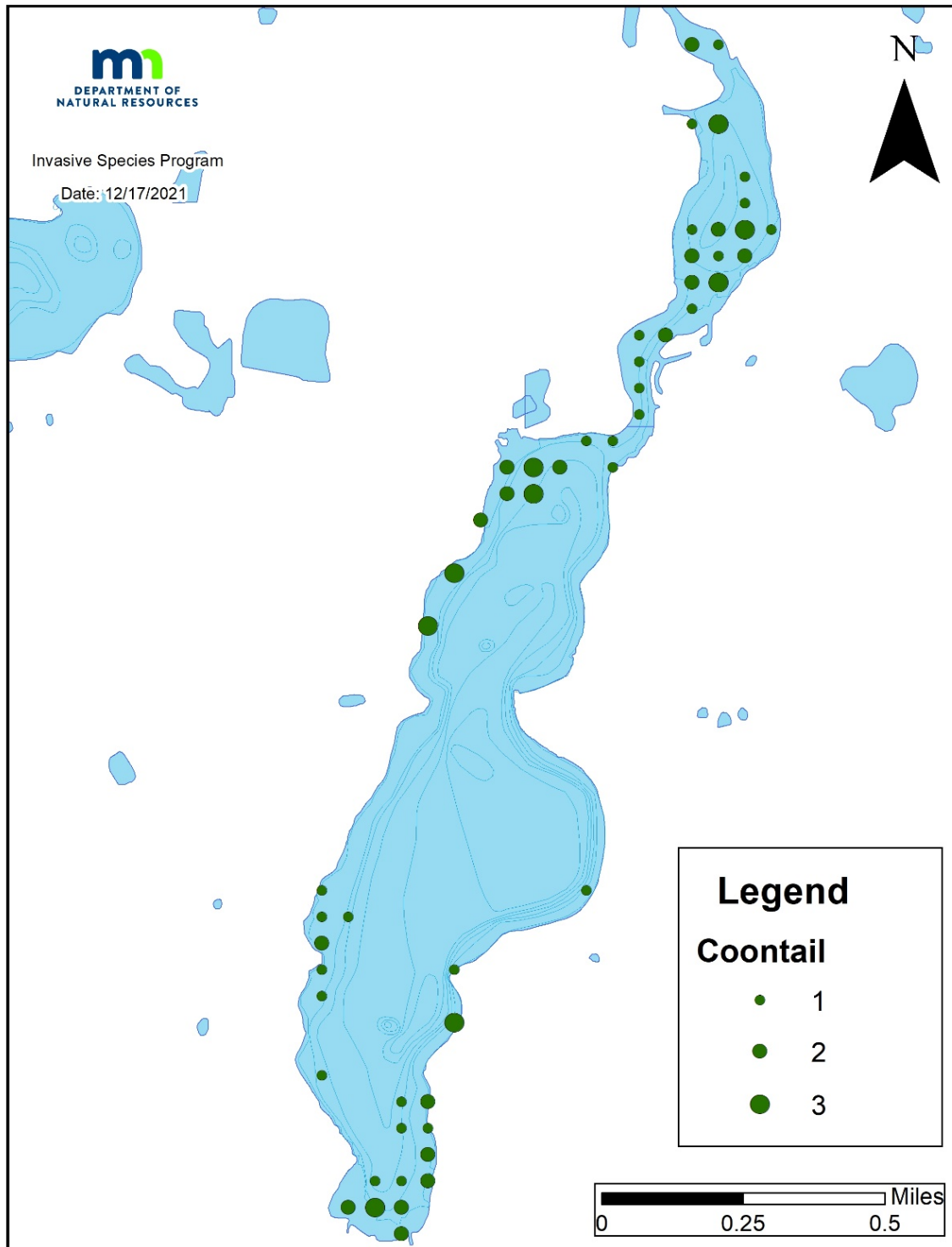


Figure 2 – 2021 Coontail Distribution. Plant distribution from the 2021 point-intercept survey for Coontail in Blue Lake, Isanti County (DOW#30010700). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.

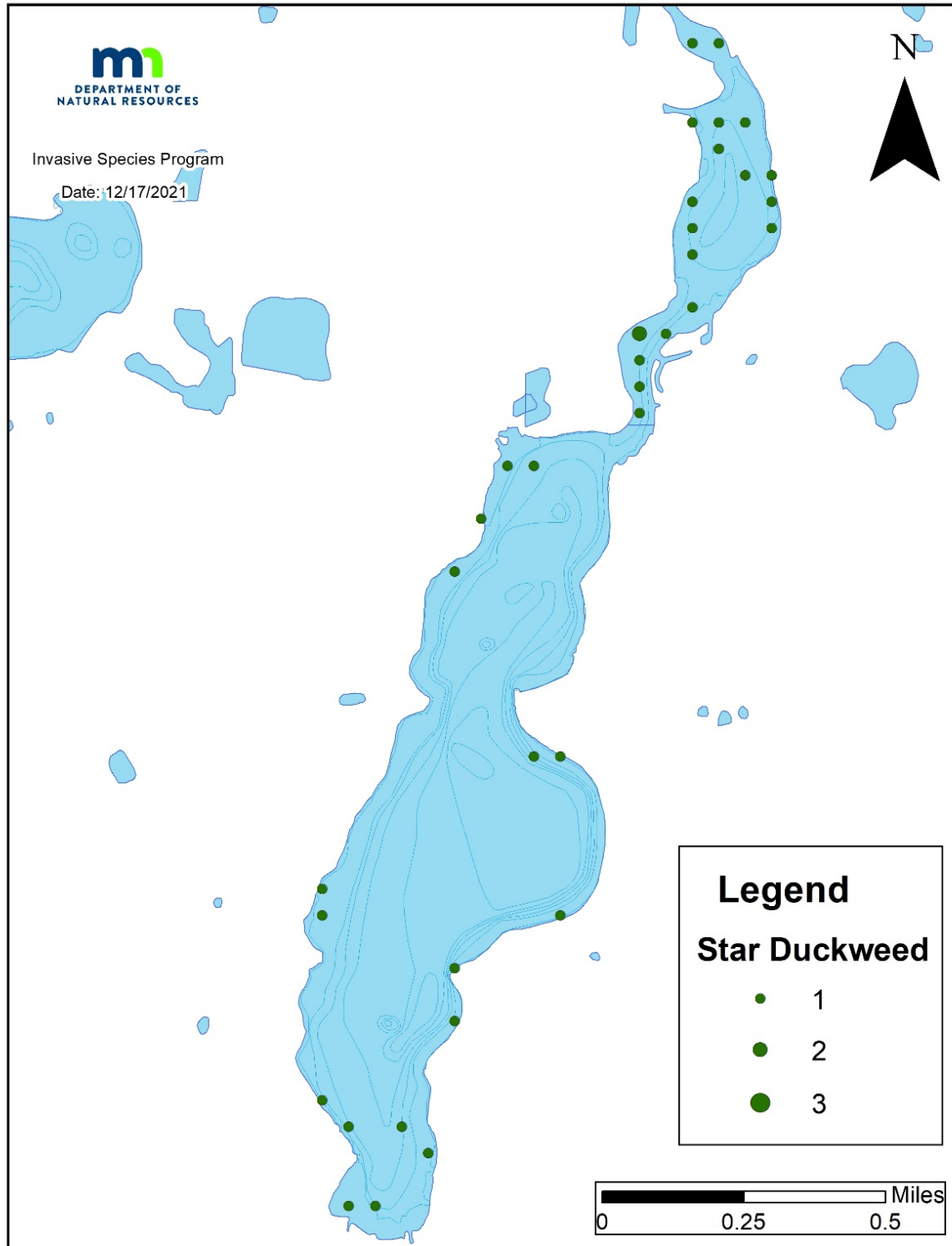


Figure 3 – 2021 Star duckweed Distribution. Plant distribution from the 2021 point-intercept survey for Star duckweed in Blue Lake, Isanti County (DOW#30010700). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.

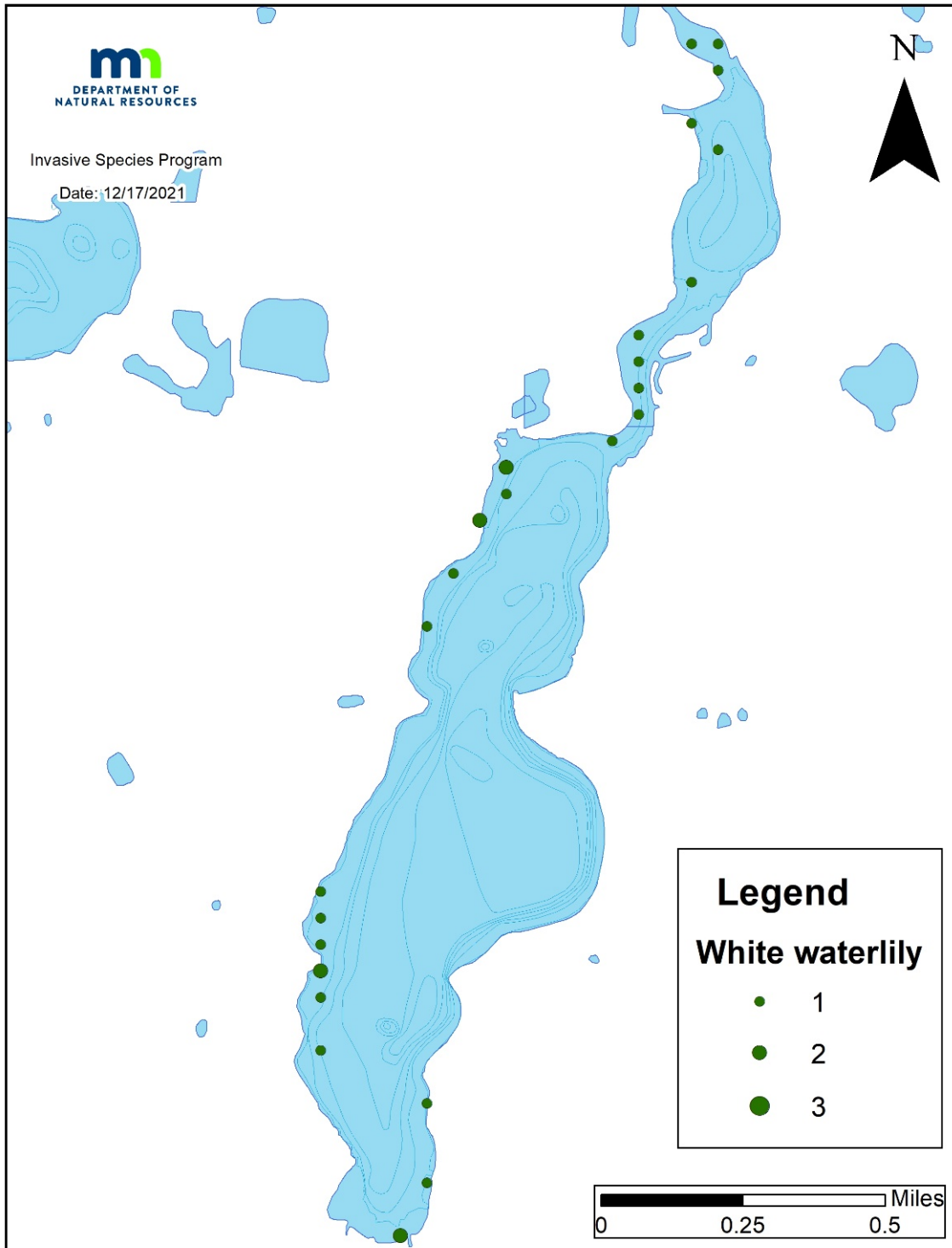


Figure 4 – 2021 White waterlily Distribution. Plant distribution from the 2021 point-intercept survey for White waterlily in Blue Lake, Isanti County (DOW#30010700). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.

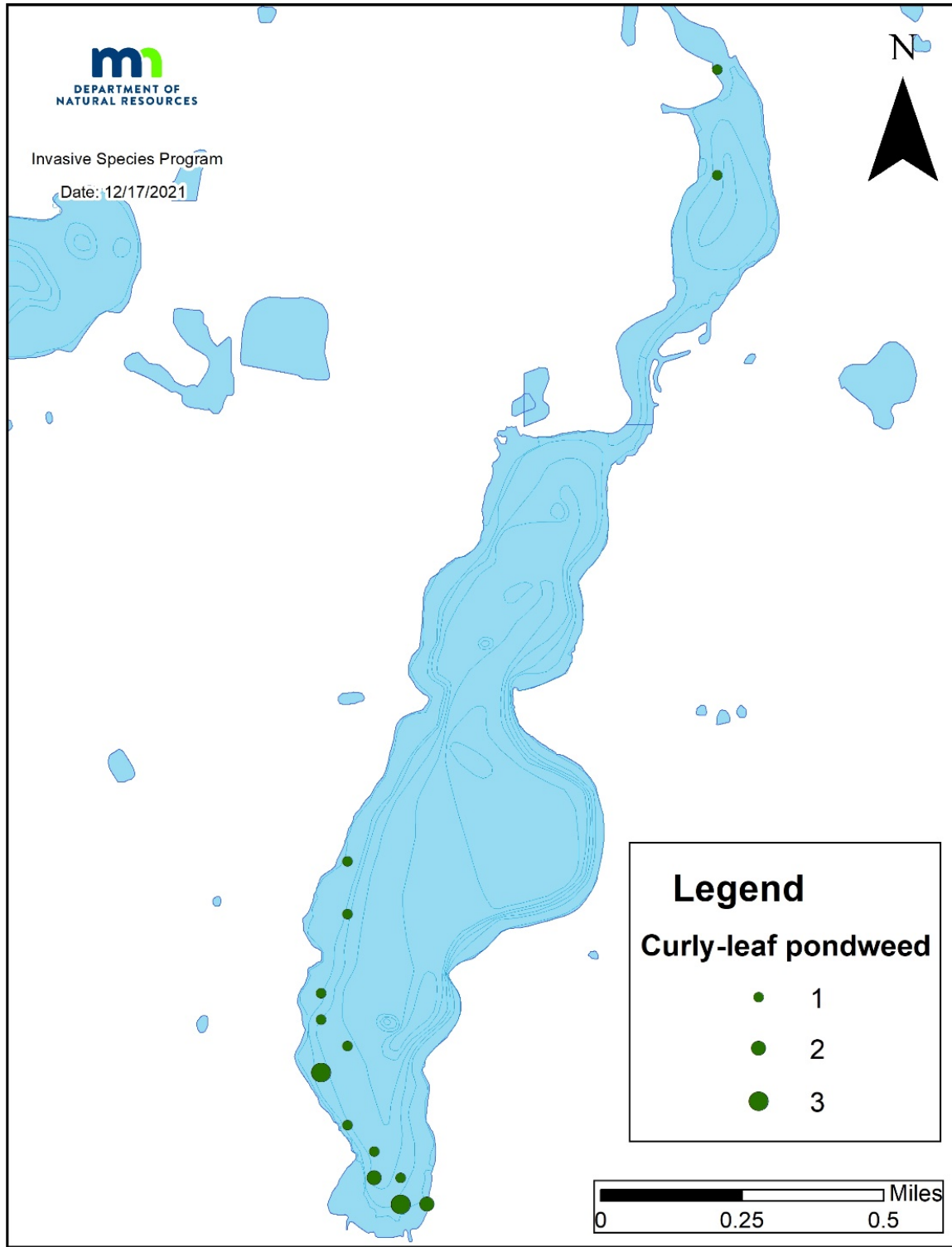


Figure 5 – 2021 Curly-leaf pondweed Distribution. Plant distribution from the 2021 point-intercept survey for Curly-leaf pondweed in Blue Lake, Isanti County (DOW#30010700). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.

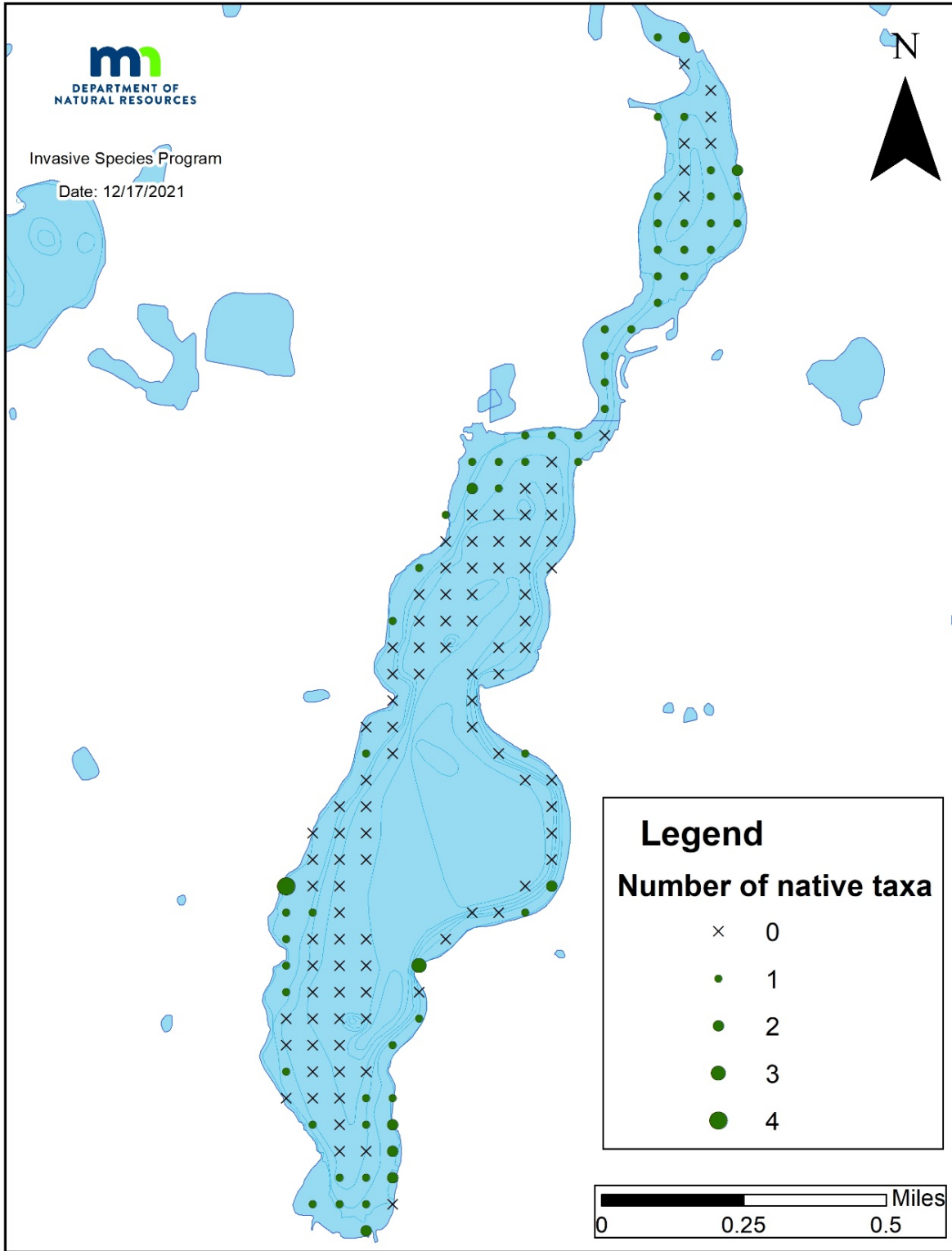


Figure 6 – Number of species per site. Maps of number of species from the 2021 point-intercept survey in Blue Lake, Isanti County (DOW#30010700).

Appendix A

Table A- 1 - Aquatic Vegetation Found in Blue Lake during Fisheries Lake Surveys.

Common Name	Scientific Name	Family	04	94	84	83	73	68	49	46
Water Shield	<i>Brasenia schreberi</i>	Nymphaeaceae			✓		✓			
Sedge	<i>Carex spp</i>	Cyperaceae	✓	✓	✓		✓	✓		
Coontail	<i>Ceratophyllum demersum</i>	Ceratophyllaceae	✓	✓	✓	✓	✓	✓	✓	✓
Muskgrass	<i>Chara vulgaris</i>	Characeae		✓						✓
Canada Waterweed	<i>Elodea canadensis</i>	Hydrocharitaceae	✓	✓		✓		✓	✓	✓
Horsetail	<i>Equisetum spp.</i>	Equisetaceae			✓		✓			
Marestail	<i>Hippuris vulgaris</i>	Hippuridaceae		✓						
Lesser Duckweed	<i>Lemna minor</i>	Lemnaceae	✓	✓						
Star Duckweed	<i>Lemna trisulca</i>	Lemnaceae	✓	✓						
Purple Loosestrife	<i>Lythrum salicaria</i>	Lythraceae	✓	✓						
Bushy Pondweed	<i>Najas flexilis</i>	Najadaceae	✓							
Northern Watermilfoil	<i>Myriophyllum sibiricum</i>	Haloragaceae	✓	✓	✓	✓	✓	✓	✓	✓
Little Yellow Water Lily	<i>Nuphar luteum pumilum</i>	Nymphaeaceae		✓						
Yellow Water Lily	<i>Nuphar variegatum</i>	Nymphaeaceae	✓	✓	✓		✓	✓	✓	✓
Little White Water Lily	<i>Nymphaea liebergii</i>	Nymphaeaceae						✓		
White Water Lily	<i>Nymphaea tuberosa</i>	Nymphaeaceae	✓	✓	✓	✓	✓	✓	✓	✓
Curlyleaf Pondweed	<i>Potamogeton crispus</i>	Potamogetonaceae	✓	✓	✓	✓	✓			
Nuttall's Pondweed	<i>Potamogeton epihydrus</i>	Potamogetonaceae		✓	✓		✓			
Claspingleaf Pondweed	<i>Potamogeton richardsonii</i>	Potamogetonaceae	✓	✓						
Narrowleaf Pondweed	<i>Potamogeton spp</i>	Potamogetonaceae						✓		✓
Flatstem Pondweed	<i>Potamogeton zosterformis</i>	Potamogetonaceae		✓	✓	✓	✓	✓		
Duck Potato	<i>Sagittaria latifolia</i>	Alismataceae	✓		✓		✓			
Arrowhead	<i>Sagittaria spp.</i>	Alismataceae		✓						
Hardstem Bulrush	<i>Scirpus acutus</i>	Cyperaceae			✓	✓	✓		✓	✓
Burreed	<i>Sparganium spp</i>	Sparganiceae						✓		
Greater Duckweed	<i>Spirodela polyrhiza</i>	Lemnaceae				✓				
Sago Pondweed	<i>Stuckenia pectinatus</i>	Potamogetonaceae	✓	✓	✓		✓	✓	✓	
Common Cattail	<i>Typha latifolia</i>	Typhaceae	✓	✓	✓	✓		✓	✓	✓
Wild Celery	<i>Valisneria americana</i>	Hydrocharitaceae	✓							
Water Meal	<i>Wolffia spp.</i>	Lemnaceae	✓							

Table A- 2 - Additional data for Blue Lake fisheries surveys.

Metric	04	94	84	83	73	68	49	46
Depth of Submerged Plant Growth (feet)	9.1	10	8	NA	8	12	NA	NA
Month of Survey	Aug	Aug	Aug	May	Aug	Jul	Aug	Oct

Source of Table: Appendix 1 found in the Blue Lake Aquatic Vegetation Management Plan 2005 to 2010 (Ed Feilder, MN DNR 2005)

Literature Cited

Crow, G.E. and C.B. Hellquist. 2000. Aquatic and wetland plants of Northeastern North America. 2 volumes. The University of Wisconsin Press.

Madsen, J. 1999. Point intercept and line intercept methods for aquatic macrophytes management. APCRP Technical Notes Collection (TN APCRP-M1-02). U.S. Army Engineer Research and Development Center, Vicksburg, MS.