Aquatic Vegetation Survey of

Roosevelt Lake (DOW #11-0043-00)

Lawrence Lake (DOW #11-0053-00)

Cass County, Minnesota

2008

Channel between Roosevelt Lake and Lawrence Lake. 2008

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Summary

Aquatic vegetation surveys of Roosevelt Lake (11-0043-00) and Lawrence Lake (11-0053-00), Cass County, Minnesota, were conducted in July and September 2008. Surveys included a lakewide assessment of vegetation and water depths at over 1300 sample stations, characterization of shoal substrate types, and mapping of emergent and floating-leaf plant beds.

The aquatic plant communities of Roosevelt and Lawrence lakes are similar to those found in other hard water Cass County lakes. Thirty-eight native aquatic plant species were found including eight emergent, six floating-leaved, two free-floating and 22 submerged species. Non-native aquatic plant species were not found.

Emergent and floating-leaved plants were generally restricted to depths of five feet and less. Within that depth zone, 27 percent of the Roosevelt Lake sites and 64 percent of the Lawrence Lake sites contained at least one emergent or floating-leaf plant. Approximately 69 acres of bulrush (*Scirpus* sp.), and 26 acres of waterlily beds (*Nymphaea odorata, Nuphar variegata)* were mapped in these lakes.

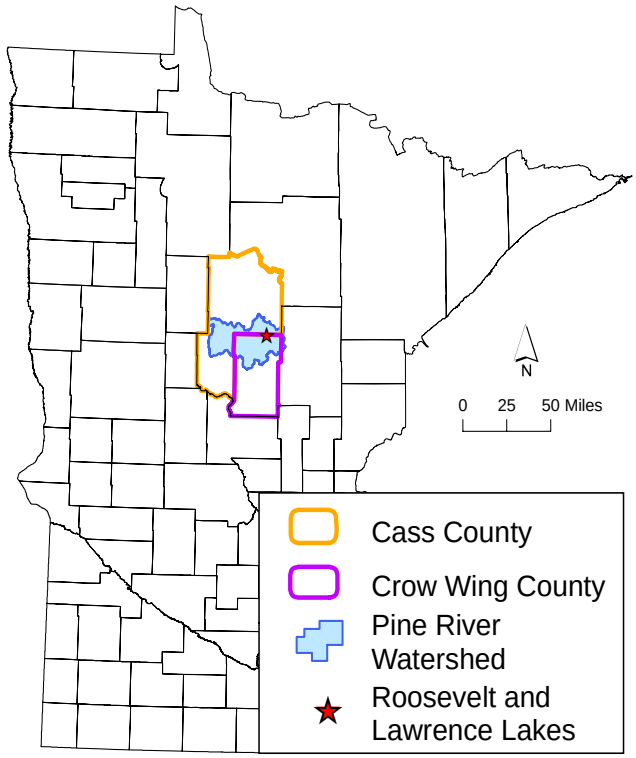
Submerged plants occurred to a maximum depth of 25 feet in Roosevelt Lake but were most common in depths from shore to 20 feet, where 80 percent of the sites contained vegetation. In Lawrence Lake submerged plants occurred to a maximum depth of 20 feet but were most common in depths from shore to 15 feet, where 72 percent of the sites contained vegetation. The most common submerged plant species were muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), flat-stem pondweed (*Potamogeton zosteriformis*), Fries' pondweed (*Potamogeton friesii*), northern watermilfoil (*Myriophyllum sibiricum*) and several broadleaf pondweeds (*Potamogeton* spp.).

Introduction

Roosevelt and Lawrence lakes are connected water bodies, located in north-central Minnesota on the border of Cass and Crow Wing counties (Figure 1). The lakes lie in the northeast corner of the Pine River Watershed.

About 150 lakes in the Pine River Watershed are at least 50 acres in size and Roosevelt Lake is the sixth largest with a surface area of 1,510 acres and nine miles of shoreline. It is an elongated, six-mile long water body, with a northeast to southwest orientation (Figure 2). The lake has distinct north and south basins that are connected by a narrow channel. The State Highway 6 Bridge crosses the lake at these narrows. There are several smaller bays that branch from the southern basin. The northern two-thirds of the lake are within Cass County and the south end is in Crow Wing County.

Figure 1. Location of Roosevelt and Lawrence Lakes in Cass County, MN.



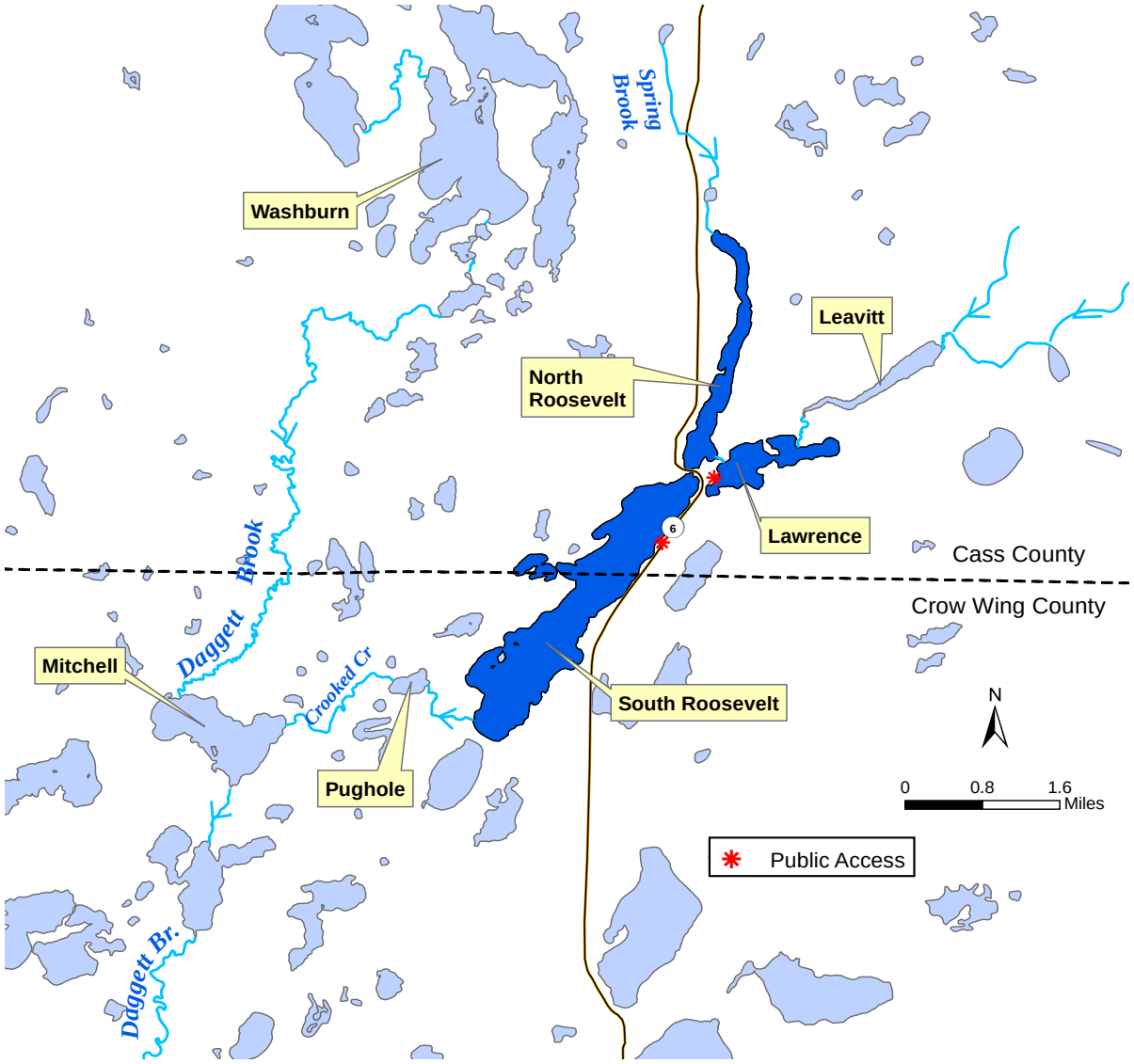
Lawrence Lake is located on the east side of Roosevelt Lake and a navigable channel joins the two lakes. Lawrence Lake is a smaller waterbody with a surface area of 225 acres and five miles of shoreline. It has two distinct basins that are connected by a shallow channel. Lawrence Lake is entirely within Cass County.

Spring Brook flows into the north end of Roosevelt Lake and Lawrence Lake receives flow from Leavitt Lake (Figure 2). Water flows south and southwest through Roosevelt Lake. An outlet on the south end of Roosevelt Lake drains to Pug Hole Lake and continues through Crooked Creek to Mitchell Lake (Figure 2). Flow continues south through Daggett Brook and a series of lakes to the Pine River and eventually to the Mississippi River.

Land use in the Pine River Watershed is predominantly forests and wetlands with numerous lakes. The shorelines of Roosevelt and Lawrence lakes are under private ownership except for about a half mile of public land on the southwest shore of Roosevelt Lake. The shorelines are developed with residential homes and resorts. Public accesses are located on the west side of Lawrence Lake and on the southeast side of Roosevelt Lake (Figure 2).

Roosevelt Lake has a maximum depth of 129 feet and it has a very narrow band of shallow water with only 26 percent of the lake basin less than 15 feet in depth (Figure 3). Lawrence Lake has a maximum depth of 71 feet and 39 percent of the lake basin less than 15 feet in depth. This

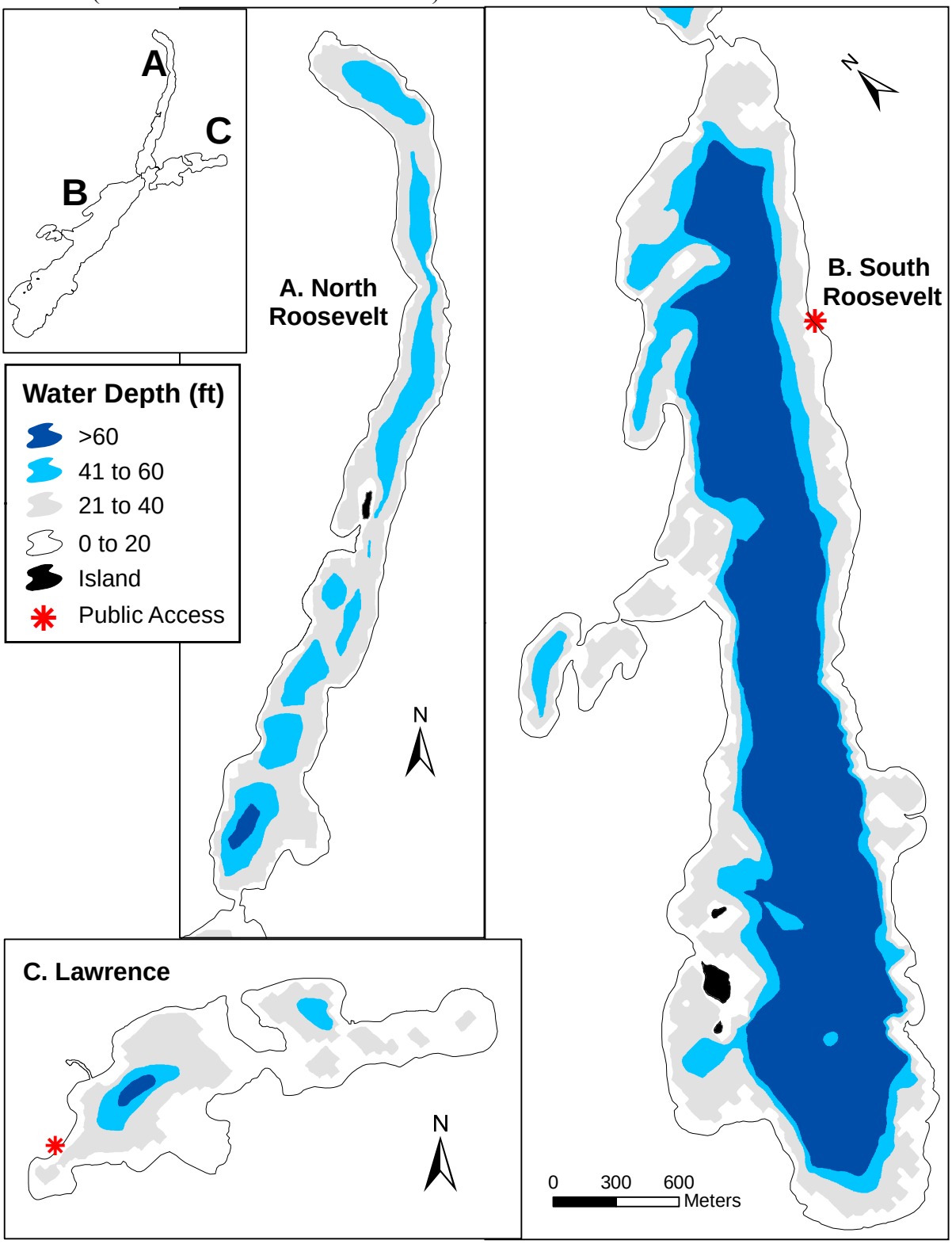
Figure 2. Inflow and outflow of Roosevelt and Lawrence Lakes.



shallow area that rings the lake shoreline is referred to as the littoral zone. Rooted submerged plants are often common in the littoral zone if adequate sunlight reaches the lake bottom.

Roosevelt and Lawrence Lakes are mesotrophic lakes, or moderately nutrient enriched, with moderate summer water clarity. The Secchi disc (Figure 4) transparency measures the depth to which a person can see into the lake and provides a rough estimate of the light penetration into the water column. Between 1994 and 2007, the mean summer water clarity, as measured by Secchi disc readings, was about 12 feet in Roosevelt Lake and about 11 feet in Lawrence Lake (MPCA, 2008). As a general rule, sunlight can penetrate to a depth of two times the Secchi depth and aquatic plants can grow to a depth of one and half times the Secchi depth. Based on

Figure 3. Depth contours of Roosevelt and Lawrence Lakes (20 ft contour based on 2008 data).



Secchi disc measurements alone, aquatic plants are expected to grow to about 17 to 18 feet in these lakes. Other factors that may influence the depth of plant growth include substrate type, wind fetch, and plant species composition.

Figure 4. Measuring Secchi Disc transparency

Previous vegetation surveys of Roosevelt and Lawrence Lakes found plants growing to depths of 10 to 15 feet with abundant plant growth described along the narrow bands of shallow water (MnDNR Fisheries Lake Files). More than 30 different aquatic plant species have previously been recorded in these lakes including: whitestem pondweed (*Potamogeton praelongus*), muskgrass (*Chara sp.*), coontail (*Ceratophyllum demersum*) and flat-stem pondweed (*Potamogeton zosteriformis*).

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2008 plant population of Roosevelt and Lawrence lakes. Specific objectives included:

1. Describe the shoal sediments of the lakes
2. Estimate the maximum depth of rooted vegetation
3. Estimate the percent of each lake occupied by rooted vegetation
4. Record the aquatic plant species that occur in the lakes
5. Estimate the abundance of common plant species
6. Develop distribution maps for the common plant species

Methods

Lakewide vegetation survey

Lakewide vegetation surveys of Roosevelt and Lawrence lakes were conducted on July 1, 2, 8, 9, 14, 21, and 22, 2008. A point-intercept survey method was used and followed the methods described by 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 40 meters apart, resulting in about two survey points per acre. In the field, surveyors did not survey sites that occurred in water depths greater than 25 feet. Surveyors did not survey several shallow sites in Lawrence Lake and around the southern islands in Roosevelt Lake because they either occurred in dense beds of emergent or floating-leaf vegetation or in shallow rocky areas. A total of 992 sites were surveyed in Roosevelt Lake and 351 sites were surveyed in Lawrence Lake (Figure 5, Table 1).

Two field crews, each consisting of two surveyors and one boat, conducted the survey. The GPS unit was used to navigate the boat to each sample point.

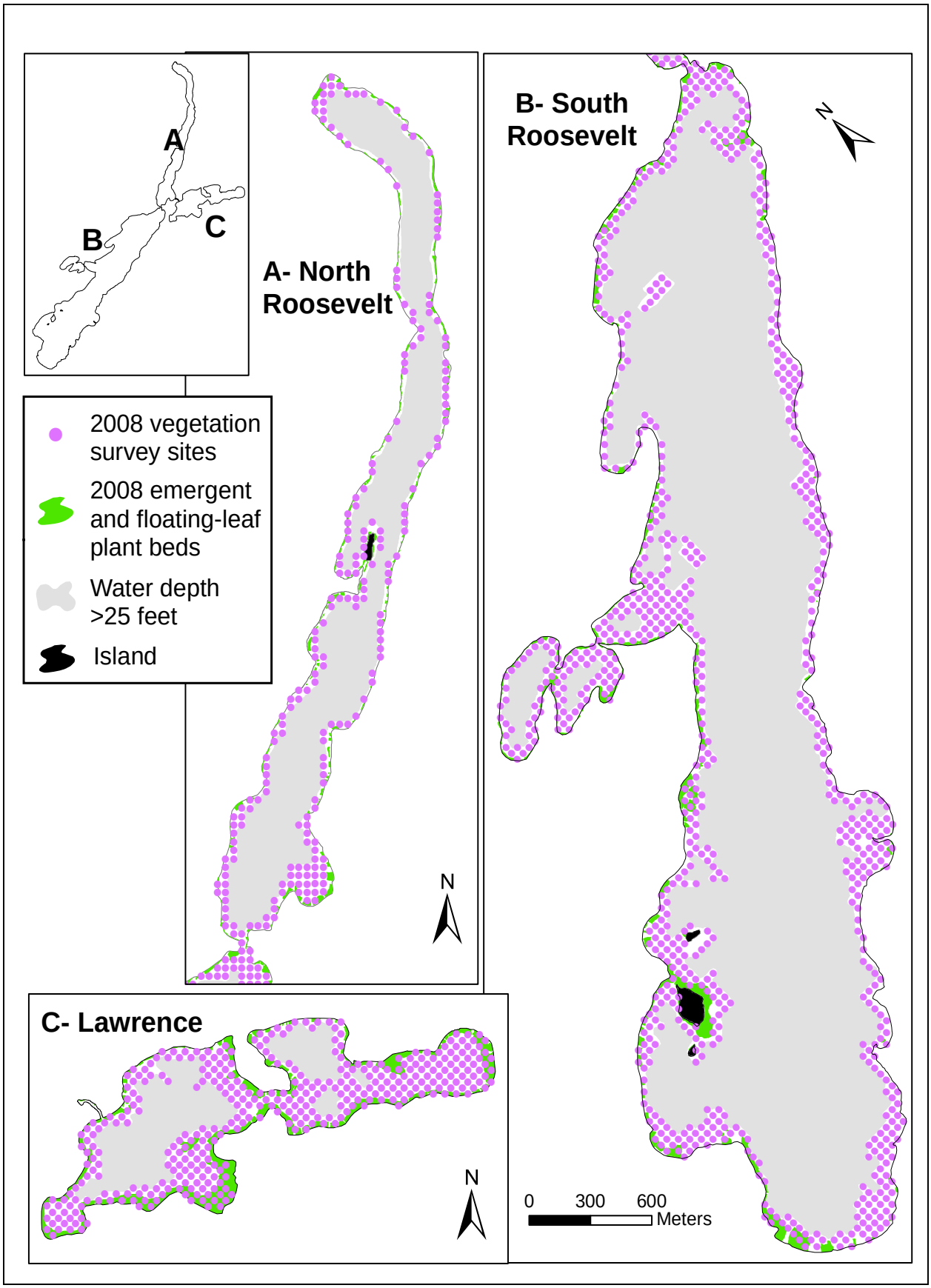


Table 1. Sampling effort by water depth.

Water depth interval	Roosevelt Lake	Lawrence Lake	Total
0 to 5	340	102	442
6 to 10	140	42	182
11 to 15	122	76	198
16 to 20	200	100	300
21 to 25	190	31	221
Total sample points	992	351	1343

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 depths greater than eight feet.

Surveyors recorded all plant species found within 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 surface (Figure 6). 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. Plant identification and nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for most plant species and are stored at the MnDNR in Brainerd.

Figure 6. Sampling rake.

At each sample site where water depths were seven feet and 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 depth 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.

Table 2. Substrate classes

muck	decomposed organic material
marl	calcareous 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
boulder	Diameter over 10 inches

Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each plant species as the number of sites in which a species occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 25 feet

and sampling points were also grouped by water depth and separated into five depth zones for analysis (Table 1).

> ***Example:*** In Roosevelt there were 992 samples sites.
> Muskgrass (*Chara* sp.) occurred in 377 sites.
> Frequency of Muskgrass in Roosevelt Lake = 377/992 (*100) = 38 %

Mapping floating-leaf and emergent vegetation beds
Beds of waterlilies and other emergents occur in near-shore areas of Roosevelt and Lawrence lakes. Field surveys to map floating-leaf and emergent vegetation were conducted in September 2008. Surveyors mapped these plant beds in the field by motoring around the perimeter of each bed and recording their track with a handheld GPS. Field data were uploaded to a computer and a GIS software program was used to estimate acreage.

Results

Shoal substrates
Hard substrates of sand, gravel, rubble and boulder were common in the shoal waters of Roosevelt Lake. Softer substrates of marl, silt and muck were found in the western bay and southwest shore of Roosevelt Lake. Lawrence Lake shoal substrates included a mix of hard and soft substrates, with soft substrates common in small bays (Figure 7).

Distribution of aquatic plants
Aquatic plants occurred around the entire perimeter of each lake. Roosevelt Lake had a narrow vegetated zone that, in many areas, extended lakeward only 35 meters (115 feet) (Figure 8). Lawrence Lake had a broader vegetated zone that, in some areas, extended 200 meters (656 feet) into the lake. Within the sampled area (shore to 25 feet zone), vegetation occurred in 61 percent of the Roosevelt Lake sites and in 46 percent of the Lawrence Lake sites.

Plant distribution by water depth
Plants were found to a maximum depth of 25 feet in Roosevelt Lake and to 20 feet in Lawrence Lake. Percent of vegetated sites decreased with increasing water depth (Figure 9). In Roosevelt Lake, vegetation was most common in the shore to 20 feet zone, where 80 percent of the sites were vegetated. This vegetated zone covers about 390 acres, or 26 percent of the lake. In depths greater than 20 feet, only seven percent of the Roosevelt Lake sites contained plants.

In Lawrence Lake, vegetation was common from shore to the 15 feet depth, where 72 percent of the sites contained plants. This area covers about 87 acres or 39 percent of Lawrence Lake. In depths greater than 15 feet, only one percent of the Lawrence Lake sites were vegetated.

Figure 7. Shoal water sediments of Roosevelt and Lawrence Lakes, 2008.

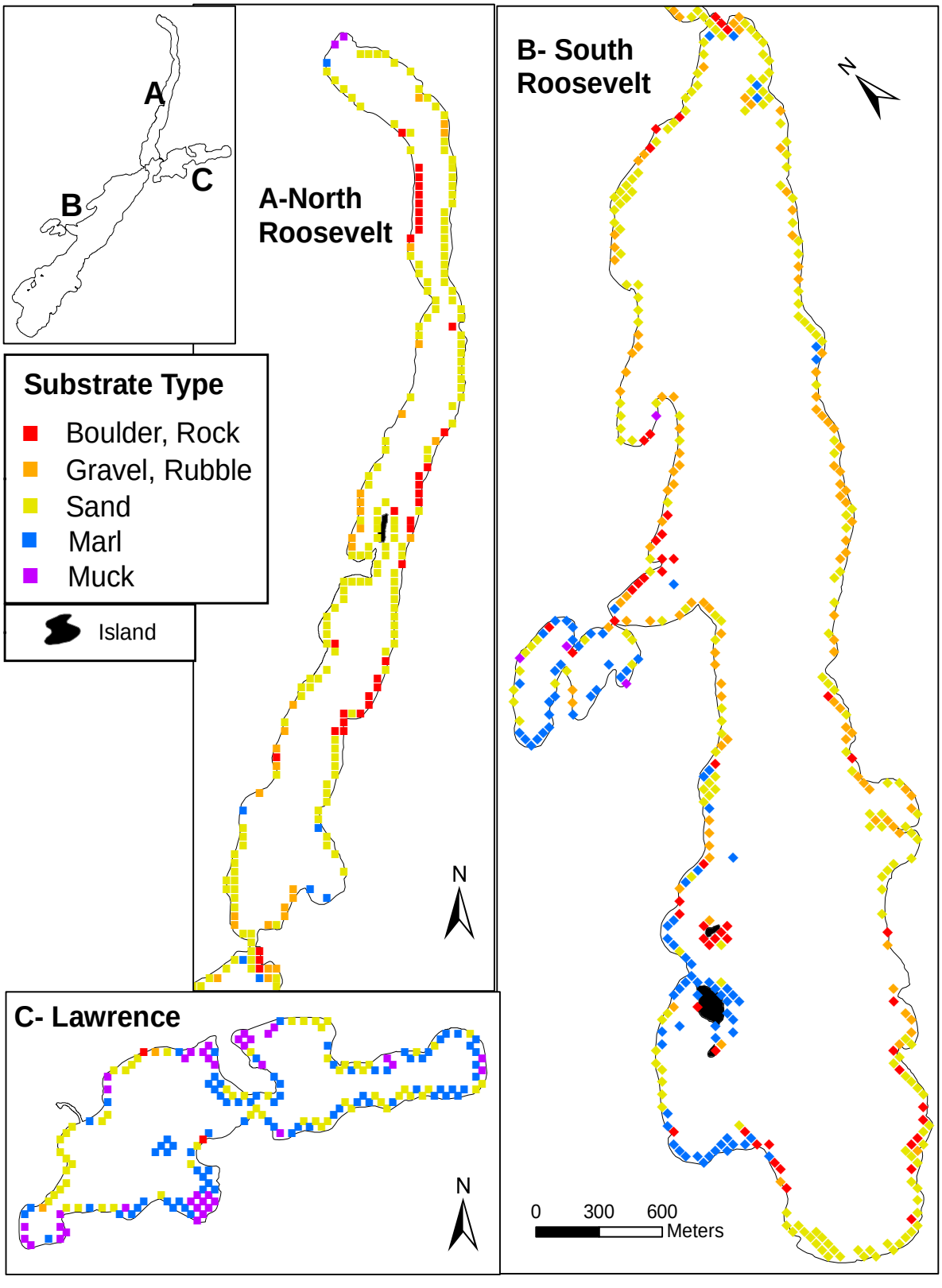


Figure 8. Distribution of aquatic plants in Roosevelt and Lawrence lakes, 2008.

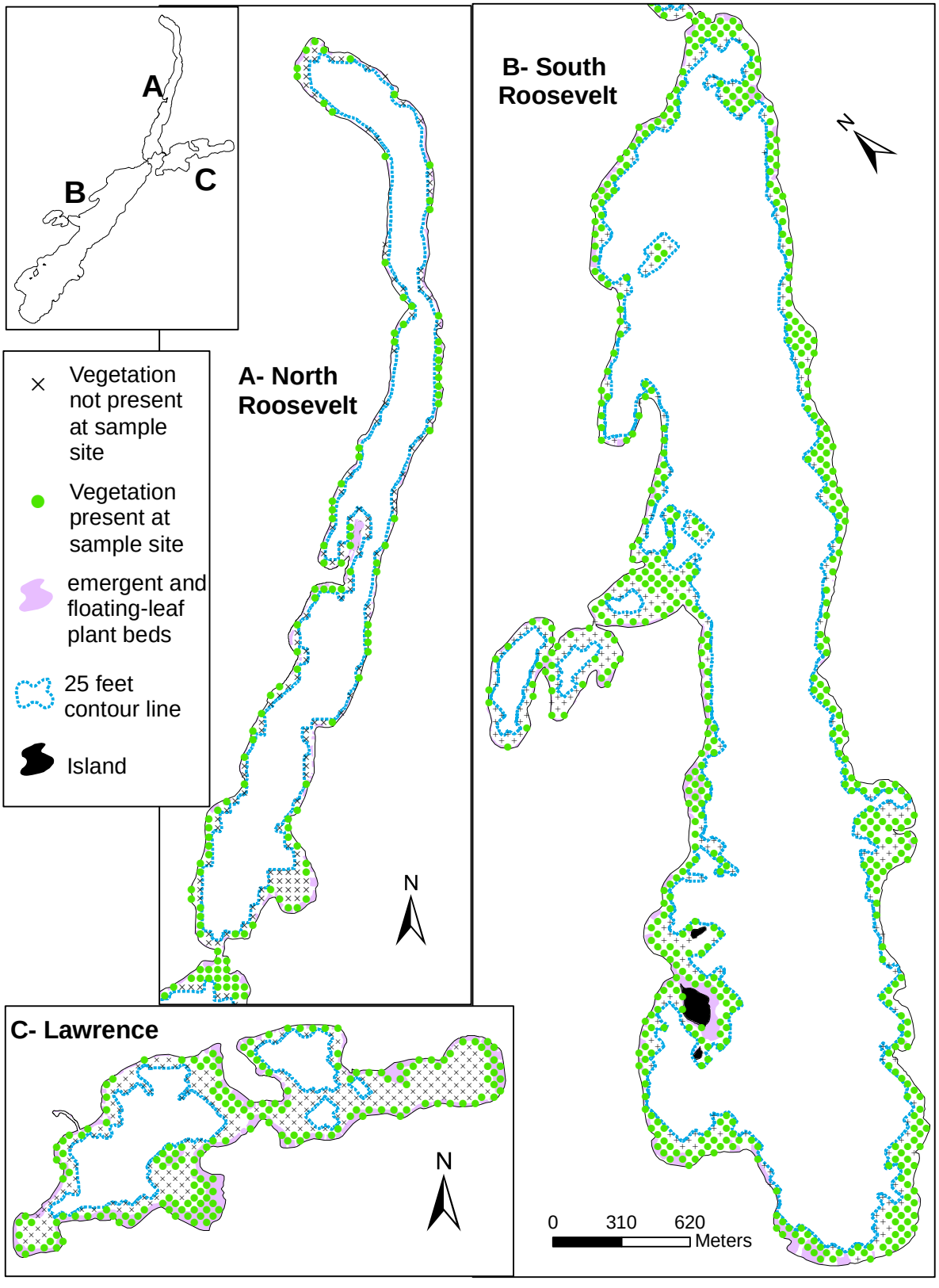
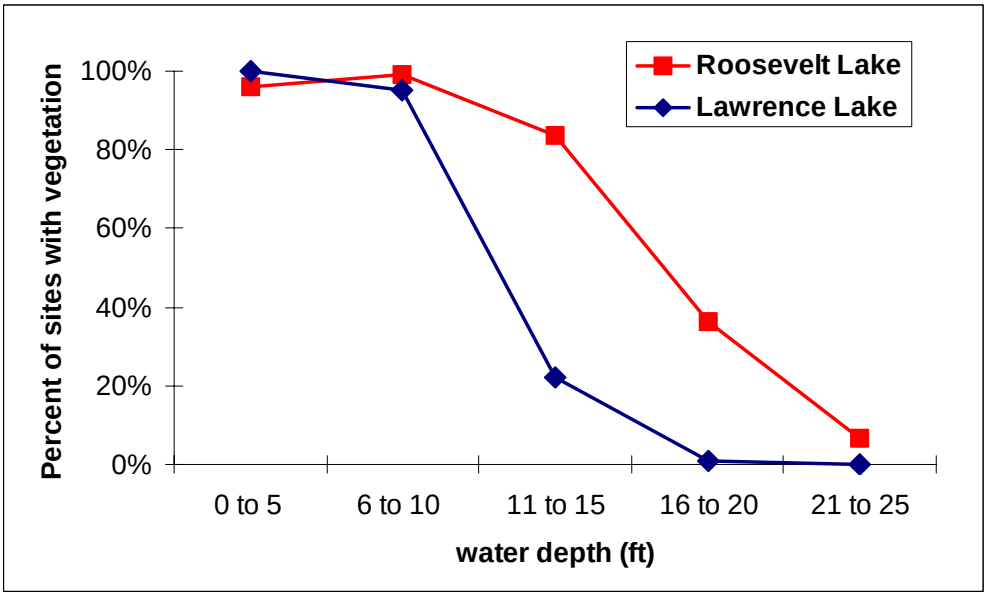


Figure 9. Percent frequency of vegetated sites by water depth interval.



Number of plant species recorded and distribution by water depth

Thirty-nine native plant species were recorded in Roosevelt and Lawrence lakes including eight emergent, six floating-leaved, 22 submerged and two free-floating species (Table 3).

Most emergent plants and floating-leaf plants occurred in water depths of five feet and less and most rooted submerged plants were restricted to depths of fifteen feet and less (Figure 10). Only eight submerged species occurred in depths greater than 15 feet and only three species occurred in depths greater than 20 feet.

Figure. 10. Number of species found at each water depth interval.

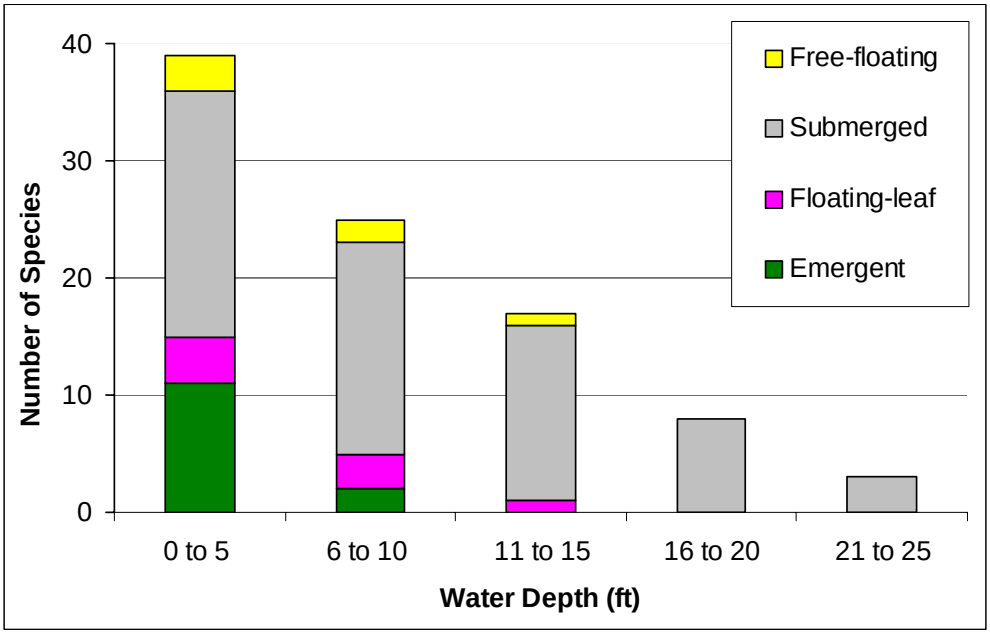


Table 3. Frequency of aquatic plants in Roosevelt and Lawrence Lakes, July 2008.
(Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 25 ft water depth.)

Life Form		Common Name	Scientific Name	Roosevelt 992 sites	Lawrence 351 sites
SUBMERGED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants may or may not be anchored to the lake bottom.	Large Algae	Muskgrass	*Chara sp.*	38	15
		Stonewort	*Nitella sp.*	2	0
	Grass-leaf rooted plants	Flat-stem pondweed	*Potamogeton zosteriformis*	17	24
		Water stargrass	*Zosterella dubia*	4	6
		Wild celery	*Vallisneria americana*	2	12
	Dissected-leaf rooted plants	Coontail	*Ceratophyllum demersum*	17	15
		Northern water milfoil	*Myriophyllum sibiricum*	15	19
		Water marigold	*Megalodonata beckii*	1	7
		White water buttercup	*Ranunculus aquatilis*	1	2
		Greater bladderwort	*Utricularia vulgaris*	<1	0
		Lesser bladderwort	*Utricularia minor*	0	<1
	Small-leaf rooted plants	Narrow-leaf pondweed	*Potamogeton sp.**	13	3
		Fries' pondweed	*Potamogeton freisii*	6	13
		Sago pondweed	*Stuckenia pectinata*	4	9
		Canada waterweed	*Elodea canadensis*	3	8
		Bushy pondweed	*Najas flexilis*	1	5
	Broad-leaf rooted plants ("cabbage")	White-stem pondweed	*Potamogeton praelongus*	10	4
		Illinois pondweed	*Potamogeton illinoensis*	8	5
		Variable pondweed	*Potamogeton gramineus*	3	1
		Clasping-leaf pondweed	*Potamogeton richardsonii*	2	4
		Large-leaf pondweed	*Potamogeton amplifolius*	1	8
	Moss	Water moss	*Not identified to genus*	<1	3
FREE-FLOATING -These plants are often found floating near or on the water surface.		Star duckweed	*Lemna trisulca*	<1	6
		Greater duckweed	*Spirodela polyrhiza*	<1	0
FLOATING These plants are rooted in the lake bottom and have leaves that float on the water surface.		Yellow waterlily	*Nuphar variegata*	3	11
		White waterlily	*Nymphaea odorata*	2	8
		Floating leaf pondweed	*Potamogeton natans*	1	3
		Watershield	*Brasenia schreberi*	<1	0
		Floating-leaf burred	*Sparganium sp.*	<1	0
		Floating-leaf smartweed	*Polygonum amphibium*	present	0
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.		Bulrush	*Scirpus acutus*	5	3
		Spikerush	*Eleocharis sp.*	<1	1
		Burreed	*Sparganium eurycarpum*	<1	1
		Arrowhead	*Sagittaria sp.*	<1	<1
		Needlerush	*Eleocharis sp.*	<1	0
		Horsetail	*Equisetum sp.*	<1	<1
		Narrow-leaf sedge	*Carex sp.*	<1	<1
		Broadleaf Cattail	*Typha latifolia*	0	<1

*Some specimens of "narrow-leaved pondweeds" were positively identified as *Potamogeton freisii* (Fries' pondweed). However, it is not known whether other "look-a-like" narrow-leaf pondweed species occurred in the lake. Therefore, a separate group of "unidentified narrow-leaf pondweeds" (*Potamogeton* spp.) are reported here but not counted in species tally.

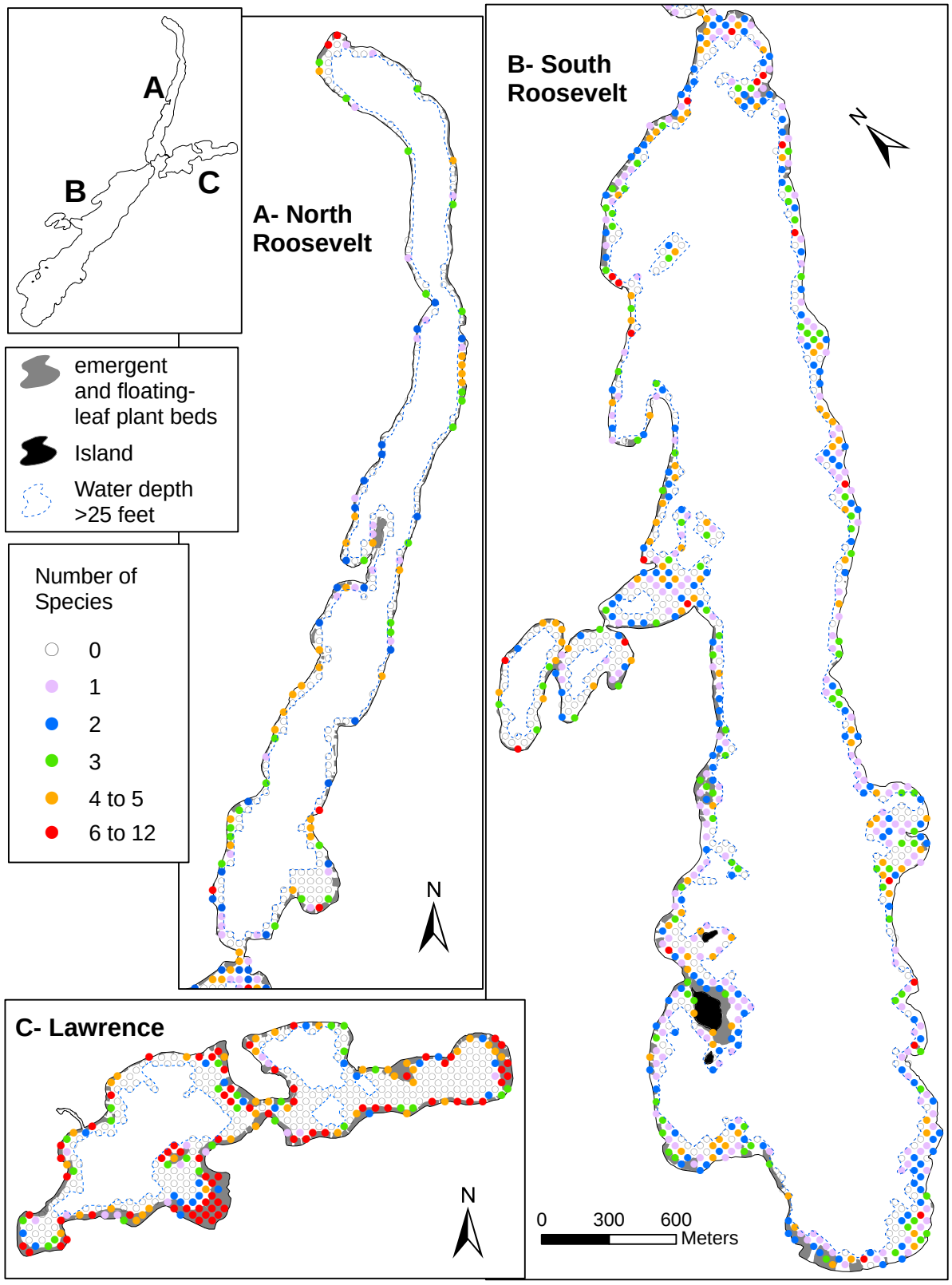
The number of plant species found at each one square meter sample site ranged from zero to 12, with a mean of two. Sites with the highest number of species occurred near shore, within mixed beds of emergent, floating-leaved and submerged plants (Figure 11). In water depths greater than 15 feet, most sites contained fewer than two species.

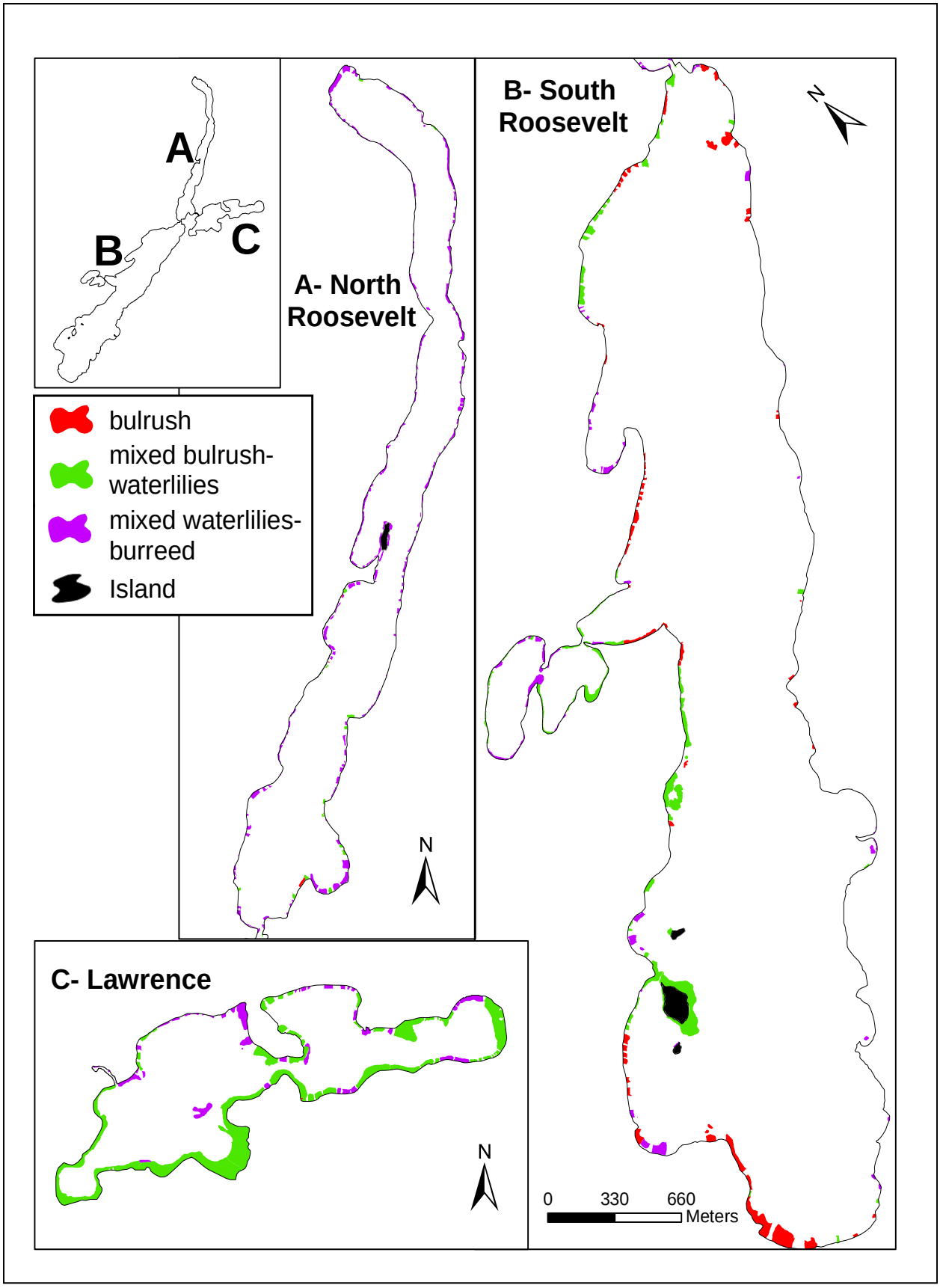
Major Emergent and Floating-leaf Plant Beds

Emergent and floating-leaf aquatic plants offer food, cover and nesting material for waterfowl, marsh birds and muskrats, and provide shelter and shade for insects and 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 51 acres of emergent and floating-leaf plant beds were mapped in Roosevelt Lake and approximately 44 acres of emergent and floating-leaf plant beds were mapped in Lawrence Lake. Within the 0-5 feet depth zone, 27% of the Roosevelt Lake sites and 64% of the Lawrence Lake sites contained at least one emergent or floating-leaf plant. Common bed types included waterlilies and bulrush (Figure 12). Waterlilies were often associated with soft substrates and bulrush was more typically found on hard substrates.

Figure 11. Number of plant species at each sample site, Roosevelt and Lawrence lakes, 2008





Hard-stem bulrush (*Scirpus acutus*) (Figure 13) was the most common emergent in Lawrence and Roosevelt lakes (Table 3). Bulrush beds, or bulrush beds mixed with waterlilies, covered about 33 acres in Roosevelt Lake and about 36 acres in Lawrence Lake. Some beds extended nearly 1,000 meters along shore and as much as 250 meters lakeward (Figure 12). Bulrush was found in three to five percent of the sample sites between shore and the five feet depth and usually occurred in sand.

Figure13. Emergent bulrush (*Scirpus*) beds in Roosevelt Lake, 2008.

Waterlily beds, or mixed beds of waterlilies and emergent plants, covered about 18 acres in Roosevelt Lake and eight acres in Lawrence Lake. Other emergent plants found included giant burreed (*Sparganium eurycarpum*) and spikerush (*Eleocharis* sp.).

Figure 14. Mixed bed of waterlilies in Roosevelt Lake, 2008.

Floating-leaf plants included yellow waterlily (*Nuphar variegata*), white waterlily (*Nymphaea odorata*), floating-leaf pondweed (*Potamogeton natans*), and watersheild (*Brasenia schreberi*). Waterlily beds often contained scattered bulrush plants, and submerged plants (Figure 14).

Submerged plants

Submerged plants occurred in 66 percent of the Roosevelt Lake sites and 46 percent of Lawrence Lake sites. The most common submerged species were muskgrass, coontail, northern watermilfoil, flat-stem pondweed, and Fries' pondweed.

Muskgrass (*Chara* sp.) (Figure 15) is a macroscopic, or large, algae that 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 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.

Muskgrass was the most common submerged plant in both lakes, occurring in 38 percent of the Roosevelt Lake sites and in 15 percent of the Lawrence Lake sites (Table 3, Figure 15). Muskgrass could be found growing in thick beds with no other vegetation and in other areas it co-occurred within mixed beds of pondweeds and other submerged plants. In Roosevelt Lake, muskgrass was common to depths of 15 feet but in Lawrence Lake it was restricted to depths of five feet and less (Figure 16).

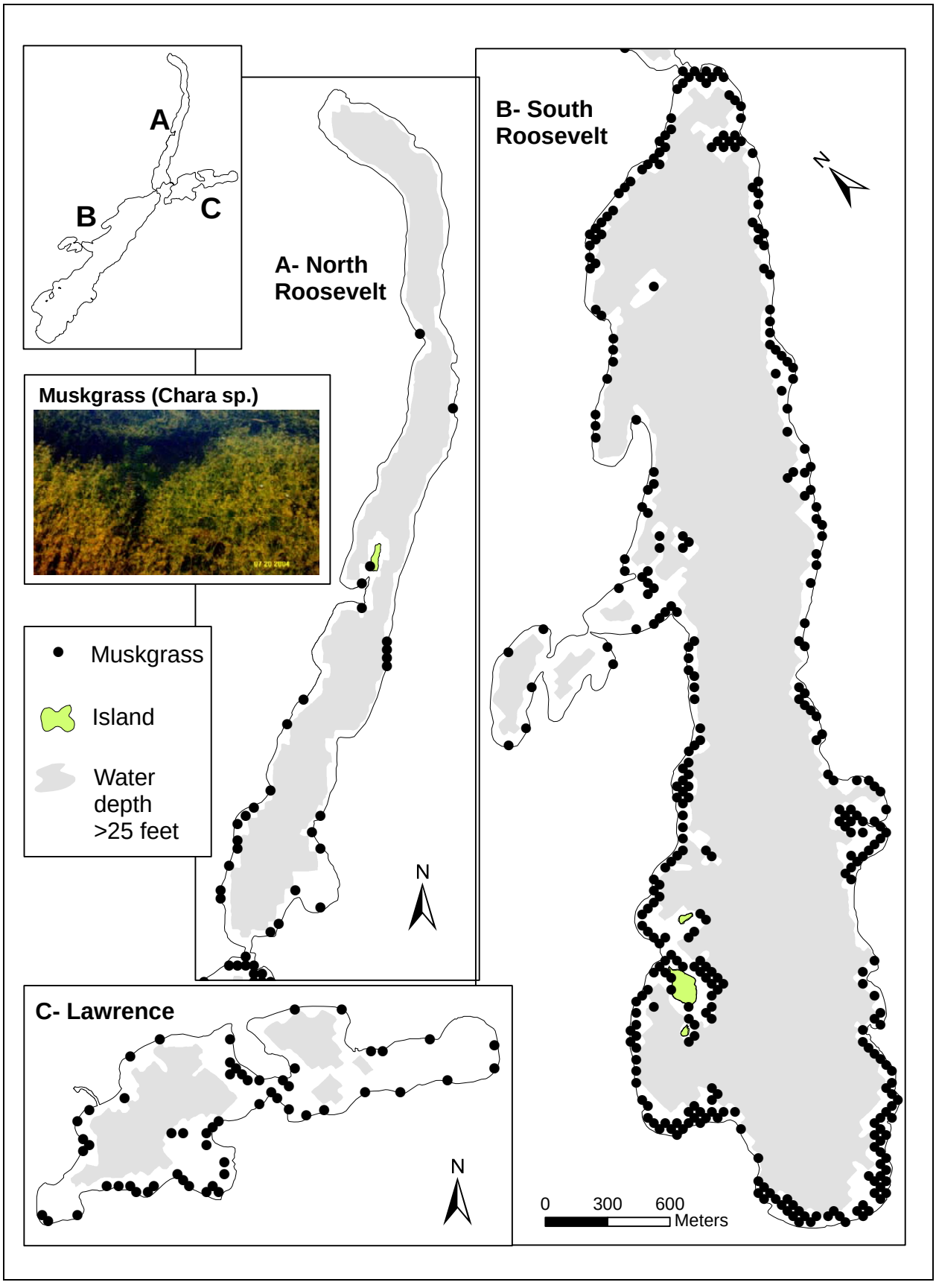
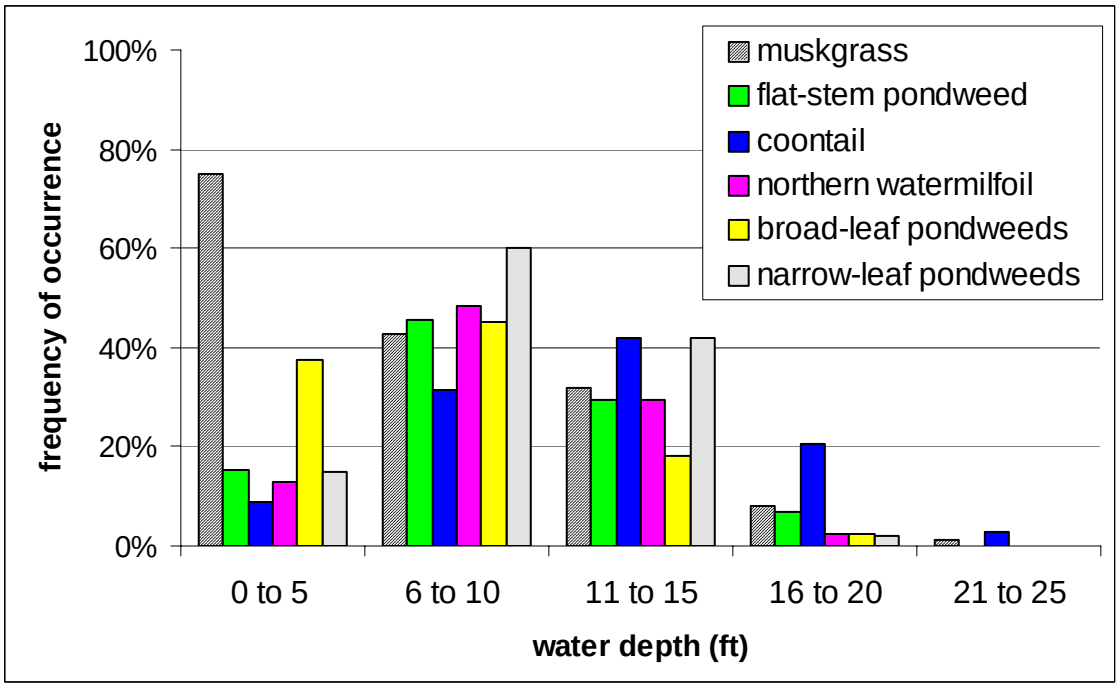
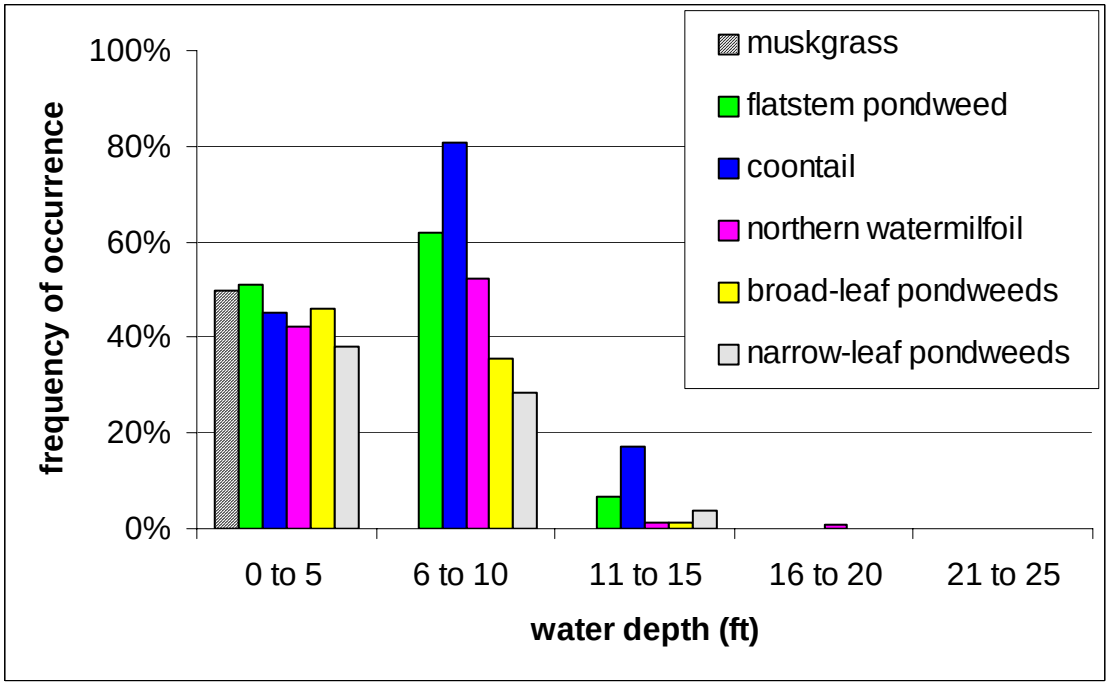

A
B
C
A- North Roosevelt
B- South Roosevelt
Muskgrass (Chara sp.)
Muskgrass
Island
Water depth >25 feet
N
C- Lawrence
N
N
0 300 600
Meters

Figure 16. Frequency of common plants by water depth interval. July 2008.

Roosevelt Lake



Lawrence Lake



Flat-stem pondweed (*Potamogeton zosteriformis*) (Figure 17) is a perennial plant that is anchored to the lake bottom by underground rhizomes and over-winters by winter buds. It is named for its flattened, grass-like leaves. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water. Flat-stem pondweed was widely distributed in both lakes and occurred in 17 percent and 15 percent of the Roosevelt and Lawrence lake survey sites, respectively (Table 3). In Roosevelt Lake, it was common to depths of 15 feet and in Lawrence Lake it was common to the ten feet depth (Figure 16).

Coontail (*Ceratophyllum demersum*) (Figure 18) grows entirely submerged and its roots are 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 (Nichols 1999). 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 insects valuable as fish food. Coontail was found in 17 percent of the Roosevelt Lake sites and in 13 percent of the Lawrence Lake sites (Table 3). In Roosevelt Lake it occurred to a maximum depth of 24 feet and was most common in the 11 to 15 feet depth zone (Figure 16). In Lawrence Lake, it was found to only 15 feet and was common in the six to ten feet depth zone (Figure 16).

Northern watermilfoil (*Myriophyllum sibiricum*) (Figure 19) is a rooted, perennial submerged plant with finely dissected leaves. It may reach the water surface, particularly in depths less than ten feet and its flower stalk extends above the water surface. It spreads primarily by stem fragments and over winters by hardy rootstalks and winter buds. Northern watermilfoil is not tolerant of turbidity (Nichols 1999) and grows best in clear water lakes. For information on how to distinguish this native plant from the non-native, Eurasian watermilfoil: identification. Northern watermilfoil was found in 15 percent of the Roosevelt Lake sites and in 19 percent of the Lawrence Lake sites (Table 3). In both lakes, it was frequent in water depths of shore to ten feet depth zone but in Roosevelt Lake it was also common in the 11 to 15 feet depth zone (Figure 16).

Broad-leaf pondweeds are a group of wide-leaved submerged plants that are often called "cabbage" by anglers. Broad-leaf pondweeds found in Roosevelt and Lawrence Lakes include large-leaf pondweed (*Potamogeton amplifolius*), Illinois pondweed (*P. illinoensis*), variable pondweed (*P. gramineus*), white-stem pondweed (*P. praelongus*), and clasping-leaf pondweed (*P. richardsonii*). These perennial plants produce tubers and fruits that are a favorite duck food and their broad leaves provide food and shelter for fish. Twenty-two percent Roosevelt Lake survey sites and 18 percent of the Lawrence Lake sites contained at least one broad-leaf pondweed species (Figure 20, Table 3). Broad-leaf pondweeds were well distributed around the lake and were most often found in depths of ten feet and less (Figure 16).

Narrow leaf pondweeds are rooted, perennial submerged plant 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 21) was positively identified in the lake, but additional narrow-leaf species may have also been present. For analysis, all narrow-leaf

Figure 17. Distribution of flat-stem pondweed (*Potamogeton zosteriformis*)

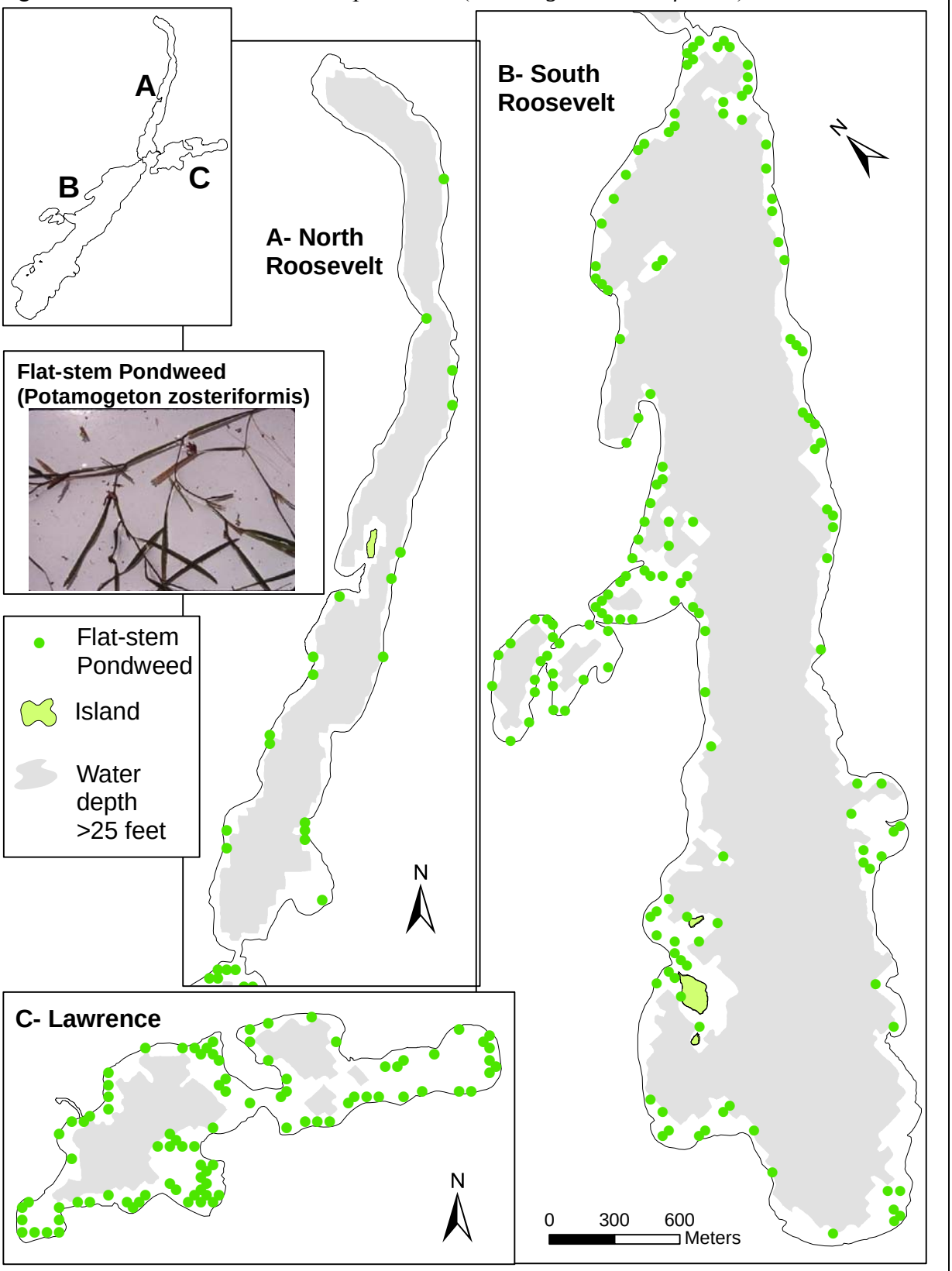


Figure 18. Distribution of coontail (*Ceratophyllum demersum*)

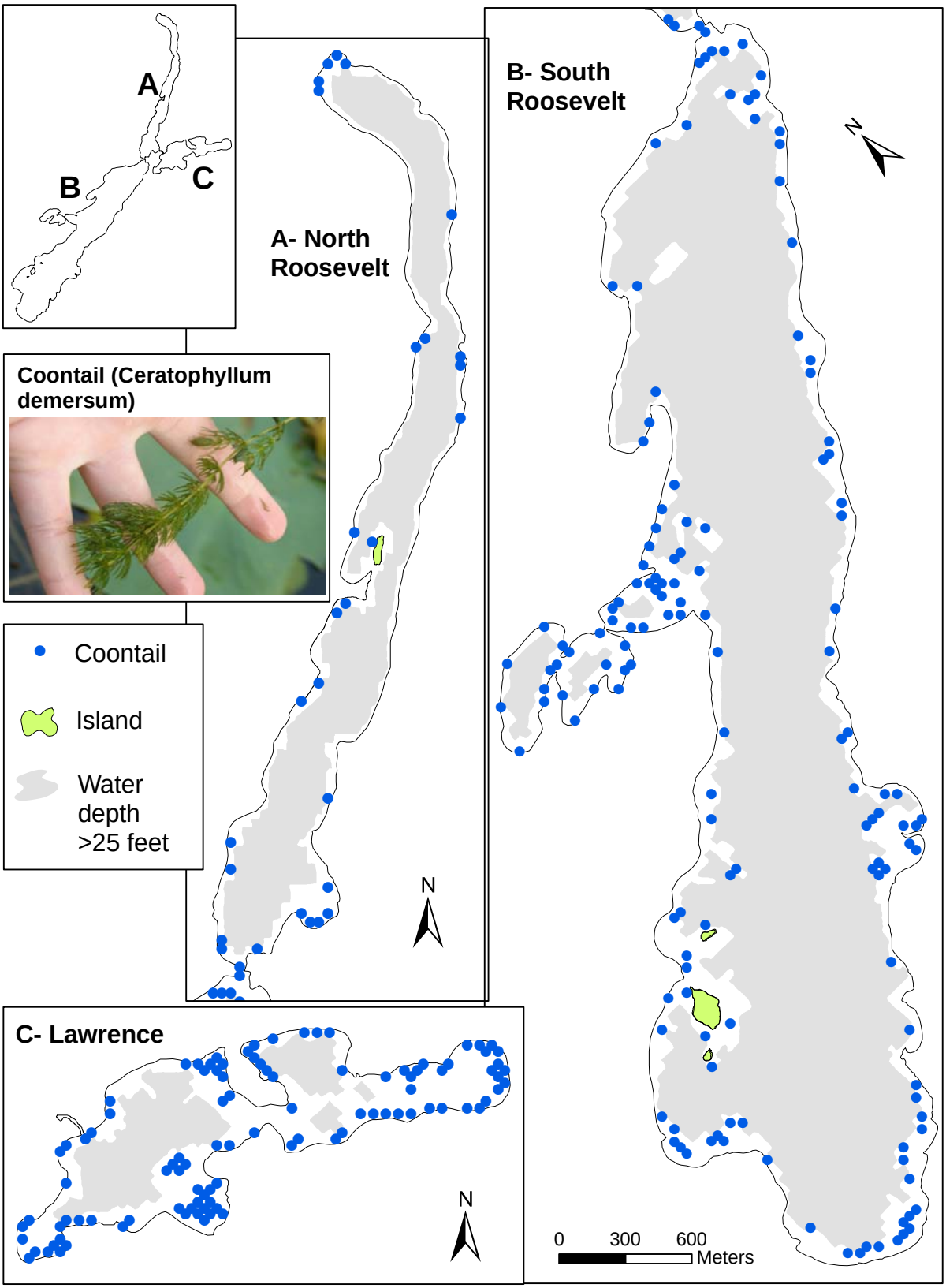


Figure 19. Distribution of northern watermilfoil (*Myriophyllum sibiricum*)

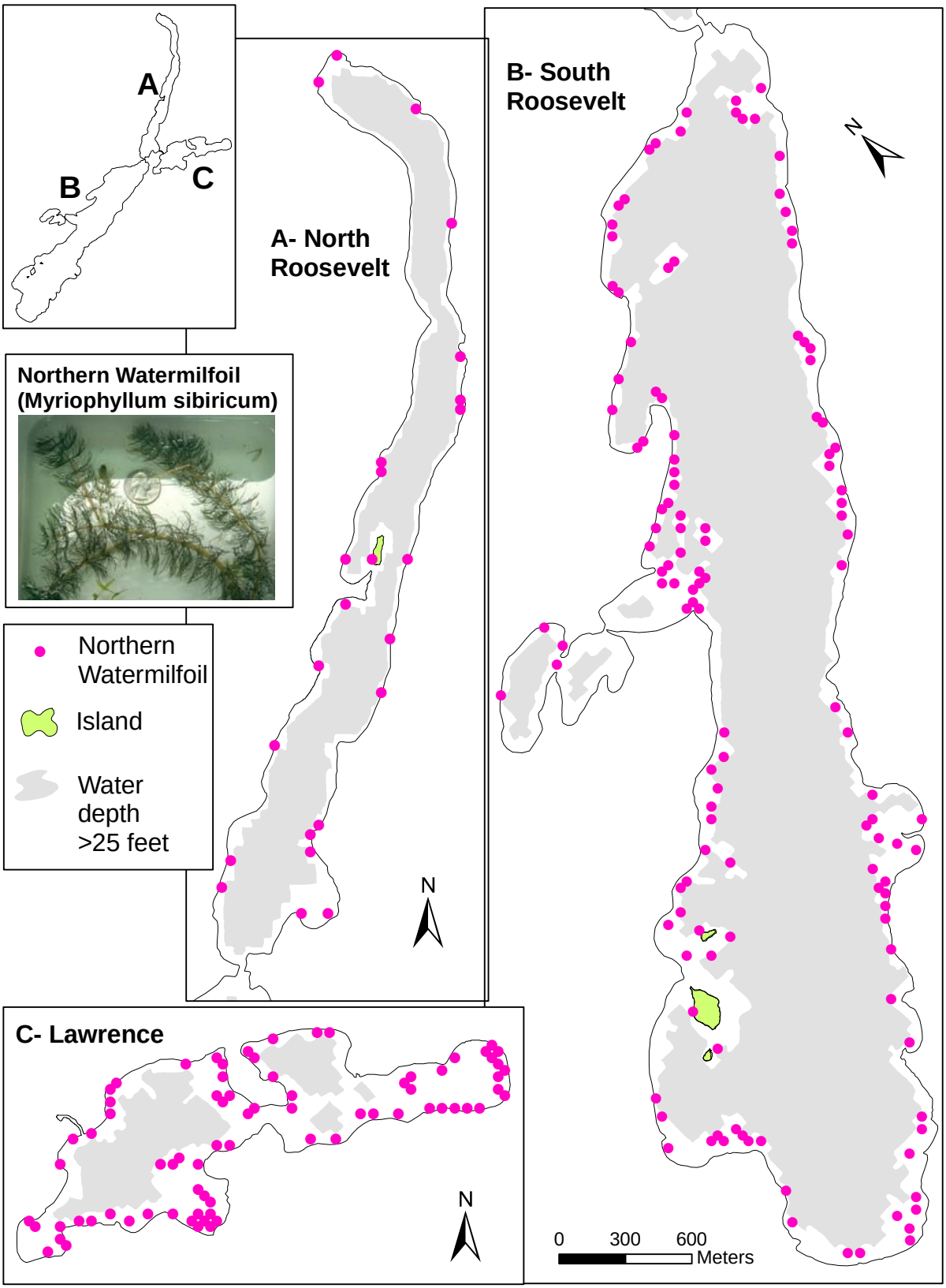


Figure 20. Distribution of broad-leaf pondweeds (*Potamogeton praelongus, P. amplifolius, P. illinoensis, P. richardsonii, P. gramineus*).

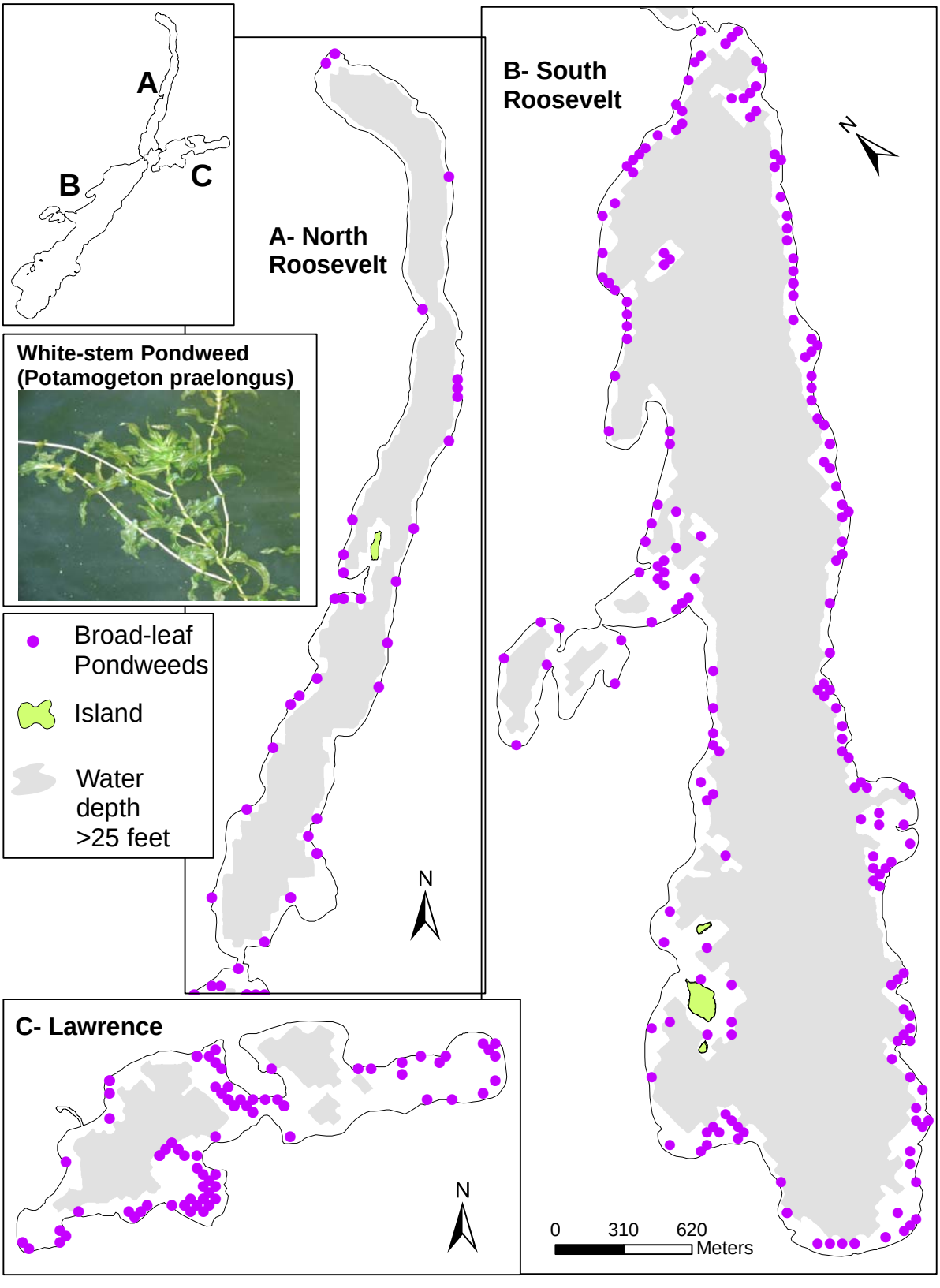
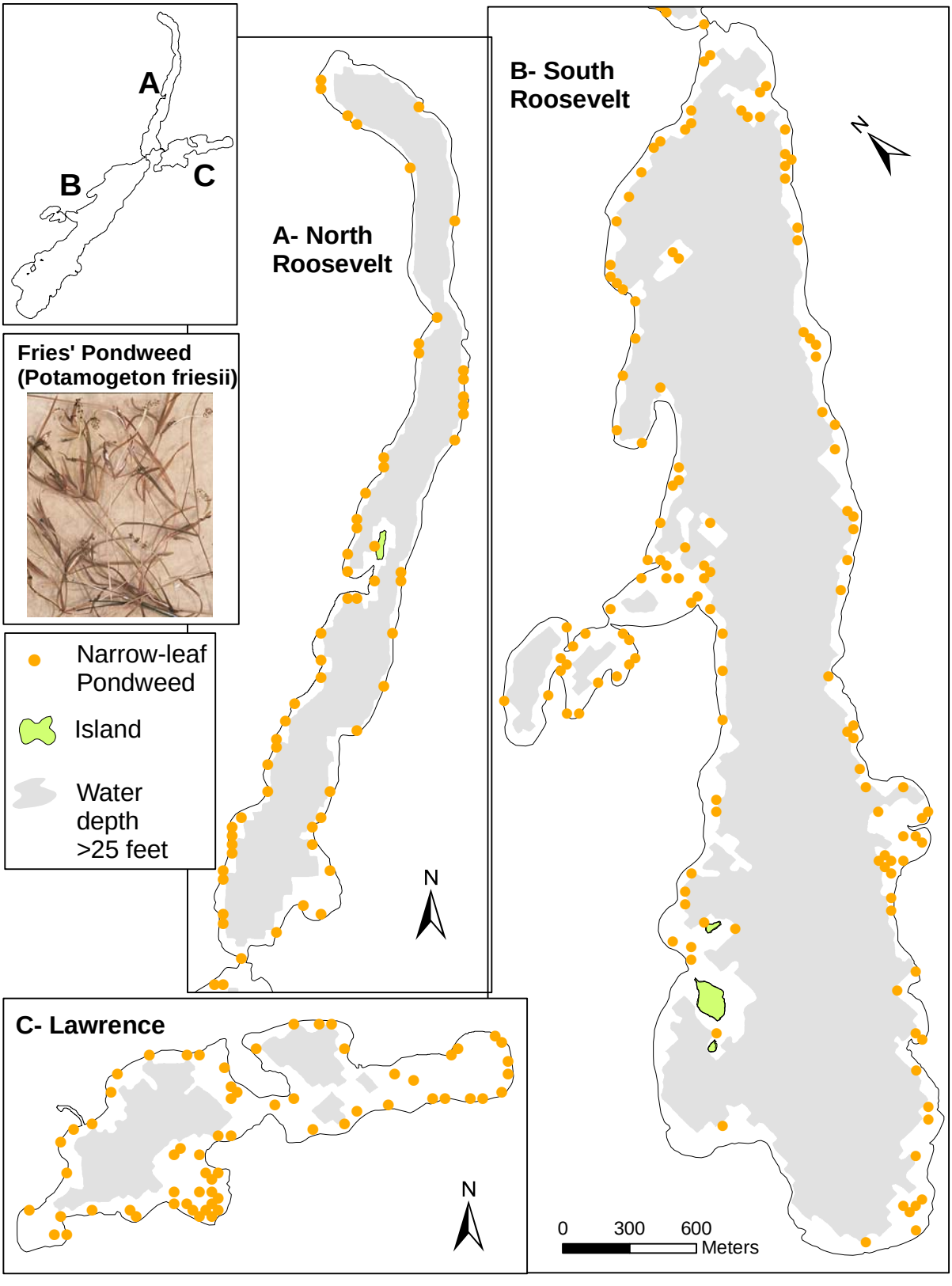


Figure 21. Distribution of Fries' pondweed (*Potamogeton friesii*) and narrow-leaf pondweed (*Potamogeton* spp.).



pondweeds were grouped together. In Roosevelt Lake, narrow-leaf pondweeds were found in 19 percent of the sites and were most frequently found in depths of six to 15 feet. In Lawrence Lake, narrow-leaf pondweeds occurred in 15 percent of the sites and were common in depths of ten feet and less (Figure 16).

Discussion

The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity, water chemistry, water depth, substrate type and wave activity. The steep depth contours and wave exposure along Roosevelt Lake shorelines limit the emergent and floating-leaf plant beds to narrow bands along protected shores. The water clarity of Roosevelt and Lawrence lakes is sufficiently high to allow aquatic plant growth to a depths of about 15 to 20 feet, but available light beyond that depth is not sufficient for most rooted plants. The abundant and diverse native aquatic plant communities found in these lakes provides critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants). Protection of existing native plant beds is particularly important on these lakes because of the limited areas suitable for aquatic plant growth.

A review of past vegetation surveys of these lakes indicates that the general aquatic plant community has not likely changed greatly in these lakes. In all survey years, a relatively high number of native plants have been recorded and rooted plants remain well distributed throughout the bays. Data collected in 2008 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. 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.

In general, factors that may lead to change in the aquatic plant communities include:

- Change in water clarity
  If water clarity decreases, submerged vegetation may be restricted to shallower water.
- Change in water level
  Many aquatic plants are adaptable to water level fluctuations and in low water years, aquatic plants may expand in distribution. The extent and duration of these distribution changes can be difficult to predict.
- Snow and ice cover
  Many submerged plants 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, some 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.
- Invasive species
  Non-native submerged species have **not** been documented in these lakes but if they invade the lake, they may directly or indirectly impact the native plant community. Non-native plant species, such as Eurasian watermilfoil (*Myriophyllum spicatum*) or curly-leaf

pondweed (*Potamogeton crispus*) may form dense surface mats that may shade out native plants. The impact of these invasive species varies among lakes but the presence of a healthy native plant community may help mitigate the harmful effects of these exotics.

- Natural fluctuation in plant species abundance
  Many submerged plants are perennial and regrow in similar locations each year. However, a few species such as bushy pondweed (*Najas flexilis*) are annuals and are dependant on the previous years seed set for regeneration.
- Aquatic plant management activities
  Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. For information on the laws pertaining to aquatic plant management, click here: MnDNR APM Program or contact your local DNR office. Motorboat activity in vegetated areas can be particularly harmful for species such as bulrush and 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. Herbicide and mechanical control of aquatic plants can directly impact the aquatic plant community. Limiting these types of activities can help protect native aquatic plant species.

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