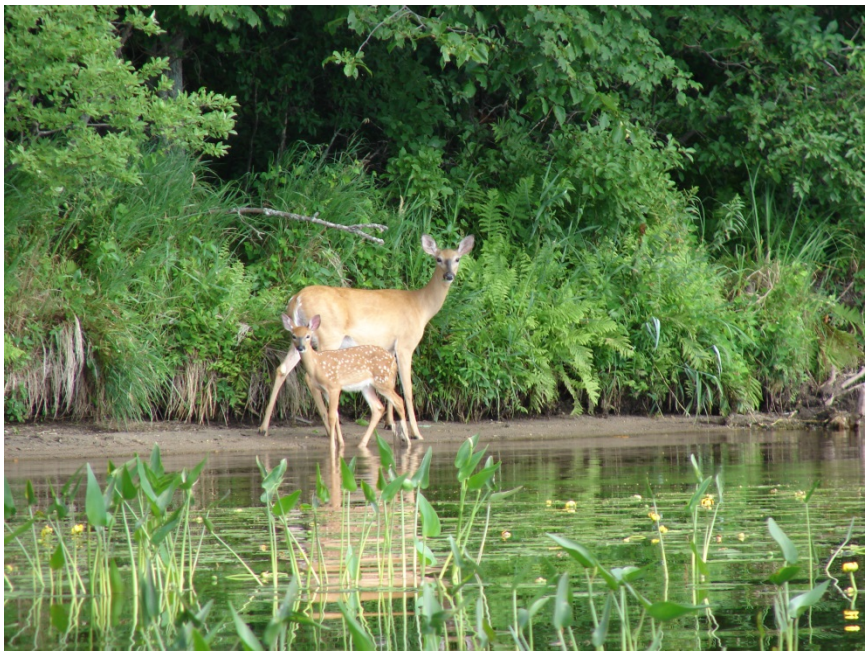
Aquatic Vegetation of Round Lake

August and September, 2013

Round Lake, ID# 01-0204-00

Aitkin County, Minnesota

Pickerelweed and waterlilies along the west shore of Round Lake, July 2013



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Contents

SUMMARY

Aquatic and shoreline vegetation surveys of Round Lake (01-0204-00), Aitkin County, Minnesota, were conducted in August and September of 2013. Three lake habitat zones were assessed: the shore, the nearshore, and the in-lake plant communities. Surveys included characterization of shore habitat and nearshore plant communities at 40 sites, delineation of all emergent and floating-leaf plant stands, and quantitative assessments of submerged plant communities at 392 sample stations within the shore to 25 feet depth.

The majority (75%) of Round Lake shore sites were classified as developed. On a scale of 0 to 100, the mean lakewide shore habitat score was 68.4, indicating that less than half of the shore habitat has been lost. Most developed sites had few or no remaining trees, shrubs and/or natural ground cover compared to undeveloped sites where these plants were present along the entire shore frontage.

Aquatic plants were evenly distributed around the perimeter of Round Lake and 71% of all in-lake sample sites contained vegetation. Thirty-eight aquatic plant taxa were found including eight emergent, six floating-leaved, two free-floating and 22 submerged taxa.

Emergent and floating-leaved plants occurred in shallow water (0-5 feet deep) and occupied 41 acres, or 26%, of that depth zone. Approximately 36 acres of bulrush (*Schoenoplectus* sp.), and 5 acres of floating-leaf stands dominated by waterlilies (*Nuphar variegata* and *Nymphaea odorata*) were delineated. Non-native plants found along shore included reed canary grass (*Phalaris* sp.), and purple loosestrife (*Lythrum salicaria*).

Submerged plants were found to a maximum depth of 25 feet but were most frequent in depths from 11 to 15 feet, where 96% of the sites contained at least one submerged taxon. Within the shore to 25 feet zone, the most common submerged plants were native: muskgrass (*Chara* sp.) (57% occurrence), stonewort (*Nitella* sp.) (4%), all pondweeds (*Potamogeton* sp.) (25%), and northern watermilfoil (*Myriophyllum sibiricum*) (8%). One non-native aquatic plant species; curly-leaf pondweed (*Potamogeton crispus*) was found growing in the lake but it occurred in less than 3% of sites.

Nearshore sites contained highest diversity and sites of high richness (6 or more taxa per site) often occurred in depths less than 10 feet and included sites where emergent and submerged plants co-occurred. All of the plant taxa found in the lake occurred in this shallow zone and 20 were only found in this depth zone.

The abundance and diversity of submerged plants along with the stands of emergent and floating-leaf plants help maintain high water clarity and provide critical habitat for fish and wildlife in this lake.

INTRODUCTION

LAKE LOCATION AND CHARACTERISTICS

Round Lake is in the Laurentian Mixed Forest Ecosystem Province of north central Minnesota, about two miles north of Garrison in Aitkin County (Map 1). This region of the state is characterized by broad areas of conifer forest, mixed hardwood and conifer forests, and conifer bogs and swamps with numerous glacial lakes. The lake lies within the north half of the Rum River watershed. It is a flow-through lake that receives inflow from an unnamed creek from the northeast. The lake outflows from the southwest to Borden Lake where Garrison Creek flows west into the Rum River which continues south to join the Mississippi River (Map 1).

Round Lake has a surface area of 733 acres, is the 11th largest lake in Aitkin County and the 6th largest lake in the watershed. The lake has an irregular outline with several islands and a total of 5 miles of shoreline. Large areas of the shoreline are developed with residential homes. The State of Minnesota maintains a public access on the southwest side of the lake and owns the west shoreline (Map 2).

Round Lake has a maximum depth of 125 feet and about 44% of the lake is 15 feet or less in depth (Map 2). The lake is a hard water lake and is characterized as mesotrophic, based on phosphorus (nutrients), chlorophyll-a (algae concentration) and Secchi depth (transparency). The 2004 to 2013 mean summer water clarity was 13 feet (MPCA 2014). Based on Secchi disk measurements alone, aquatic plants have the potential to reach depths of about 20 feet in the lake. Other factors that may influence the depth of plant growth include substrate, wind fetch and the types of plants present.

HISTORICAL AQUATIC PLANT COMMUNITY

Six previous aquatic plant surveys of Round Lake were conducted between 1941 and 1998 (MNDNR Lake files). These surveys varied in methods; the earliest surveys focused on the commonly occurring in-lake plants while the 1995 survey included a detailed listing of any plant taxa encountered by an experienced botanist. The areas of the lake surveyed and the surveyor's botanical experience influence the number and types of plants detected in each survey. Data from these surveys were compiled and compared to recent data collected in 2013.

SURVEY OBJECTIVES

The 2013 surveys assessed three habitat zones of Round Lake: the shore, the near-shore area, and the lakewide plant community. Specific objectives included:

1. Estimate the remaining shore habitat on a scale of 0 to 100.
2. Describe the types and general distribution of plants in the lake.
3. Describe and map the emergent and floating-leaf plant stands.
4. Estimate the abundance of aquatic plants by estimating the frequency of occurrence of all plants and each taxon within the vegetated zone.

METHODS

In 2013, four different methods were used to survey the different plant and habitat zones of Round Lake.

SHORE HABITAT ASSESSMENT

The shoreline habitat of Round Lake was assessed using the "Score the Shore" method (Perleberg et al. 2015). Survey sites were established every 200 meters along the shoreline and corresponded to the nearshore aquatic plant survey sites (Map 3). Surveys were conducted on May 24th by boat and at each site surveyors visually assessed 100 feet of shoreline. Habitat features were assessed in the Shoreland, Shoreline and Aquatic zones and included tree cover, shrub cover, natural ground cover, overhanging vegetation, and woody habitat. Disturbance to habitat was assessed by noting the presence of artificial openings in aquatic plant stands and the presence of human structures such as docks. Sites with a high percentage or tree, shrub and natural ground cover and with little or no human disturbance receive higher scores than sites where vegetation is lacking.

MAPPING FLOATING-LEAF AND EMERGENT VEGETATION STANDS

Mapping focused on emergent and floating-leaf plant beds that were at least 0.01 acres, or about 400 square feet, in size (generally larger than the surface area covered by a pontoon boat). Field surveys were conducted August 26, 2013. Surveyors motored or waded around the perimeter of each bed and recorded a track with a handheld Geographic Positioning System (GPS) unit. Field data were uploaded to a computer and a Geographic Information System (GIS) software program was used to estimate acreage. Plant beds were classified by the dominant taxa (Table 1).

Table 1. Plant stands

Class	Dominant Species
Rushes	Bulrush (*Schoenoplectus*) or Spikerush (*Eleocharis*)
Rushes and other	Bulrush (*Schoenoplectus*) or Spikerush (*Eleocharis*) and other common taxa
Waterlilies	White waterlily (*Nymphaea*) or Yellow waterlily (*Nuphar*)
Waterlilies and other	White waterlily (*Nymphaea*) or Yellow waterlily (*Nuphar*) and other common taxa
Cattail	*Typha* spp.
Other emergent	Ex. arrowhead (*Sagittaria*), giant cane (*Phragmites*)
Other floating	Ex. Watershield (*Brasenia*), floating-leaf pondweed (*Potamogeton natans*)

2013 LAKEWIDE VEGETATION SURVEY (POINT-INTERCEPT)

A lakewide vegetation survey was conducted on July 3, 17-18, 25, 29, 2013 using a point-intercept survey method (Perleberg et al. 2015, Madsen 1999). Survey waypoints were created using a GIS computer program and downloaded into a handheld GPS unit. Sampling was stratified by water depth and an effort was made to sample 50 to 100 sites in each stratum (Table 2). Survey points were placed in a grid pattern and point spacing varied between strata. In the 0 to 10 feet stratum, points were spaced 65 meters apart; in deeper strata points were spaced 50 meters (213 feet) (Map 3). The depth contours from the 1944 survey were used to

determine approximate depth strata locations; in 2013 the water depth at any given site may have been different than what is shown on that historical map.

The survey was conducted by boat and a GPS unit was used to navigate to each sample point. One side of the boat was designated as the sampling area. At each site, water depth was recorded in one-foot increments using a measured stick in water depths less than seven feet and an electronic depth finder in deeper water. Preliminary sampling detected no vegetation in water depths greater than 25 feet. Surveyors attempted to sample all sites in water depths less than 26 feet for a total of 392 samples in that zone (Table 2).

Table 2. Survey effort by depth

Water depth (feet)	Number of survey sites
0 to 5	159
6 to 10	170
11 to 15	23
16 to 20	14
21 to 25	26
Total	392

SUBSTRATE SAMPLING

At each sample site where water depths were seven feet and less, surveyors described the bottom substrate using standard substrate classes (Table 3). Surveyors evaluated substrate by tapping a pole into the lake bottom; soft substrate could usually be brought to the surface on the pole or sampling rake for evaluation. If this method was not feasible, substrate was evaluated by visual observation of the lake bottom. If more than one substrate type was found, surveyors recorded the most common type. Surveyors attempted to record a substrate description around the entire perimeter of the lake. If a sample site occurred near shore but in water depths greater than seven feet, surveyors collected depth and vegetation data and then motored into shallower water and recorded the substrate type adjacent to the actual survey point; this information was used for mapping purposes.

Table 3. Substrate classes

muck	decomposed organic material
marl	calcareous material
silt	fine material with little grittiness
sand	diameter < 1/8 inch
gravel	diameter 1/8 - 3 inches
rubble	diameter 3 - 10 inches
boulder	diameter > 10 inches

PLANT SAMPLING

Surveyors recorded all plant taxa found at each sample site (approximately a one square meter sample site at the pre-designated side of the boat). A double-headed, weighted garden rake, attached to a rope was used to survey vegetation not visible from the water surface (Photo 1). Any additional plant taxa found outside of sample sites were recorded as “present” in the lake but these data were not used in frequency of occurrence calculations. Plant identification followed Crow and Hellquist (2000) and Flora of North America (1993+) and nomenclature followed MnTaxa (2013). Frequency of occurrence was calculated for the entire vegetated zone (0-25 feet) and data were also separated into five feet increment depth zones for analysis (Table 2). Frequency estimates were also calculated for individual taxa and selected groups of plants.

Photo 1. Survey rake.

2013 NEAR-SHORE PLANT COMMUNITY ASSESSMENTS (PLOTS)

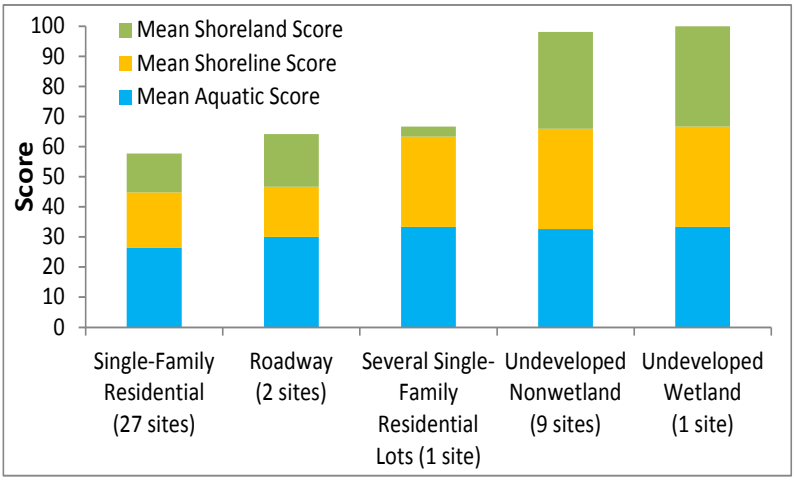
Because the point-intercept method may under sample near-shore plant zone, additional surveys were conducted at the shore-water interface (or near-shore) zone of Round Lake. Survey waypoints were created using a GIS computer program. Sample sites were spaced 200 meters apart along the shoreline for a total of 40 sites (Map 3). At each site, surveyors sampled a plot area measuring approximately 5 meters along the shore and extending 5 meters lakeward. Surveyors waded through the plot and recorded all plant taxa observed; view tubes were used to aid in visual observation of plants. Water depth at the center of the plot was recorded and substrate was described using classes in Table 3.

Results and Discussion

SHORE HABITAT

Shore habitat was assessed at 40 sites and the mean habitat score was 68.4. The score is considered low on the overall scale from 0 to 100. The majority of the sites (75%) were classified as developed and included 27 sites with a single residential home, one site with more than one residential home, and two roadway sites. Developed sites primarily occurred on the north and south shores and had a mean score of 62.8. There were 10 undeveloped sites which received a mean score of 99.0. Developed sites scored lower than undeveloped sites, particularly in the Shoreline and Shoreland Zones (Figure 1) where trees, shrubs and/or natural ground cover had been removed.

Figure 1. Mean habitat score for each habitat zone.

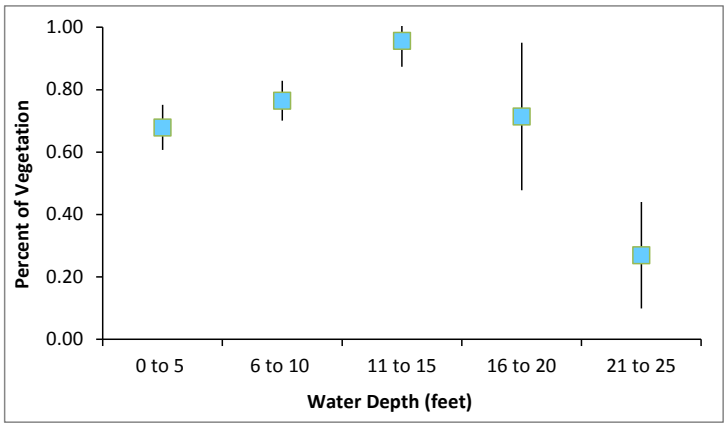


IN-LAKE HABITAT

The near-shore substrates of Round Lake were primarily sand with areas of gravel, rubble and boulder (Map 4). Softer substrates of marl, silt or muck where found in areas such as small protected bays.

Aquatic Plants were evenly distributed around the perimeter of the lake and were found to a depth

Figure 2. Percent of vegetated sites vs. water depth.



of 25 feet. Within the 0 to 25 feet depth zone, vegetation occurred in 69% of all sampled sites (Map 5). The 11 to 15 feet depth zone contained the most plants with 96% of sites vegetated (Figure 2). Plant occurrence declined with increasing water depth and in depths of 21 to 25 feet, 27% of the sites were vegetated. Plant growth was also lower in very shallow water where only 50% of the nearshore plots contained vegetation.

AQUATIC PLANT DIVERSITY

A total of 38 aquatic and wetland plants were observed in Round Lake in 2013 including nine emergent, six floating-leaved, 22 submerged plants and two free-floating (Table 4). Nine of these taxa (water arum (*Calla palustris*), sedge (*Carex* sp.), narrow-leaf cattail (*Typha angustifolia*), floating-leaf burreed (*Sparganium* sp.), southern naiad (*Najas guadalupensis*), large-leaf pondweed (*Potamogeton amplifolius*), minor bladderwort (*Utricularia minor*), greater bladderwort (*Utricularia vulgaris*), and lesser duckweed (*Lemna* sp.)) were recorded for the first time during the 2013 survey. These plants are all native to central Minnesota and were likely present during earlier surveys of Round Lake but went undetected. Some of these plants are marginal wetland plants that were not included in other surveys while other plants may have been missed if they were present in low numbers.

All aquatic plants observed in Round Lake in 2013 are native to Minnesota with the exception of the submerged plant curly-leaf pondweed (*Potamogeton crispus*). Non-native terrestrial and wetland plants were present along the shore and included purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris* sp.).

The highest number of plant taxa was found in shallow water, in depths less than 11 feet. All of the taxa found in the lake were present within this shallow zone and 20 were only found in this area. The number of plant taxa from rake toss sites found at each sample site ranged from 0 to 9 with a mean of one taxon per site. Sites of high richness (6 or more taxa per site) often occurred in depths less than 10 feet and included sites where emergent, floating-leaf and submerged plants co-occurred (Map 7).

EMERGENT AND FLOATING-LEAF PLANT STANDS

Emergent and floating-leaf plants were restricted to shallow water of Round Lake and within the 0 to 5 feet depth zone, they occupied 41 acres (Map 6). Emergent plant stands were primarily found on the east and west shores and only 12.5% of the shore sites contained these plant stands.

Bulrush (*Schoenoplectus* spp.) occupied about 36 acres and was found on sandy sites in water depths from shore to five feet. The largest, uninterrupted stand of bulrush occurred along the undeveloped west shore and measured 29 acres in area, extending as far as 245 meters lakeward and 1,000 meters along the shore. Bulrush is an emergent, perennial plant that is rooted in the lake bottom with narrow stems that may extend several feet above the water. In addition to providing valuable fish and wildlife habitat, the extensive root network of these plants help to stabilize sandy shorelines. In shallow water, they may spread by underground

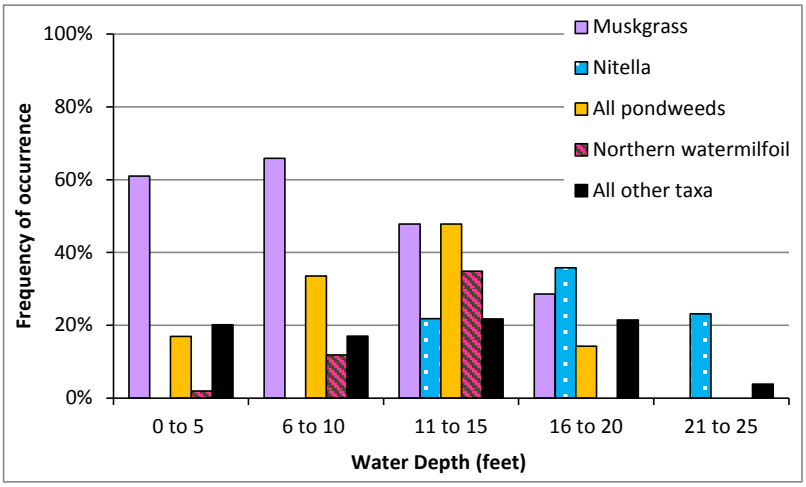
rhizomes but these plants are particularly susceptible to destruction by direct cutting by human, motorboat activity and excess herbivory. Restoration of bulrush beds can be very difficult, making established beds particularly unique and valuable.

Most of the other plant beds were classified as "waterlilies and other" beds and occupied about 5 acres. Three main areas of floating-leaf plant stands included the west shore, the northwest bay and the eastern bay. Waterlily beds were dominated by floating-leaf plants such as white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), floating-leaf burreed (*Sparganium* sp.), and floating-leaf pondweed (*Potamogeton natans*). Waterlily beds often contained scattered emergent plants such as bulrush and submerged plants. The floating leaves of waterlilies provide shade and shelter for fish, frogs and invertebrates. The showy flowers produce seeds that are eaten by waterfowl and the rhizome are a food source for muskrats and deer (Borman et al. 2001).

SUBMERGED PLANTS OF ROUND LAKE

Lakewide, submerged plants were the most common type of vegetation and were found in 68% of all sites sampled, 70% of all of the Point-Intercept (rake toss) sample sites and in 45% of the nearshore plots. The most frequently occurring taxa were muskgrass (*Chara* sp) (57% occurrence in 0-25ft zone), stonewort (*Nitella* sp.) (4% of all sites and 30% of sites from 11-25 ft), all pondweeds (*Potamogeton* sp.) (25%), and northern watermilfoil (*Myriophyllum sibiricum*) (8%). All other taxa occurred in less than 8% of the sample sites. Each plant taxa varied in frequency within each depth zone (Figure 3).

Figure 3. Common submerged aquatic plants in Round Lake.



Muskgrass (*Chara* sp.) is a freshwater macroalgae and is common in many hard water Minnesota lakes. It has a brittle texture and a characteristic "musky" odor. Because muskgrass does not form true stems, it is a low-growing plant, often found entirely beneath the water surface where it may form low "carpets" on the lake bottom (Photo 2). Muskgrass is adapted to variety of substrates, can withstand heavier wave action than can rooted plants, and is often the first plant to colonize open areas of lake bottom where it can act as a sediment stabilizer. Beds of muskgrass can provide important fish spawning and nesting habitat.

Photo 2. Muskgrass

Muskgrass dominated the submerged plant community in Round Lake, occurring in 57% of the survey sites (Table 4). It was the most frequent plant in the 0 to 10 feet depth zone (Figure 3).

Stonewort (*Nitella* sp.) is also a large algae but lacks the brittle texture and musky odor of muskgrass. It is often bright green in color and resembles strands of hair (Photo 3). Stonewort is often found in deeper water than muskgrass. Stonewort was common in depths greater than 15 feet (Figure 3).

Photo 3. Stonewort

Pondweeds (*Potamogeton* spp. and *Stuckenia* spp.) are primarily submerged, perennial plants that are anchored to the lake bottom by underground rhizomes. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water. Pondweed seeds and tubers are an important source of waterfowl food (Fassett 1957). The foliage of pondweeds is food for a variety of marsh birds, shore birds and wildlife and provides shelter, shade and spawning sites for a range of fish species (Borman et al. 2001). In Round Lake 25% of the sites contained at least one pondweed (Table 4). Pondweeds were found most often in the shallower water and were common in depths of 15 feet and less (Figure 3).

Photo 4. White-stem pondweed

Watermilfoils are mostly submerged rooted perennial plants with finely dissected, "feather-shaped" leaves. There are several native species of watermilfoils in Minnesota and these plants are not tolerant of turbidity (Nichols 1999) and grow best in clear water lakes. Particularly in depths less than 10 feet, watermilfoils may reach the water surface and their flower stalk will extend above the water surface (Photo 5). They spread primarily by stem fragments and over-winters by hardy rootstalks and winter buds. Northern watermilfoil (*Myriophyllum sibiricum*) was the only watermilfoil found in Round Lake. It was found in 8% of all sites (Table 4), occurred to a depth of 14 feet and was most common in the 11 to 15 feet depth zone (Figure 3).

Photo 5. Northern watermilfoil

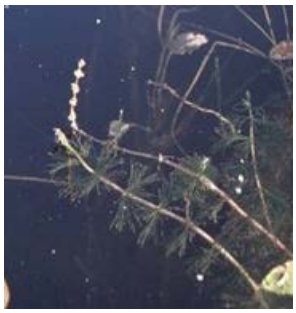


Photo by: Andrew Hipp (UW Madison-Wisc State Herbarium)

AQUATIC PLANT COMMUNITY DYNAMICS

Round Lake supports an excellent diversity of native plant communities that provide critical fish and wildlife habitat along with other lake benefits. (Click here for more information on: value of aquatic plants). The types and amounts of aquatic plants are influenced by a variety of factors including water clarity, water chemistry, depth, substrate type and wave activity. Within the lake, differences in these physical features as well as different levels of human activity can result in different types and amounts of vegetation.

The 2013 survey provides a snapshot of the Round Lake plant communities where there may be a year to year difference in amounts and types of plants present in the lake. The annual abundance, distribution and composition of aquatic plant communities may change annually due to environmental factors and the specific phenology of each plant species. Monitoring change in the aquatic plant community can be helpful in determining whether changes in the lake water quality are occurring and for estimating the quality of vegetation habitat available for fish and wildlife communities. Data collected in 2013 can be used to monitor finer-scale changes that may occur, such as an increase in a particular species, loss of species, or changes in the depths at which individual species occur.

Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. The results of these control activities can be difficult to predict and should be conducted with caution to reduce potential negative impacts to non-target species. Motorboat activity in vegetated areas can be particularly harmful for taxa such as bulrush. Shoreline and watershed development can also indirectly influence aquatic plant growth if it results in changes to the overall water quality and clarity. For information on the laws pertaining to aquatic plant management: MNDNR APM Program.

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TABLE 4: HISTORICAL AND CURRENT PLANTS OF ROUND LAKE

Emergent plants

Common Name	Scientific Name	1941	1970	1982	1988	1995	1998	2013 lake wide	2013 NS
River bulrush	*Bolboschoenus fluviatilis*						X	--	--
Water arum	*Calla palustris*							<1	--
Sedge	*Carex* sp.							<1	--
Bald spikerush	*Eleocharis erythropoda*					X		--	--
Spikerush	*Eleocharis palustris*						X	1	8
Pickerelweed	*Pontedaria cordata*			C	P			P	--
Broad-leaf arrowhead	*Sagittaria latifolia*			O		X		--	--
Stiff wapato	*Sagittaria rigida*			C	P	X		--	--
Arrowhead	*Sagittaria* sp.						X	<1	13
Bulrush	*Schoenoplectus* sp.	X	C	C	C	X	X	5	--
Burreed	*Sparganium* sp.					X		--	--
Narrow-leaf cattail	*Typha angustifolia*							P	--
Wild rice	*Zizania palustris*			R	R			P	--
	Total	1	1	5	3	5	4	8	2

Floating-leaved plants

Common Name	Scientific Name	1941	1970	1982	1988	1995	1998	2013 lake wide	2013 NS
Watershield	*Brasenia schreberi*				P			P	--
White waterlily	*Nymphaea odorata*					X	X	1	3
Yellow waterlily	*Nuphar variegata*		P	O	P	X	X	1	--
Floating-leaf smartweed	*Persicaria amphibian*					X	X	<1	--
Floating-leaf pondweed	*Potamogeton natans*	X			P	X	X	<1	--
Floating-leaf burreed	*Sparganium* sp.							P	--
	Total	1	1	1	3	4	4	6	1

Submerged plants

	Common Name	Scientific Name	1941	1970	1982	1988	1995	1998	2013 lake wide	2013 NS
Macro algae	Muskgrass	*Chara* sp.	X					X	57	15
	Stonewort	*Nitella* sp.						X	4	--
Monocots	Needlegrass	*Eleocharis acicularis*					X		--	--
	Canada waterweed	*Elodea canadensis*			C	C	X	X	2	3
	Water star-grass	*Heteranthera dubia*						X	1	8
	Bushy pondweed	*Najas flexilis*					X	X	2	20
	Southern naiad	*Najas guadalupensis*							2	--
	Large-leaf pondweed	*Potamogeton amplifolius*							<1	--
	Curly-leaf pondweed (I)	*Potamogeton crispus*		O	O	P	X	X	2	3
	Fries' pondweed	*Potamogeton friesii*				P			4	8
	Small pondweed	*Potamogeton pusillus*								
	Variable pondweed	*Potamogeton gramineus*						X	7	8
	Illinois pondweed	*Potamogeton illinoensis*		O				X	8	--
	White-stem pondweed	*Potamogeton praelongus*					X	X	7	--
	Clasping-leaf pondweed	*Potamogeton richardsonii*	X				X	X	3	3
	Flat-stem pondweed	*Potamogeton zosteriformis*					X	X	4	--
	Sago pondweed	*Stuckenia pectinata*	X			P	X	X	2	10
Dicots	Water marigold	*Bidens beckii*					X	X	<1	--
	Coontail	*Ceratophyllum demersum*		C	O	C	X	X	3	10
	Northern watermilfoil	*Myriophyllum sibiricum*	X				X	X	8	5
	White-water buttercup	*Ranunculus aquatilis*					X	X	1	--
	Minor bladderwort	*Utricularia minor*							<1	--
	Greater bladderwort	*Utricularia vulgaris*							6	--
	Wild celery	*Vallisneria americana*					X	X	3	--
		Total	4	3	3	4	13	17	22	11

Free-floating plants

Common Name	Scientific Name	1941	1970	1982	1988	1995	1998	2013	2013

								lake wide	NS
Lesser duckweed	*Lemna* sp.							<1	3
Turion duckweed	*Lemna turionifera*					X		--	--
Greater duckweed	*Spirodela polyhriza*					X		<1	3
	Total	0	0	0	0	2	0	2	2

Wetland emergent plants

Common Name	Scientific Name	1941	1970	1982	1988	1995	1998	2013 lake wide	2013 NS
Blue flag iris	*Iris versicolor*							P	--
Purple loosestrife	*Lythrum salicaria*							P	--
Reed canary grass (I)	*Phalaris arundinaceae*							P	5
	Total	0	0	0	0	0	0	3	1

A = abundant, C = common, O = occasional, R = rare, sparse, X = present (abundance not described)
I = introduced
** = plant only identified to genus level*

1941 (July 28-30) – George Moore – Department of Conservation – Division of Game and Fish

1970 (August 24-26) – Jeffrey Gorton – MNDNR Division of Game and Fish – Section of Fisheries

1982 (August 30-31, September 3) – Michael J. Patrick – MNDNR Division of Fish and Wildlife

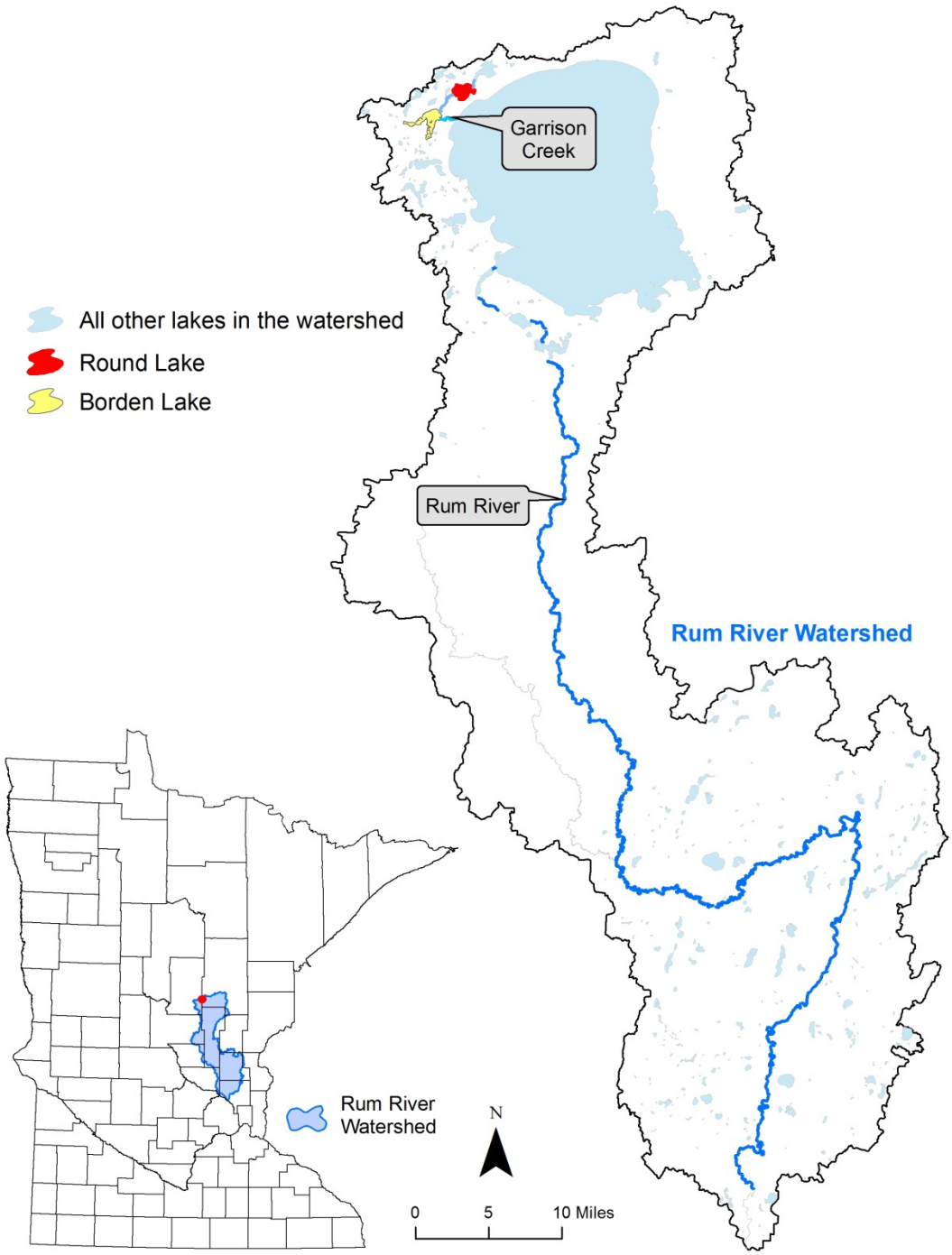
1988 (August 22-27) – Stanley VanEpps – MNDNR Division of Fish and Wildlife

1995 (August 28) – Karen Myhre - MNDNR Division of Ecological and Water Resources – Minnesota Biological Survey

1998 (August 24) MNDNR Department of Fisheries

2013 (July 3, 17, 18, 25, 29) – Perleberg, Simon, Schubert, Froelich, Hauck, Carlson – MNDNR EWR Division – Lake Habitat Program

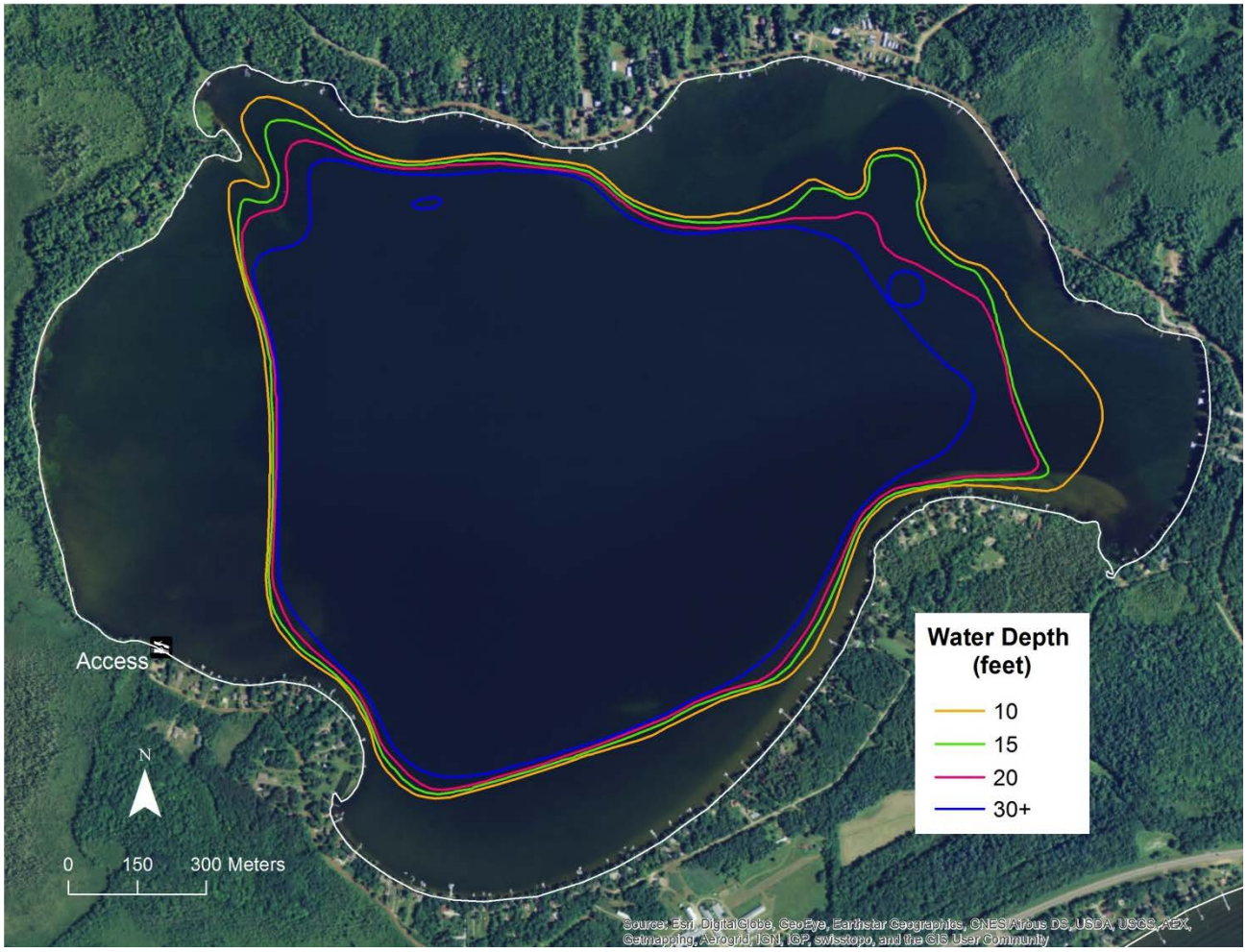
MAP 1. ROUND LAKE WITHIN THE RUM RIVER WATERSHED



MAP 2. DEPTH CONTOUR MAP

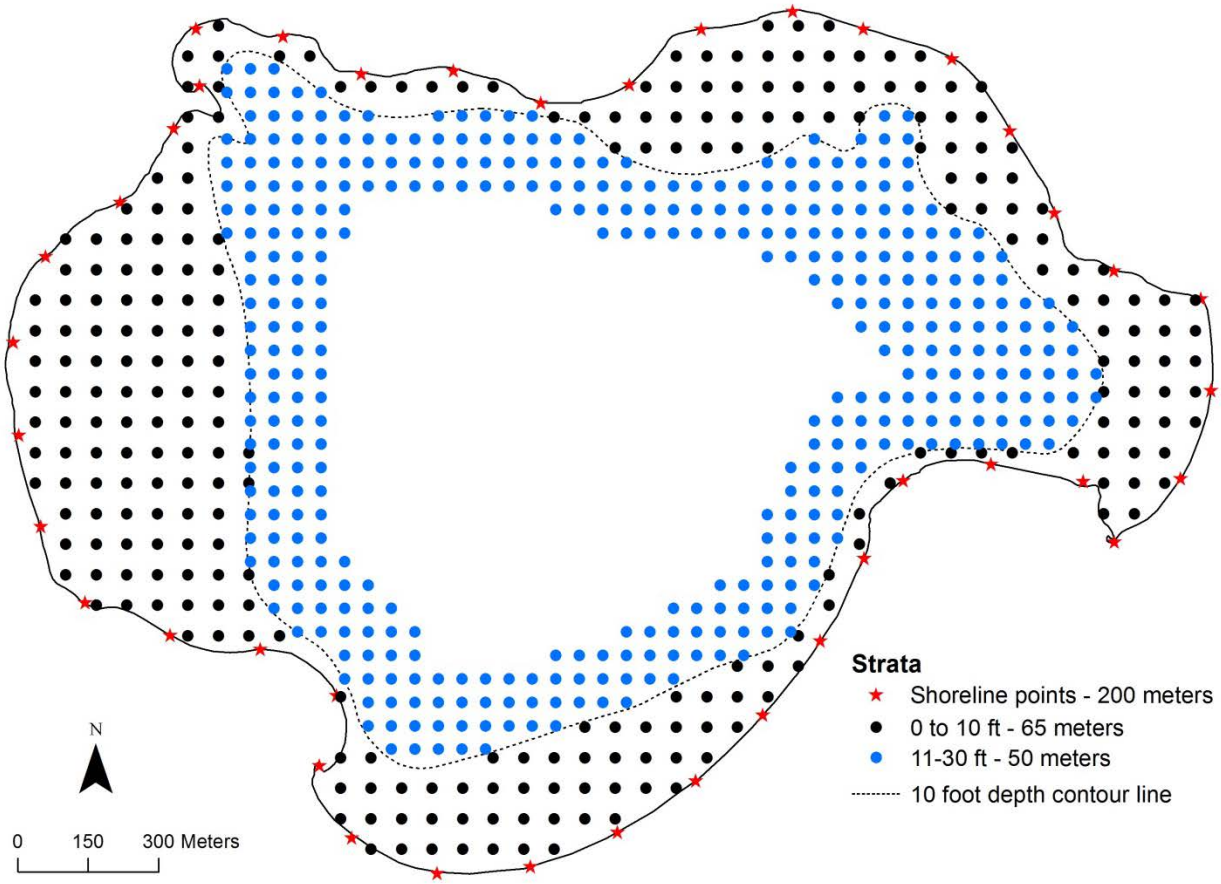
*Depth contours based on 1944 survey

*photo source: ESRI World Imagery



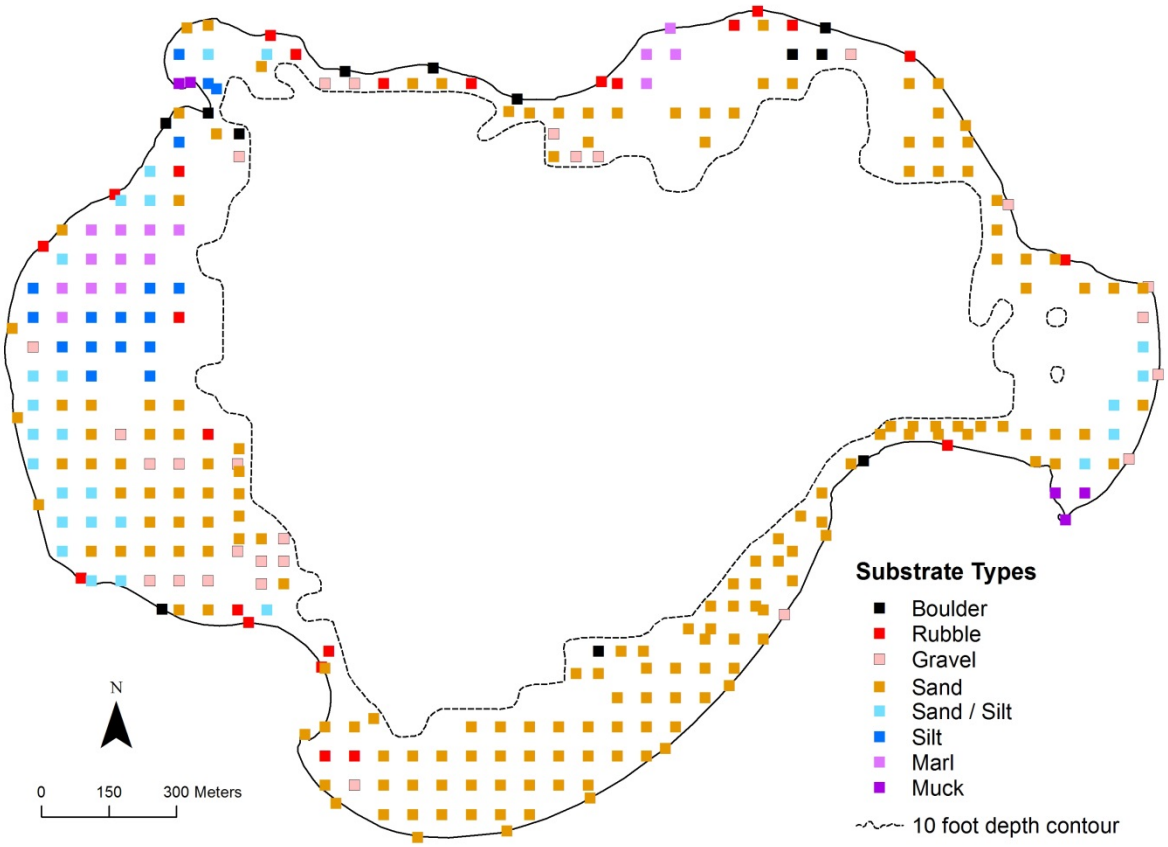
MAP 3. 2013 VEGETATION SURVEY SITES.

**contour lines shown are based on 1944 mapping survey of lake and were used to stratify survey points. In the field, surveyors recorded actual water depth at each site and used these data to modify contour lines.



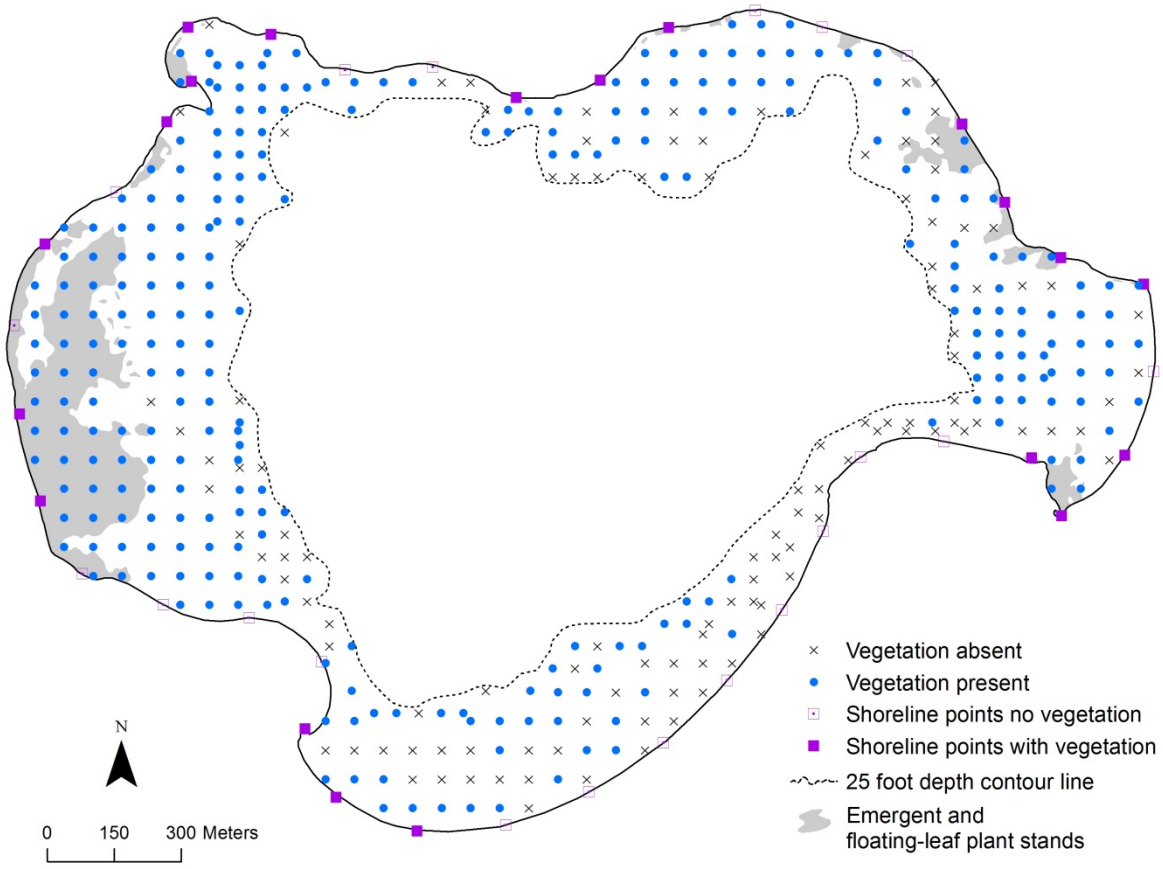
MAP 4. NEAR-SHORE SUBSTRATES OF ROUND LAKE, 2013.

*10 foot depth contour line based on 2013 data



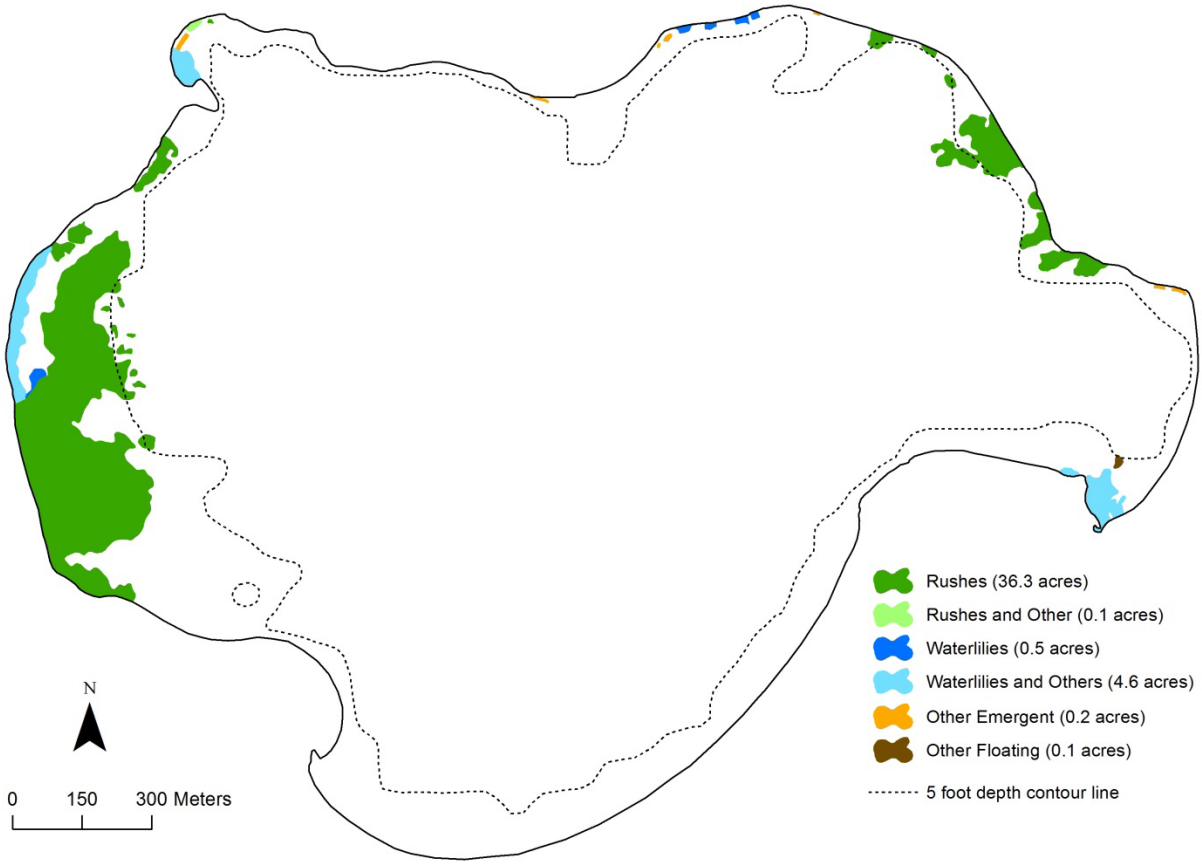
MAP 5. ROUND LAKE SAMPLE SITES WITH AQUATIC VEGETATION, 2013.

*25 foot depth contour line based on 2013 data



MAP 6. EMERGENT AND FLOATING-LEAF PLANT STANDS, ROUND LAKE, 2013.

*5 foot depth contour line based on 2013 data



MAP 7. NUMBER OF PLANT TAXA PER SAMPLE SITE, ROUND LAKE, 2013.

*25 foot depth contour line based on 2013 data