Aquatic Vegetation Survey of Big Fish Lake

Division of Fish and Wildlife
Minnesota Department of Natural Resources

Lake: **Big Fish Lake** DOW Number: 73010600 Date of inspection**: July 27, 2015**

County: **Stearns County** **Surveyors**: J. Neuman, R. Andvik, and A. Liestman

Type of inspection: Point-intercept survey of aquatic plants

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A note to readers:
Text that appears in blue underline is a hypertext link to a web page where additional information is provided. If you are connected to the Internet, you can click on the blue underlined text to link to those web pages.

Summary

Big Fish Lake is a 558 acre lake in central Stearns County, Minnesota. In July 2015, surveyors conducted a lakewide assessment of Big Fish Lake's vegetation and sampled aquatic plants and water depth at 262 sites. This information was combined with emergent plant bed delineation conducted in August 2015.

The aquatic plant communities of Big Fish Lake have historically contained a diversity of native plants and in 2015, 27 species were observed including 3 emergent, 2 floating-leaved and 22 submerged and/or free-floating species. Plants occurred around the entire perimeter of the lake to a depth of 28 feet. Within the 0-30 feet depth zone, 87% of sites contained plants. The broadest zones of plants were found on the northern, central, southeastern portions of the lake.

Emergent and floating-leaf plants occupied 7.4 acres, but were restricted to water depths less than 6 feet. Within the shallow water (0-5 feet) zone, emergent and floating-leaf plants occurred in 3% of the sample sites and included bulrush (Schoenoplectus sp.), arrowhead (Sagittaria sp.), cattails (Typha sp.), yellow waterlily (Nuphar variegata), and white waterlily (Nymphaea odorata). Submerged plants were found to a maximum depth of 28 feet. Muskgrass (Chara sp.) was the most common submerged species and occurred in 52% of the survey sites. It dominated the 0 to 5 feet depth zones where it was found in 87% of the sites. Other submerged plants that occurred in at least 10% of the sites were coontail (*Ceratophyllum demersum*), northern watermilfoil (*Myriophyllum sibiricum*), flatstem pondweed (*Potamogeton zosteriformis*), water celery (*Vallisneria Americana*), Canada waterweed (*Elodea Canadensis*), Fries pondweed (*Potamogeton Friesii*), white-stemmed pondweed (*Potamogeton praelongus*), water marigold

(*Bidens beckii*), sago pondweed (*Potamogeton pectinatus*), and narrowleaf pondweed species group (*Potamogeton* sp.).

Methods

Lakewide vegetation survey
A point-intercept survey method was used following the methods described in Madsen (1999) and MNDNR (2008). Survey waypoints were created using a Geographic Information System (GIS) computer program and downloaded into a handheld Global Positioning System (GPS) receiver. Survey points were placed in a grid pattern and spaced 65 meters apart.

Plant sampling
Surveyors recorded all plant species found within a one square meter sample site at the pre-designated side of the boat. A weighted, double-headed garden rake, attached to a rope was used to survey vegetation not visible from the water surface. Any additional plant species found outside of sample sites were recorded as "present" in the lake but these data were not used in frequency calculations. Data was entered into a database and frequency of occurrence was calculated for each species as the number of sites in which the species occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 30 feet and sampling points were also grouped by water depth and separated into 6 depth zones for analysis. A total of 262 sites were surveyed. Points in areas deeper than 30ft were not surveyed (Figure 1, Table 1).

Table 1. Sampling effort by water depth.

Water depth interval (feet)	Number of samples
0 to 5	38
6 to 10	62
11 to 15	64
16 to 20	35
21 to 25	53
26 to 30	10
>30	0
0 to 30	262

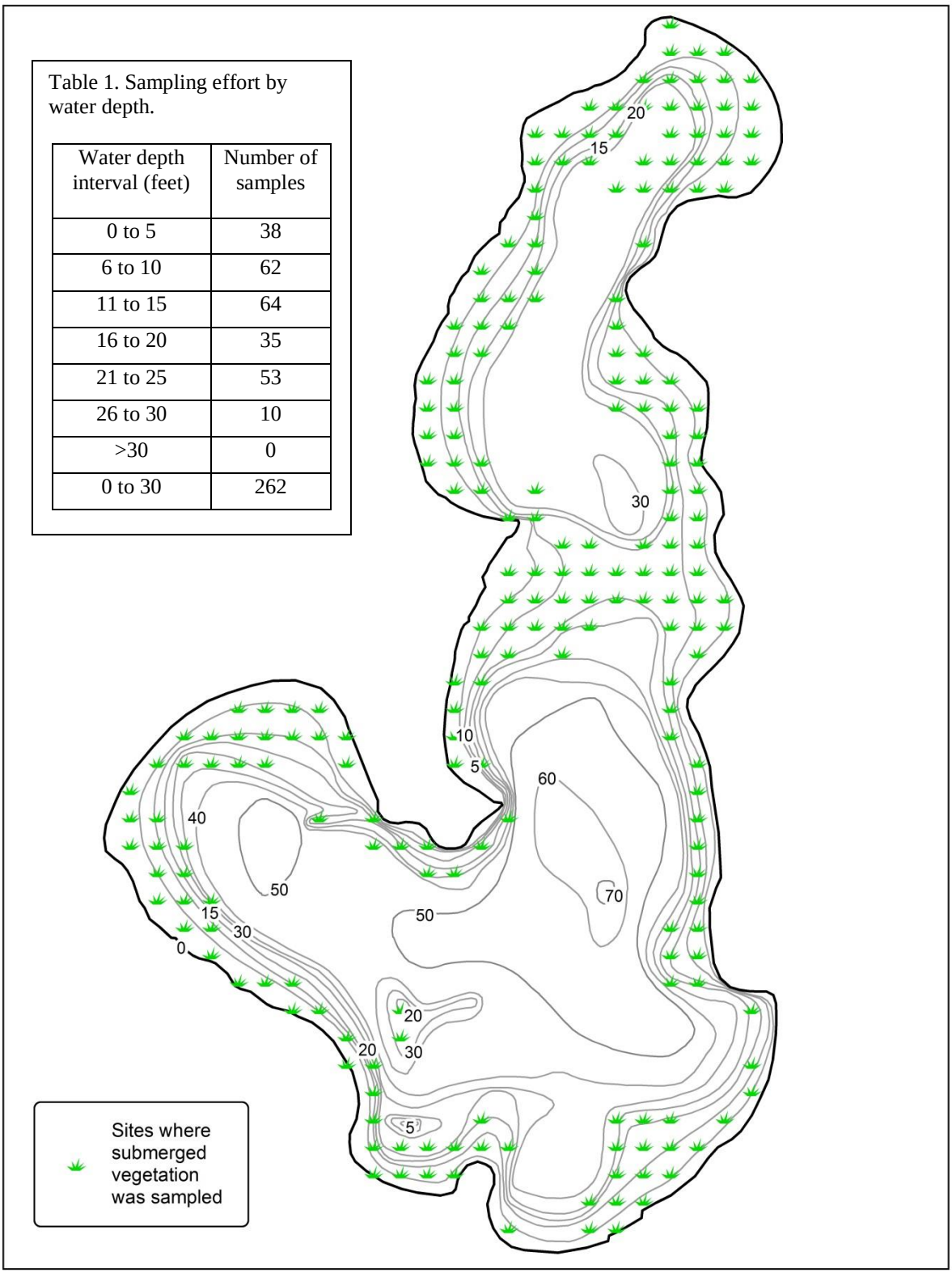


Figure 1: Survey points generated in ArcGIS for Big Fish Lake point intercept survey. Points were vegetation was sampled are shown as a green vegetation symbols. Areas deeper than 30 feet were not sampled.

Substrate sampling
At each sample site where water depths were 7 feet or less, surveyors described the bottom substrate using standard substrate classes (Table 2). If more than one substrate type was found, surveyors recorded the most common type. Surveyors attempted to record a substrate description at the shore side of each row of points. If a sample site occurred near shore but in water depths greater than 7 feet, surveyors collected depth and vegetation data and then motored into shallower water and recorded the substrate type adjacent to the actual survey point.

Table 2. Substrate Classes

muck	decomposed organic material
silt	fine material with little grittiness
sand	diameter less than 1/8 inch
gravel	diameter 1/8 to 3 inches
rubble	diameter 3 to 10 inches

Results and Discussion

Shoal Substrates
Hard substrates(sand, gravel, and rubble) were found along most of the north, south, east and west shores (Figure 2). While soft substrates (silt and muck) were most found on the northeast and northwest shores where cattails and water lilies were found (Figure 2).

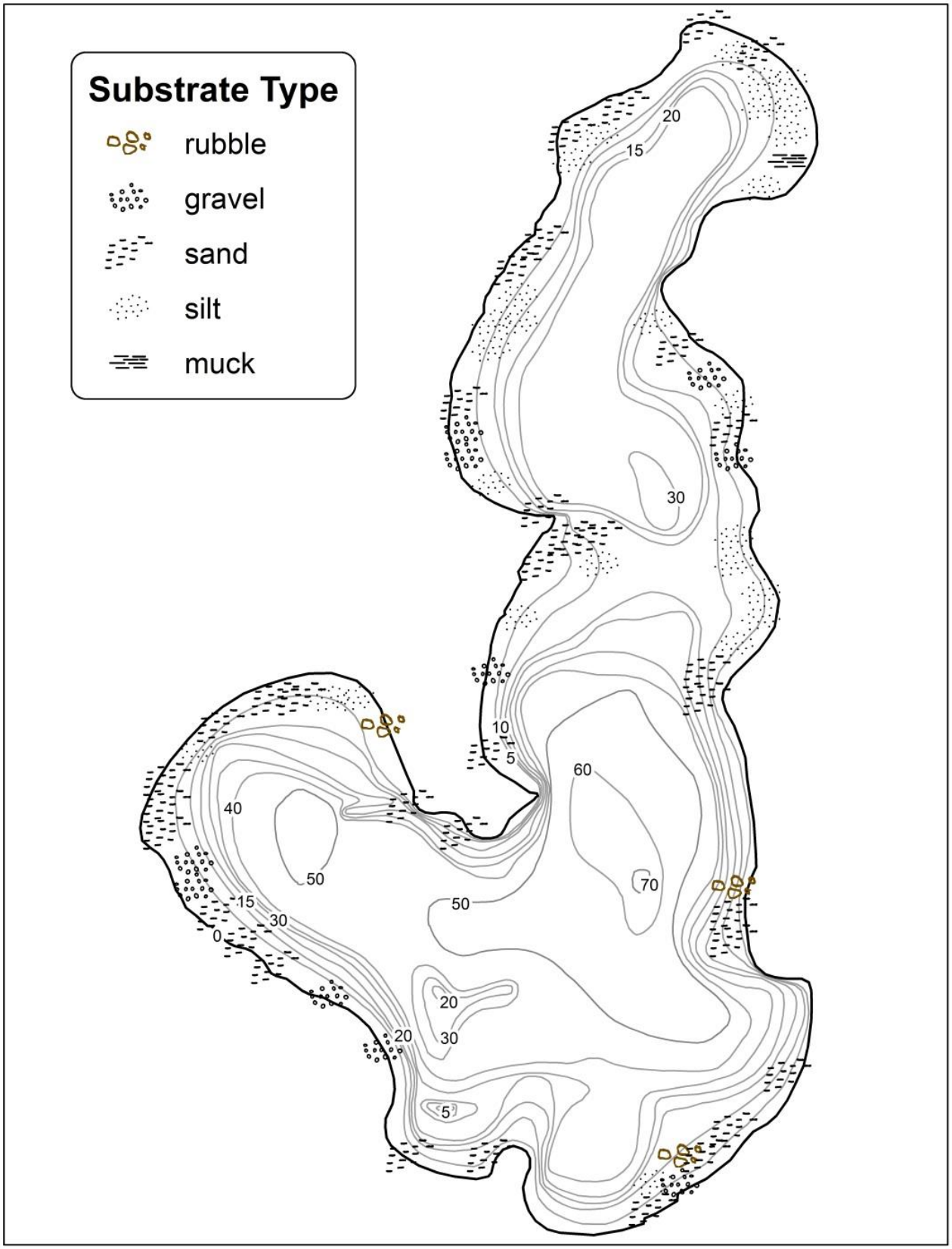


Figure 2. Shoal substrates of Big Fish Lake, 2015.

Types of plants recorded

In 2015, 27 native plant species were recorded in Big Fish Lake including 3 emergent, 2 floating-leaved, and 22 submerged and/or free-floating plants (Table 3). Submerged plants included macroalgae and a diversity of rooted, flowering plants that can be grouped by leaf shape and size: dissected, small, narrow, broad and grass-leaved plants.

Table 3. Frequency of aquatic plants in Big Fish Lake Point-intercept survey, July 27, 2015.(Frequency is the percent of sample sites in which a plant taxon occurred) within the shore to 30 foot water depth.)

Common Name	Scientific Name	Percent Frequency (262 points)
Submerged		
Coontail	*Ceratophyllum demersum*	45%
Northern Watermilfoil	*Myriophyllum sibiricum*	40%
Flatstem Pondweed	*Potamogeton zosteriformis*	40%
Water Celery	*Vallisneria americana*	33%
Canada Waterweed	*Elodea canadensis*	27%
Fries Pondweed	*Potamogeton Friesii*	19%
White-stemmed pondweed	*Potamogeton praelongus*	13%
Water Marigold	*Bidens beckii*	12%
Sago Pondweed	*Potamogeton pectinatus*	10%
Narrowleaf Pondweed	*Potamogeton sp.*	10%
Bushy Naiad	*Najas flexilis*	7%
Large-leaved Pondweed	*Potamogeton amplifolius*	5%
Water Stargrass	*Heteranthera dubia*	3%
Common Bladderwort	*Utricularia vulgaris*	<1%
Clasping-leaf Pondweed	*Potamogeton richardsonii*	<1%
Floating-leaf Pondweed	*Potamogeton natans*	<1%
Illinois Pondweed	*Potamogeton illinoensis*	<1%
Robbins Pondweed	*Potamogeton robbinsii*	<1%
White Water Buttercup	*Ranunculus aquatilis*	<1%
Algae		
Muskgrass	*Chara sp.*	52%
Stonewort	*Nitella sp.*	15%
Floating-Leaf		
White Water Lily	*Nymphaea odorata*	<1%
Yellow Waterlily (common)	*Nuphar variegata*	1%
Free Floating		
Star Duckweed	*Lemna trisulca*	2%
Emergent		
Bulrush	*Scirpus sp.*	<1%
Arrowhead Sp.	*Sagittaria Sp.*	2%
Cattail	*Typha Sp.*	<1%

Plant communities richness

The highest number of plant species was found in shallow water, from shore to a depth of 10 feet (Figure 3). Most emergent and floating-leaf plants were restricted to shallow water (less than 6 feet). Most submerged species were found in depths of 20 feet and less and only 6 species (coontail, chara, narrow-leaf pondweed, flatstem pondweed, Fries pondweed, and Canada waterweed,) occurred in depths greater than 20 feet.

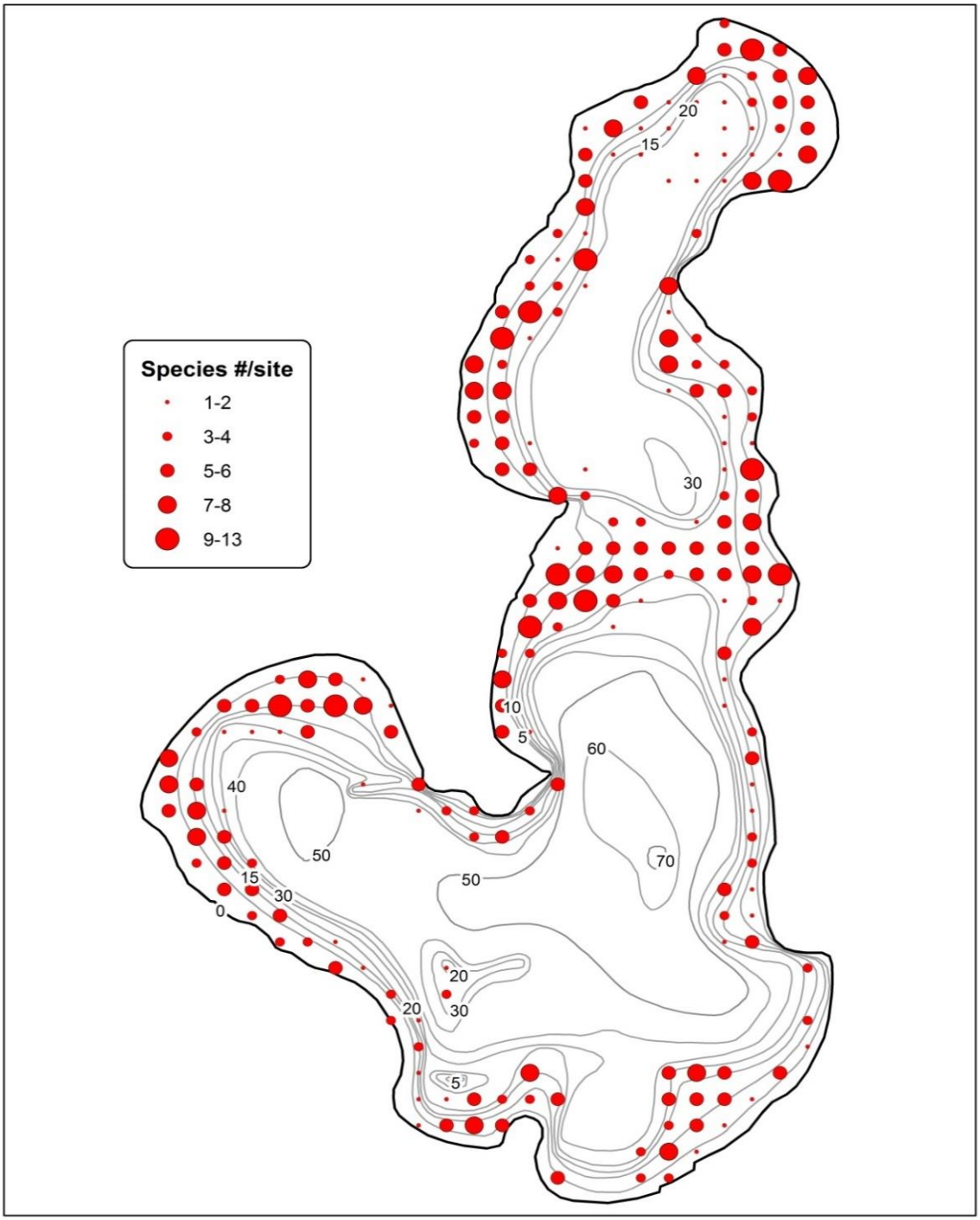


Figure 3. Number of species of submerged plants per site in Big Fish Lake, 2015.

Submerged aquatic plants

Submerged plants occurred in 87% of the Big Fish Lake sample sites and were found throughout the littoral zone (Figure 4 & 5). The most frequently occurring species were muskgrass, coontail, northern watermilfoil, flatstem pondweed, water celery, Canada waterweed, Fries pondweed, and native stonewort. These species were all common in the 0-20 feet zone, where they each occurred with a frequency of at least 15%.

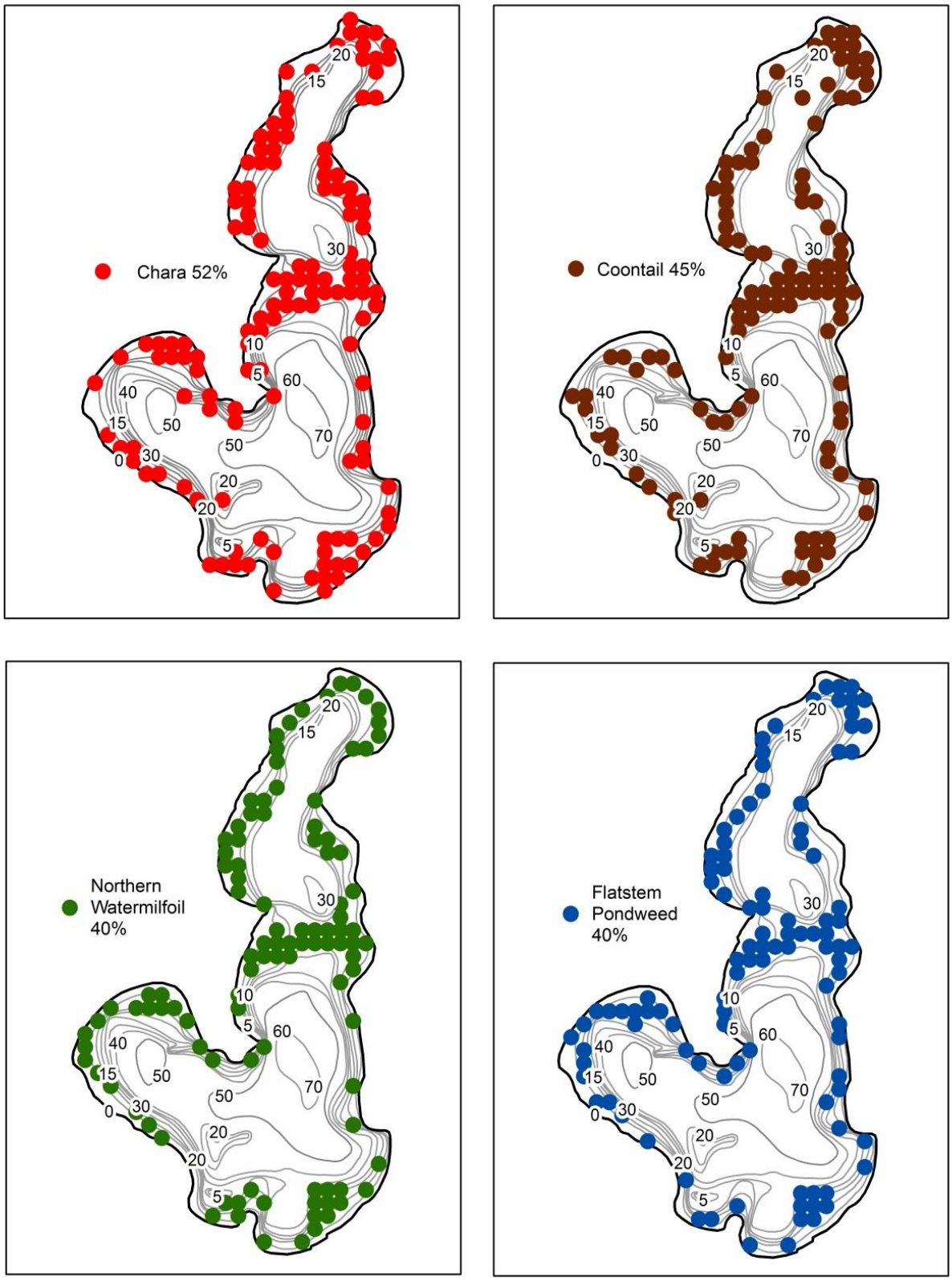


Figure 4. Distribution and frequency of occurrence of common submerged plants in Big Fish Lake, 2015.

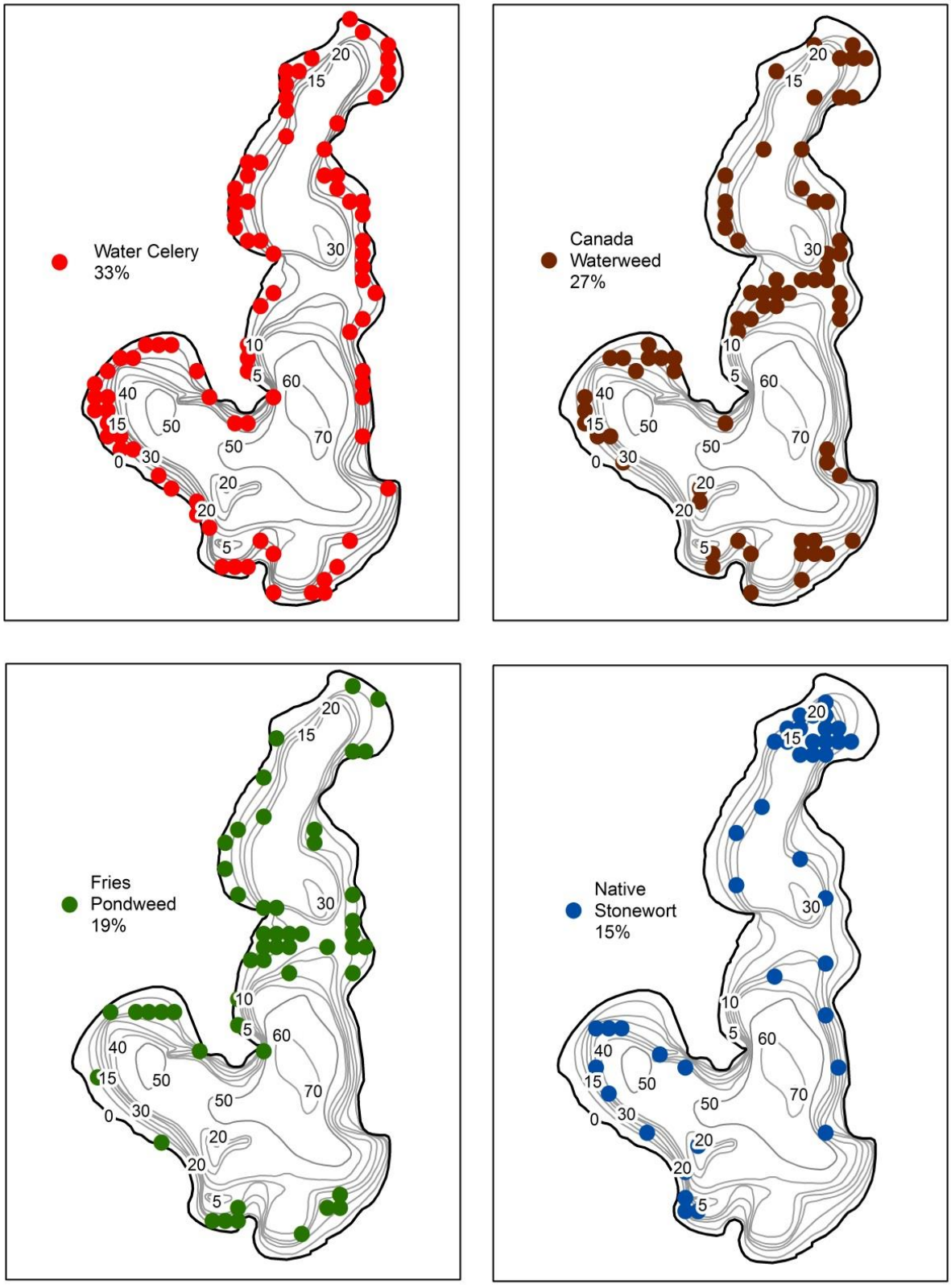
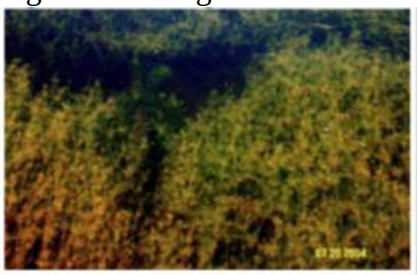


Figure 5. Distribution and frequency of occurrence of common submerged plants in Big Fish Lake, 2015.

Submerged native plants

Figure 6. Muskgrass



Muskgrass (Figure 6) is a freshwater macroalgae, a primitive plant that does not form true roots, flowers or has vascular tissue. Macroalgae often resemble rooted plants and provide similar habitat and water quality benefits and were therefore included in this survey. Muskgrass 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. Muskgrass is adapted to a variety of substrates and is often the first species 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. In Big Fish Lake, muskgrass occurred with a frequency of 52% (Table 3). It occurred along the sandy shorelines of Big Fish Lake (Figure 4).

Figure 7. Coontail

Coontail (Figure 7) grows entirely submerged and may float freely or be loosely anchored to the lake bottom. It is adapted to a broad range of lake conditions and is tolerant of higher turbidity and can grow in muck substrates. Coontail is perennial and can over winter as a green plant under the ice and then begins new growth early in the spring, spreading primarily by stem fragmentation. The finely divided leaves of this plant provide a home for aquatic insects which are a valuable food for fish. Coontail was found in 45% of the sample sites in Big Fish Lake (Table 3).

Figure 8. Flatstem Pondweed

Flatstem pondweed (*Potamogeton zosteriformis*; Figure 8) is named for its flattened, grass-like leaves. It was the most common pondweed in Big Fish Lake, occurring with a frequency of 40% (Table 3).

Figure 9. Wild Celery

Wild celery (*Vallisneria americana*; Figure 9) is a rooted, perennial submerged plant that resembles ribbon-leaved pondweeds. Unlike the pondweeds that have branches of leaves, wild celery leaves all rise from the base of the plant. Beds of wild celery provide food and shelter for fish and all parts of the plant are consumed by waterfowl, shorebirds and muskrats (Borman et al. 2001). Wild celery is a particularly important food source for canvasback ducks (Varro 2003). Wild celery occurred in 33% of the sample sites (Table 3).

Northern Watermilfoil is a submerged, rooted perennial plant with finely dissected leaves and flowers that extend above the water surface. Northern watermilfoil (Figure 10) has been documented in Big Fish Lake. The non-native, Eurasian watermilfoil has not yet been found in the lake. For information on how to distinguish the native watermilfoils from Eurasian watermilfoil, click here: Identifications. Watermilfoils are not tolerant of turbidity and grow best in clear water lakes. Northern watermilfoil was found in 40% of the Big Fish Lake sites (Table 3). It occurred throughout the littoral zone and was the third most frequently occurring plant in the 11 to 15 feet depth zone where it occurred in 46% of the sites.

Figure 10. Northern watermilfoil

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

Narrow-leaf pondweeds are rooted, perennial submerged plants with small, thin leaves. Leaves grow entirely below the water surface but flowers extend above the water. There are several species of narrow-leaf pondweeds and they can be difficult to identify if not found in flower or fruit. Fries' pondweed (*Potamogeton friesii*; Figure 11), small pondweed (*Potamogeton pusillus*) and straight-leaved pondweed (*Potamogeton strictifolius*) have been previously been documented in Big Fish Lake. In Big Fish Lake, Freis pondweed was found in 19% of the sites.

Figure 11. Fries' pondweed

Photo by : O Angerer

Canada waterweed (Figure 12) is a perennial submerged species that is widespread throughout Minnesota. It is adapted to a variety of conditions and is tolerant of low light and prefers soft substrates. Canada waterweed can overwinter as an evergreen plant and spreads primarily by fragments. It was found in 27% of the Big Fish Lake survey sites (Table 3) and was most frequent in depths of 11 to 15 feet.

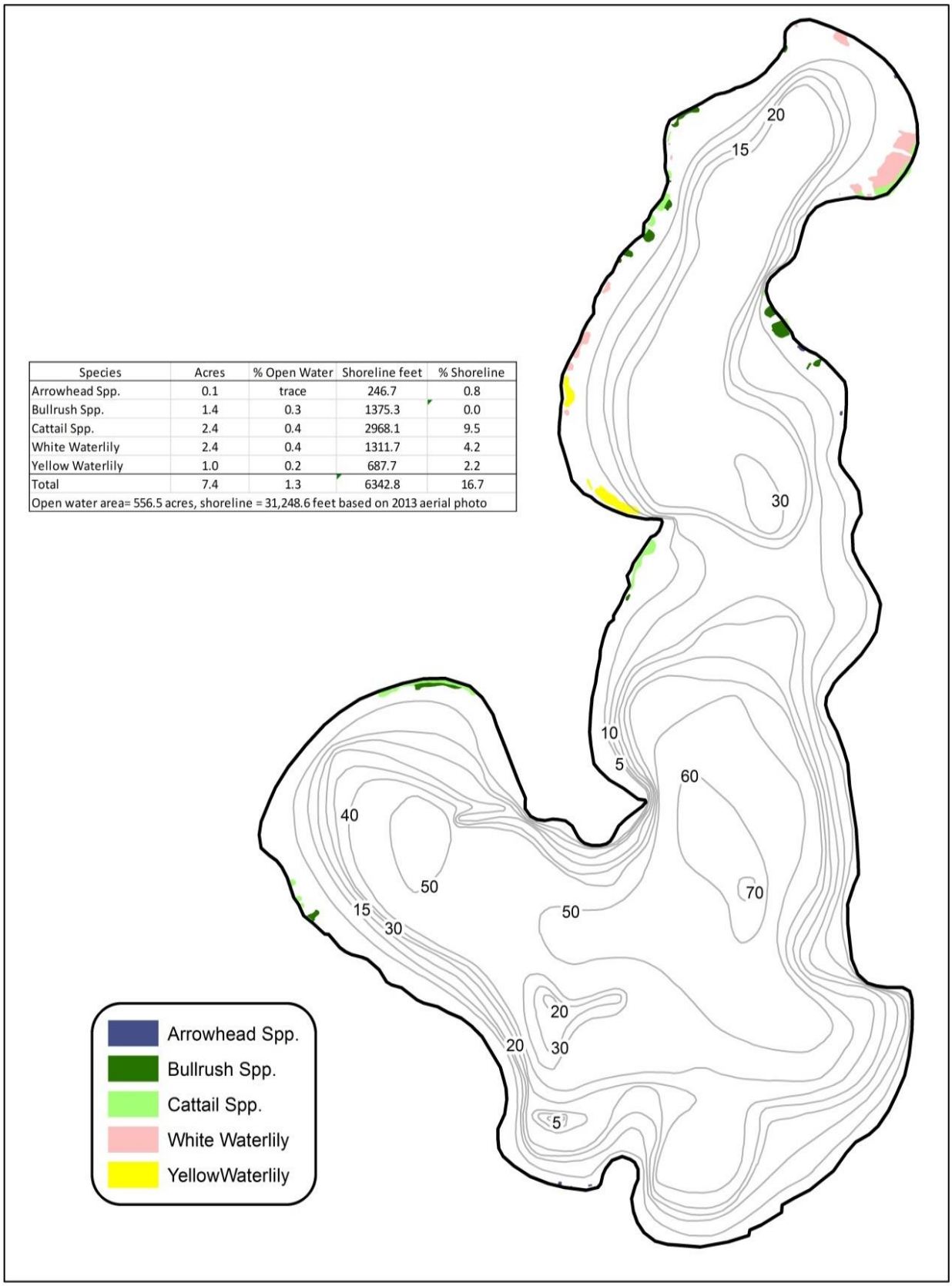
Figure 12 Canada waterweed.

Stonewort (*Nitella* sp.) (Figure 13) is a large algae that resembles a submerged flowering plant but does not form true stems, leaves, roots or flowers. Like coontail and Canada waterweed, it may be loosely attached to the substrate or may float freely and it obtains nutrients directly from the water column. It grows entirely submerged is often found in deeper water than rooted plants. In some lakes it may represent the only submerged habitat in the deep water zone. In Big Fish Lake stonewort occurred in 40% of the sample sites and the was most frequent plant observedin the depth zone of 21 to 25 feet.

Figure 13 Native Stonewort

Emergent and Floating-leaf Plant Beds

Emergent and floating-leaf aquatic plants offer food, cover, and nesting material for waterfowl, marsh birds and muskrats, and provides shelter and shade for insects, young fish, and amphibians. The root systems of emergent and floating-leaf plants protect shorelines against erosion by buffering the wave action and by holding soil in place. Approximately 11.4 acres of bulrush, wild rice and cattail stands were mapped in Big Fish Lake. Emergent and floating-leaf plants were restricted to 5 feet and less, and were common in the shallow water zone (0 to 5 feet) where 18% of the Big Fish Lake sites contained at least one emergent or floating-leaf plant. Plant beds were classified by the dominant species (Figure 14).



Species	Acres	% Open Water	Shoreline feet	% Shoreline
Arrowhead Spp.	0.1	trace	246.7	0.8
Bullrush Spp.	1.4	0.3	1375.3	0.0
Cattail Spp.	2.4	0.4	2968.1	9.5
White Waterlily	2.4	0.4	1311.7	4.2
Yellow Waterlily	1.0	0.2	687.7	2.2
Total	7.4	1.3	6342.8	16.7
Open water area= 556.5 acres, shoreline = 31,248.6 feet based on 2013 aerial photo				

Figure 14. Emergent and floating-leaf plant beds of Big Fish Lake, 2015.

Bulrush (Schoenoplectus sp.; Figure 15) 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 system of this plant helps stabilize sandy shorelines. In shallow water, bulrush may spread by underground rhizomes but is particularly susceptible to destruction by direct cutting by humans, motorboat activity and excess herbivory. Restoration of these plant beds can be very difficult, making established beds particularly unique and valuable. In Big Fish Lake, bulrush was most often found on sandy or rocky substrates along the east and west shores (Figure 14). A total of 1.4 acres of bulrush or mixed bulrush beds were mapped.

Figure 15. Bulrush

Cattails (Typha spp.; Figure 16) are emergent plants that are found in lakes and marshes throughout Minnesota. They are perennial plants that emerge from a spreading rhizome and have long, narrow leaves. Cattails provide shelter and food for many different kinds of fish and bird species. A total of 2.4 acres of cattails were mapped throughout parts of Big Fish Lake (Figure 14).

Figure 16. Cattails

Floating-leaf plants included white waterlily (*Nymphaea odorata*; Figure 17), and yellow waterlily (*Nuphar variegata*; Figure 18).Waterlily beds often contained arrowhead (Sagittaria latifolia) (Figure 19), and other emergent and submerged plants. Waterlily beds, or mixed beds of waterlilies and arrowhead, covered 3.5 acres in Big Fish Lake and were primarily found in the west and northeast bays (Figure 14) and were often associated with muck substrates.

Figure 17. White waterlily

Figure 18. Yellow waterlily

Figure 19. Arrowhead (*Sagittaria latifolia*)

Change in aquatic plant communities

The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity, water chemistry, depth, substrate type and wave activity. 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 aquatic habitat available for fish and wildlife communities. Data collected in 2015 can be used to monitor finer-scale changes that may occur, such as an increase in a particular species or a change in the depths at which individual species occur. In general, factors that may lead to changes in native and non-native aquatic plant communities include:

• Change in water clarity

If water clarity in Big Fish Lake increases, submerged vegetation may be more common at depths greater than 20 feet.

• Snow and ice cover

Curly-leaf pondweed, (not found in this survey but known to exist in Big Fish Lake), may fluctuate in abundance in response to snow cover. Many native submerged plants also have the ability to grow under the ice, especially if there is little snow cover and sunlight reaches the lake bottom. In years following low snow cover, and/or a reduced ice-over period, curly-leaf and some native submerged plants may increase in abundance.

• Water temperatures/length of growing season

In years with cool spring temperatures, submerged plants may be less abundant than in years with early springs and prolonged warm summer days.

• Aquatic plant management activities

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 species such as wild rice. 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.

The abundant and diverse aquatic plant communities found in Big Fish Lake provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

References cited

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