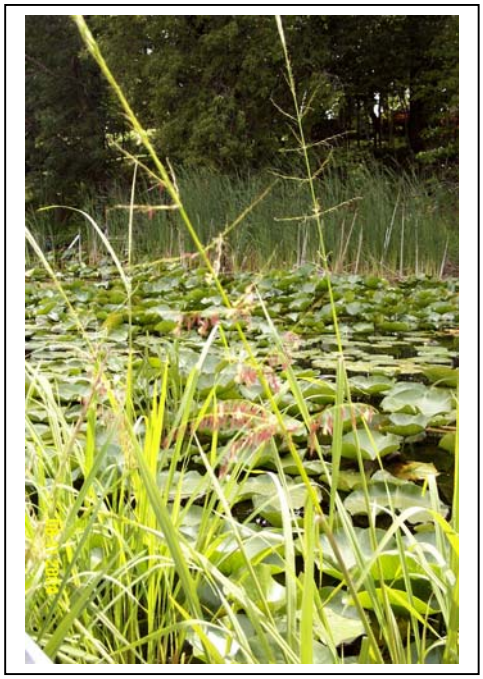
Aquatic Vegetation of Dixon Lake
Itasca County, Minnesota
(DOW 31-0921-00)
June 29-30, 2004



Report by: Donna Perleberg[1] and Nicole Brown
Minnesota Department of Natural Resources
Division of Ecological Services
1601 Minnesota Dr.
Brainerd, MN 56401

[1] Phone: 218.833.8727
Fax: 218.855.5072
Email: donna.perleberg@dnr.state.mn.us

Acknowledgments

Lake sampling: Donna Perleberg, MnDNR Division of Ecological Services
Josh Knopik, MnDNR Division of Ecological Services
Don Klick, MnDNR Division of Fish and Wildlife, Bemidji Area Fisheries

Data Entry/ Analysis / Maps: Donna Perleberg, Nicole Brown, Patrick McGowan, Minnesota Department of Natural Resources-Division of Ecological Services

General report format review: Steve Enger, Kelly Randall, Welby Smith, Chip Welling, Jan Wolff, David Wright, MnDNR Division of Ecological Services; Don Klick, Chris Kavanaugh, MnDNR Division of Fish and Wildlife.

Funding: Collection of these data was made possible by support from the Heritage Enhancement Fund.

This report should be cited as:
Perleberg, D. and N. Brown. 2005. Aquatic vegetation of Dixon Lake, Itasca County, Minnesota (DOW 31-0921-00), August 29-30, 2004. Minnesota Department of Natural Resources, Ecological Services Division, 1601 Minnesota Dr., Brainerd, MN 56401.

Table of Contents

List of Tables

List of Figures

Summary

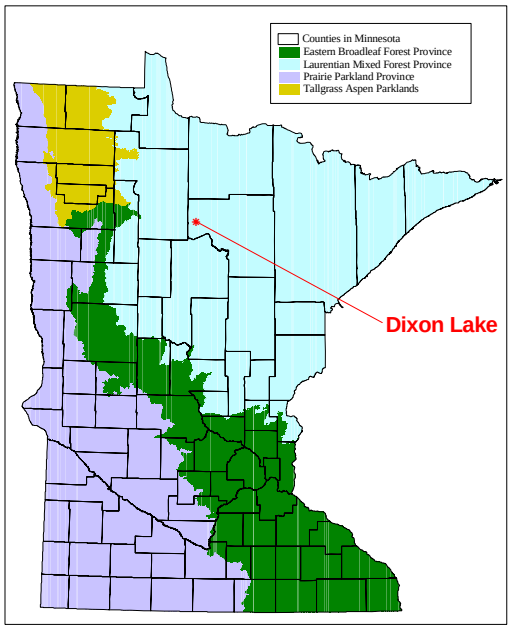
Dixon Lake, (DOW 31-0921-00), Itasca County, Minnesota is an example of a northern lake with lower than average summer clarity. Differences in water depth and clarity between the north and south basin are reflected in the differences in aquatic plant distribution and abundance between those basins. Wild rice is the dominant emergent plant and is most abundant in protected shallow bays of the north basin. Lower water clarity limits submerged vegetation to water depths less than ten feet. During spring and early summer, the submerged plant community is dominated by the non-native, curly-leaf pondweed (*Potamogeton crispus*). In the shallow north bay, curly-leaf forms dense beds but is infrequent in the southern basin. Common native submerged plants include species that are tolerant of lower light levels, such as flat-stem pondweed (*Potamogeton zosteriformis*), narrow-leaf pondweed (*Potamogeton* spp.) and star duckweed (*Lemna trisulca*).

Introduction

Description of Survey Lake

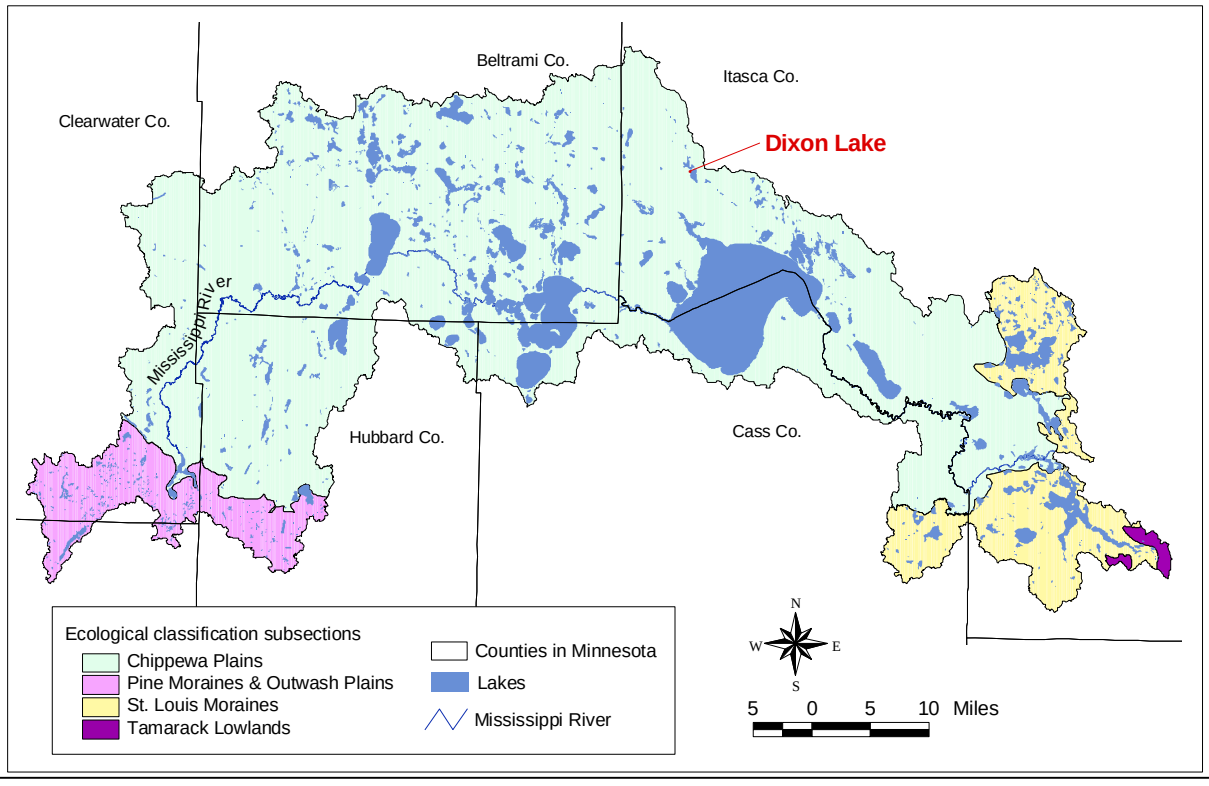
Dixon Lake (DOW 31-0921-00) is located about 40 miles northwest of the city of Grand Rapids in Itasca County, Minnesota. It occurs within ecological region known as the Laurentian Mixed Forest Province (Fig. 1).

Figure 1: Location of Dixon Lake in Minnesota.



The lake lies at the northern edge of the Mississippi River Headwaters Watershed within the ecological subsection called the Chippewa Plains. The Mississippi River is the major river running through the Chippewa Plains. The headwaters is just to the south in the Pine Moraines and Outwash Plains Subsection. Two large bodies of water are present - they are Lake Winnibigoshish (a reservoir) and Cass Lake. The drainage network throughout the subsection is poorly developed due to the age and characteristics of the landforms. The Third River flows

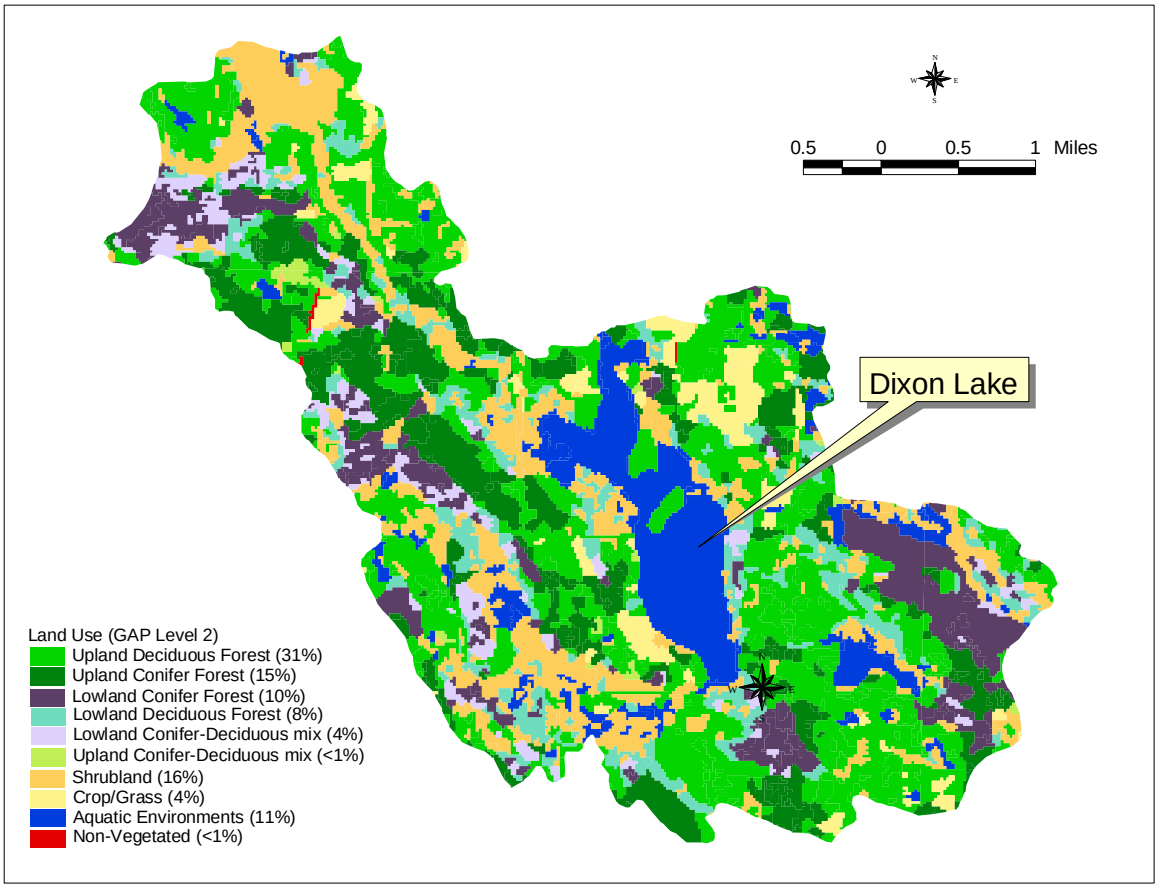
Figure 2. Location of Dixon Lake within the Mississippi River Headwaters Watershed.



south from Dixon Lake to Lake Winnibigoshish and then the Mississippi River drains the watershed to the southeast (Fig. 2).

The sub-watershed of Dixon Lake is a mix of upland and lowland deciduous forest, upland and lowland coniferous forest, and shrubland (Fig. 3).

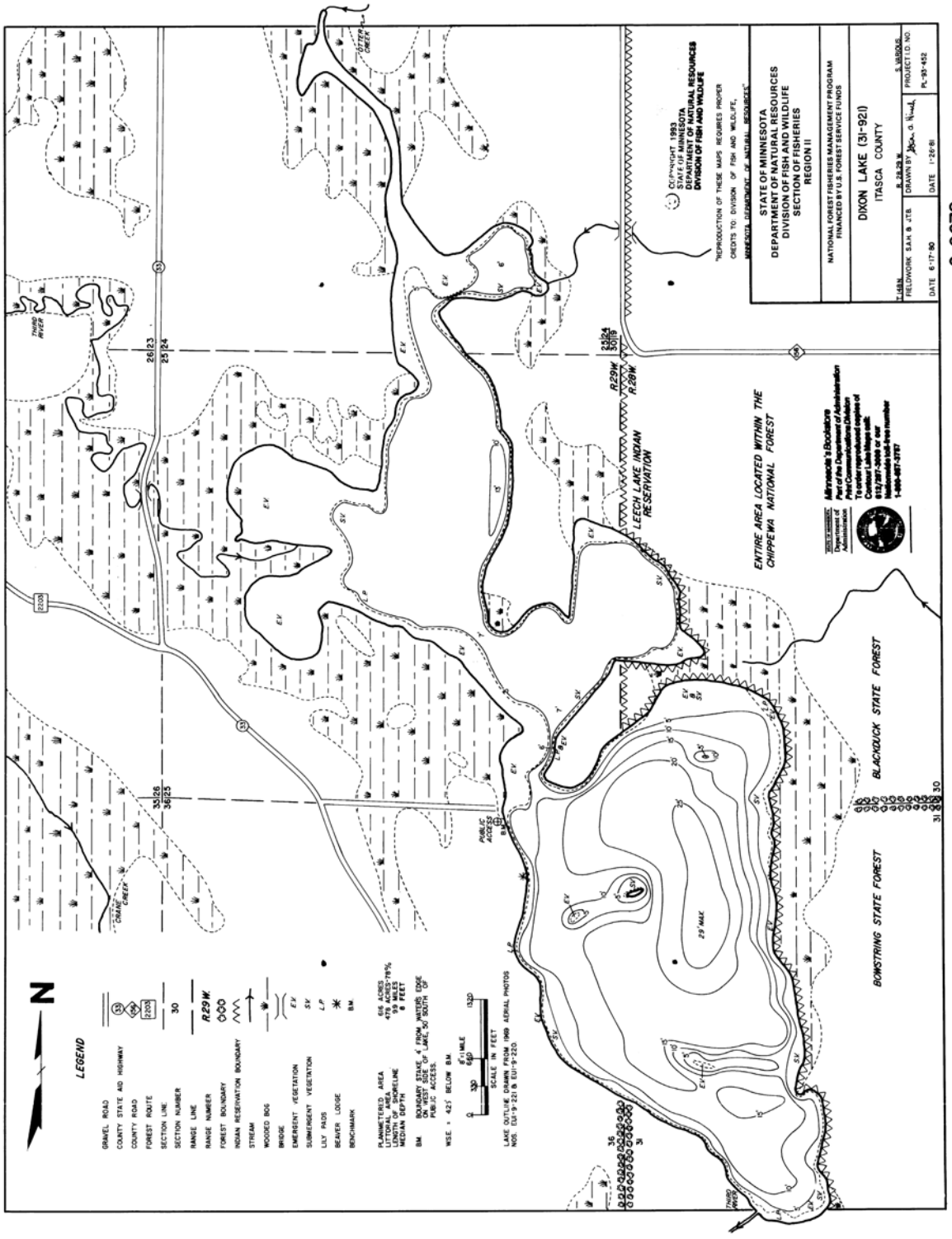
Figure 3: Land Use of sub-watershed containing Dixon Lake.



The surface area of Dixon Lake is about 616 acres and it includes two basins (Fig. 4). The north basin is shallow with a maximum depth of thirteen feet and the south basin has a maximum depth of 29 feet. Overall, 80 percent of Dixon Lake is less than 15 feet deep. Dixon is a hardwater lake and classified as eutrophic with moderate to high nutrients (MPCA 2003). Previous surveys indicate mid-summer algal blooms frequently occur on Dixon Lake.

Dixon Lake is entirely within the Chippewa National Forest but shoreland ownership includes Leech Lake Indian Reservation, Bowstring State Forest, Blackduck State Forest and private lands. Residential homes occur on the northeast and southwest upland shores. A public access is located between the north and south basin on the west shore (Fig. 4).

Figure 4: Hydrologic contour map of Dixon Lake, Itasca County, Minnesota.



Vegetation Survey Objectives

The purpose of the 2004 survey of Dixon Lake is to describe the current aquatic plant community including:

1) Estimate the maximum depth of rooted vegetation
2) Estimate the percent of the lake occupied by rooted vegetation
3) Record the aquatic plant species that occur in the lake
4) Estimate frequencies of occurrence of individual species
5) Develop maps of the distribution of the common species

Data from the 2004 vegetation surveys can be used to monitor annual changes in the native and exotic plant species composition and may also be used to guide vegetation management decisions.

Methods

Point-Intercept Survey

A Point-Intercept vegetation survey of Dixon Lake was conducted on June 29-30, 2004 following the methodology described by Madsen (1999). At a minimum, we wanted to sample 100 points within the vegetated zone and place sample point no further than 100 meters apart for mapping purposes. Sample points were established in using ArcView GIS program using a 80 meter by 80 meter grid across the lake surface (Fig. 5). In the field, surveyors decided not to sample in depths greater than 25 feet because they consistently were not finding vegetation beyond a depth of 9 feet. As a result, 325 sites were actually sampled and 217 of those fell within the vegetated zone from shore to a depth of 9 feet.

Survey waypoints were created and downloaded into a Garmin GPS. The GPS unit was used to navigate the boat 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 eight feet and an electronic depth finder in water depths greater than eight feet. The surveyors recorded all plant species found within a one meter squared 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 surface (Fig. 6). If non-native species were present, surveyors recorded whether or not the non-native plants formed surface mats at that site.

Nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for most plant species.

Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each species as the number of sites in which a species occurred divided by the total number of sample sites.

Figure 5. 2004 Vegetation Survey Points on Dixon Lake, Itasca County, Minnesota.

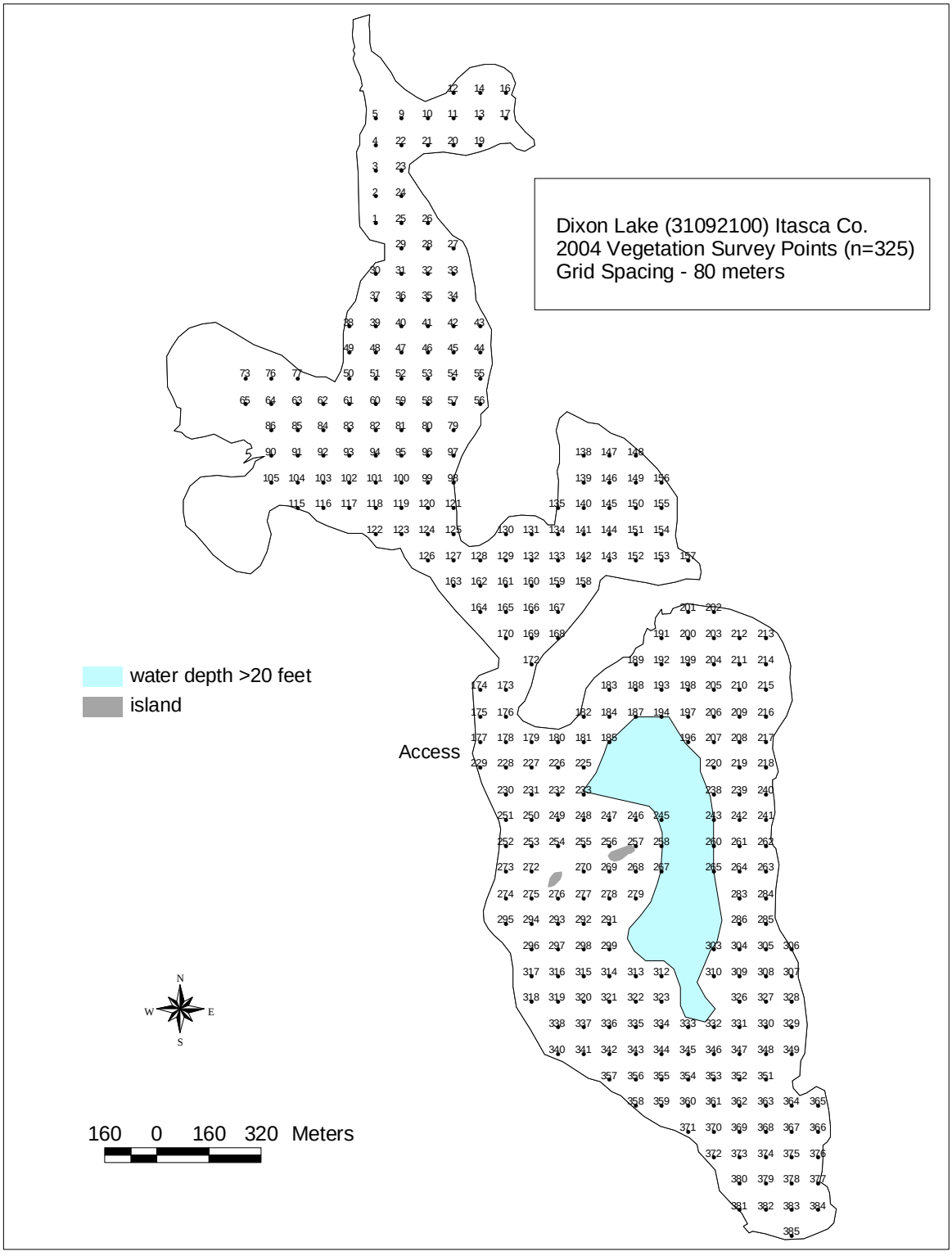


Figure 6. Rake used to sample vegetation

Frequency = number of sites in which species occurred

Total number of sample sites

Example:

There were 217 sample sites within the shore to 9 feet zone.

Curly-leaf pondweed occurred in 95 of those sample sites.

Frequency of curly-leaf pondweed = 95/217 = 44 percent

Frequency was calculated for the entire vegetated zone (0 to 10 feet) and sampling points were also grouped by water depth and separated into five depth zones for analysis: 0 to 5 feet, and 6 to 10 feet, 11 to 15 feet, 16 to 20 feet and 21 to 25 feet.

Plant Bed Delineation

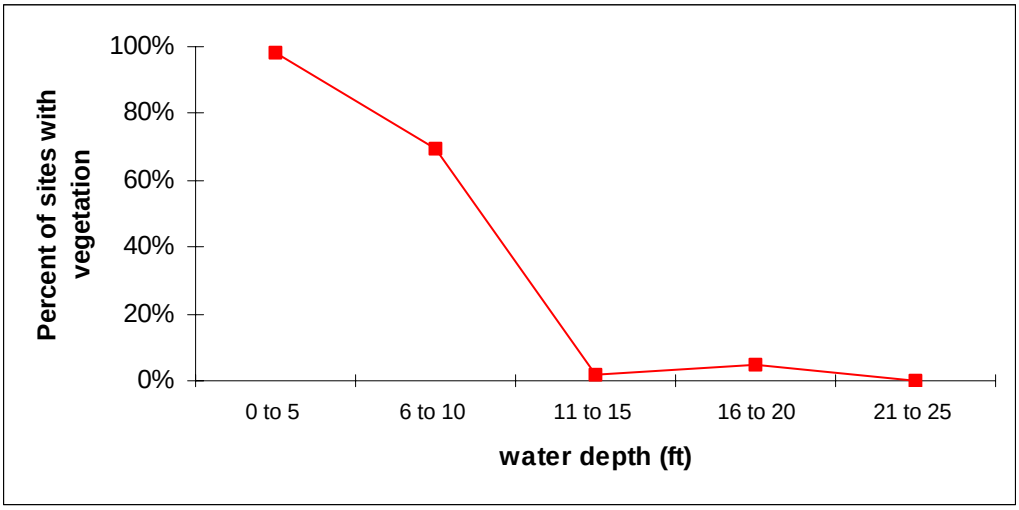
The boundaries of major plant beds were estimated using the results of the point-intercept survey and from review of 2003 aerial photographs. This provided a general estimation of plant bed location and size but detailed mapping of plant beds using GPS was not conducted.

Results / Discussion

Maximum depth of vegetation and percent of lake with vegetation.

In Dixon Lake, vegetation was most abundant in water depths less than six feet where 98 percent of the sites contained vegetation (Fig. 7). In six to nine feet of water, 70 percent of the sites were vegetated. In depths greater than nine feet, a few sites contained duckweed (*Lemna triculca*) but these plants are not anchored to the lake bottom and drift through the water column.

Figure 7. Plant abundance vs. water depth, Dixon Lake, Itasca Co. (31-0921-00) June 29-20, 2004.



Types of aquatic plants found

Thirty-one species of aquatic plants were located during the 2004 survey, including nineteen submerged, three floating-leaved and nine emergent (Table 1). Three native wetland emergent plant species were recorded but a thorough survey of the wetland plant community was not conducted. The non-native species, curly-leaf pondweed (*Potamogeton crispus*) was verified for the first time during this survey.

The major emergent and floating-leaf beds can be seen in the 2003 aerial photograph of Dixon Lake (Fig. 8) and the approximate locations of all major plant beds are outlined in Figure 9.

Emergent plants

Wild rice (*Zizania palustris*) (Fig. 10) formed extensive beds in the shallow bays of the northern basin, was found in 23 percent of the surveyed sites and occurred from shore to a depth of five feet. (Survey points in the northern bay and the eastern bays were omitted to avoid disturbing the wild rice beds with our motor).

Hardstem bulrush (*Scirpus acutus*) was also common along the shoreline, occurred in eight percent of the surveyed sites and was found to a depth of three feet.

Table 1. Aquatic Plants of Dixon Lake, Itasca County, (31-0921-00), June 29, 30, 2004.

Frequency calculated for vegetated zone (shore to 9 feet depth)
Frequency = percent of sites in which species occurred
217 sample sites

Life Forms	Common Name	Scientific Name	Frequency
SUBMERGED -ANCHORED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants are rooted or anchored to the lake bottom.	Curly-leaf pondweed	*Potamogeton crispus (v)*	44
	Flatstem pondweed	*Potamogeton zosteriformis (v)*	34
	Narrowleaf pondweeds	*Potamogeton freisii** (v)*	17
		*Potamogeton obtusifolius** (v)*	
	Northern watermilfoil	*Myriophyllum sibiricum (v)*	10
	Sago pondweed	*Stuckenia pectinata (v)*	6
	Muskgrass	*Chara sp. (v)*	5
	Water stargrass	*Zosterella dubia (v)*	3
	Water marigold	*Megaladonta beckii (v)*	3
	Clasping leaf pondweed	*Potamogeton richardsonii (v)*	2
	Canada waterweed	*Elodea canadensis*	2
	White-stem pondweed	*Potamogeton praelongus*	1
	Bushy pondweed	*Najas flexilis (v)*	<1
	Marestail	*Hippuris vulgaris*	<1
	Large-leaf pondweed	*Potamogeton amplifolius*	present*
SUBMERGED-NOT ANCHORED These plant grow under the water surface but are not firmly anchored to the lake bottom and may drift with water currents.	Star duckweed	*Lemna trisulca*	40
	Coontail	*Ceratophyllum demersum*	10
	White water buttercup	*Ranunculus sp.*	6
	Greater bladderwort	*Utricularia vulgaris (v)*	1
	Water moss	*Drepanocladus sp.*	1
FLOATING These plants are rooted in the lake bottom and have leaves that float on the water surface. Many have colorful flowers that extend above the water	Yellow waterlily	*Nuphar variegata (v)*	12
	White waterlily	*Nymphaea odorata (v)*	3
	Floating-leaf pondweed	*Potamogeton natans (v)*	present
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.	Wild Rice	*Zizania palustris (v)*	23
	Bulrush	*Scirpus acutus (v)*	8
	Needlerush	*Eleocharis acicularis*	1
	Spikerush	*Eleocharis sp. (v)*	present
	Arrowhead	*Sagittaria cuneata*** (v)*	<1
	Water horsetail	*Equisetum fluviatile*	present
	River bulrush	*Scirpus fluviatile*	present
	Cattail	*Typha sp.*	present
	Giant cane	*Phragmites australis*	present
WETLAND EMERGENTS	Blue flag iris	*Iris versicolor*	present
	Sedges	*Carex sp.*	present
	Sweetflag	*Acorus calamus*	present

* present indicates plant was found during survey but did not occur within a specific sample site.

** At least two narrow-leaf pondweeds (*Potamogeton freisii* and *Potamogeton obtusifolius*) were identified in the lake but species were not distinguished at individual sample sites. Therefore, "POSN" = narrowleaf pondweed group (*Potamogeton* spp.) was entered into database).

*** *Sagittaria cuneata* was identified in the lake but it is not known whether sterile, submerged forms were *Sagittaria cuneata* of another species. Therefore, *Sagittaria* sp. was entered into database for sterile forms.

Figure 8. 2003 Aerial photograph of Dixon Lake, Itasca Co., MN (Source: Farm Service Administration).

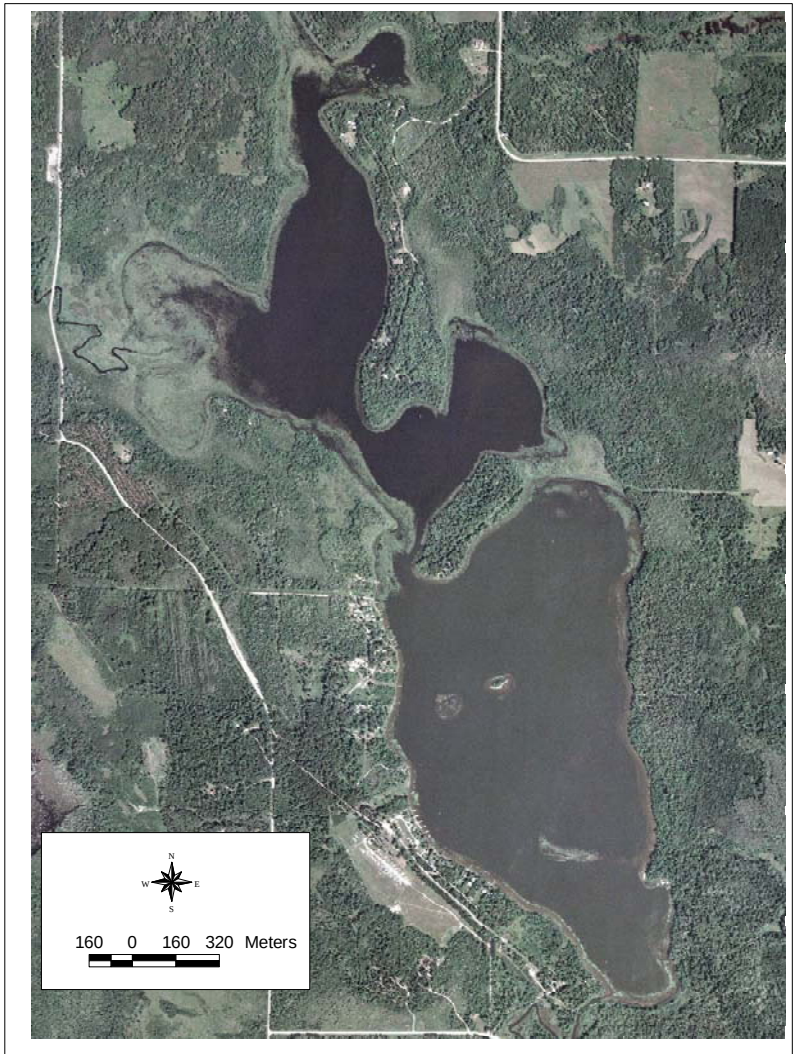
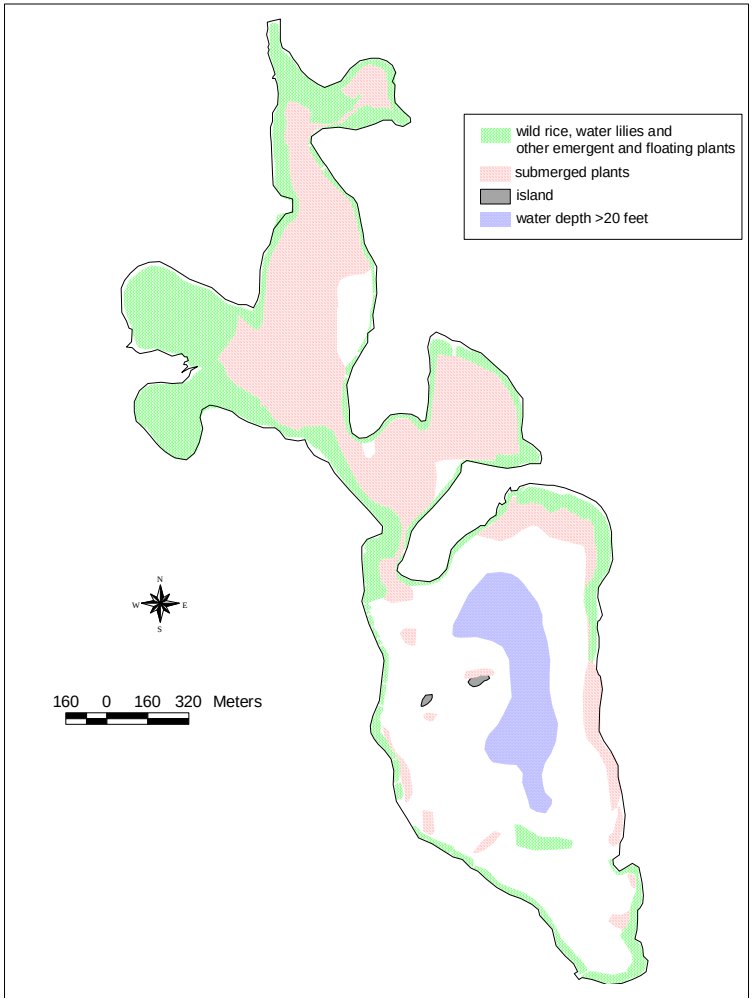


Figure 9. Major plant beds in Dixon Lake, Itasca Co., MN June, 2004.



Floating-leaved plants

Yellow waterlily (*Nuphar variegata*) was the most common floating-leaf plant, was found in 12 percent of the sample sites (Table 1) and occurred to a depth of six feet. White waterlily (*Nymphaea tuberosa*) and floating-leaf pondweed (*Potamogeton natans*) were also present but were restricted to depths less than five feet.

Figure 10. Wild rice (*Zizania palustris*) and White waterlily (*Nymphaea odorata*)

Submerged plants

Submerged plants primarily occurred to a depth of nine feet, and a few free-floating, submerged species were infrequently found at deeper depths (Fig. 7). The shallow north basin contained extensive submerged plant beds but in the south basin, submerged plants were less common and found only in isolated areas of shallow water (Fig. 10).

The non-native Curly-leaf pondweed (Fig. 11 and 12) was the most common submerged species. Within the vegetated zone (shore to nine feet), it was found in 44 percent of the survey sites and formed dense mats at 13 percent of the sites (Fig 13). Curly-leaf pondweed was mostly restricted to the north basin of Dixon Lake and within that basin it occurred in 65% of the sites and formed dense mats at 20% of the sites (Fig. 13).

Figure 12. Bed of curly-leaf pondweed (*Potamogeton crispus*)

Figure 11. Curly-leaf pondweed (*Potamogeton crispus*) (photo source: Univ of Florida Center for Aquatic and Invasive Plants

Curly-leaf occurred in one to eight feet of water and was most abundant in six to eight feet where it formed dense beds (Fig. 14).

Figure 13. Distribution of Curly-leaf pondweed (Potamogeton crispus) in Dixon Lake, June 29-30, 2004.

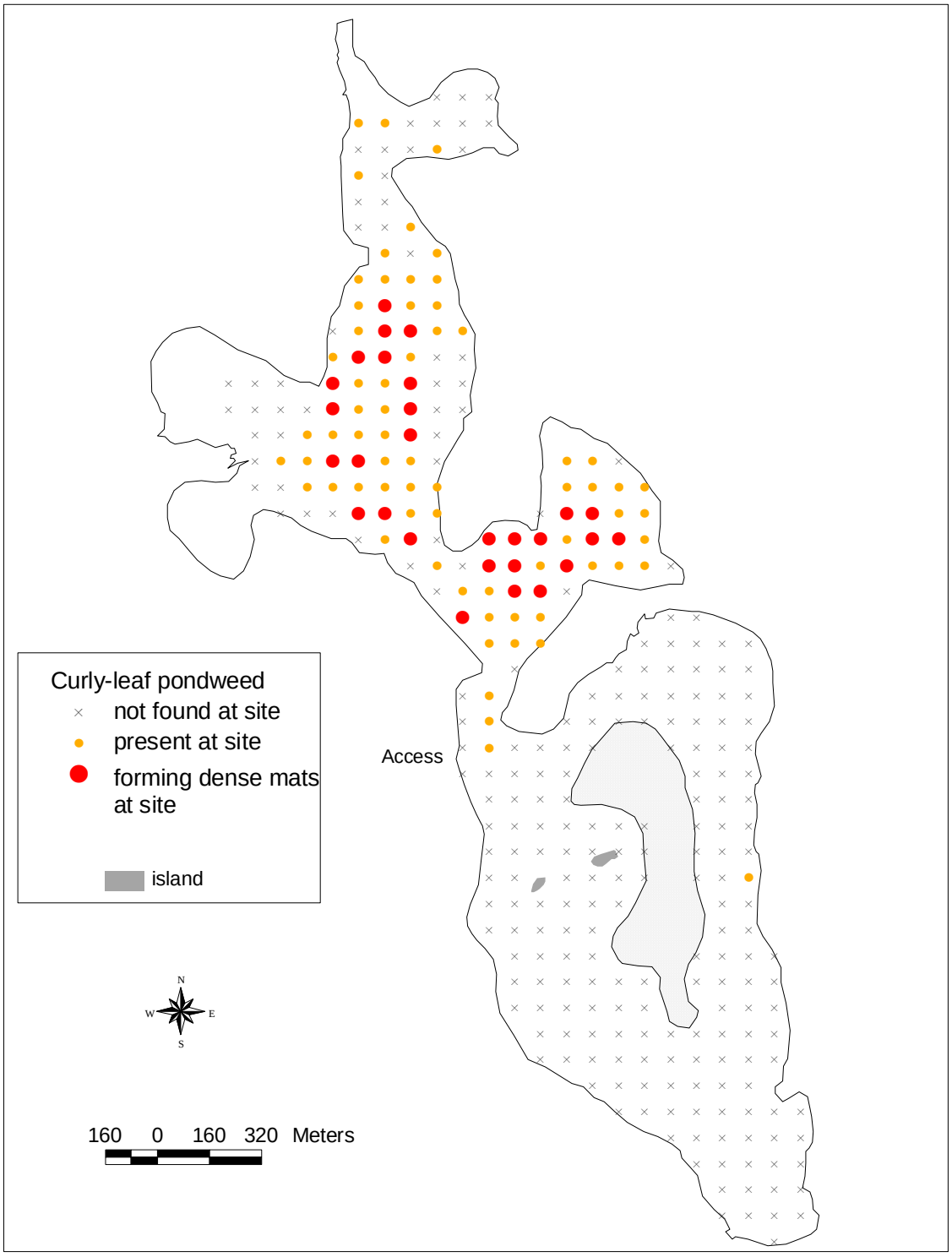
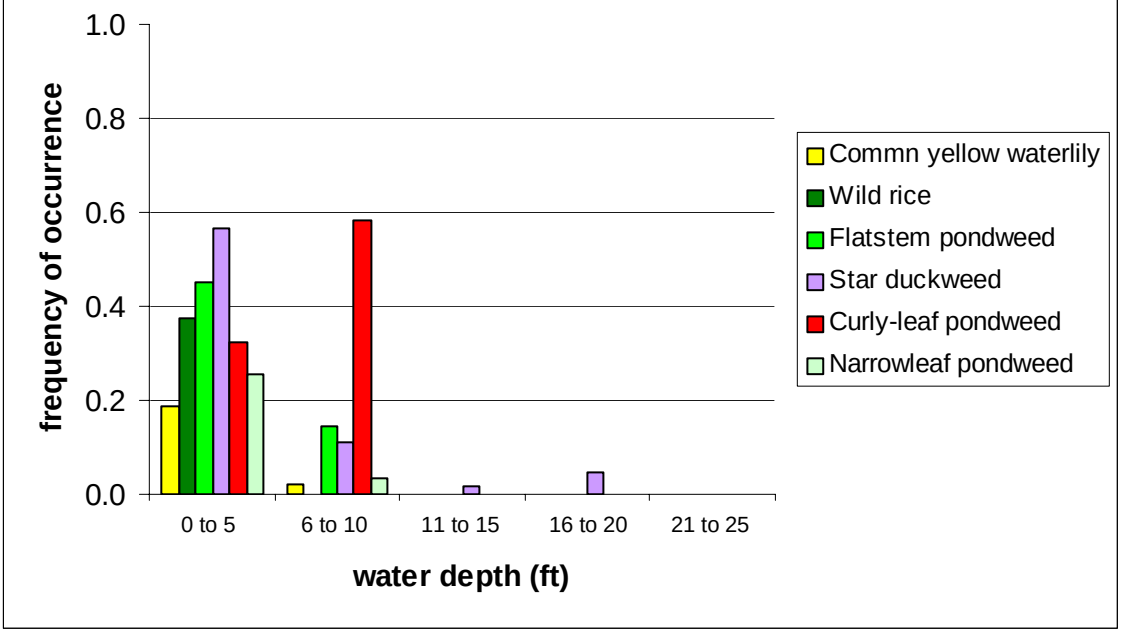


Figure 14. Frequency of common aquatic plants vs. water depth. Dixon Lake, Itasca Co. (31-0921-00), June 29-30, 2004.



Other submerged species that were common in Dixon Lake included Flat-stem pondweed (*Potamogeton zosteriformis*) (Fig. 15), Star duckweed (*Lemna trisulca*), and narrow-leaf pondweeds (*Potamogeton freisii and P. obtusifolius*). These species occurred in 40, 34, and 17 percent of the sample sites, respectively. Northern watermilfoil (*Myriophyllum sibiricum*) and coontail (*Ceratophyllum demersum*) each occurred in 10 percent of the sites. All other submerged species occurred in less 10 percent of the sample sites. Unlike curly-leaf pondweed, which was most common depths of six to eight feet, all native submerged species were most common in depths less than six feet (Fig. 14).

Figure 15. Flat-stem pondweed (*Potamogeton zosteriformis*) and muskgrass (*Chara* sp.).

Star duckweed was found throughout the vegetated zone (Fig. 16) and occurred to a maximum depth of 19 feet. However, it was most often found in depths less than ten feet. Because this species is does not root into the substrate, it easily drifts with the water current and therefore was found at greater depths than rooted plants.

Flatstem pondweed grew to a depth of seven feet and narrow-leaf pondweed occurred to a depth of six feet. These species were evenly distributed around the shoreline at this depth

(Fig. 16). Coontail and northern milfoil were only found to a depth of six feet and were not widely distributed in the lake (Fig. 16).

The total number of species found at a particular sample site in Dixon Lake ranged from zero to nine, with the highest numbers of species found at near-shore sites where water depth was less than five feet (Fig. 17). Submerged species, such as large-leaf pondweed (*Potamogeton amplifolius*), white-stem pondweed (*P. praelongus*) and mare's tail (*Hippuris vulgaris*) are less tolerant of low light conditions and are typically found in lakes with high water clarity. Though these species were present in Dixon Lake, they occurred very infrequently and were likely restricted to shallow sites where sufficient light was available for their growth.

The 2004 vegetation survey gives a "snapshot" of the Dixon Lake conditions during late spring and early summer. Curly-leaf pondweed typically dies back by mid-summer and when that happens in Dixon Lake, it is expected that native species may increase in distribution, though they are unlikely to expand into deeper water. Curly-leaf die-offs are often associated with algal blooms as nutrients from the dying vegetation is released and made available to the algae. This would further decrease available light in the lake and prevent native vegetation from growing beyond their current depth limits.

Factors influencing the Dixon Lake plant community and monitoring change over time

The lake conditions of Dixon Lake greatly influence the types and abundance of aquatic plant found there. Wild rice, for example, grows best in waterbodies with flowage and this condition is met in Dixon Lake. If changes are made to the flow and/or water level regime of Dixon Lake, it is expected that plants like wild rice would be affected.

Light availability is one of the greatest factors that influences submerged vegetation. Curly-leaf pondweed and the common native submerged species of Dixon Lake are plant species that are moderately tolerant of lower light conditions and do not have specific habitat requirements. For this reason, they are common in many Minnesota lakes because they are able to grow in a variety of conditions.

Comparison of the spring 2004 survey with historical vegetation surveys is not straight forward because few previous surveys exist, and they were conducted in late summer with different methods. However, some general comparisons can be made.

Review of historical surveys does not show much change in the emergent plant community. Wild rice has historically been an abundant plant in Dixon Lake, particularly in the north half of the lake and bulrush has been recorded as scattered around the lake (Mn Dept. of Conservation 1961, MnDNR 1979). Over the past 45 years, the maximum rooting depth of submerged plants in Dixon Lake has consistently been reported as ten feet and there are frequent notes about abundant algal growth (Mn Dept of Conservation 1959, MnDNR 1979). From this review of patchy historical surveys, it appears that curly-leaf pondweed has displaced some of the native species that were once more common. It is impossible to determine exactly when curly-leaf invaded the lake, but it has only been reported within the last few years. Flat-stem pondweed and star duckweed were both common in 2004, but only flat-stem pondweed was reported as common in previous surveys. Several other native species such as muskgrass (*Chara* sp.),

Figure 16. Distribution of common submerged plants, Dixon Lake, Itasca County, (31092100), June 29-30, 2004.

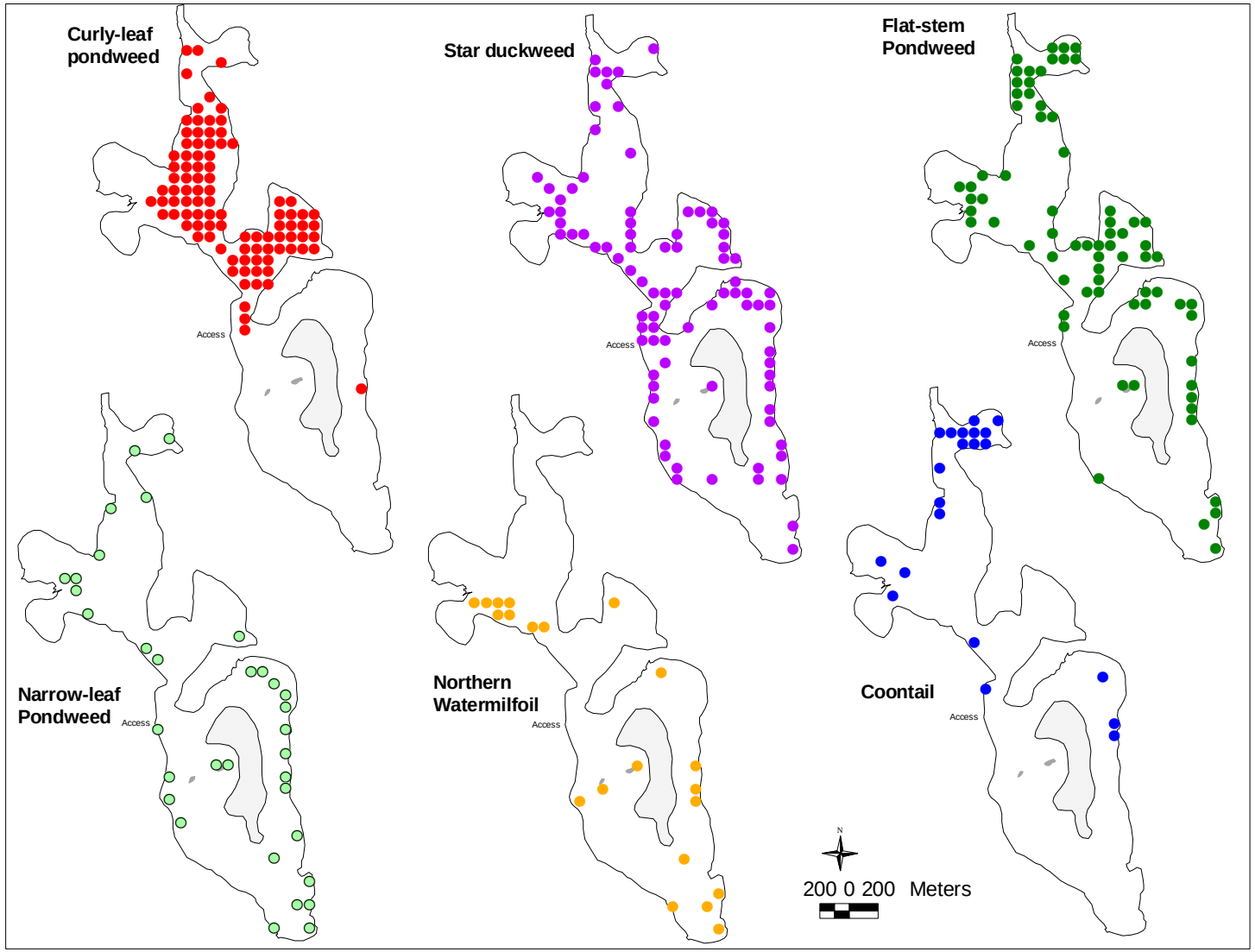
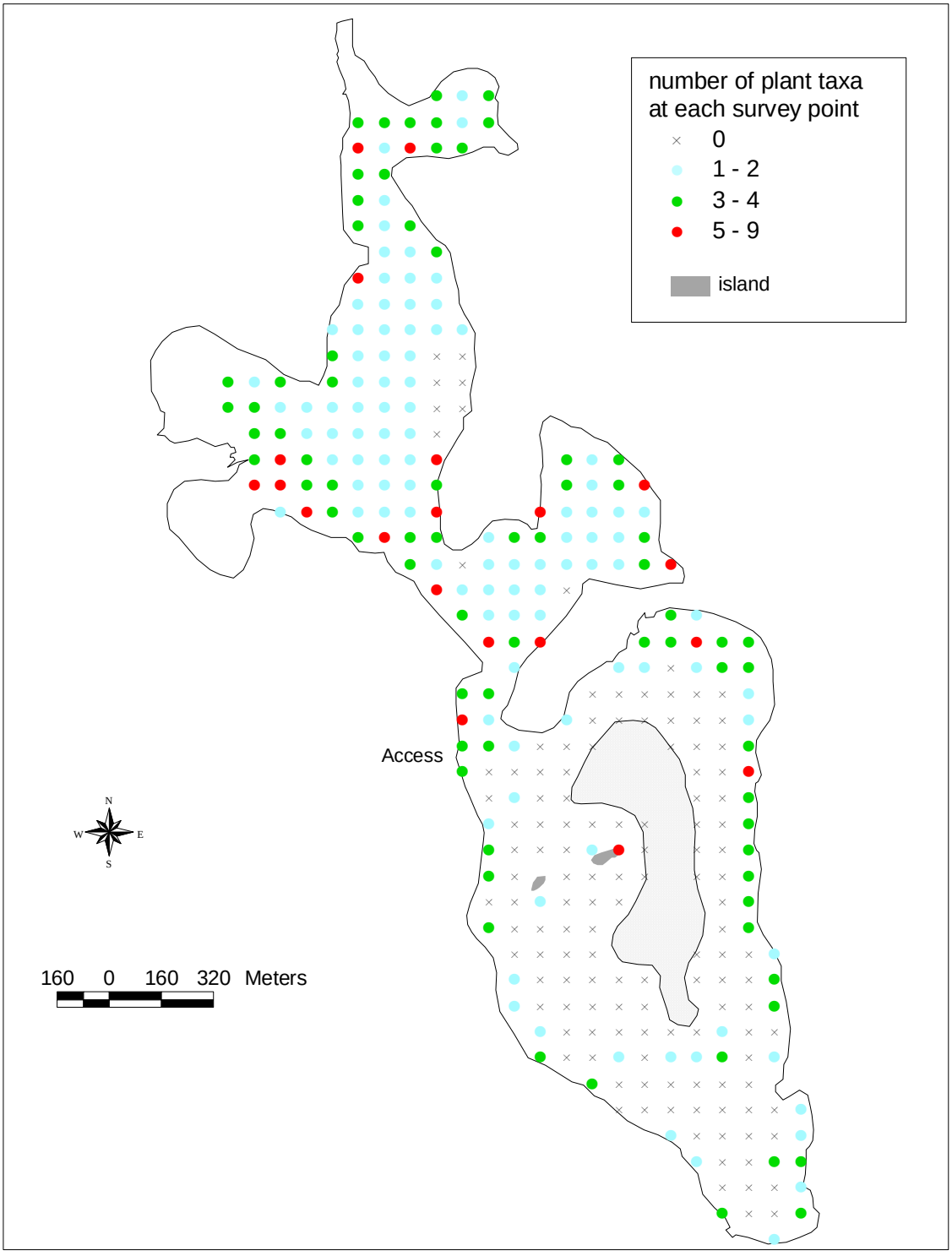


Figure 17. Number of plant species occurring at each survey site on Dixon Lake, 2004.



floating-leaf pondweed (*Potamogeton natans*) and coontail were recorded as common in previous surveys but were uncommon in 2004. Bushy pondweed (*Najas flexilis*) was reported as common in previous surveys but this species has a later growing season and therefore it's absence during the spring 2004 survey is not suprising; it may still be present in the lake but not during the spring.

Data collected during the 2004 survey can be compared to future quantitative surveys of Dixon Lake to better estimate how the plant community may be changing. Monitoring changes in aquatic plant communities can help reflect changes in the overall water quality of the lake and watershed as well as specific changes in the non-native and native species abundance.

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.

Hotchkiss, N. 1932. Marsh and aquatic vegetation of Minnesota and its value to waterfowl. U.S. Dept. of Agriculture. Bureau of Biological Survey. Division of Food Habits. Washington D.C.

Madsen, J. D. (1999). "Point intercept and line intercept methods for aquatic plant management." *APCRP Technical Notes Collection* (TN APCRP-M1-02). U.S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/aqua

Minnesota Department of Conservation. 1959. Game Lake Survey of Dixon Lake, Itasca County, August 7-10, 1959 by R. Holmes and E. Kupischke. In: Minnesota Dept. of Natural Resources, Division of Fisheries Lake files. 500 Lafayette Rd., St. Paul, MN 55155.

Minnesota Dept. of Natural Resources. 1979. Lake Survey Summary for Dixon Lake, Itasca County, July 30-Aug 3, 1979. Division of Fisheries Lake files. 500 Lafayette Rd., St. Paul, MN 55155.

MPCA. 2003. Minnesota Pollution Control Agency website. Lake Water Quality Assessment Program. http://data.pca.state.mn.us/cgi-bin/lkwq95ReadFull.pl?lakeid=18-0374

