Final Report
Sensitive Lakeshore Survey
Boy Lake (11-0143-00)
Cass County, Minnesota

June 2010

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ECOLOGICAL RESOURCES

A Product of the
Intra-Lake Zoning to Protect Sensitive Lakeshores Project

Application of
Minnesota's Sensitive Lakeshore Identification Manual: *A Conservation Strategy for Minnesota's Lakeshores*

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Executive Summary

A total of 34 native aquatic plant taxa were recorded in Boy Lake, including 24 submerged and free-floating, three floating-leaf, and seven emergent taxa. More than 30 additional shoreline plant taxa were also documented. Submerged plants occurred to a depth of 20 feet but were most common in the shore to ten feet depth zone, where 89% of the sample sites contained vegetation. Common submerged plants included muskgrass, coontail, flat-stem pondweed, greater bladderwort, and northern watermilfoil. Emergent plants covered more than 20% of the lake, and surveyors mapped over 600 acres of wild rice and 170 acres of hard-stem bulrush. Two unique wetland plants and one unique submerged plant occur in or adjacent to Boy Lake.

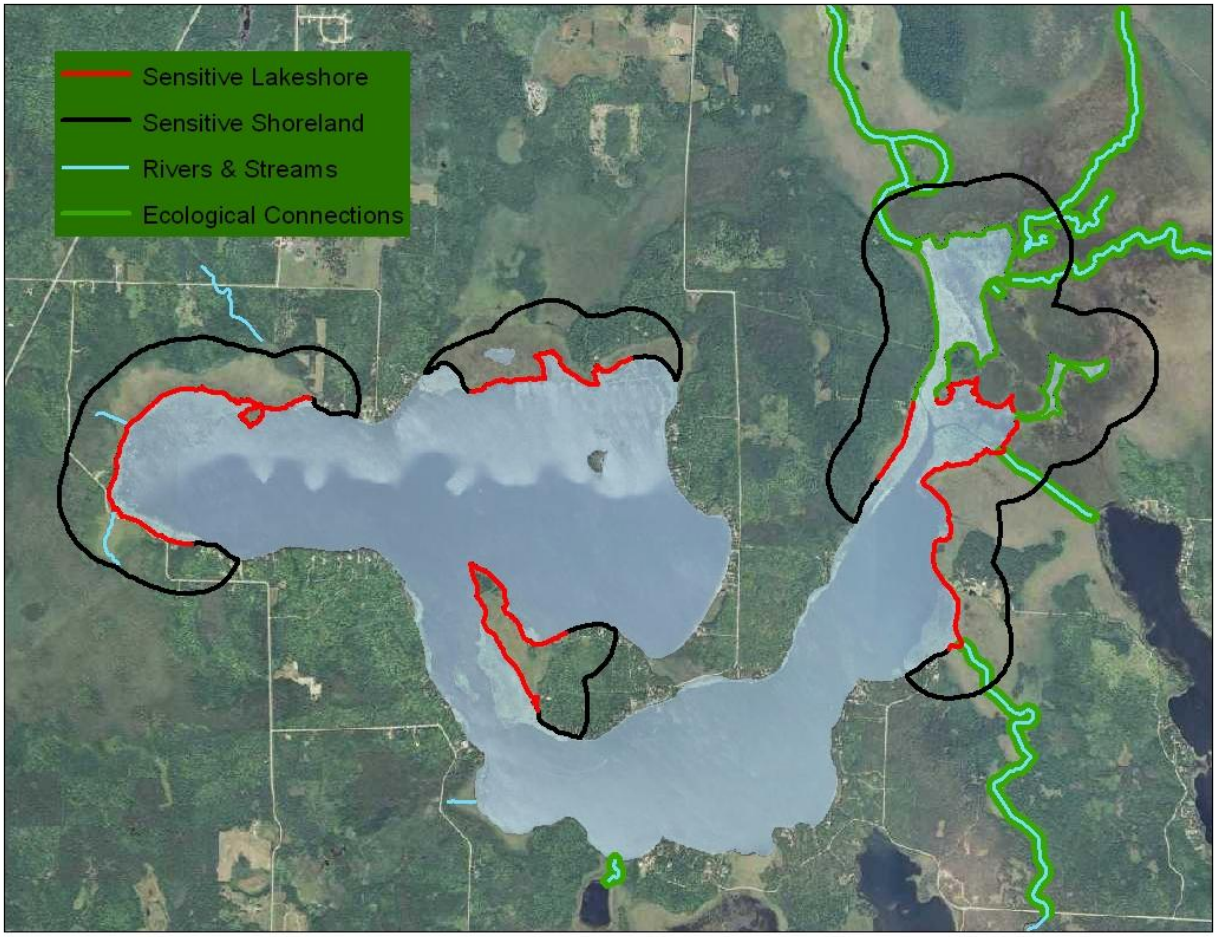
Twenty-eight bird species of greatest conservation need were identified during the Boy Lake bird surveys. They included nine forest habitat-dependent species, seven wetland habitat-dependent species, six aquatic habitat-dependent species, and six species that utilize other or multiple habitat types. In total, 93 bird species were documented on Boy Lake.

One near-shore fish species of greatest conservation need, the pugnose shiner, and one offshore-dwelling species of greatest conservation need, the greater redhorse, were identified at Boy Lake. Three proxy species (blackchin shiner, blacknose shiner, and banded killifish) were also documented. Thirty-eight different species were indentified during surveys, including 19 species not previously documented, bringing the total historical observed fish community to 40 species. The newly documented species were blackchin shiner, blacknose shiner, bluntnose minnow, brook stickleback, central mudminnow, common shiner, creek chub, emerald shiner, fathead minnow, finescale dace, golden shiner, Iowa darter, johnny dater, longnose dace, mimic shiner, mottled sculpin, pugnose shiner, smallmouth bass, and tadpole madtom. Green frogs and mink frogs were documented at multiple locations on Boy Lake, particularly near or within protected bays.

An ecological model based on major conservation principles was used to assess lakeshore sensitivity. The benefit of this approach is that criteria come from the science-based surveys and the value of the lakeshore is objectively assessed. Environmental decision-making is complex and often based on multiple lines of evidence. Integrating the information from these multiple lines of evidence is rarely a simple process. Here, the ecological model used 15 attributes (hydrological conditions and documented plant and animal presence) to identify sensitive areas of shoreland. A sensitivity index was calculated for each shoreland segment by summing the scores of the 15 attributes. Lakeshore segments were then clustered by sensitivity index values using established geospatial algorithms. Sensitive lakeshore areas were buffered and important ecological connections or linkages mapped. The identification of sensitive lakeshore areas by this method is an objective, repeatable and quantitative approach to the combination of multiple lines of evidence through calculation of weight of evidence. The ecological model results are lake-specific, in that the model results are intended to recognize the most probable highly sensitive lakeshores for a specific lake. Plant and animal assemblages differ naturally between lakes, and sensitivity scores should not be compared across lakes.

The ecological model identified four primary sensitive lakeshore areas to be considered for potential resource protection districting by Cass County. The County may use this objective,

science-based information in making decisions about districting and reclassification of lakeshore areas. The most probable highly sensitive lakeshore areas and the recommended resource protection districts are:



Introduction

Minnesota's lakes are one of its most valuable resources. The 12,000 lakes in the state provide various industrial, commercial, and recreational opportunities. They are also home to numerous fish, wildlife, and plant species. In particular, naturally vegetated shorelines provide critical feeding, nesting, resting and breeding habitat for many species. Common loons avoid clear beaches and instead nest in sheltered areas of shallow water where nests are protected from wind and wave action. Mink frogs and green frogs are shoreline-dependent species that prefer quiet bays and protected areas with a high abundance of aquatic plants. Fish such as the least darter, longear sunfish, and pugnose shiner are strongly associated with large, near-shore stands of aquatic plants. Increasing development pressure along lakeshores may have negative impacts on these species – and Minnesota's lakeshores are being developed at a rapid rate. With this in mind, the Minnesota Department of Natural Resources developed a protocol for identifying "sensitive" areas of lakeshore. Sensitive lakeshores represent geographical areas comprised of shorelands, shorelines and the near-shore areas, defined by natural and biological features, that provide unique or critical ecological habitat. Sensitive lakeshores also include:

1. Vulnerable shoreland due to soil conditions (i.e., high proportion of hydric soils);
2. Areas vulnerable to development (e.g., wetlands, shallow bays, extensive littoral zones, etc.);
3. Nutrient susceptible areas;
4. Areas with high species richness;
5. Significant fish and wildlife habitat;
6. Critical habitat for species of greatest conservation need; and
7. Areas that provide habitat connectivity

Species of greatest conservation need are animals whose populations are rare, declining or vulnerable to decline (MN DNR 2006). They are also species whose populations are below levels desirable to ensure their long-term health and stability. Multiple species of greatest conservation need depend on lakeshore areas.

The sensitive shorelands protocol consists of three components. The first component involves field surveys to evaluate the distribution of high priority plant and animal species. Aquatic plant surveys are conducted in both submerged habitats and near-shore areas, and assess the lake-wide vegetation communities as well as describe unique plant areas. Target animal species include species of greatest conservation need as well as proxy species that represent animals with similar life history characteristics. This first component also involves the compilation of existing data such as soil type, wetland abundance, and size and shape of natural areas.

The second component involves the development of an ecological model that objectively and consistently ranks lakeshore areas for sensitive area designation. The model is based on the results of the field surveys and analysis of the additional variables. Lakeshore areas used by focal species, areas of high biodiversity, and critical and vulnerable habitats are important elements in the ecological model used to identify sensitive lakeshore areas. Because the model is based on scientific data, it provides objective, repeatable results and can be used as the basis for regulatory action.

The final component of identifying sensitive lakeshore areas is to deliver advice to local governments and other groups who could use the information to maintain high quality environmental conditions and to protect habitat for species in greatest conservation need.

This report summarizes the results of the field surveys and data analysis and describes the development of the ecological model. It also presents the ecological model delineation of Boy Lake sensitive lakeshore areas.

Lake Description

Boy Lake (DOW 11-0143-00) is located about eight miles north of the city of Longville, in Cass County, north-central Minnesota (Figure 1). The lake occurs in the northeastern portion of the Leech Lake Watershed. The Boy River flows through this watershed and connects a series of lakes beginning at Ten Mile Lake. The Boy River then flows north through the east side of Boy Lake and continues northwest to Leech Lake. Boy Lake also receives flow from the Swift River entering from Swift Lake to the east (Figure 2).

Figure 1. Location of Boy Lake in Cass County, Minnesota.

Boy Lake occurs within the Chippewa National Forest but the shoreline includes a mix of federal, state, county, tribal and privately owned lands. Areas of privately owned, upland shoreline have been developed with residential homes and several resorts but the shoreline remains primarily forested. A public boat launch is located on the southwest corner of the lake.

Boy Lake has a surface area of nearly 3,500 acres and over 20 miles of shoreline. The shoreline is irregular in outline with a large north basin connected by an elongated channel to the eastern basin. A five acre island occurs on the east side of the north basin. Boy Lake has a maximum depth of 45 feet but more than 60% of the lake is less than 15 feet in depth (Figure 3).

Boy Lake is described as a Class 25 lake; these lakes are generally clear, deep, and irregularly shaped (MN DNR 2005). It is a mesotrophic lake, with moderate levels of nutrient enrichment (MPCA 2009). The average Secchi depth, based on a small number of readings, is approximately 11 feet (MPCA 2009). The Secchi disc readings, which measure water transparency, indicate moderately high water clarity. The Minnesota DNR Section of Fisheries manages Boy Lake primarily for walleye, northern pike, and muskellunge (MN DNR 2005).

Figure 2. Features of Boy Lake.

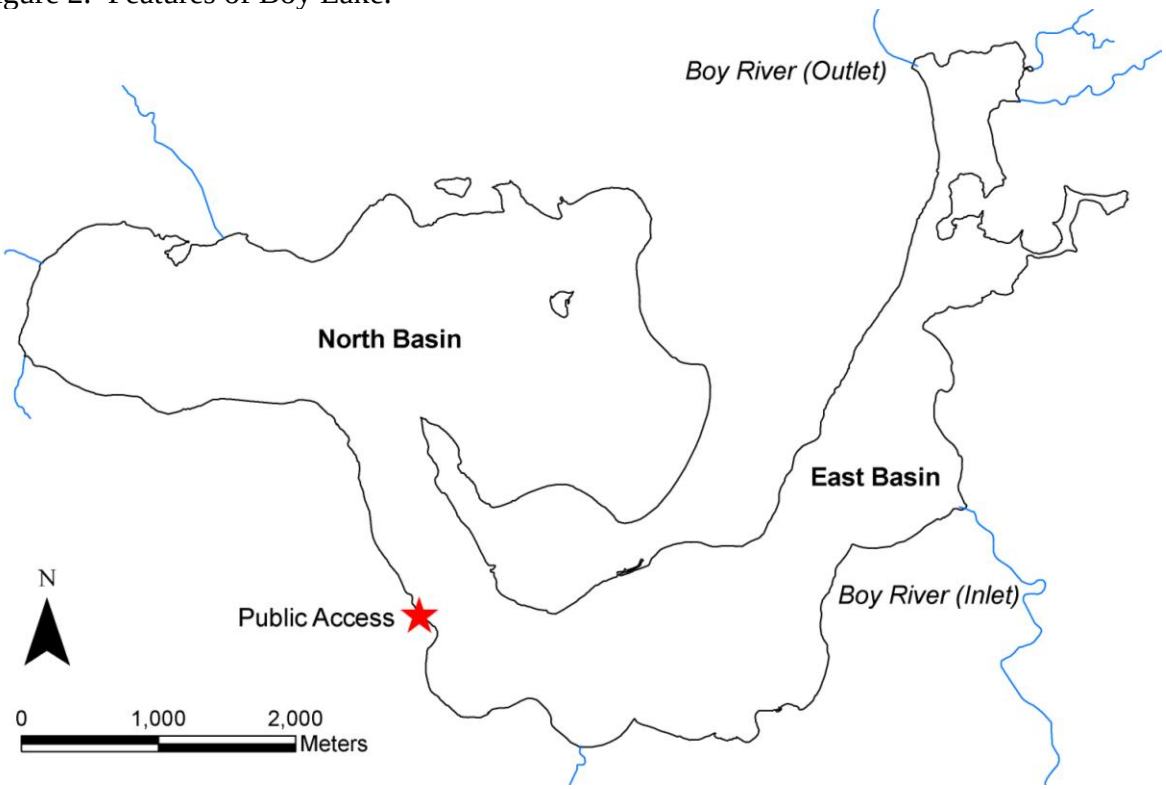
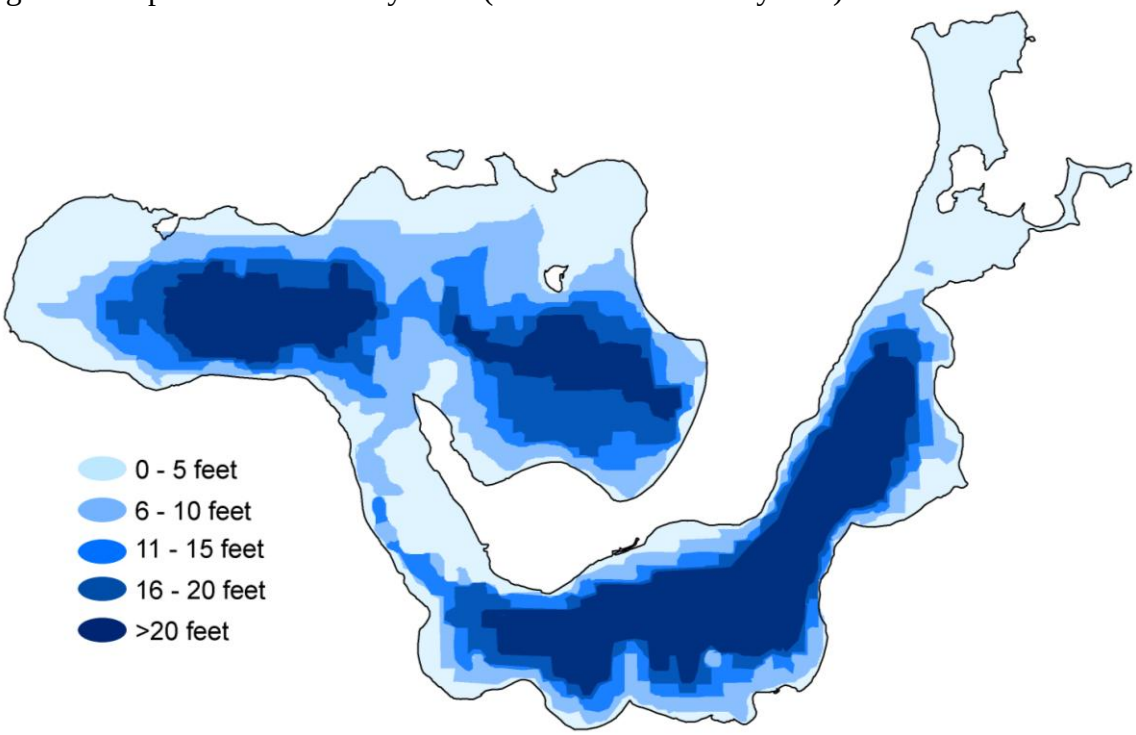


Figure 3. Depth contours of Boy Lake (based on 2008 survey data).



I. Field Surveys and Data Collection

Survey and data collection followed Minnesota's Sensitive Lakeshore Identification Manual protocol (MN DNR 2008). Resource managers gathered information on 15 different variables in order to develop the sensitive shorelands model. Sources of data included current and historical field surveys, informational databases, aerial photographs, and published literature. The variables used in this project were: wetlands, hydric soils, near-shore plant occurrence, aquatic plant richness, presence of emergent and floating-leaf plant beds, unique plant species, near-shore substrate, birds, bird species richness, loon nesting areas, frogs, fish, aquatic vertebrate species richness, rare features, and size and shape of natural areas.

Pugnose shiner photo courtesy of Konrad Schmidt

Wetlands

Objective

1. Map wetlands within the extended state-defined shoreland area (within 1320 feet of shoreline) of Boy Lake

Introduction

Wetlands are important habitat types that provide a variety of services to the environment, to plants and animals, and to humans. Wetland vegetation filters pollutants and fertilizers, making the water cleaner. The roots and stems of wetland plants trap sediments and silt, preventing them from entering other water bodies such as lakes. They protect shorelines against erosion by buffering the wave action and by holding soil in place. Wetlands can store water during heavy rainfalls, effectively implementing flood control. This water may be released at other times during the year to recharge the groundwater. Wetlands also provide valuable habitat for many wildlife species. Birds use wetlands for feeding, breeding, and nesting areas as well as migratory stopover areas. Fish may utilize wetlands for spawning or for shelter. Numerous plants will grow only in the specific conditions provided by wetlands. Finally, wetlands provide a variety of recreational opportunities, including fishing, hunting, boating, photography, and bird watching.

Although the definitions of wetlands vary considerably, in general, wetlands are lands in which the soil is covered with water all year, or at least during the growing season. This prolonged presence of water is the major factor in determining the nature of soil development and the plants and animals that inhabit the area. The more technical definition includes three criteria:

1. Hydrology – the substrate is saturated with water or covered by shallow water at some time during the growing season of each year
2. Hydrophytes – at least periodically, the land supports predominantly hydrophytes (plants adapted to life in flooded or saturated soils)
3. Hydric soils – the substrate is predominantly undrained hydric soil (flooded or saturated soils) (adapted from Cowardin et al. 1979)

Methods

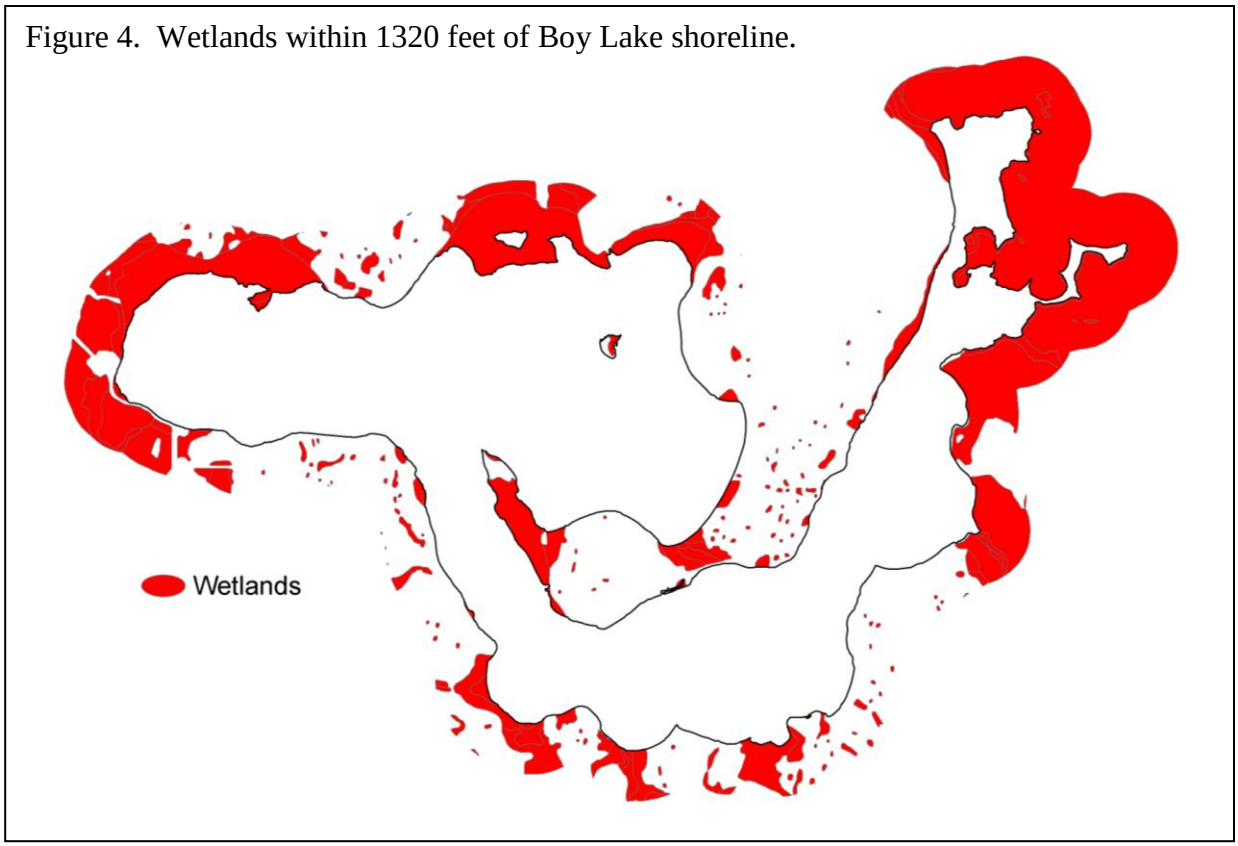
Wetland data were obtained from the National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service (USFWS). The NWI project was conducted between 1991 and 1994 using aerial photography from 1979 – 1988. Wetland polygons obtained from the NWI were mapped in a Geographic Information System (GIS) computer program. Only wetlands occurring within the extended state-defined shoreland area (i.e., within 1320 feet of the shoreline) were considered in this project. Wetlands classified as lacustrine or occurring lakeward of the Boy Lake ordinary high water mark were excluded from this analysis.

Results

Nearly 1600 acres within the shoreland area of Boy Lake are described as wetlands by NWI. These wetlands comprise approximately 50% of the Boy Lake shoreland. The largest areas of wetland are along the northern and eastern edges of the east basin (Figure 4). Other large complexes occur along the northern perimeter of the north basin.

The dominant wetland types are emergent (Cowardin et al. 1979) or marsh (MN DNR 2003) systems and palustrine scrub-shrub (Cowardin et al. 1979) or wetland shrubland (MN DNR 2003) systems. The emergent systems are characterized by herbaceous, emergent wetland vegetation, whereas the palustrine scrub-shrub systems are dominated by deciduous or evergreen shrubs. There are also small areas of unconsolidated bottom wetlands (Cowardin et al. 1979), characterized by sparse vegetative cover. The water regime of these wetlands includes saturated, semipermanently flooded, seasonally flooded, and intermittently exposed soils.

Figure 4. Wetlands within 1320 feet of Boy Lake shoreline.



Hydric Soils

Objective

1. Map hydric soils within the extended state-defined shoreland area (within 1320 feet of shoreline) of Boy Lake

Introduction

Hydric soils are defined as those soils formed under conditions of saturation, flooding, or ponding. The saturation of these soils combined with microbial activity causes oxygen depletion; hydric soils are characterized by anaerobic conditions during the growing season. These conditions often result in the accumulation of a thick layer of organic matter, and the reduction of iron or other elements.

Hydric soils are one of the "diagnostic environmental characteristics" that define a wetland (along with hydrology and vegetation). Identification of hydric soils may indicate the presence of wetlands, and provide managers with valuable information on where to focus conservation efforts.

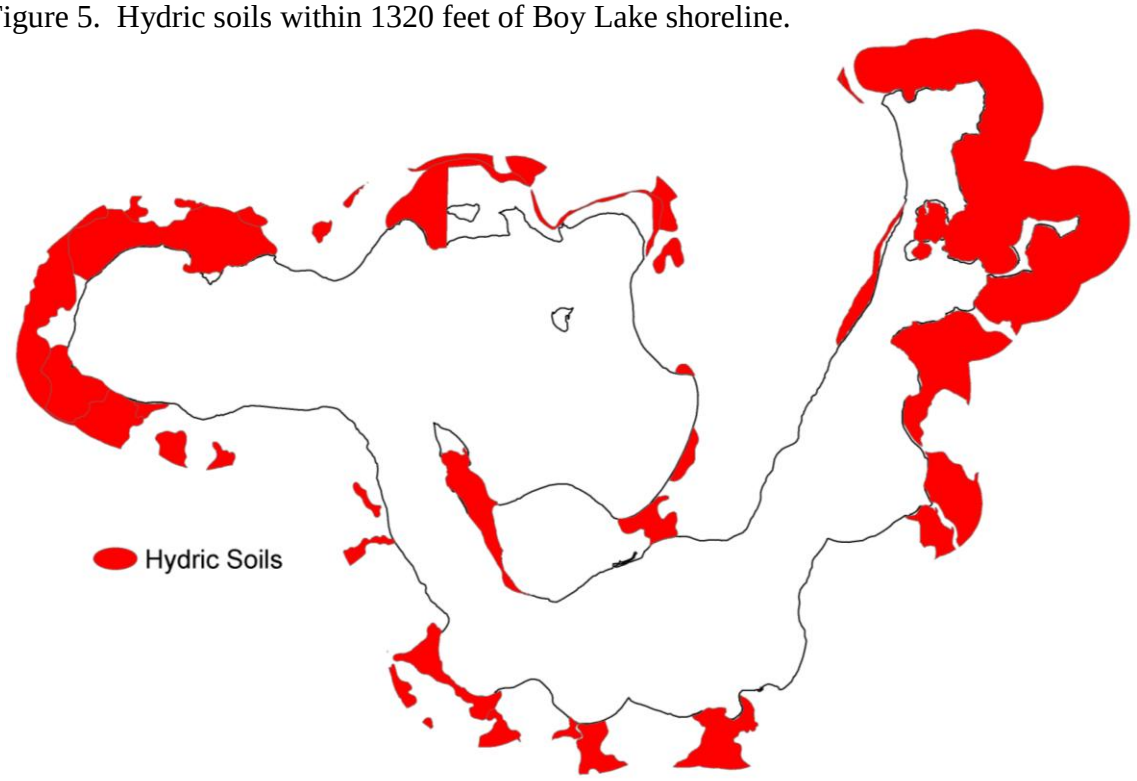
Methods

The National Cooperative Soil Survey, a joint effort of the USDA Natural Resources Conservation Service (NRCS) with other Federal agencies, State agencies, County agencies, and local participants, provided soil survey data. Polygons delineating hydric soils were mapped in a GIS computer program. Only hydric soils within 1320 feet of the shoreline were considered in this project.

Results

Approximately 1400 acres of hydric soils occur within the Boy Lake shoreland area. These soils make up over 40% of the shoreland (area within 1320 feet of the shoreline). Like the wetlands, the largest areas are located along the east basin of the lake (Figure 5). Large complexes of hydric soils are also located along the northwestern edge of the north basin. The soils have an organic matter content that ranges from moderate to very high, and the majority of them are very poorly drained. Soil types include muck, mucky peat, and loamy sand.

Figure 5. Hydric soils within 1320 feet of Boy Lake shoreline.



Plant Surveys

Objectives

1. Record presence and abundance of all aquatic plant taxa
2. Describe distribution of vegetation in Boy Lake
    a. Estimate maximum depth of plant colonization
    b. Estimate plant occurrence in bays versus main lake
    c. Estimate and map the near-shore occurrence of vegetation
3. Delineate and describe floating-leaf and emergent plant beds
4. Map distribution and describe habitat of unique plant species
5. Calculate and map aquatic plant taxa richness

Summary

A total of 34 native aquatic plant taxa were recorded in Boy Lake, including 24 submerged and free-floating, three floating-leaf, and seven emergent taxa. More than 30 additional shoreline plant taxa were also documented.

Submerged plants occurred to a depth of 20 feet but were most common in the shore to ten feet depth zone, where 89% of the sample sites contained vegetation. Common submerged plants included muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), flat-stem pondweed (*Potamogeton zosteriformis*), greater bladderwort (*Utricularia vulgaris*), and northern watermilfoil (*Myriophyllum sibiricum*).

Emergent plants covered more than 20% of the lake, with 605 acres of wild rice (*Zizania palustris*) and 170 acres of hard-stem bulrush (*Schoenoplectus acutus*) mapped. Floating-leaf plants, such as white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), and floating-leaf pondweed (*Potamogeton natans*) were mixed within and adjacent to these emergent beds. Within the shore to five feet depth zone, 51% of the sample sites contained at least one emergent or floating-leaf plant.

Unique plants that occur in or near Boy Lake include two peatland plants, bog rosemary (*Andromeda glaucophylla*), and dragon's mouth (*Arethusa bulbosa*), and a submerged aquatic plant, flat-leaved bladderwort (*Utricularia intermedia*).

Introduction

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. Deep or wind-swept areas may lack in aquatic plant growth, whereas sheltered shallow areas may support an abundant and diverse native aquatic plant community that in turn, provides critical fish and wildlife habitat and other lake benefits. The annual abundance, distribution and composition of aquatic plant communities may change due to environmental factors, predation, the specific phenology of each plant species, introductions of non-native plant or animal species, and human activities in and around the lake.

Non-native aquatic plant species have not been documented in Boy Lake. However, 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 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.

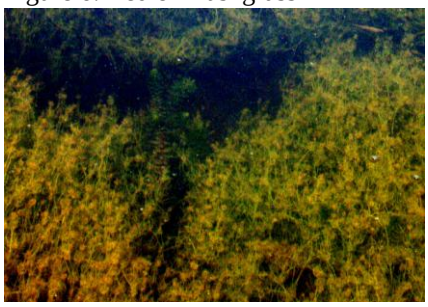
Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. Motorboat activity in vegetated areas can be particularly harmful for species such as bulrush and wild rice. Shoreline and watershed development can also indirectly influence aquatic plant growth if it results in changes to the overall water quality and clarity. Limiting these types of activities can help protect native aquatic plant species.

Submerged plants

Submerged plants have leaves that grow below the water surface but some species also have the ability to form floating and/or emergent leaves, particularly in shallow, sheltered sites. Submerged plants may be firmly attached to the lake bottom by roots or rhizomes, or they may drift freely with the water current. This group includes flowering plants that may produce flowers above or below the water surface, as well as non-flowering plants such as large algae and mosses.

Muskgrass (*Chara* sp.; Figure 6) is a large algae that is common in many hard water Minnesota lakes. This plant resembles higher plants but does not form flowers or true leaves, stems and roots. Muskgrass grows entirely submerged, is often found at the deep edge of the plant zone (Arber 1920), and may form thick "carpets" on the lake bottom. These beds provide important habitat for fish spawning and nesting. Muskgrass has a brittle texture and a characteristic "musky" odor. It 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.

Figure 6. Bed of muskgrass



Pondweeds (*Potamogeton* spp. and *Stuckenia* spp.) are one of the largest groups of submerged plants in Minnesota lakes. These plants are rooted perennials and their rhizomes may form mats on the lake bottom that help consolidate soil (Arber 1920). Pondweeds have opposite, entire leaves and form "cigar-shaped" flowers that emerge above the water surface. Many pondweed species overwinter as hardy rhizomes while other species produce tubers, specialized winter buds, or remain "evergreen" under the ice. Seeds and tubers of pondweeds 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). Pondweeds inhabit a wide range of aquatic sites and species vary in their water chemistry and substrate preferences and tolerance to turbidity. There are over 35 species of pondweeds in Minnesota and they vary in leaf shapes and sizes.

Flat-stem pondweed (*Potamogeton zosteriformis*; Figure 7) is a perennial plant that is anchored to the lake bottom by underground rhizomes. 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. These pondweeds are anchored to the lake bottom by rhizomes and overwinter by winter buds.

Figure 7. Flat-stem pondweed

Coontail (*Ceratophyllum demersum*; Figure 8) is the most common submerged flowering plant in Minnesota lakes. It grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. Coontail is a perennial and can overwinter as a green plant under the ice before beginning new growth early in spring. Because it is only loosely rooted to the lake bottom it may drift between depth zones (Borman et al. 2001). Coontail provides important cover for young fish, including bluegills, perch, largemouth bass and northern pike. It also supports aquatic insects beneficial to both fish and waterfowl.

Figure 8. Coontail

Bladderworts (*Utricularia* spp.; Figure 9) are a group of submerged plants that produce roots but do not firmly anchor to the lake bottom. Greater bladderwort (*U. vulgaris)* is commonly found in lakes and ponds throughout Minnesota. Bladderworts have specialized air bladders that regulate their position in the water column. They also act as "underwater Venus fly-traps" by catching and digesting small insects in the bladders. Bladderworts produce small but showy flowers (Figure 9) that emerge above the water surface. They prefer soft substrates (Nichols 1999b) but also float freely in the water column and may be found in protected areas such as waterlily beds.

Figure 9. Bladderwort in flower among watershield

Northern watermilfoil (*Myriophyllum sibiricum*; Figure 10) 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 overwinters by hardy rootstalks and winter buds. Northern watermilfoil is not tolerant of turbidity and grows best in clear water lakes. This native plant provides fish shelter and insect habitat and the extensive root systems help stabilize near-shore substrates.

Figure 10. Northern watermilfoil

Floating-leaf and emergent plants

Floating-leaf and emergent aquatic plants are anchored in the lake bottom and their root systems often form extensive networks that help consolidate and stabilize bottom substrate. Beds of floating-leaf and emergent plants help buffer the shoreline from wave action, offer shelter for insects and young fish, and provide shade for fish and frogs. These beds also provide food, cover and nesting material for waterfowl, marsh birds and muskrat. Floating-leaf and emergent plants are most often found in shallow water to depths of about six feet and may extend lake-ward onto mudflats and into adjacent wetlands.

Figure 11. White waterlily

White and yellow waterlilies can be found in lakes in both northern and southern Minnesota. White waterlily (*Nymphaea odorata*; Figure 11) has showy white flowers and round leaves with radiating veins. Yellow waterlily (*Nuphar variegata*; Figure 12) has smaller yellow flowers and oblong leaves with parallel veins. These species often co-occur in mixed beds but yellow waterlily is generally restricted to depths less than seven feet while white waterlily may occur to depths of ten feet (Nichols 1999b).

Figure 12. Yellow waterlily

Floating-leaf pondweed (*Potamogeton natans*; Figure 13) also occurs in lakes throughout the state. It may co-occur with other vegetation or may be found on the deep end of bulrush beds. This plant forms very narrow submerged leaves and oval-shaped floating leaves. The fruits of floating-leaf pondweed are eaten by geese and ducks, including scaup and blue-winged teal (Borman et al. 2001).

Figure 13. Floating-leaf pondweed

Emergent aquatic plants have stems and/or leaves that extend well above the water surface. Most emergent plants are flowering plants, though their flowers may be reduced in size. Emergent plants include perennial plants as well as annual plants.

Hard-stem bulrush (*Schoenoplectus acutus;* Figure 14) is an emergent, perennial plant that occurs in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). Bulrush stems are round in cross section and lack showy leaves (Figure 14). Clusters of small flowers form near the tips of long, narrow stalks. This emergent may occur from shore to water depths of about six feet and its stems may extend several feet above the water surface.

Figure 14. Bulrush bed

Bulrush stands are particularly susceptible to destruction by excess herbivory and direct removal by humans.

Wild rice (*Zizania palustris*; Figure 15) is an emergent annual plant that reproduces each year from seed set in the previous fall. Wild rice is most commonly found in lakes of central and northern Minnesota. Cass County is one of five Minnesota counties with the highest concentration of lakes supporting natural wild rice stands (MN DNR 2008b). Wild rice generally requires habitat with some water flow, such as lakes with inlets and outlets. This plant most often is found in water depths of 0.5 to three feet in soft substrates (MN DNR 2008b). Wild rice is one of the most important waterfowl foods in North America and is used by more than 17 species of wildlife listed by the Minnesota Department of Natural Resources as "species of greatest conservation need" (MN DNR 2008b). Other ecological benefits associated with wild rice stands include habitat for fish and aquatic invertebrates, shoreline protection and stabilization, and nutrient uptake. This plant also has special cultural and spiritual significance to the Ojibwe people and wild rice harvest provides important economic benefits to local economies (MN DNR 2008b).

Figure 15. Wild rice

Unique aquatic plants

Unique aquatic plant species are of high conservation importance. These species are not listed as rare but are important because:

- They are uncommon in the state or locally. These may include species that are proposed for rare listing.
- They are plants species with high coefficient of conservatism values (C values). These values range from 0 to 10 and represent the "estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition" (Nichols 1999a, Bourdaghs et al. 2006). Plant species with assigned C values of 9 and 10 were included as unique species.

Dragon's mouth (*Arethusa bulbosa*; Figure 16) is an uncommon plant in the orchid family that occurs in conifer swamps and peatlands. It has a single, grass-like leaf and a showy magenta flower which blooms from late June to mid-August. Although this species is not considered rare in MN, it is known to be rare and declining over a significant portion of its North American range.

Figure 16. Dragon's mouth

Bog rosemary (*Andromeda glaucophylla*; Figure 17) is a low-growing evergreen shrub in the Heath family. The undersides of the blue-green leaves are covered with fine white hairs. Small, bell-shaped, pink or white flowers occur at the tips of the branches. This plant has specific habitat requirements, occurring in acidic bogs within the forested region of Minnesota. In several Eastern states, bog rosemary is listed as a rare species because of degraded wetland habitat.

Figure 17. Bog rosemary

Photo by: Joanne Kline, Wisconsin State Herbarium

Flat-leaved bladderwort (*U. intermedia*; Figure 18) is a small, submerged plant that is often confused with algae because of its fine stems and leaves. It is closely related to the common bladderwort but occurs less frequently in the state. It has been documented in protected, shallow lake areas throughout northern Minnesota (Ownbey and Morley 1991).

Rare plants

White adder's-mouth orchid (*Malaxis monophylla* var. *brachypoda;* Figure 19) is a small bog orchid that grows in conifer swamps in northern Minnesota. This plant is less than nine inches in height and has one oval-shaped leaf at the base of the stem. Minute greenish flowers occur along a slender stalk (Figure 18). There are several small bog orchids native to Minnesota and white adder's-mouth orchid is listed as a State species of Special Concern. This species occurs in unique habitat within forested rich peatlands, typically under a canopy of northern white cedar, black spruce, balsam fir, black ash and tamarack; these forests are usually at the margins of lake basins or other wetlands (MN DNR 2008c). The sensitive and fragile nature of this species' habitat is one reason for its rarity.

Figure 18. Flat-leaved bladderwort

Species richness

Species richness is defined as the number of species present in a community and is often used as a simple measure of biodiversity (Magurran 2004). In aquatic plant communities, species richness is influenced by many complex factors (Pip 1987) including water chemistry, transparency, habitat area and habitat diversity (Vestergaard and Sand-Jensen 2000, Rolon et al. 2008). In Minnesota, water chemistry strongly influences which plant species can potentially occur in a lake (Moyle 1945), and thus indirectly influences lakewide species richness. The trophic status of a lake further influences plant species richness, and eutrophic and hypereutrophic habitats have been associated with reduced species richness (Pip 1987). Within a region of Minnesota, lakewide aquatic plant species richness can be used as a general indicator of the lake clarity and overall health of the lake plant community. Loss of aquatic plant species has been associated with anthropogenic eutrophication (Stuckey 1971, Nicholson 1981, Niemeier and Hubert 1986) and shoreland development (Meredith 1983). Within a lake, plant species richness generally declines with increasing water depth, as fewer species are tolerant of lower light levels available at deeper depths. Substrate, wind fetch, and other physical site characteristics also influence plant species richness within lakes.

Figure 19. White adder's-mouth orchid

Methods

The aquatic plant communities of Boy Lake were described and measured using several techniques as found in Minnesota's Sensitive Lakeshore Identification Manual (MN DNR 2008). Plant nomenclature follows MNTaxa 2009.

Grid point-intercept survey

A grid point-intercept survey was conducted in Boy Lake on June 25 and 26 and July 15 and 17, 2008 (Perleberg and Loso 2008). A GIS computer program was used to establish aquatic plant survey points throughout the littoral (i.e., vegetated) zone of the lake to a depth of 20 feet. Points were spaced 100 meters apart and 919 sites were sampled within the shore to 20 feet depth interval. An additional 13 sites were surveyed in the 21 to 25 feet depth zone but since no vegetation was found, these deeper water sites were not used in analyses. Sample sites that occurred within dense beds of wild rice or other emergent/floating-leaf vegetation were not surveyed in order to minimize damage to these plant beds. Surveyors navigated to each site using a handheld Global Positioning (GPS) unit. At each sample site, water depth and all vegetation within a one-meter squared sample area was sampled using a double-headed garden rake. All aquatic plant species present within the sample plot were recorded and frequency of occurrence was calculated for each species. Any additional species found outside the sample plots were recorded as present in the lake. Voucher specimens were collected for most species and were submitted to The Herbarium of the University of Minnesota Bell Museum of Natural History, St. Paul, MN.

Emergent and floating-leaf bed delineation

Protocol for mapping plant beds were based on the procedures documented in the DNR draft Aquatic Vegetation Mapping Guidelines (MN DNR 2005b). They included a combination of aerial photo delineation and interpretation, field delineation, ground-truthing and site specific surveys. Waterlily beds were delineated using 2003-2004 and 2008 Farm Service Administration (FSA) true color aerial photos. Black and white aerial photos from 1999 were used to help distinguish the true shoreline from mats of perennial vegetation. In 2008, reconnaissance surveys were conducted of the largest beds to verify species composition and, if needed, modify boundary lines. Field mapping focused on bulrush beds, which were difficult to see on aerial photos. Bulrush beds were mapped in 2008 using handheld GPS technology.

Near-shore vegetation survey

Near-shore vegetation surveys were conducted at two plots. Plots were selected based on the presence of non-game fish. Each plot measured 15 meters along the shoreline and 16 meters lakeward, and 30 (one-meter squared) sites were sampled within each plot. Surveyors recorded plant species present, water depth, substrate and presence of woody debris.

Searches for unique and rare species

Prior to fieldwork, surveyors obtained known locations of state and federally listed rare plants within one mile of Boy Lake from the Rare Features Database of the MN DNR Natural Heritage Information System. Surveyors also queried the University of Minnesota Herbarium Vascular Plant Collection database and DNR Fisheries Lake Files to determine if certain plant species had previously been documented in or near Boy Lake.

Surveyors searched for unique and rare plant species in 2008 during the lakewide point-intercept surveys and during the near-shore plot surveys. If unique or rare plant species were located, surveyors recorded the site location, the plant species found, associated plant species, approximate water depth, and substrate type. Any new sites of rare plant species were documented and entered into the MN DNR Natural Heritage Information System.

Results

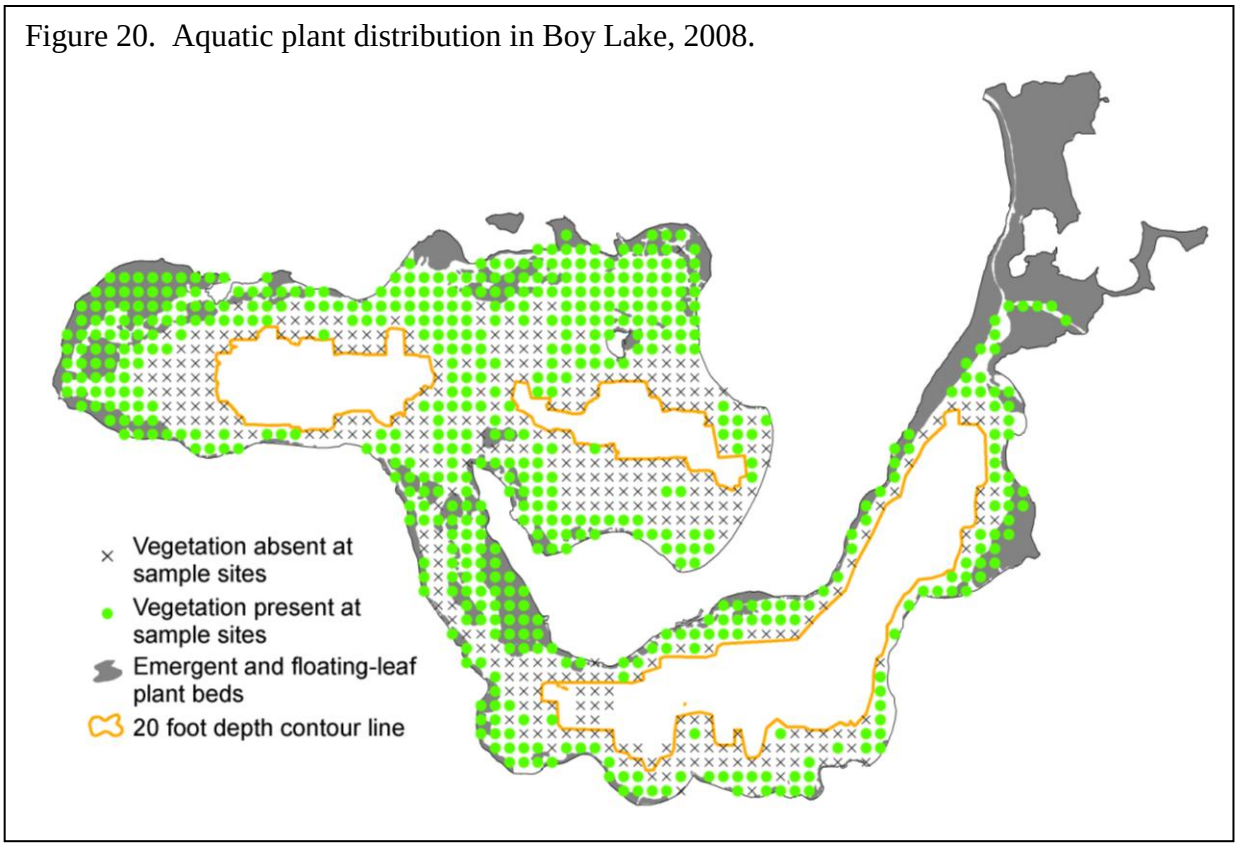
Distribution of plants by water depth

Submerged plants were found to a water depth of 20 feet (Figure 20). This vegetated zone includes about two-thirds of the lake and within this area, 63% of the survey sites contained vegetation. Plant occurrence was greatest in depths from shore to 10 feet, where 89% of the sites were vegetated. In water depths of 11 to 20 feet, only 16% of the sites contained plants. Emergent and floating-leaf plants occurred in water depths of nine feet and less.

Distribution of plants in main basin versus bays

Aquatic plants occurred around the entire lake perimeter and emergent and floating-leaf plant beds were scattered throughout Boy Lake.

Figure 20. Aquatic plant distribution in Boy Lake, 2008.



Aquatic plant species observed

A total of 34 native aquatic plant taxa were recorded in Boy Lake. These included 24 submerged and free-floating taxa (Table 1), three floating-leaf, and seven emergent taxa (Table 2). More than 30 additional shoreline plants were also documented (Appendix 1).

Table 1. Submerged and free-floating aquatic plants recorded in Boy Lake, 2008.

Description			Common Name	Scientific Name	Frequency[a]
SUBMERGED and/or FREE-FLOATING	Algae and mosses		Muskgrass	*Chara* sp.	35
			Stonewort	*Nitella* sp.	2
			Watermoss	Not identified to species	2
	Rooted plants	Grass-leaf plants	Flat-stem pondweed	*Potamogeton zosteriformis*	20
			Wild celery	*Vallisneria americana*	<1
			Water stargrass	*Zosterella dubia*	<1
		Dissected-leaf plants	Coontail	*Ceratophyllum demersum*	15
			Northern watermilfoil	*Myriophyllum sibiricum*	8
			White water buttercup	*Ranunculus aquatilis*	1
			Water marigold	*Bidens beckii*	<1
		Bushy-leaf plants	Canada waterweed	*Elodea canadensis*	6
			Bushy pondweed	*Najas* sp.	4
			Narrow-leaf pondweed	*Potamogeton* sp.[b]	2
			Fries' pondweed	*Potamogeton friesii*	1
		Broad-leaf plants	White-stem pondweed	*Potamogeton praelongus*	3
			Illinois pondweed	*Potamogeton illinoensis*	2
			Large-leaf pondweed	*Potamogeton amplifolius*	2
			Clasping-leaf pondweed	*Potamogeton richardsonii*	1
			Variable pondweed	*Potamogeton gramineus*	<1
		Fine-leaf plants	Sago pondweed	*Stuckenia pectinata*	1
	Free-drifting		Greater bladderwort	*Utricularia vulgaris*	9
			Lesser bladderwort	*Utricularia minor*	1
			Star duckweed	*Lemna trisulca*	2
			Lesser duckweed	*Lemna minor*	<1
			Greater duckweed	*Spirodela polyrhiza*	<1

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations (N = 919). They represent the percent of the sample stations that contained a plant taxon.

[b]Some specimens of "narrow-leaved pondweeds" were positively identified as *Potamogeton friesii* (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* sp.) are reported here but not counted in species tally.

Nomenclature follows MNTaxa 2009.

Submerged plants
Submerged plants occurred in 63% of Boy Lake sample sites. The plant community included leafy plants that are anchored to the lake bottom by roots as well as large algae that may resemble leafy plants but are weakly anchored to the lake bottom.

Muskgrass was found in 35% of all sample sites and was well-distributed throughout the lake (Figure 21A). It was the most common submerged plant in depths from zero to 15 feet and was found most frequently in depths of 10 feet and less.

Nine different pondweed species (*Potamogeton* spp. and *Stuckenia* spp.) were found in Boy Lake. Flat-stem pondweed was the most abundant and was found in 20% of all sample sites (Table 1). It was one of the few species found in the 16 to 20 feet depth zone but was most frequent in the zero to 10 feet depth zone. Flat-stem pondweed often co-occurred with muskgrass and other submerged species (Figure 21B).

Coontail (Figure 21C), greater bladderwort (Figure 22A), and northern watermilfoil (Figure 22B) occurred in less than 20% of the sites but were found throughout the littoral zone.

Figure 21. Distribution of common aquatic plants in Boy Lake, 2008.

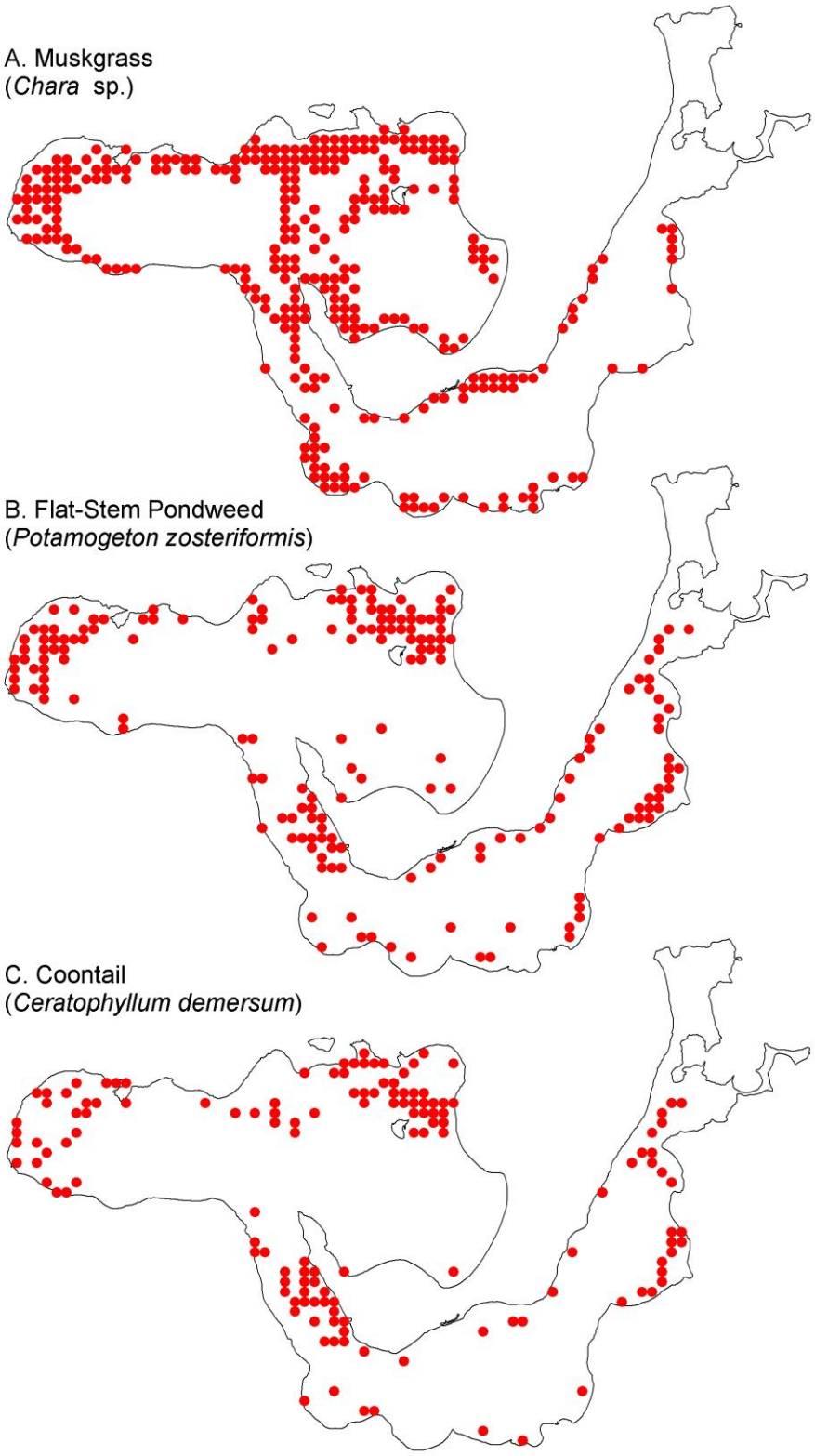
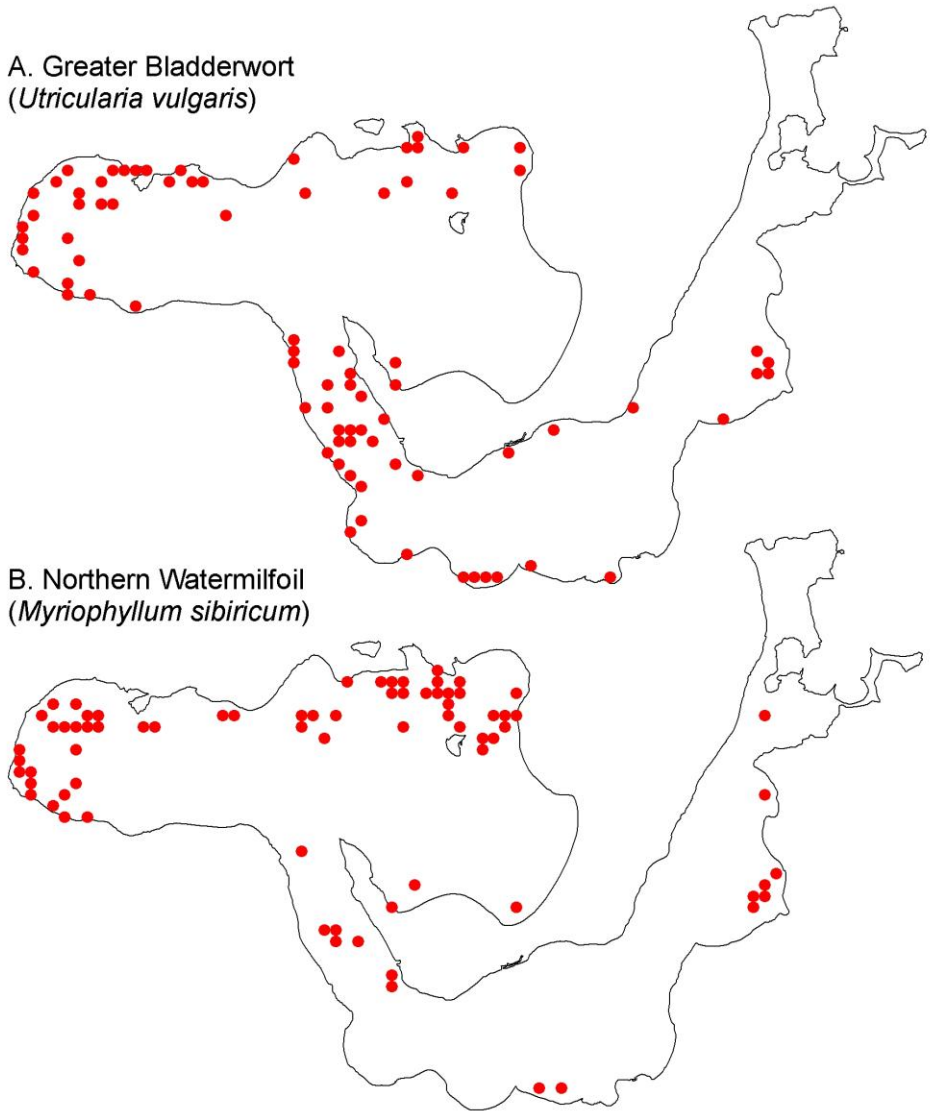


Figure 22. Distribution of common aquatic plants in Boy Lake, 2008.



Emergent and floating-leaf plants

At least 20% of Boy Lake was occupied by emergent and/or floating-leaf plants. Wild rice was the most abundant species and covered at least 605 acres (Figure 23). It formed extensive beds in the northern basin, the channel to the north basin and in the northeast bay. Wild rice was also a dominant plant within the Boy River. Wild rice beds were often part of mixed vegetation stands including waterlilies and/or bulrush.

Floating-leaf stage of wild rice in Boy Lake, 2008.

Approximately 170 acres of bulrush beds were delineated and were located in scattered locations around the north basin and on the west end of the south basin (Figure 23).

Bulrush in Boy Lake, 2008.

About three acres of floating-leaf plant beds were mapped and were common within the shallow, non-accessible areas of emergent plant beds. (Figure 23). The most common species were white waterlily, yellow waterlily, and floating-leaf pondweed. Because surveyors avoided motoring into floating-leaf plant beds, the frequency values obtained for these taxa (Table 2) were lower than the actual lakewide occurrence. Frequency values for floating-leaf taxa represent the occurrence of these taxa only within the sites that were surveyed.

Waterlilies mixed with emergent plants in Boy Lake, 2008.

Other emergent plants occurred at scattered locations around the lake and included giant cane (*Phragmites australis*) and cattail (*Typha* sp.). Many of these emergent plants occupied the transitional zone between the lake and adjacent wetlands. Numerous additional native emergents occurred in these adjacent wetlands but this survey did not include an exhaustive wetland species inventory.

Table 2. Floating-leaf and emergent aquatic plants recorded in Boy Lake, 2008.

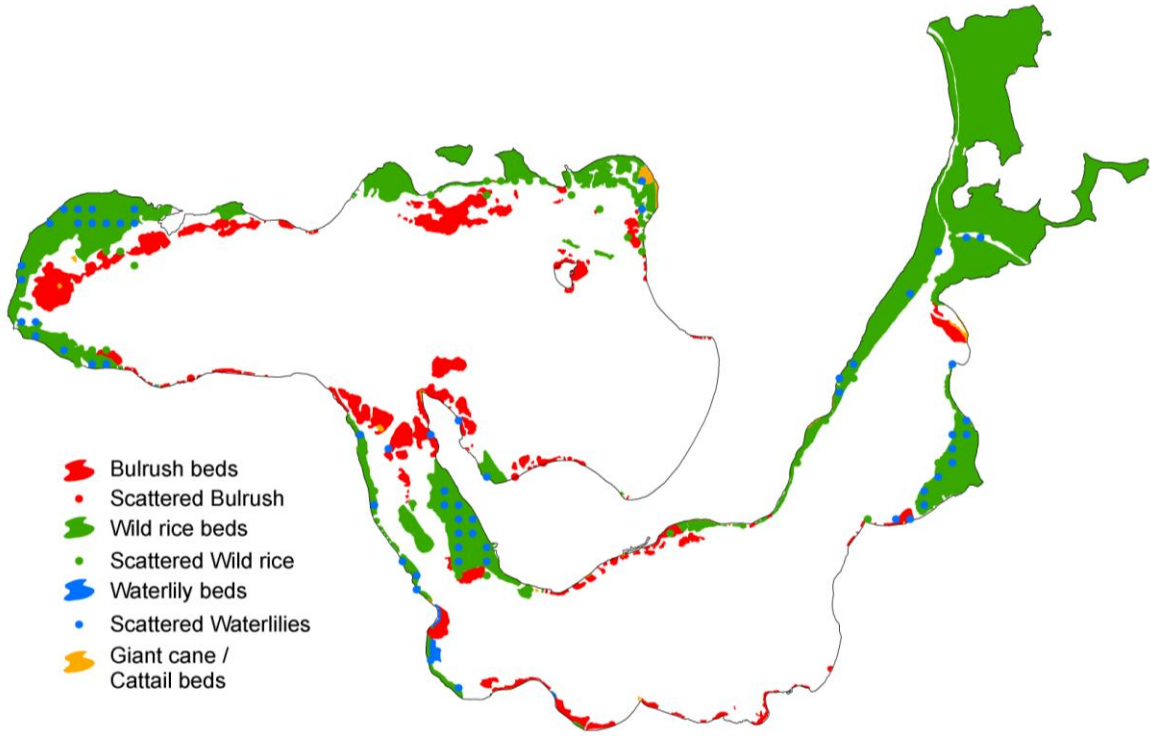
Description	Common Name	Scientific Name	Frequency[a]
FLOATING-LEAF	Yellow waterlily	*Nuphar variegata*	4
	Floating-leaf pondweed	*Potamogeton natans*	4
	White waterlily	*Nymphaea odorata*	3
EMERGENT	Wild rice	*Zizania palustris*	13
	Hard-stem bulrush	*Schoenoplectus acutus*	5
	Cattail	*Typha* sp.	<1
	Giant cane	*Phragmites australis*	<1
	Giant burreed	*Sparganium eurycarpum*	Present
	Arum-leaved arrowhead	*Sagittaria cuneata*	Present
	Broad-leaved arrowhead	*Sagittaria latifolia*	Present

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations (N = 919). They represent the percent of the sample stations that contained a plant taxon.

[b]Present = present in lake but not found at point-intercept sample stations.

Nomenclature follows MNTaxa 2009.

Figure 23. Distribution of emergent and floating-leaf plant beds in Boy Lake, 2008.



Unique plants

In addition to the commonly occurring plants in Boy Lake, surveyors located two unique plant species (Figure 24). Bog rosemary was found along the north shore of the lake and was likely present at additional sites within wetlands adjacent to the lake. Flat-leaved bladderwort was found at ten sites during the survey and was concentrated in protected bays. These species are not widespread in Minnesota but their presence is indicative of relatively undisturbed native plant beds in and adjacent to Boy Lake.

Species richness

The number of plant taxa found in each one square meter sample site ranged from zero to 12 (Figure 25). Sites with the highest number of species occurred in depths less than six feet, where a mixture of emergent, floating-leaved and submerged species occurred. In water depths greater than ten feet, most sites were either devoid of vegetation or contained only one species.

Figure 24. Unique aquatic plant species in Boy Lake, 2008.

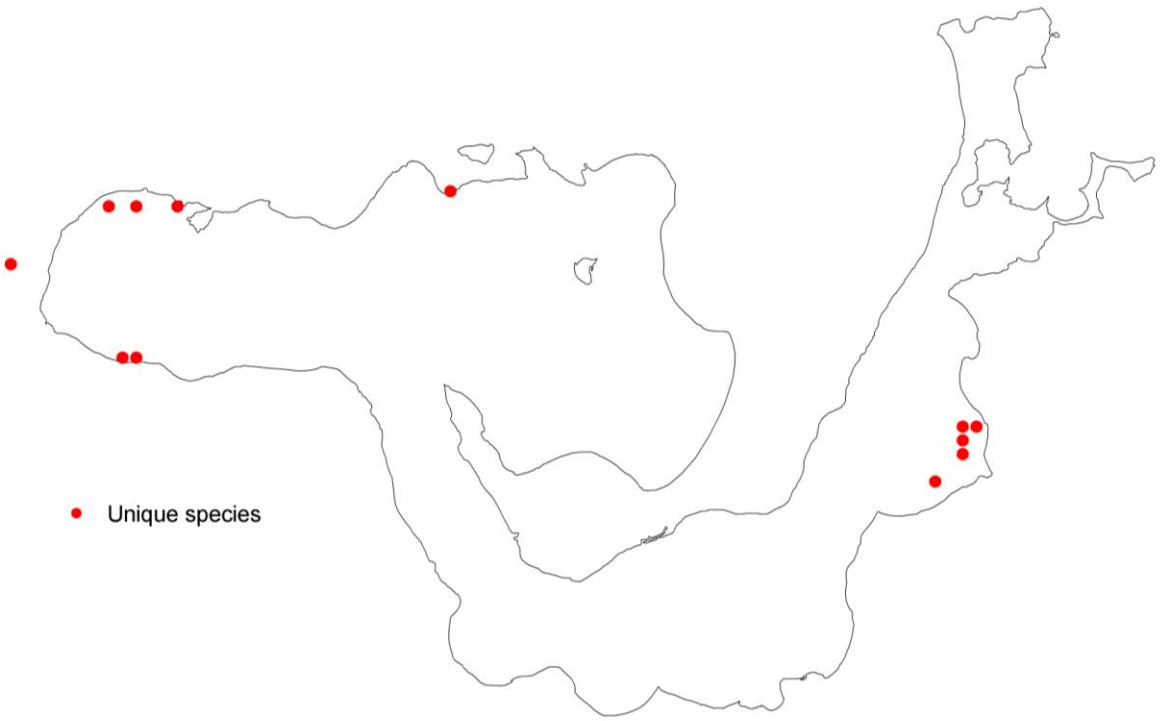
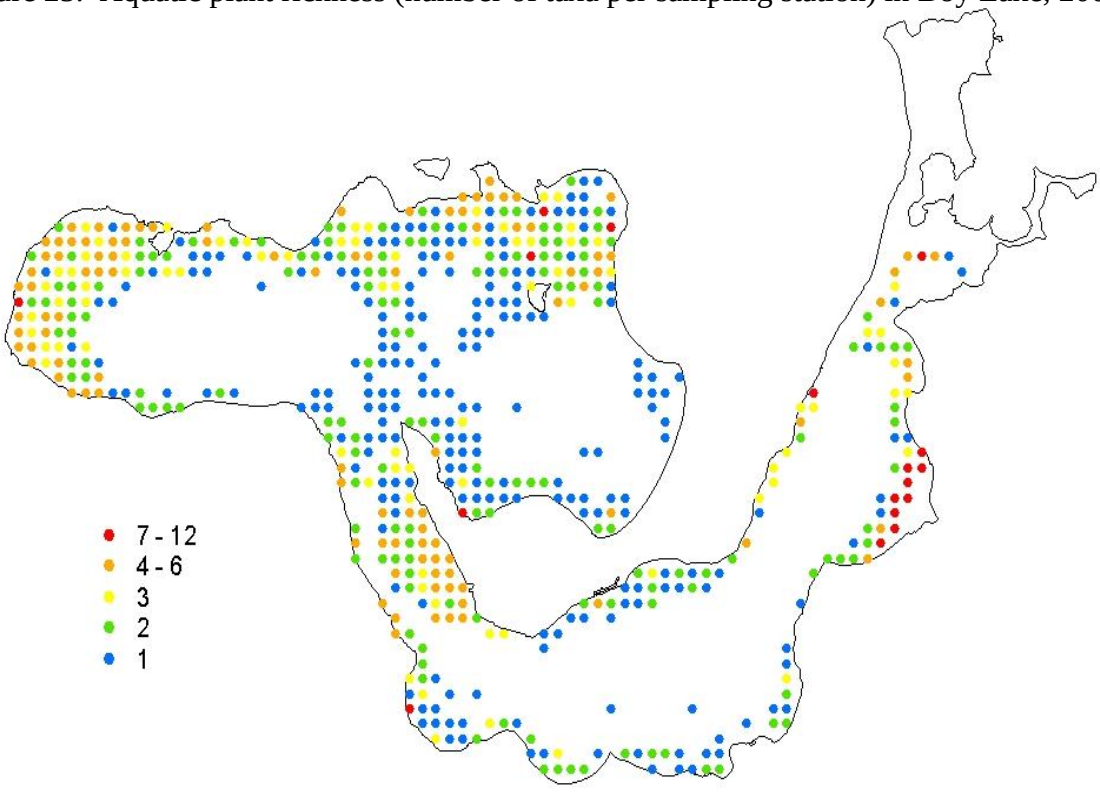


Figure 25. Aquatic plant richness (number of taxa per sampling station) in Boy Lake, 2008.



Near-shore Substrates

Objective

1. Describe and map the near-shore substrates of Boy Lake

Introduction

Substrate type can have an effect on species make-up and richness. Some fish, such as the pugnose shiner, least darter, and longear sunfish, prefer small diameter substrates, such as silt, muck, and sand. Other species, such as walleye, prefer hard bottom substrates with a larger diameter, such as gravel and rubble. A diverse substrate will also allow plants with different habitat requirements to exist within a system. For example, bulrush may occur on sand or gravel whereas yellow waterlily prefers soft substrates (Nichols 1999b).

Methods

Near-shore substrates in Boy Lake was evaluated at a total of 534 sampling stations set up in the grid point-intercept aquatic plant surveys and near-shore fish surveys. Plant sample stations were 100 meters apart and occurred in a grid from shore to a depth of 20 feet. To increase sample coverage at near-shore sites not covered by the grid sampling, substrate was also evaluated at near-shore fish sample stations. Fish sample stations were located every 400 meters around the perimeter of the lakeshore and substrate was evaluated at 87 of these stations. Sample sites that occurred within dense beds of wild rice or other emergent/floating-leaf vegetation were not surveyed in order to minimize damage to these plant beds.

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 was not feasible, substrate was evaluated by visual observation. Standard lake substrate classes were based on the DNR Fisheries Survey Manual (MN DNR 1993):

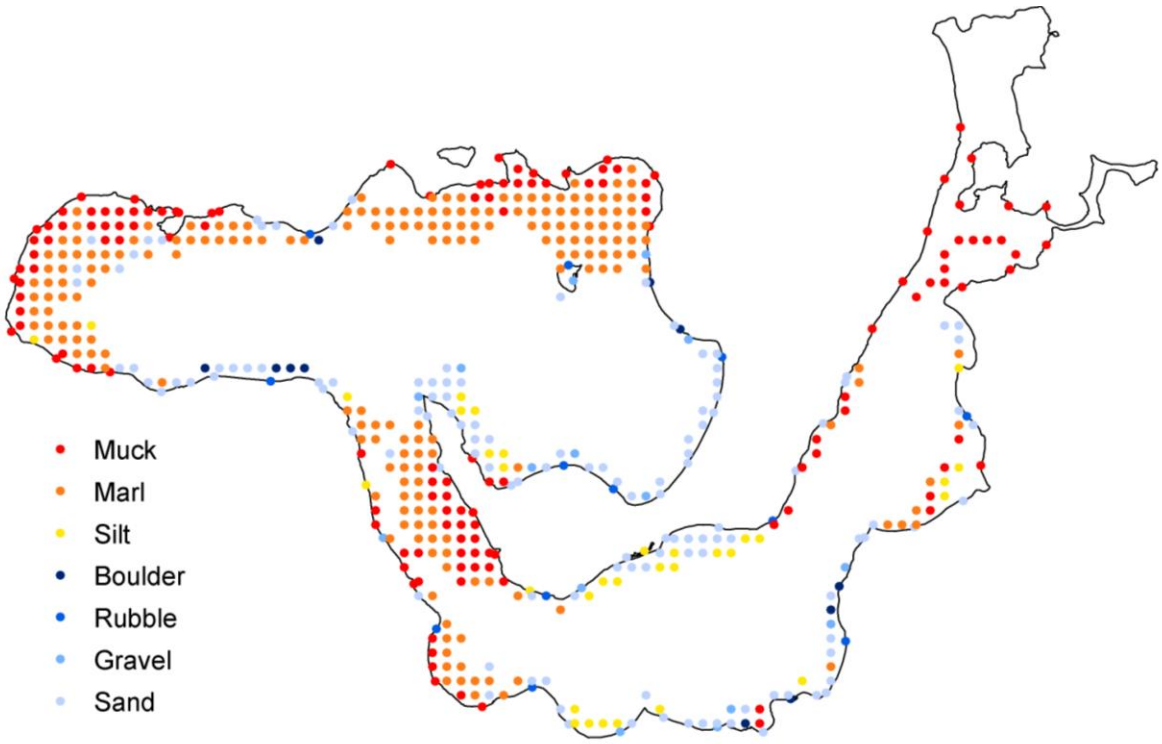
Substrate Group	Type	Description
Hard Bottom	Boulder	Diameter over 10 inches
	Rubble	Diameter 3 to 10 inches
	Gravel	Diameter 1/8 to 3 inches
	Sand	Diameter less than 1/8 inch
Soft Bottom	Silt	Fine material with little grittiness
	Marl	Calcareous material
	Muck	Decomposed organic material

Results

Soft substrates dominated the Boy Lake near-shore areas (Figure 26). Marl was the most common substrate type, followed by muck. These soft substrates (including silt) occurred at

nearly 70% of the sample locations. Approximately 25% of the sample locations were comprised of sand. This substrate was found along the eastern edge of the north basin, and at scattered sites along the east basin. Large-diameter hard substrates, including boulders and rubble, were found only occasionally.

Figure 26. Distribution of Boy Lake near-shore substrates, 2008.



Bird Surveys

Objectives

1. Record presence of all bird species detected during point count surveys
2. Record presence of marsh birds detected with call-playback surveys
3. Document all non-survey observations of birds
4. Develop distribution maps for species of greatest conservation need

Introduction

Bird Species of Greatest Conservation Need

There are 97 bird species of greatest conservation need (SGCN) in Minnesota. Species of greatest conservation need are documented in Minnesota's State Wildlife Action Plan, Tomorrow's Habitat for the Wild and Rare (2006). Twenty-eight of these species were identified at Boy Lake.

Figure 27. American bittern at Boy Lake

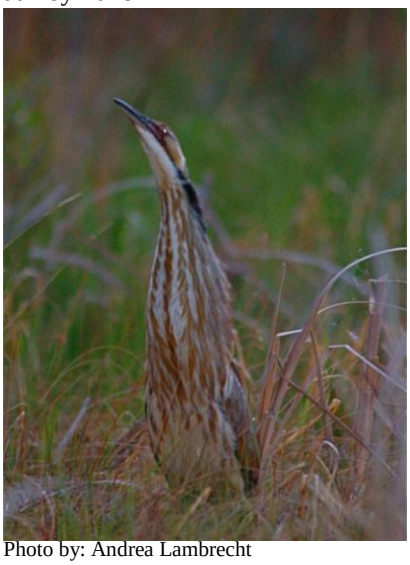


Photo by: Andrea Lambrecht

American bitterns (*Botaurus lentiginosus*; Figure 27) are medium-sized wading birds. The upperparts are dark brown, while the neck and body are streaked with brown. Adults have a black patch on either side of the throat. When disturbed, bitterns "freeze" with their bills pointed upward, allowing them to blend into the reeds. Habitat includes shallow, densely vegetated shorelines and marshes. Habitat loss has been a major factor in the decline of American bittern populations. Habitat degradation and pesticide contamination have also negatively affected bittern numbers.

American white pelicans (*Pelecanus erythrorhynchos*; Figure 28) are one of the largest birds in North America. These white waterbirds have a wingspan of nearly 10 feet, and weigh up to 30 pounds. They have black wingtips and an orange bill with a pouch. Unlike some pelicans, American white pelicans do not dive for their food, but feed while swimming. They nest in colonies on remote freshwater lakes, and depend on wetlands for many stages of their life cycle. Habitat loss is the largest known cause of nesting failure, although predation and boating disturbance can also be factors.

Figure 28. American white pelican

Photo by: Carrol Henderson

Bald eagles (*Haliaeetus leucocephalus*; Figure 29) are an increasingly common sight in Minnesota. Once listed as an endangered species, bald eagle numbers have rebounded due to effective environmental protection laws and conservation efforts. Adult bald eagles are easily identified by the white head and tail, although these colors don't appear until birds are 4 or 5 years old. Prior to that, eagles are generally dark brown with white feathers scattered along the wings, head, tail and back. With a wingspan of up to 7 feet, bald eagles are one of the largest birds in North America. They are found in forested areas near large, open bodies of water. Although bald eagle numbers are increasing, these birds still face threats from environmental contaminants and destruction of habitat. Bald eagles are listed as a species of Special Concern in the state of Minnesota.

Figure 29. Bald eagle

Photo by: Carrol Henderson

Black-billed cuckoos (*Coccyzus erythropthalmus*; Figure 30) are one of two cuckoo species regularly found in Minnesota. These slender, long-tailed birds summer and breed in Minnesota and the east-central United States before heading south to spend the winter in South America. Black-billed cuckoos have a brown back and white underside, and may be distinguished by a curved black bill and red ring around the eye. They inhabit deciduous forests and thickets, and are often found near water. The black-billed cuckoo is listed as a species of Regional Concern on the Partners in Flight watchlist.

Figure 30. Black-billed cuckoo

Photo source: U.S. Fish and Wildlife Service

Black terns (*Chlidonias niger*; Figure 31) are distinguished by a black head and chest with gray wings, back, and tail. The nonbreeding plumage is lighter in color, and much of the black is replaced with white or gray. The bill is long and slightly curved. Black terns are loosely colonial, and often are found in freshwater marshes or wetlands. They may also occur along lake edges with abundant emergent vegetation. Black tern populations have declined dramatically since the 1960s. Habitat loss, environmental contamination, and human disturbance are often cited as causes of the decline.

Figure 31. Black tern

Photo by: Carrol Henderson

Bobolinks (*Dolichonyx oryzivorus*; Figure 32) are distinctive, medium-sized birds of the blackbird family. During breeding season, the male possesses a black chest, wings, and tail, while the shoulders and rump are white. The back of the head is yellow. Females and non-breeding males brown streaked appearance resembles that of a sparrow. Bobolinks breed in open grassy fields, including hay fields. They may also utilize freshwater marshes and grain fields. Bobolinks are long-distance migrants, and every year make a round-trip journey of over 12,000 miles. Populations of bobolinks are declining over much of their range. Loss of grassland habitat is the primary cause of this decline.

Figure 32. Bobolink

Photo by: Dave Herr

The Cape May warbler (*Dendroica tigrina*; Figure 33) is a small, active warbler. Breeding plumage is striking, with a bright yellow rump, throat, and breast streaked with black. The face is orange-brown with a black eyestripe, and the wings exhibit a narrow white wing bar. Cape May warblers breed across the northern United States and into Canada, where large expanses of coniferous woodland are present. They feed mainly on spruce budworms, but also consume other insects and nectar. Numbers of Cape May warblers rise and fall somewhat regularly, in response to availability of spruce budworms. However, loss of mature boreal forest through logging and loss of winter habitat may lead to long-term population declines.

Figure 33. Cape May warbler

Photo by: S. Maslowski, USFWS

Common loons (*Gavia immer*; Figure 34) are one of Minnesota's most recognizable birds. They are found from northeastern to central Minnesota, and numbers are higher here than in any other state except Alaska. These large diving birds possess red eyes and a large, dark pointed bill that is well-adapted for catching fish. Loons spend most of their time in water, and go ashore only to mate and incubate eggs. Summer plumage is spotted black and white, while in winter the colors are gray above and white below. Loon populations are closely monitored in Minnesota; however, these birds still face threats, particularly in the form of human disturbance and lead poisoning.

Figure 34. Common loon

Photo by: Carrol Henderson

Common nighthawks (*Chordeiles minor*; Figure 35) are most often seen in the air, exhibiting an erratic flight pattern as they forage for insects. They are cryptically colored with brown, gray, and white mottling. A white bar is visible across the wing when the bird is in flight. The breeding ritual includes a dramatic display during which the male dives straight toward the ground before quickly turning upward; air rushing through the wings makes a deep booming sound. Originally found in open rural areas, the nighthawk has adapted to urban settings and often nests on gravel rooftops. Despite their adaptability, nighthawks have declined in some areas. Predation and a decreased insect food base due to the use of pesticides may be factors in this decline.

Figure 35. Common nighthawk

Photo by: Carrol Henderson

Common terns (*Sterna hirundo*; Figure 36) are the most widespread terns in North America. In the breeding season common terns have a solid black cap with gray back and underparts. The gray wings have dark edges. The rump is white, and the legs and bill are orange-red in color. Common terns nest in colonies, often on islands or peninsulas of larger lakes with sandy substrates. Populations of common terns declined in the late 1800s, when their feathers were used to adorn clothing, and again in the 1970s, likely due to poisoning by pesticides. Habitat loss, nest predation, and disturbance by humans may also negatively affect common terns.

Figure 36. Common tern

Photo by: Carrol Henderson

Eastern wood-pewees (*Contopus virens*; Figure 37) are medium-sized, nondescript birds common in Eastern forests. They utilize multiple habitat types, including deciduous forests, mixed woods, and suburban areas. This bird gets its name from its call, a slurred "pee-ah-wee." Eastern wood-pewees are grayish-olive above, with a paler throat and belly and whitish wingbars. They forage throughout the canopy, often flying out from their perch to catch insects before returning to the same perch. Populations of eastern wood-pewees are declining throughout much of their range. One possible cause of the decline is the increase in white-tailed deer. Deer browse and decrease the lower-canopy foraging area available to the pewee.

Figure 37. Eastern wood-pewee

Photo by: J.A. Spendelow

The horned grebe (*Podiceps auritus*; Figure 38) is a small member of the grebe family. This bird gets its name from yellow patches of feathers behind the eyes ("horns") that appear during the breeding season. At this time, the neck and belly are reddish, and the head is black. Non-breeding plumage is mainly grayish-black and white. Horned grebes breed on freshwater lakes and wetlands of small to medium size, and migrate to coastal areas during the winter. They feed on fish, insects, and crustaceans, and often eat their own feathers to help with the filter and digestion of fish bones. Although horned grebe numbers appear stable, the breeding range is contracting toward the northwest. Oil spills and pesticide contamination also pose threats to horned grebe populations.

Figure 38. Horned grebe

Photo by: Dave Herr

Least flycatchers (*Empidonax minimus*; Figure 39) are the smallest flycatchers found in Minnesota. Like many other flycatchers, they are olive to gray in color with two white wingbars and whitish underparts. They have a small bill and a prominent white eye ring. The best way to distinguish least flycatchers from other flycatchers is the call, a harsh "che-bek." These birds are often found along water edges in mature, open woods. Least flycatchers are common throughout most of their range where habitat is suitable. However, they are sensitive to human disturbance and require large areas of forest to survive.

Figure 39. Least flycatcher

Photo by: J.A. Spendelow

The LeConte's sparrow (*Ammodramus leconteii*; Figure 40) is a small, elusive sparrow of open, grassy areas. Wet meadows, sedge marshes, and prairies may all harbor populations of this bird. Males and females look similar, with a buffy orange face, throat and breast and white belly. The sides are streaked with black, and the nape is pinkish and streaked with chestnut. Because of their secretive habits, little is known about the population status of the LeConte's sparrow. Drainage of wetlands may have caused population declines in some areas, but long-term geographic trends have been inconsistent. Maintenance of grassland areas will be beneficial to the LeConte's sparrow.

Figure 40. LeConte's sparrow

Photo by: David Arbour

Marsh wrens (*Cistothorus palustris*; Figure 41) are small, stocky wrens. Their color is brown with black and white streaks on the back and black barring on the tail. They have a dark brown or black cap and a white eye line. Marsh wrens are noisy birds, and sing almost continually during the breeding season. They often hold their tails in an upright position, in "classic" wren posture. Marsh wrens inhabit a variety of marshes. Emergent vegetation, such as cattails or bulrush, is one of the most important habitat components. While populations of marsh wrens are increasing in some areas, others are threatened by loss and degradation of wetland habitat.

Figure 41. Marsh wren

Photo by: Dave Herr

Small and secretive, Nelson's sparrows (*Ammodramus nelsoni*; Figure 42) spend their summers in densely vegetated freshwater marshes. They have a bright orange-brown face with gray cheeks, and the upperparts are streaked with brown. The breast is buffy and the belly is white. Nelson's sparrows feed mainly on spiders and insects, foraging on the ground and even probing in the mud to find food. Although populations are hard to estimate because of the birds' secretive nature, they may be vulnerable to habitat loss due to fragmentation and draining of wetlands. The Nelson's sparrow is listed as a species of Special Concern in Minnesota.

Figure 42. Nelson's sparrow

Photo by: Dave Russell, Avian Research and Education Institute. © 2005

The northern harrier (*Circus cyaneus*; Figure 43) is a hawk of the open country. These birds inhabit grasslands, marshes, and meadows, and can often be seen flying low and slow over the ground as they hunt. Male and female northern harriers are quite different in appearance. The males have a whitish chest, belly, and underwings, while the head and back are light gray. The wingtips are black and the tail has narrow dark bars. Females, which are much larger than males, are dark brown above with streaks on the face, breast, and underwings. There is a white patch on the rump. Populations declined in the 20th century due to the loss of wetlands, use of pesticides, and changes in farming practices.

Figure 43. Northern harrier

Photo courtesy of: Robert Bastarache

Northern rough-winged swallows (*Stelgidopteryx serripennis*; Figure 44) are small, fairly common songbirds. They are brown on the head and back with a pale brown throat and white belly. The outer wing feathers, or primaries, have "hooks" on the edge, giving them a rough feel. These swallows are insectivorous and feed in the air, often over water. They will nest either singly or colonially near rocky or exposed banks of clay or sand. Open habitat is preferred for breeding. Northern rough-winged swallows are fairly adaptable and are even increasing in parts of their range. Continued monitoring is important to help maintain this trend.

Figure 44. Northern rough-winged swallow

Photo by: Dave Herr

Ovenbirds (*Seiurus aurocapillus*; Figure 45) are rarely seen birds of the forest. However, their loud "teacher, teacher, teacher" song is commonly heard during the summer months. They dwell on the ground, and build a covered nest that resembles a Dutch oven. Ovenbirds are olive-brown with a boldly streaked breast. Two black stripes border an orange crown. They have a thin bill and a white eye ring. They breed in mature deciduous and mixed forests, especially those with minimal undergrowth. Ovenbird numbers appear to be stable, but the birds are vulnerable to forest fragmentation and parasitism by brown-headed cowbirds (*Molothrus ater*).

Figure 45. Ovenbird

Photo courtesy of: U.S. Fish and Wildlife Service

Rose-breasted grosbeaks (*Pheucticus ludovicianus*; Figure 46) are summer visitors to Minnesota bird feeders. The males are easily identified by a red triangle on a white breast, with a black head and back and a large bill. Females are more difficult to identify, and resemble a large sparrow with brown and white streaks. Rose-breasted grosbeaks are found in open woodlands near water, edges of marshes, meadows and woodlands, and suburban parks and gardens. The winter range spans from southern Mexico to South America and the Caribbean. Significant regional declines in rose-breasted grosbeak populations have been noted. Protection of large, unfragmented areas of hardwood forest would be beneficial to the rose-breasted grosbeak.

Figure 46. Rose-breasted grosbeak

Photo by: J.A. Spendelow

Sedge wrens (*Cistothorus platensis*; Figure 47) are small, brown wrens with buffy underparts and white streaks on the back and crown. They have an indistinct white eye stripe, and often hold their short tails in a cocked, upright position. As their name implies, they prefer marshes and meadows with abundant dense sedges and grasses. The nest is often made of sedges, as well. Sedge wrens are unpredictable in their migration patterns, and may be abundant in an area one year and completely absent the next. Human development of wetlands is the primary reason for the recent notable declines in sedge wren populations.

Figure 47. Sedge wren

Photo by: Berlin Heck

The swamp sparrow's (*Melospiza georgiana*; Figure 48) slow trill is a familiar sound in swampy areas in the summer. Other wetlands, such as bogs and meadows, may also harbor populations of this species. Swamp sparrows eat mainly seeds and fruits, but may also be adventurous feeders, wading in the water and putting their heads underneath in order to capture aquatic insects. This rusty-colored bird has black streaks on the back and an unstreaked gray breast and neck. A reddish cap is easily visible during the breeding season. Swamp sparrows thrive in suitable habitat; however, destruction of wetlands has put this species at risk.

Figure 48. Swamp sparrow

Photo by: Jim Stasz

The trumpeter swan (*Cygnus buccinator*; Figure 49) is the largest of the North American waterfowl. It inhabits lakes, ponds, and large rivers, feeding on roots and stems of aquatic vegetation. Adult trumpeter swans are all white with a black bill and face. Juveniles are whitish-gray with a mottled bill. Historically, trumpeter swans nested across much of North America. However, excessive hunting in the 19th and early 20th centuries led to large population declines, and by 1880 trumpeter swans had disappeared from Minnesota. Captive breeding programs and habitat protection efforts have been successful, and the Minnesota population now numbers over 2000. However, habitat loss and lead poisoning still pose threats to trumpeter swan populations. This bird is listed as Threatened in Minnesota.

Figure 49. Trumpeter swan

Photo by: Dave Herr

The veery (*Catharus fuscescens*; Figure 50) is one of the most easily identifiable thrushes. It has faint dark spots on a buffy breast and a reddish brown back and head. The legs are pink and the eyes are dark with an indistinct light eye ring. The veery was named after its most common call, a "vee-er" sound. Riparian areas with dense vegetation and wetlands within large forests are good places to find the veery. The veery is suffering declines throughout many parts of its range. Destruction of winter habitat and parasitism by brown-headed cowbirds are major reasons cited for the decline.

Figure 50. Veery

Photo by: Deanna Dawson

Virginia rails (*Rallus limicola*; Figure 51) are a rarely seen, ground-dwelling marsh bird. They have a rusty-colored breast and belly, brown-streaked back, and black and white barring on the flanks. The bill is reddish and slightly curved. The cheeks are gray and the throat is white. The Virginia rail rarely flies, and spends most of its time walking through dense vegetation in freshwater marshes. Like many of the marsh birds, Virginia rails are best detected through their vocalizations, including grunts and a metallic "tic." Population information is limited, but several reports have indicated declines in some areas. Loss of wetland habitat may negatively affect Virginia rail numbers.

Figure 51. Virginia rail

Photo by: David Arbour

White-throated sparrows (*Zonotrichia albicollis*; Figure 52) are common in Minnesota during their spring and fall migrations. They are recognizable by the white patch on the throat and their characteristic "Old Sam Peabody Peabody Peabody" song. The head is striped with black and tan or white, and has a yellow spot above the eye. The chest is gray and the back is streaked with brown and black. They inhabit coniferous or mixed forests, and prefer areas with multiple openings and abundant low-growing vegetation. During winter and migration, they may also be found in woodlots, city parks, and backyards.Nests are often build on or near the ground. Although white-throated sparrows are widespread, they are declining over portions of their breeding range.

Figure 52. White-throated sparrow

Photo by: Dave Herr

The yellow rail (*Coturnicops noveboracensis*; Figure 53) is one of the smallest rails in North America. Like the Virginia rail, it is difficult to see, and often the only way to detect a yellow rail is to hear it. Their call is distinctive, and sounds like two stones being tapped together. Yellow rails are brownish in color with pale yellow stripes. The breast is buffy and the beak is short and yellow. The crown is dark and dark eye patches are present. Yellow rails breed in dense sedge meadows and shallow marshes in the northern US and Canada, and migrate south to spend their winters along the Gulf Coast. Yellow rail populations are difficult to monitor, but may be at risk due to degradation of wetlands. Yellow rails are listed as a species of Special Concern in Minnesota.

Figure 53. Yellow rail

Photo courtesy of: U.S. Fish and Wildlife Service (photographer unknown)

The yellow-bellied sapsucker's (*Sphyrapicus varius*; Figure 54) name describes it well. This medium-sized woodpecker exhibits a yellow underside, and feeds primarily on sap it harvests from trees. The forehead and crown are red, and the throat is also red in the male. The back and sides are striped with black and white. Deciduous forests and riparian areas along streams characterize the breeding habitat of this species. Yellow-bellied sapsuckers create a food source for many other species when they drill holes for sap, and are therefore considered an important part of the ecosystem. Populations currently appear stable, and care should be taken to ensure they remain that way.

Figure 54. Yellow-bellied sapsucker

Photo by: J.A. Spendelow

Methods

Surveyors used several techniques to collect information on bird species. Point counts were conducted at 105 stations, located 400 meters apart along the lakeshore. Surveyors listened for five minutes per station and recorded all species detected (heard or seen) within that time. Point count surveys were conducted in the early morning hours, when species were most likely to be singing. Call-playback surveys were conducted at survey stations that had appropriate habitat. At each station, surveyors played a tape that included the calls of six marsh birds (least bittern (*Ixobrychus exilis*), yellow rail (*Coturnicops noveboracensis*), sora (*Porzana carolina*), Virginia rail (*Rallus limicola*), American bittern (*Botaurus lentiginosus*), and pied-billed grebe (*Podilymbus podiceps*)) and listened for a response. Call-playback surveys generally took place in the early evening. Both survey techniques were dependent on good listening conditions, and surveys were stopped if inclement conditions prevented the ability to hear bird vocalizations. Casual observations of birds seen or heard on the lake or on the lakeshore were also recorded.

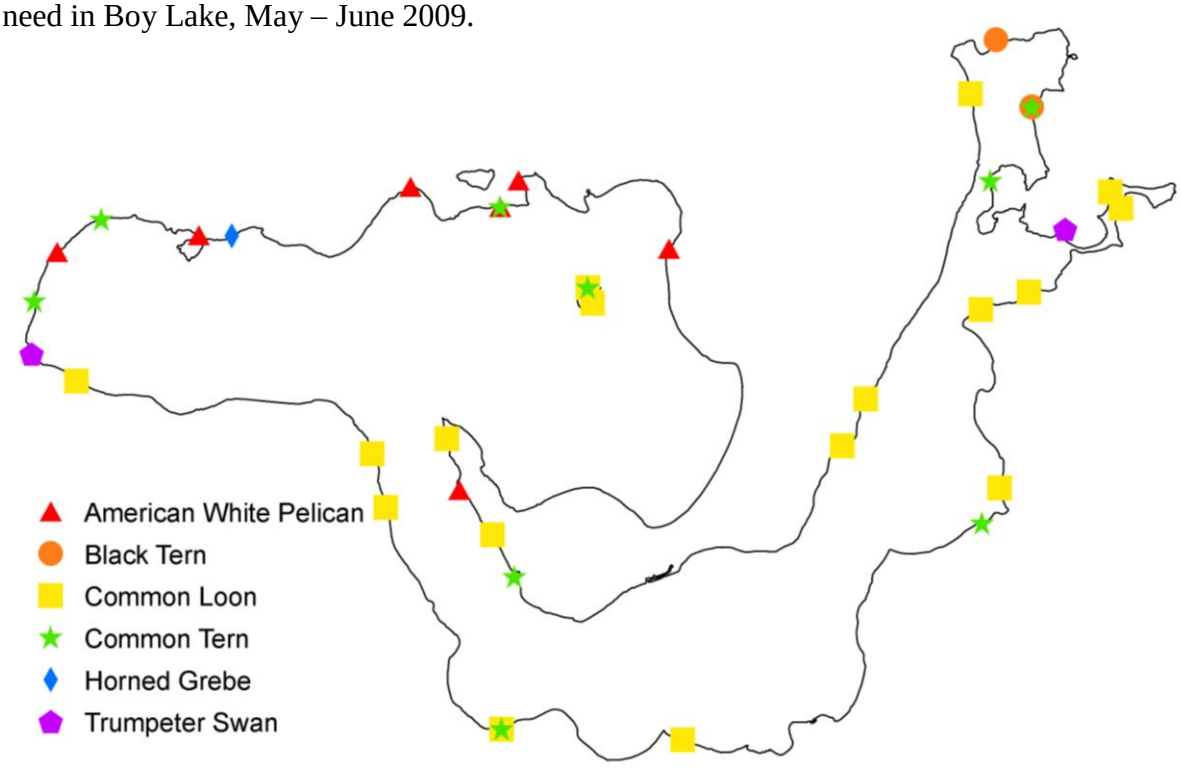
Results

Twenty-eight bird species of greatest conservation need were identified during the Boy Lake bird surveys. They included nine forest habitat-dependent species, seven wetland habitat-dependent species, six aquatic habitat-dependent species, and six species that utilize other habitat, or multiple habitat types. In total, 93 bird species were documented on Boy Lake (Appendix 2); the majority of these were recorded during point count or call-playback bird surveys (Table 3).

Red-winged blackbirds were the most commonly documented species on Boy Lake. Surveyors recorded this bird at over 70% of the survey stations. Swamp sparrows were the most commonly documented species of greatest conservation need, and the second most commonly documented species overall. They were identified at nearly 60% of the survey stations. Two warbler species, the yellow warbler and common yellowthroat, were each recorded at over half of the Boy Lake survey stations.

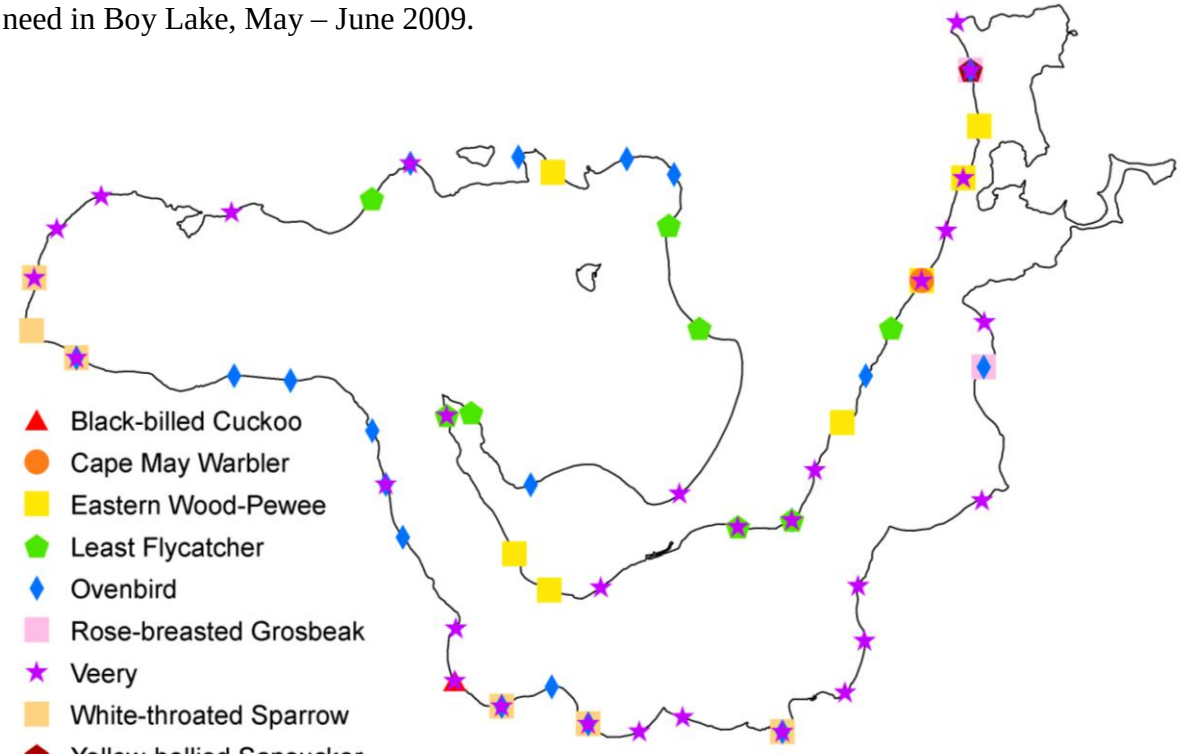
Of the six aquatic habitat-dependent species of greatest conservation need identified on Boy Lake, the common loon was the most frequently detected. Common loons were found near 17 different survey stations along much of the shoreline (Figure 55). Common terns were also scattered along the Boy Lake shoreline, and were found at nine survey stations. American white pelicans were recorded at seven locations, six of which were along the northern edge of the north basin. Black terns were detected at two sites at the northern tip of the east basin, while the two trumpeter swan locations were on opposite ends of the lake. One horned grebe was seen in the north basin.

Figure 55. Distribution of aquatic habitat-dependent bird species of greatest conservation need in Boy Lake, May – June 2009.



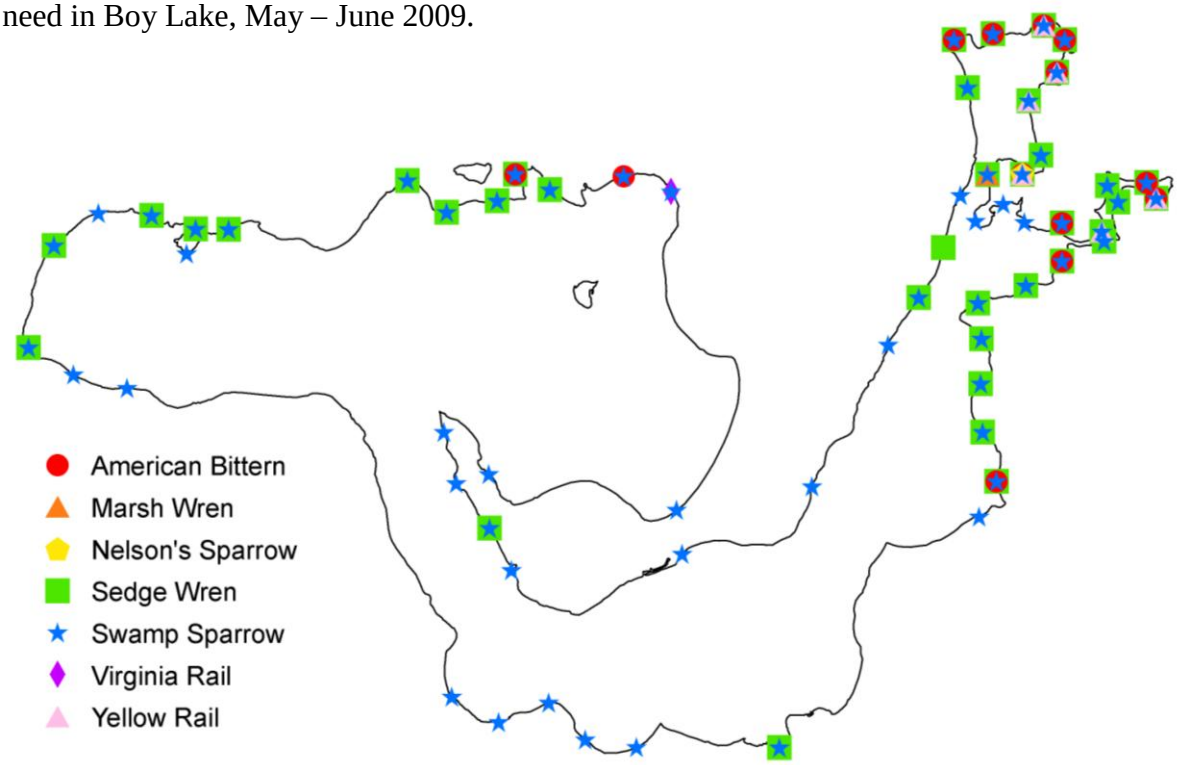
The veery, a forest habitat-dependent species, was the third most commonly detected species of greatest conservation need. It was recorded along virtually the entire Boy Lake shoreline, with the exception of the large wetland complex in the northeastern portion of the east basin (Figure 56). This species was noted at 30 (of 105) survey stations. The ovenbird was another frequently detected forest-dwelling SGCN, and was recorded at 23 survey locations. Least flycatchers and eastern wood-pewees, recorded at nine and seven sites, respectively, were restricted in their distribution to the northern edge of the north and east basins. White-throated sparrows (found at six survey stations) were documented along the western and southern shorelines, while rose-breasted grosbeaks (found at three survey stations) were documented only within the east basin. The black-billed cuckoo, Cape May warbler, and yellow-bellied sapsucker were detected at one survey location each.

Figure 56. Distribution of forest habitat-dependent bird species of greatest conservation need in Boy Lake, May – June 2009.



Wetland-dependent species of greatest conservation need were abundant on Boy Lake. The swamp sparrow, recorded at nearly 60% of the survey stations, was detected along much of the shoreline in both the north and east basins (Figure 57). The sedge wren was identified at nearly 40% of the sample sites. It occurred primarily within the northern half of the east basin and along the northern edge of the north basin. American bitterns were documented in these same areas; 11 of 13 records came from the east lake basin, while the other two were located along the north basin's northern shoreline. Yellow rails were detected within the large wetland complex in the east basin, as were a marsh wren and a Nelson's sparrow. Three Virginia rails were documented at one survey station along the northern shoreline of the north basin.

Figure 57. Distribution of wetland habitat-dependent bird species of greatest conservation need in Boy Lake, May – June 2009.



Several bird species of greatest conservation need detected on Boy Lake utilize habitat types other than those described above. The bobolink, Le Conte's sparrow, and northern harrier do inhabit wetland areas, but are described primarily as grassland species. Bobolinks were detected at 15 survey stations, all of which were located within the northern portion of the east basin (Figure 58). The two northern harrier locations were also within this area of Boy Lake. The Le Conte's sparrow was recorded at four survey stations. Two of these stations were along the eastern lake edge and two were along the northern edge of the north basin.

The final three bird species of greatest conservation need identified on Boy Lake, the bald eagle, common nighthawk, and northern rough-winged swallow, utilize a variety of different habitat types. The bald eagle was the most frequently documented species within this group. Surveyors recorded bald eagles at 16 survey stations in various areas of the lake. Common nighthawks were detected at 15 stations, located primarily along the northern shoreline of the north basin, along the southern shoreline, and within the northern half of the east basin.

Figure 58. Distribution of bird species of greatest conservation need that occupy other or multiple habitats in Boy Lake, May – June 2009.

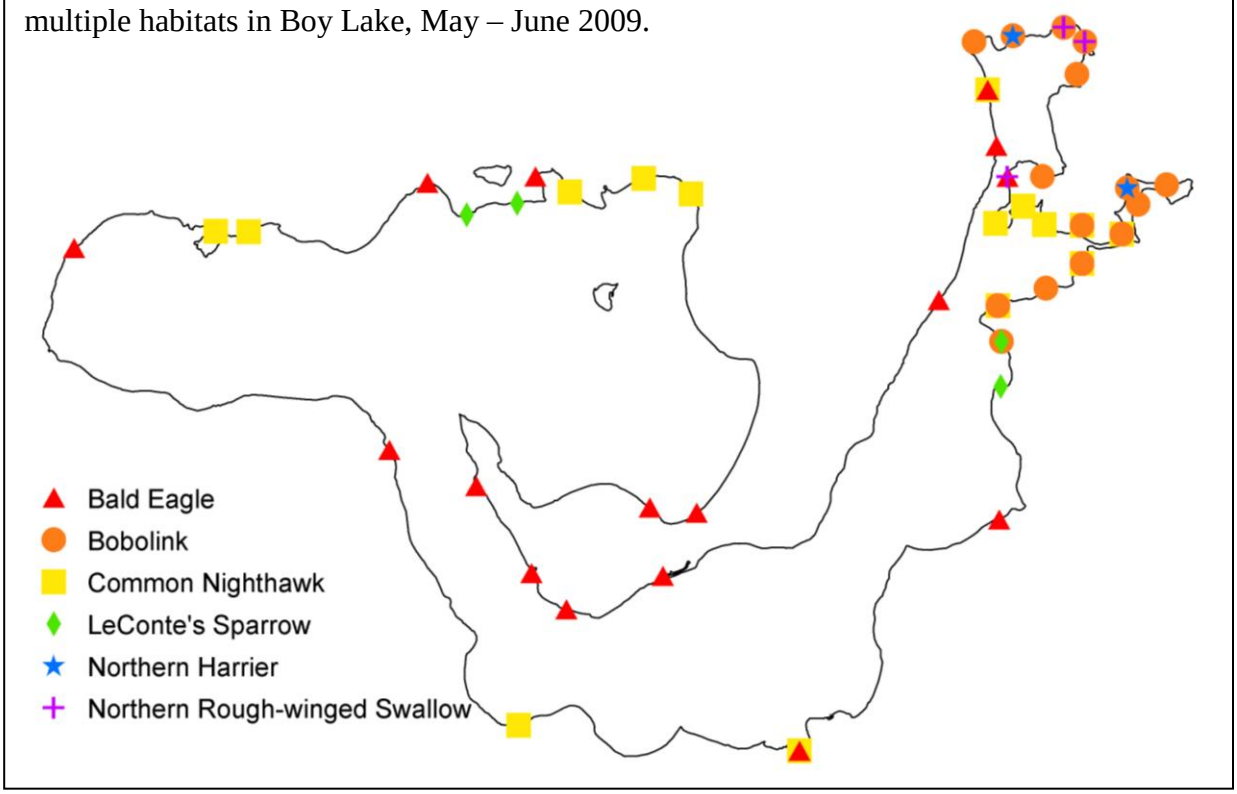


Table 3. Species list and frequency of occurrence of bird species identified during Boy Lake surveys, May – June 2009. * denotes a species of greatest conservation need.

Description	Common Name	Scientific Name	%[a]
Waterfowl	Canada Goose	*Branta canadensis*	6
	Trumpeter Swan*	*Cygnus buccinator*	2
	Wood Duck	*Aix sponsa*	15
	Mallard	*Anas platyrhynchos*	35
	Blue-winged Teal	*Anas discors*	3
	Green-winged Teal	*Anas crecca*	2
	Ring-necked Duck	*Aythya collaris*	5
	Common Goldeneye	*Bucephala clangula*	10
	Common Merganser	*Mergus merganser*	4
Grouse/turkeys	Ruffed Grouse	*Bonasa umbellus*	1
Loons	Common Loon*	*Gavia immer*	16
Grebes	Horned Grebe*	*Podiceps auritus*	1
Pelicans	American White Pelican*	*Pelecanus erythrorhynchos*	7
Herons/bitterns	American Bittern*	*Botaurus lentiginosus*	12
	Great Blue Heron	*Ardea herodias*	12
	Green Heron	*Butorides virescens*	3
Vultures	Turkey Vulture	*Cathartes aura*	2
Hawks/eagles	Osprey	*Pandion haliaetus*	2
	Bald Eagle*	*Haliaeetus leucocephalus*	15
	Northern Harrier*	*Circus cyaneus*	2
	Cooper's Hawk	*Accipiter cooperii*	1
Falcons	Merlin	*Falco columbarius*	1
Rails	Yellow Rail*	*Coturnicops*	6
	Virginia Rail*	*Rallus limicola*	1
	Sora	*Porzana carolina*	4
Cranes	Sandhill Crane	*Grus canadensis*	5
Sandpipers	Solitary Sandpiper	*Tringa solitaria*	1
Gulls/terns	Ring-billed Gull	*Larus delawarensis*	10
	Caspian Tern	*Hydroprogne caspia*	4
	Black Tern*	*Chlidonias niger*	2
	Common Tern*	*Sterna hirundo*	9
Cuckoos	Black-billed Cuckoo*	*Coccyzus erythropthalmus*	1
Owls	Barred Owl	*Strix varia*	1
Nightjars	Common Nighthawk*	*Chordeiles minor*	14
Hummingbirds	Ruby-throated Hummingbird	*Archilochus colubris*	2
Kingfishers	Belted Kingfisher	*Megaceryle alcyon*	2

Table 3, continued.

Description	Common Name	Scientific Name	% [a]
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*	10
	Yellow-bellied Sapsucker*	*Sphyrapicus varius*	1
	Hairy Woodpecker	*Picoides villosus*	2
	Northern Flicker	*Colaptes auratus*	2
	Pileated Woodpecker	*Dryocopus pileatus*	8
Flycatchers	Eastern Wood-Pewee*	*Contopus virens*	7
	Alder Flycatcher	*Empidonax alnorum*	24
	Least Flycatcher*	*Empidonax minimus*	9
	Eastern Phoebe	*Sayornis phoebe*	9
	Great Crested Flycatcher	*Myiarchus crinitus*	10
	Eastern Kingbird	*Tyrannus tyrannus*	4
Vireos	Warbling Vireo	*Vireo gilvus*	5
	Red-eyed Vireo	*Vireo olivaceus*	44
Jays/crows	Blue Jay	*Cyanocitta cristata*	13
	American Crow	*Corvus brachyrhynchos*	37
	Common Raven	*Corvus corax*	3
Swallows	Purple Martin	*Progne subis*	3
	N. Rough-winged Swallow*	*Stelgidopteryx serripennis*	3
	Tree Swallow	*Tachycineta bicolor*	35
	Cliff Swallow	*Petrochelidon pyrrhonota*	1
	Barn Swallow	*Hirundo rustica*	16
Chickadees	Black-capped Chickadee	*Poecile atricapilla*	3
Nuthatches	White-breasted Nuthatch	*Sitta carolinensis*	6
Wrens	House Wren	*Troglodytes aedon*	1
	Sedge Wren*	*Cistothorus platensis*	36
	Marsh Wren*	*Cistothorus palustris*	1
Thrushes	Veery*	*Catharus fuscescens*	29
	American Robin	*Turdus migratorius*	24
Mockingbirds	Gray Catbird	*Dumetella carolinensis*	12
Waxwings	Cedar Waxwing	*Bombycilla cedrorum*	7
Warblers	Nashville Warbler	*Vermivora ruficapilla*	1
	Yellow Warbler	*Dendroica petechia*	52
	Chestnut-sided Warbler	*Dendroica pensylvanica*	18
	Cape May Warbler*	*Dendroica tigrina*	1
	Black-and-white Warbler	*Mniotilta varia*	11
	American Redstart	*Setophaga ruticilla*	6
	Ovenbird*	*Seiurus aurocapilla*	22
	Northern Waterthrush	*Seiurus noveboracensis*	3
	Common Yellowthroat	*Geothlypis trichas*	50

Table 3, continued.

Description	Common Name	Scientific Name	% [a]
Sparrows/allies	Chipping Sparrow	*Spizella passerina*	7
	Savannah Sparrow	*Passerculus sandwichensis*	10
	Le Conte's Sparrow*	*Ammodramus leconteii*	4
	Nelson's Sparrow*	*Ammodramus nelsoni*	1
	Song Sparrow	*Melospiza melodia*	41
	Swamp Sparrow*	*Melospiza georgiana*	58
	White-throated Sparrow*	*Zonotrichia albicollis*	6
Cardinals/allies	Rose-breasted Grosbeak*	*Pheucticus ludovicianus*	3
Blackbirds	Bobolink*	*Dolichonyx oryzivorus*	14
	Red-winged Blackbird	*Agelaius phoeniceus*	73
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	1
	Common Grackle	*Quiscalus quiscula*	12
	Brown-headed Cowbird	*Molothrus ater*	5
	Baltimore Oriole	*Icterus galbula*	8
Finches	American Goldfinch	*Spinus tristis*	4

[a] % – Percent of surveyed sample sites in which a bird species occurred (N=105)

Bird Species Richness

Objective

1. Calculate and map bird richness around the shoreline of Boy Lake

Introduction

Bird species richness is affected by a number of factors, including habitat diversity and area, habitat composition, fragmentation, competition, and presence of exotic species. Species richness is generally highest in non-fragmented habitats with a variety of vegetation types. Anthropogenic disturbance, in particular, may negatively affect bird species richness in a variety of ways. Human presence in an area may result in the loss or destruction of critical habitat. Elimination of vegetation and use of pesticides may reduce the food base for a number of bird species. Human activity in an area may also disturb breeding or nesting birds. Maintaining large areas of natural habitat will be beneficial to maintaining diversity of bird species.

Methods

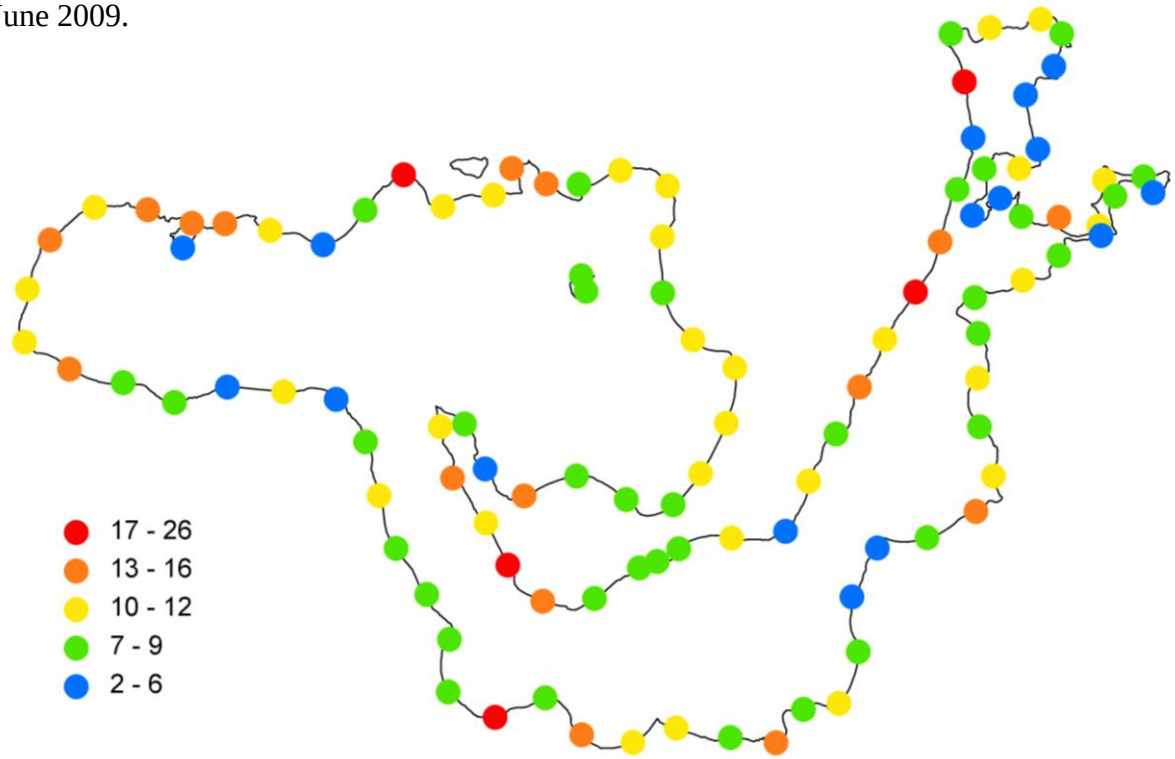
Bird species were documented during the point count and call-playback sampling surveys. At each sample station, surveyors identified and recorded the number of species found.

Results

Maximum bird species diversity at Boy Lake was 26 species at a single survey station (Figure 59). Eleven additional sites contained 15 or more species, and 40 sites contained between 10 and 15 species. The survey sites with the highest bird diversity were scattered along the shoreline, and occurred within both the north and east basins. Eight survey stations contained five or fewer bird species; the minimum number of bird species identified at a survey station was two.

The number of species of greatest conservation need at a single survey station ranged from zero to nine. One survey station contained nine species of greatest conservation need; 25 stations contained five or more. Approximately 15% of the stations did not have any species of greatest conservation need recorded.

Figure 59. Bird species richness (number of species per sample site) in Boy Lake, May – June 2009.



Loon Nesting Areas

Objectives

1. Map current and historical loon nesting areas
2. Identify loon nests as natural or manmade

Introduction

The Volunteer LoonWatcher survey began in 1979 as a way for the DNR to obtain information on loon numbers and nesting success on a variety of lakes in Minnesota. Each year volunteer loon watchers observe the loons on a selected lake and fill out a report, noting information such as number of loons, number of nests, and number of chicks. Locations of loon nests, if known, are also documented in the report.

Loon pair with chick

Photo by: Paul Bolstad

Common loons may be easily disturbed by human presence, and tend to avoid nesting where development has occurred. They prefer protected areas such as bays and islands, especially those areas with quiet shallow water and patchy emergent vegetation that provides cover. Identification of these loon nesting sites will help managers prevent degradation and destruction of these sensitive areas.

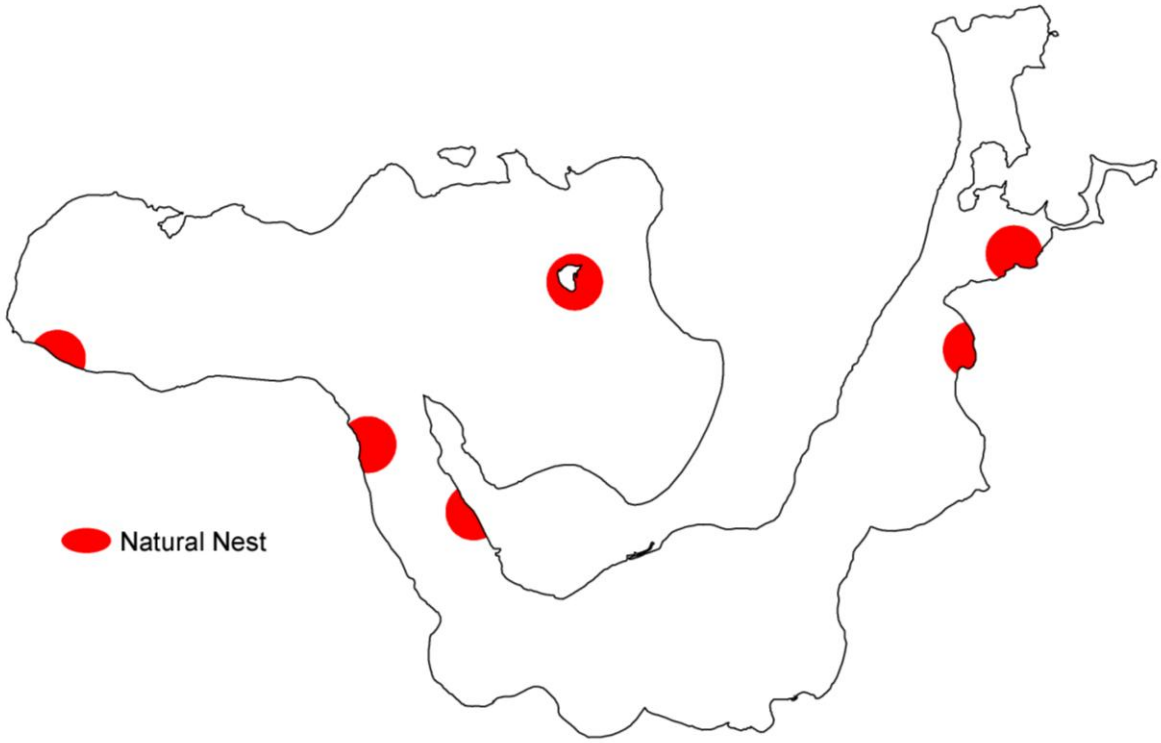
Methods

Using information from LoonWatcher reports and bird, fish, and vegetation survey crews, researchers mapped loon nesting locations in GIS. Mapped nests were buffered by 200 meters to account for locational uncertainty. Nests were identified as either natural or manmade (artificial platforms). All former and current natural nesting locations and artificial platforms used by loons were included in the maps and analysis; artificial platforms not utilized by loons were not included. Volunteers began reporting on Boy Lake loons in 1979.

Results

Since 1979, six probable loon nesting areas have been identified on Boy Lake (Figure 60). Two of the nesting areas are located in the east basin, two are in the north basin (one of which was located on the island), and two nesting areas have been documented in the long arm connected to the north basin. All of the documented nests are natural; artificial platforms have not been utilized on this lake. In 2009, four active loon nesting areas were identified on Boy Lake.

Figure 60. Location of natural loon nests recorded on Boy Lake between 1978 – 2009.



Aquatic Frog Surveys

Objectives

1. Record index of abundance for all frogs and toads
2. Estimate actual abundance of green and mink frogs
3. Develop distribution maps for green and mink frogs

Introduction

Amphibians are ideal indicator species of lakeshore habitats. Although population declines may be caused by a number of factors, including predation, competition, and introduction of exotic species, amphibians are particularly prone to local extinctions resulting from human-caused alteration and fragmentation of their habitat. Removal of vegetation and woody debris, retaining wall construction, and other common landscaping practices all have been found to negatively affect amphibian populations.

Target species for the frog surveys were mink frog (*Rana septentrionalis*) and green frog (*Rana clamitans*). These frogs, which are strongly associated with larger lakes, are easily surveyed during their breeding season, which extends from May until August. During this time they establish and defend distinct territories, and inhabit vegetated areas along the lakeshore.

Figure 61. Mink frog

Photo by: Jeff LeClere, www.herpnet.net

Mink frogs (Figure 61) are typically green in color with darker green or brown mottling. They emit an odor similar to that of a mink when handled. They inhabit quiet waters near the edges of wooded lakes, ponds, and streams, and are considered the most aquatic of the frogs found in Minnesota. Populations of mink frogs have potentially been declining recently, and the numbers of observed deformities have been increasing.

Figure 62. Green frog

Photo by: Jeff LeClere, www.herpnet.net

Green frogs (Figure 62) are medium-sized, greenish or brownish frogs with small dark spots. The belly is often brighter in color than the back. A large tympanum (eardrum) helps identify the green frog. They can be found in a variety of habitats surrounding lakes, streams, marshes, and swamps, but are strongly associated with the shallow water of lakeshores. Although green frog populations are generally stable, regional declines and local extinctions have been noted.

Methods

The aquatic frog survey methodology followed the Minnesota Frog and Toad Calling Survey (MFTCS) protocol (see Minnesota's Sensitive Lakeshore Identification Manual for additional information on how this protocol was adjusted for water routes). Frog survey points were located around the entire lake, spaced 400 meters apart. Sample sites that occurred within dense beds of wild rice or other emergent/floating-leaf vegetation were not surveyed in order to minimize damage to these plant beds. Surveys were conducted between sunset and 1:00 AM. At each station surveyors listened for up to five minutes for all frog and toad calls. An estimate of abundance and a calling index were recorded for both green and mink frogs. For other species, only a calling index was recorded. If survey conditions such as rain or wind noticeably affected listening ability, the survey was terminated.

Frog surveys were not conducted along the northern shorelines of the east basin (Figures 63 – 65). Dense aquatic vegetation made these areas inaccessible during the survey period.

Results

Target species

Both mink and green frogs were identified at Boy Lake. Mink frogs were the most frequently detected species, found at 29 of 91 sites surveyed (Figure 63). Estimates of abundance at these locations ranged from one to eight calling males. Green frogs were less frequently detected, recorded at 23 of 91 survey sites (Figure 64). Numbers of calling males ranged from one to between 20-100 individuals. Mink frogs were found around much of the shoreline, although absent from the south portion of the lake, while green frogs were more restricted, limited to the central and northeast shorelines (Figure 65).

Other species

Gray treefrogs (*Hyla versicolor*) were the only other anuran species documented at Boy Lake. Surveyors heard this species calling at 43 of 91 sites, distributed around much of the shoreline. Index values for gray treefrogs ranged from 1 (individual frogs could be distinguished, calls did not overlap) to 3 (full chorus, individuals could not be differentiated). Other frog or toad species that may be found near Pleasant Lake, such as wood frog (*Rana sylvatica*), spring peeper (*Pseudacris crucifer*), chorus frog (*Pseudacris triseriata*), leopard frog (*Rana pipiens*), and American toad (*Bufo americanus*), usually breed earlier in the year and are not strongly associated with larger lakes.

Figure 63. Abundance of mink frogs heard during Boy Lake frog surveys, July 2008.

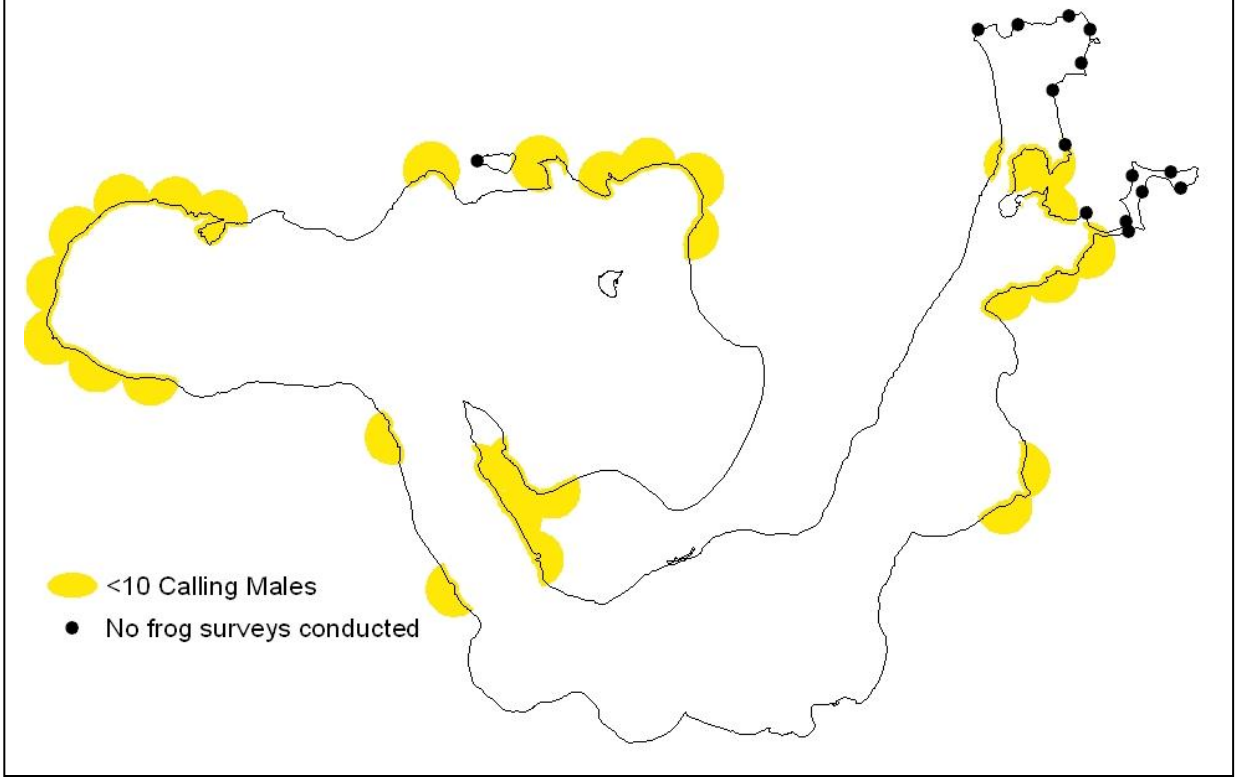


Figure 64. Abundance of green frogs heard during Boy Lake frog surveys, July 2008.

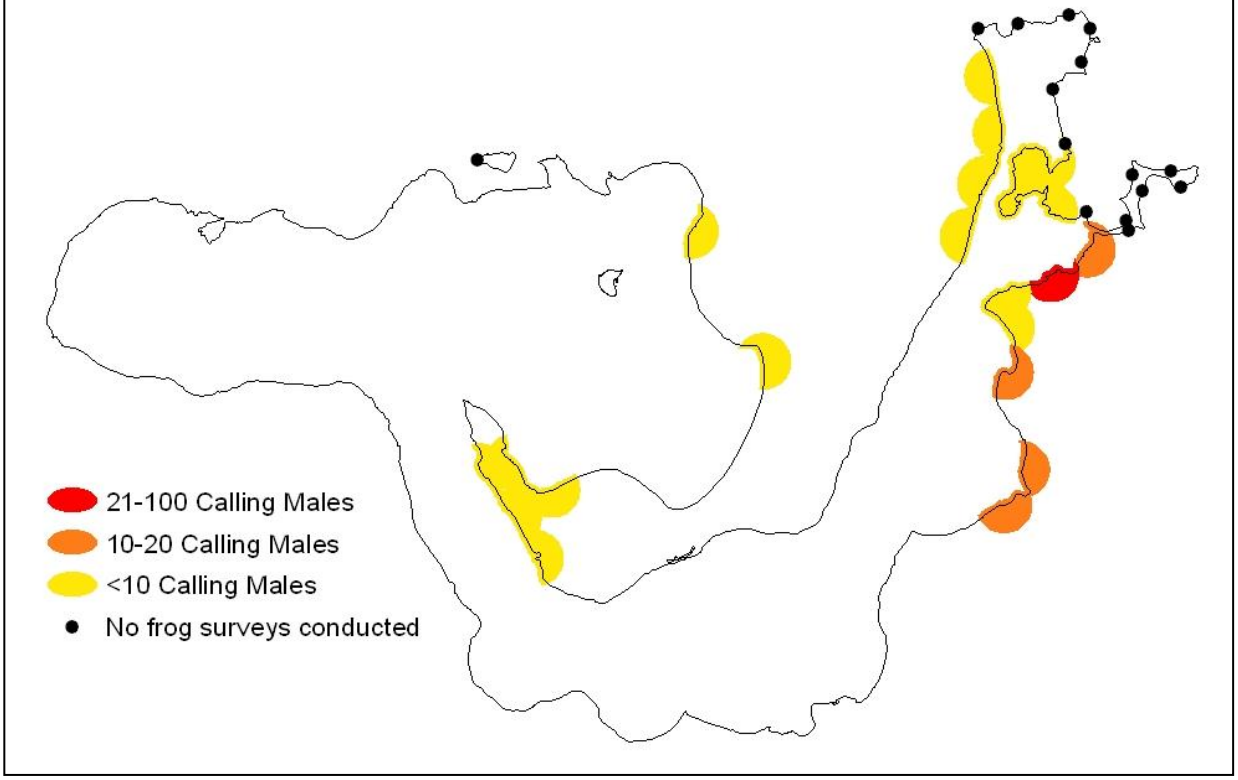
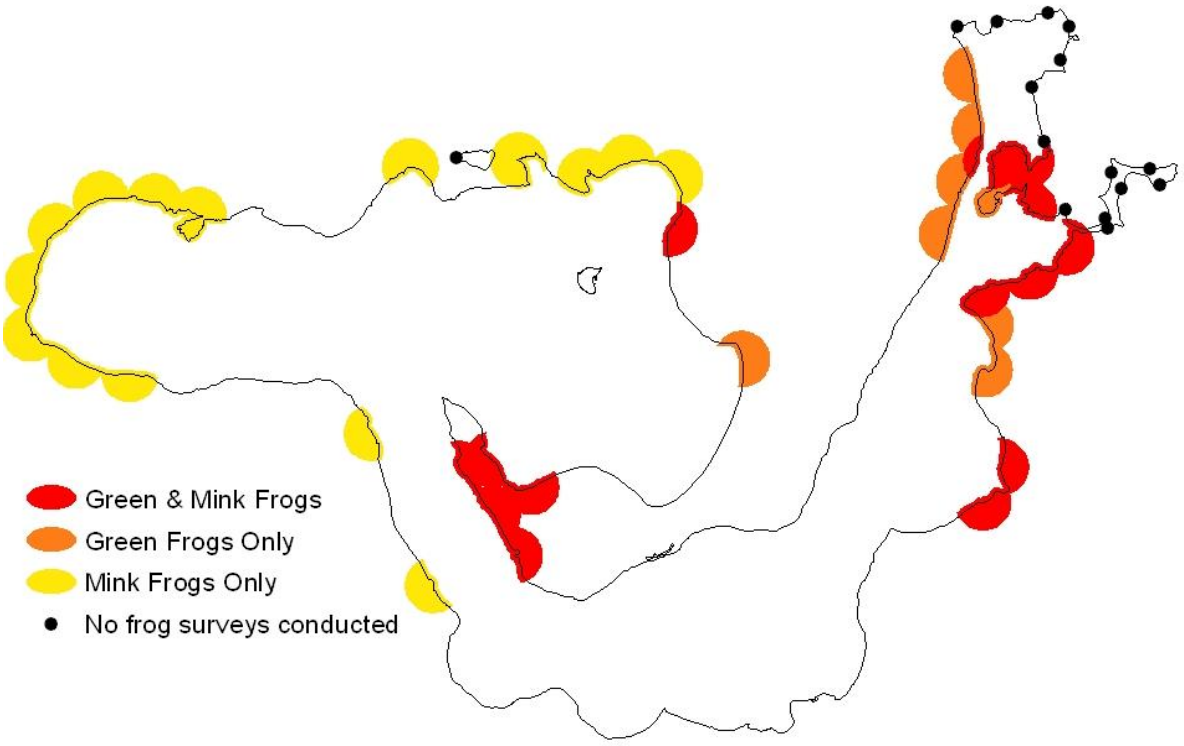


Figure 65. Distribution of green and mink frogs heard during surveys on Boy Lake, July 2008.



Nongame Fish Surveys

Objectives

1. Record presence and abundance of near-shore fish species of greatest conservation need
2. Record presence and abundance of proxy species
3. Develop distribution maps for species of greatest conservation need and proxy species
4. Identify habitat (substrate and aquatic vegetation biovolume) associated with presence of species of greatest conservation need and proxy species
5. Identify near-shore fish assemblages

Introduction

Fish Species of Greatest Conservation Need

There are 47 fish species of greatest conservation need (SGCN) within the state of Minnesota. Of these 47 species, three are near-shore species found within Cass County. The pugnose shiner and least darter are listed as species of Special Concern in the state of Minnesota. The longear sunfish exhibits a spotty distribution, and is listed as threatened in Wisconsin.

Pugnose shiners (*Notropis anogenus*; Figure 66) are small (38 – 56 mm), slender, silverish-yellow minnows. They possess large eyes and a distinctively upturned mouth that gives them a "pugnose" appearance. They are secretive minnows, and are found often in schools of 15 to 35 individuals. Pugnose minnows inhabit clear lakes and low-gradient streams and are extremely intolerant of turbidity. Vegetation, particularly pondweed, coontail, and bulrush, is an important habitat component.

Figure 66. Pugnose shiner

Photo by: Konrad Schmidt

Least darters (*Etheostoma microperca*; Figure 67) are Minnesota's smallest fish, averaging only 25 – 38 mm in length. They are olive-brown in color with scattered dark brown spots and markings and four dark bars radiating from the eye. Males possess an extremely long pectoral fin. Least darters are found in clear, shallow areas of low-gradient streams or lakes. Extensive beds of muskgrass (*Chara* spp.) are a preferred habitat feature. Removal of vegetation, riparian area modification, and poor water quality all pose threats to the least darter.

Figure 67. Least darter

Photo by: Konrad Schmidt

Longear sunfish (*Lepomis megalotis*; Figure 68) are a deep-bodied fish reaching a length of 71 – 94 mm. These colorful fish have a belly that is orange-red, and the sides are speckled with turquoise. Adults have an elongated opercular "ear flap" that is trimmed in white. Like the other species of greatest conservation need, the longear sunfish prefers clear, shallow, vegetated areas and is intolerant of turbidity.

Figure 68. Longear sunfish

Photo by: Konrad Schmidt

Proxy species

Proxy species have similar life history characteristics and occupy habitat similar to species of greatest conservation need; they represent indicator species for those SGCN.

Blackchin shiners (*Notropis heterodon*; Figure 69) are small (50 – 75 mm) fish with a bronze-colored back and silver sides and belly. A dark lateral band extends through the chin. Like the species of greatest conservation need, the blackchin shiner inhabits clear water with abundant submerged aquatic vegetation; it also prefers a clean sand or gravel substrate. This species cannot tolerate turbidity or loss of aquatic vegetation.

Figure 69. Blackchin shiner

Photo by: Konrad Schmidt

Blacknose shiners (*Notropis heterolepis*; Figure 70) are similar in size and coloration to blackchin shiners. However, the dark lateral line does not extend through the lips or chin. Scales on the back are outlined in a dark color, giving them a crosshatch appearance. Blacknose shiners are sensitive to turbidity and pollution, and their range has contracted since the beginning of the century. Habitat includes clean, well-oxygenated lakes and streams with plentiful vegetation and low turbidity and pollution.

Figure 70. Blacknose shiner

Photo by: Konrad Schmidt

Banded killifish (*Fundulus diaphanus*; Figure 71) are slender fish with slightly flattened heads. The mouth, which opens dorsally, is an adaptation for surface feeding.

Dark vertical bars are present along the sides. Size ranges from about 50 – 100 mm. Calm, clear, shallow water with abundant aquatic vegetation and a sandy or gravely substrate is preferred by the killifish.

Figure 71. Banded killifish

Photo by: Konrad Schmidt

Methods

Fish surveys were conducted using Minnesota's Sensitive Lakeshore Survey Protocol. Fish survey stations were located 400 meters apart, and were the same stations used for surveying birds and aquatic frogs. At each station, fish were sampled using three different methods: trapnetting, shoreline seining, and electrofishing. At several locations, excessive vegetation, depth, or soft substrate prevented surveyors from using seines or trapnets. However, electrofishing samples were still collected, from a boat if necessary. Sample sites that occurred within dense beds of wild rice or other emergent/floating-leaf vegetation were not surveyed in order to minimize damage to these plant beds. All species captured using the different sampling methods were identified and counted. Target fish species included near-shore species of greatest conservation concern (pugnose shiner, least darter, and longear sunfish) and proxy species (blackchin shiner, blacknose shiner, and banded killifish). These species are associated with large, near-shore stands of aquatic grasses and macrophytes. They are intolerant to disturbance, and have been extirpated from lakes where extensive watershed and lakeshore development has occurred.

In addition to the fish data, habitat data were collected at each sampling station. Substrate data were recorded using standard near-shore classes. Aquatic vegetation biovolume was also estimated at each station; this represented the volume (percent) of a sampling area that contained submerged aquatic vegetation.

Fish surveys were not conducted along the northern shorelines of the east basin (Figures 73 – 74). Dense aquatic vegetation made these areas inaccessible during the survey period.

Results

One near-shore fish species of greatest conservation need was identified at Boy Lake. The pugnose shiner was found at 13 of 89 (15%) of stations surveyed (Figure 73). Additional targeted species of greatest conservation need (i.e., least darters and longear sunfish) were not found. All three proxy species were documented by surveyors (Figure 74). Blackchin shiners were found at 18%, blacknose shiners were found at 34%, and banded killifish were found at 25% of all stations surveyed.

One additional fish species of greatest conservation need, the greater redhorse (*Moxostoma valenciennesi*; Figure 72) was documented at Boy Lake. Individual greater redhorse were

recorded at two survey stations. Although greater redhorse are not a near-shore species, they are sensitive to chemical pollutants and turbidity, and inhabit clear water rivers and streams.

Figure 72. Greater redhorse

The presence of fish species of greatest conservation need and proxy species may indicate minimal disturbance along some sections of shoreline. However, because populations of these species are at risk throughout their ranges, continued monitoring and maintenance are necessary to ensure continued existence of these populations. Limiting macrophyte removal, pesticide and herbicide use, and modification of the riparian zone will help maintain good water quality and a healthy aquatic plant community.

Target fish species were found at sites with varying substrate types, including muck, sand, and rubble. Biovolume (amount of submerged vegetation) was slightly higher at sites with species of greatest conservation need and proxies than those without.

Species richness at the sample sites ranged from no species (at three sites) to 22 species (at one site). Ten or more species were recorded at 52 of the 89 stations surveyed.

Thirty-eight fish species were recorded during the 2008 surveys at Boy Lake (Table 4). Yellow perch were the most abundant and the most frequently documented species. Yellow perch were identified at 91% of the survey stations, and numbered over 6,000. Large numbers of bluntnose minnows (over 1,700 individuals) and young-of-the-year white suckers (over 1,100 individuals) were also recorded. Other common species included bluegills (90% of stations surveyed) and largemouth bass (70% of stations surveyed).

Surveyors recorded several fish species previously undocumented at Boy Lake. Nineteen new species were identified, bringing the total historical observed fish community in the lake to 40 species. The newly recorded species were blackchin shiner, blacknose shiner, bluntnose minnow, brook stickleback, central mudminnow, common shiner, creek chub, emerald shiner, fathead minnow, finescale dace, golden shiner, Iowa darter, johnny darter, longnose dace, mimic shiner, mottled sculpin, pugnose shiner, smallmouth bass, and tadpole madtom. Only two species previously known to occur at Boy Lake, the cisco and muskellunge, were not found during the 2008 surveys.

Figure 73. Distribution of rare near-shore species documented during Boy Lake fish surveys, July 2008.

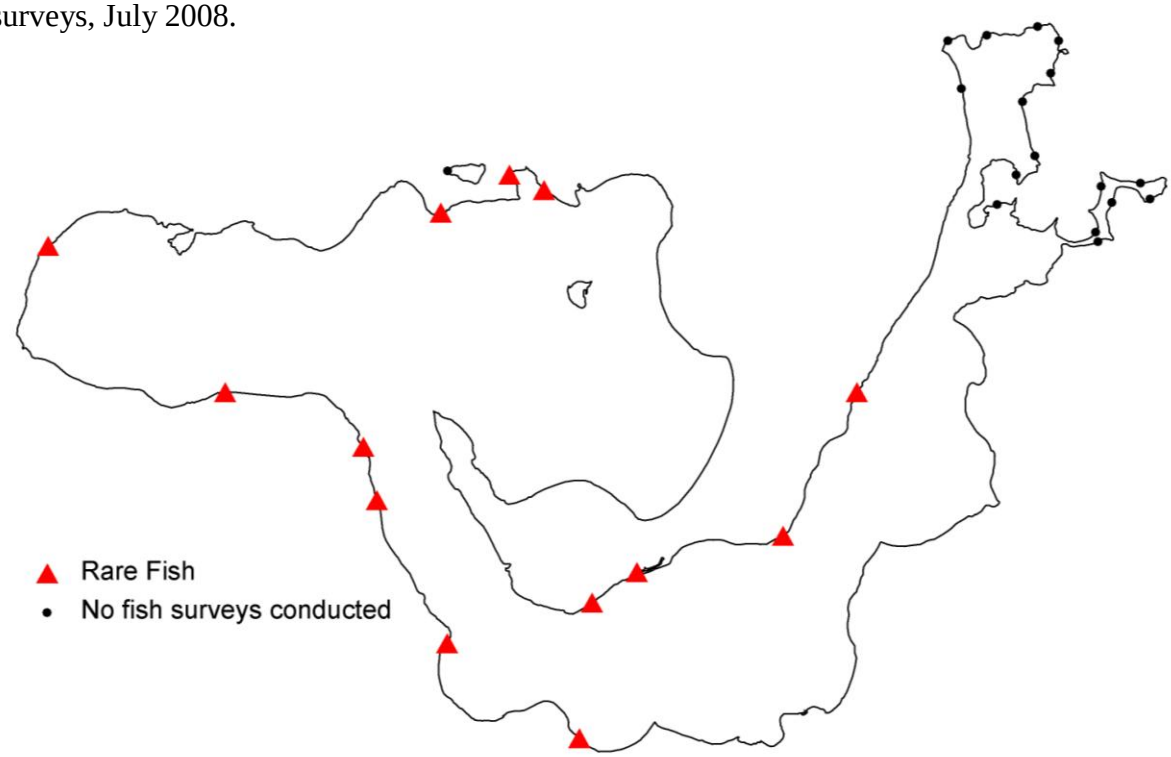


Figure 74. Distribution of proxy species documented during Boy Lake fish surveys, July 2008.

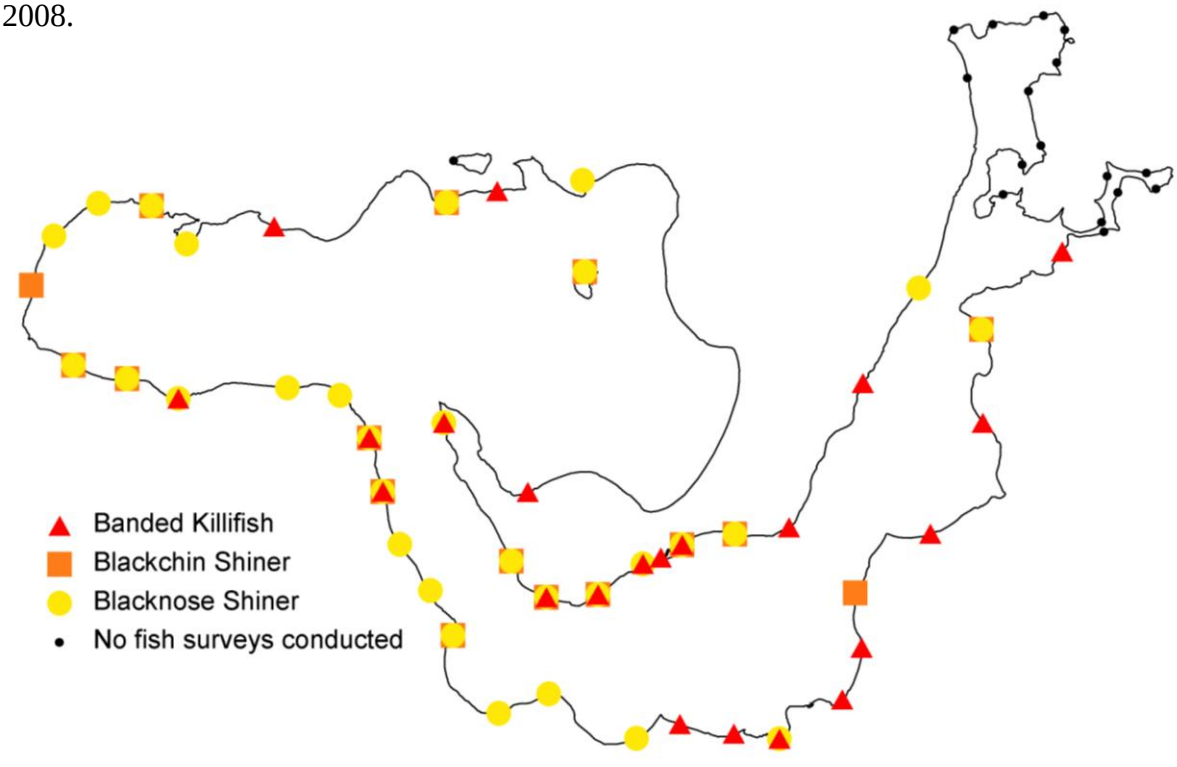


Table 4. Abundance and frequency of fish species identified during Boy Lake fish surveys, July 2008. * denotes species of greatest conservation need

Description	Common Name	Scientific Name	# [a]	% [b]
Bowfins	Bowfin	*Amia calva*	64	29
Minnows	Common shiner	*Luxilus cornutus*	126	16
	Golden shiner	*Notemigonus crysoleucas*	21	10
	Emerald shiner	*Notropis atherinoides*	8	2
	Pugnose shiner*	*Notropis anogenus*	20	15
	Blackchin shiner	*Notropis heterodon*	34	18
	Blacknose shiner	*Notropis heterolepis*	499	34
	Spottail shiner	*Notropis hudsonius*	24	10
	Mimic shiner	*Notropis volucellus*	212	37
	Bluntnose minnow	*Pimephales notatus*	~1700	52
	Fathead minnow	*Pimephales promelas*	1	1
	Finescale dace	*Phoxinus neogaeus*	1	1
	Longnose dace	*Rhinichthys cataractae*	1	1
	Creek chub	*Semotilus atromaculatus*	1	1
Suckers	White sucker	*Catostomus commersonii*	~1200	48
	Shorthead redhorse	*Moxostoma macrolepidotum*	1	1
	Greater redhorse*	*Moxostoma valenciennesi*	2	2
Catfishes	Black bullhead	*Ameiurus melas*	52	34
	Yellow bullhead	*Ameiurus natalis*	302	69
	Brown bullhead	*Ameiurus nebulosus*	21	15
	Tadpole madtom	*Noturus gyrinus*	31	17
Pikes	Northern pike	*Esox lucius*	32	28
Mudminnows	Central mudminnow	*Umbra limi*	12	8
Sculpins	Mottled sculpin	*Cottus bairdii*	12	10
Burbots	Burbot	*Lota lota*	22	11
Killifishes	Banded killifish	*Fundulus diaphanus*	165	25
Sticklebacks	Brook stickleback	*Culaea inconstans*	4	4
Sunfishes	Rock bass	*Ambloplites rupestris*	168	53
	Pumpkinseed	*Lepomis gibbosus*	251	62
	Bluegill	*Lepomis macrochirus*	857	90
	Smallmouth bass	*Micropterus dolomieu*	2	2
	Largemouth bass	*Micropterus salmoides*	755	70
	Black crappie	*Pomoxis nigromaculatus*	160	54
Perches	Iowa darter	*Etheostoma exile*	21	9
	Johnny darter	*Etheostoma nigrum*	65	24
	Yellow perch	*Perca flavescens*	~6200	91
	Logperch	*Percina caprodes*	219	27
	Walleye	*Sander vitreus*	116	28

[a] # – Total number of individuals found. Numbers above 1000 were rounded to the nearest 100.
[b] % – Percent of surveyed sample sites in which a species occurred (N=89).

Aquatic Vertebrate Richness

Objective

1. Calculate and map aquatic vertebrate richness around the shoreline of Boy Lake

Introduction

A variety of factors may influence aquatic vertebrate richness, including habitat diversity, water chemistry, flow regime, competition, and predation. High aquatic vertebrate richness indicates a healthy lakeshore community with diverse habitat, good water quality, varied flow regimes, and a sustainable level of competition and predation. A diverse aquatic vertebrate community will also help support diversity at higher trophic levels.

Methods

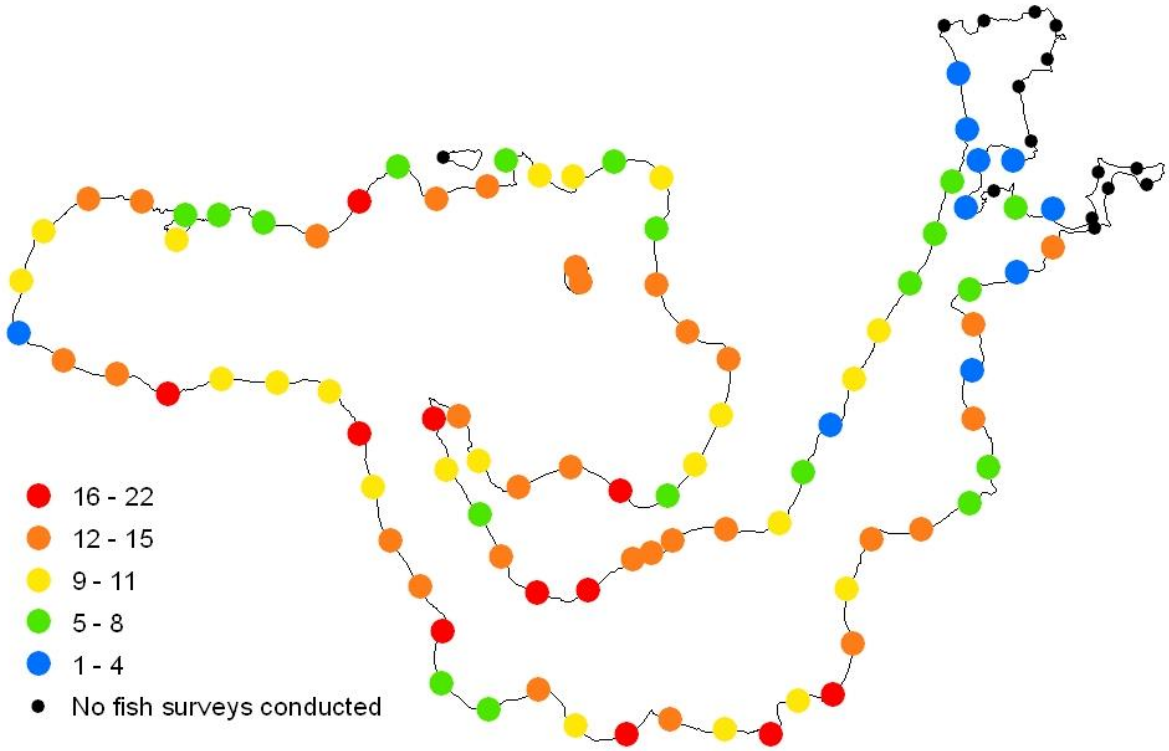
Aquatic vertebrate species were documented during the nongame fish sampling surveys. All aquatic vertebrates, including fish, frogs, and turtles, captured during trapnetting, seining, and electrofishing surveys were identified to the species level. Young-of-year animals that could not be identified to the species level and hybrids were not used in the analysis.

Surveys were not conducted along the northern shorelines of the east basin (Figure 75). Dense aquatic vegetation made these areas inaccessible during the survey period.

Results

Maximum aquatic vertebrate species richness at a single sampling station was 22 species, and 57 of the 91 stations had 10 or more species (Figure 75). The majority of the documented species were fish, although painted turtles, snapping turtles, green frogs, and mink frogs were also identified. All aquatic vertebrate species documented during the survey were native.

Figure 75. Aquatic vertebrate species richness (number of species per sample site) in Boy Lake, July 2008.



Other Rare Features

Objective

1. Map rare features occurring within the extended state-defined shoreland area (within 1320 feet of shoreline) of Boy Lake

Introduction

The Minnesota Natural Heritage Information System provides information on Minnesota's rare animals, plants, native plant communities, and other features. The Rare Features Database includes information from both historical records and current field surveys. All Federally and State-listed endangered and threatened species and state species of special concern are tracked by the Natural Heritage program. The program also gathers information on animal aggregations, geologic features, and rare plants with no legal status.

Methods

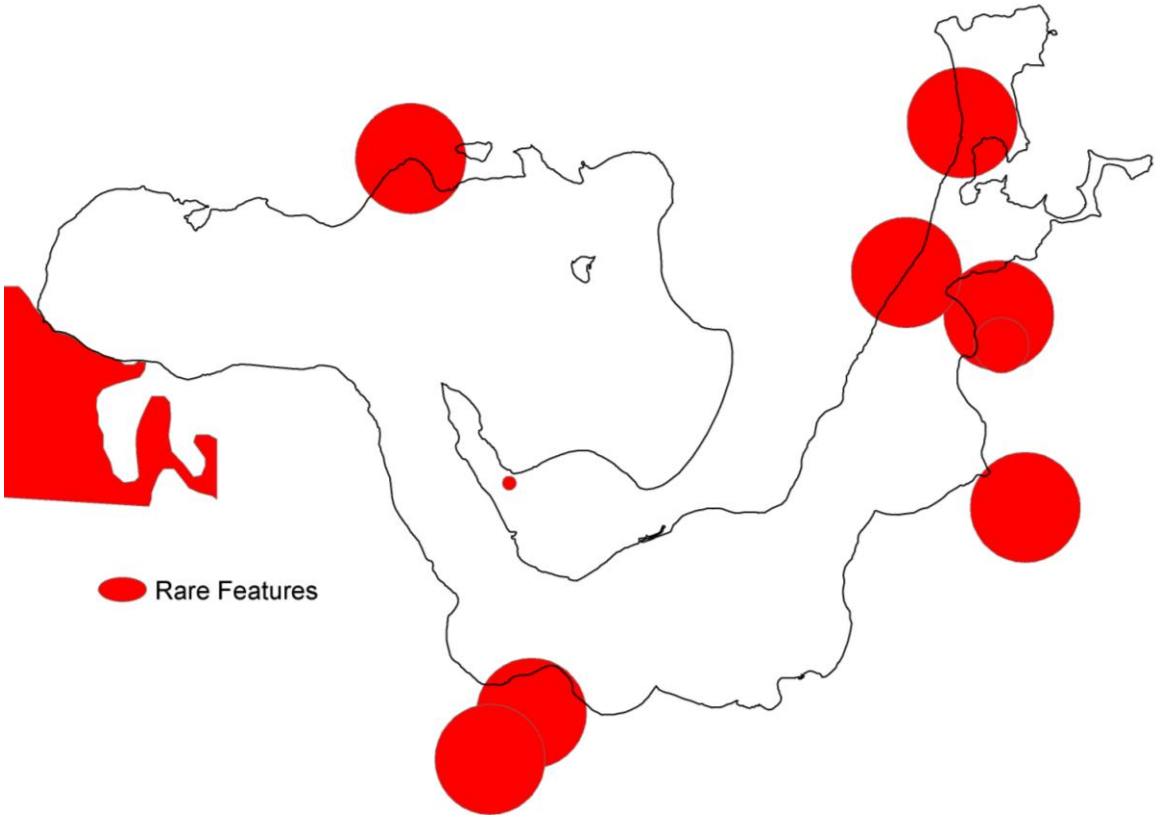
Researchers obtained locations of rare features from the Rare Features Database. Only "listed" plant and animal species (Federal or State endangered, threatened, or special concern) were considered in this project; non-listed unique plant species were included in the "Unique Plant Species" section of this report. Rare features within 1320 feet of the shoreline were mapped using GIS. Varying buffer sizes around rare feature locations represent locational uncertainty and do not indicate the size of the area occupied by a rare feature.

Results

Numerous rare features have been documented at Boy Lake (Figure 76). These features include multiple locations of three bird species of Special Concern, two locations of a vascular plant species of Special Concern, and one location of a vascular plant species with Threatened status. The publication of exact descriptive and locational information is prohibited in order to help protect these rare species.

Although specific management recommendations will vary depending on the rare features that are present at Boy Lake, practices that maintain good water quality and the integrity of the shoreline will be beneficial to all species involved.

Figure 76. Natural Heritage Database rare features (Federal or State-listed endangered, threatened, or special concern species) located within 1320 feet of Boy Lake shoreline.



Bay Delineation

Objective

1. Determine whether areas of the lake are in isolated bays, non-isolated bays, or not within bays

Introduction

Bays are defined as bodies of water partially enclosed by land. They often offer some degree of protection from the wind and waves to those species living within them. These protected areas provide habitat for a number of aquatic plant species, and bays are frequently characterized by abundant vegetation. These areas of calm water and plentiful vegetation, in turn, provide habitat for a number of fish and wildlife species. Protecting these areas will be beneficial to a variety of plant and animal species.

Methods

Bays were delineated using lake maps and aerial photos. Obvious bays (e.g., significant indentations of shoreline, bodies of water set off from main body or enclosed by land) were mapped based on inspection of lake maps. Additional bays were identified using aerial photos. Underwater shoals or reefs that offset a body of water from the main body were visible only in these photographs. Non-isolated bays were open to the main water body by a wide mouth. Isolated bays had a narrower connection to the main water body, or were offshoots of non-isolated bays.

Results

No bays were delineated on Boy Lake.

II. Ecological Model Development

The second component of the sensitive lakeshore area protocol involved the development of an ecological model. The model scored lakeshore areas based on calculations of sensitivity. The model incorporated results of the field surveys and analysis of additional data, so included information on plant and animal communities as well as hydrological conditions.

In order to develop a continuous sensitivity score along the shoreline, the ecological model used a moving analysis window that included both shoreland and near-shore areas. Resource managers developed a system to score each of the 15 variables. These scores were based on each variable's presence or abundance in relation to the analysis window (Table 5). Each analysis window was assigned a score, which was equal to the highest score present within a window. On occasion, point data were buffered by a set distance and converted to polygons to account for locational uncertainty before inclusion in the model.

Scores for each of the layers were summed (Figure 77). This map represents an index of sensitivity; those points with higher total scores are highly sensitive, whereas points with lower total scores have lower sensitivity.

Once the total score index was developed for the shoreline, clusters of points along the shoreline with similar values were identified using GIS (Figure 78). The clusters with high values (i.e., areas of highly sensitive shoreline) were buffered by ¼ mile. These buffered areas were defined as most likely highly sensitive lakeshore areas. These areas will be forwarded to the local government for potential designation as resource protection areas (Figure 79).

Table 5. Criteria for assigning scores to analysis windows for each variable

Variable	Score	Criteria
Wetlands	3	> 25% of analysis window contains wetlands
	2	12.5 – 25% contains wetlands
	1	< 12.5% contains wetlands
	0	No wetlands present
Hydric Soils	3	> 25% of analysis window contains hydric soils
	2	12.5 – 25% hydric soils
	1	< 12.5% hydric soils
	0	No hydric soils present
Near-shore Plant Occurrence	3	Frequency of occurrence is > 75% (> 75% of points within analysis window contained vegetation)
	2	Frequency of occurrence is 25 – 75%
	1	Frequency of occurrence < 25%
	0	No vegetation present
Aquatic Plant Richness	3	Total number of plant taxa per analysis window > 10
	2	Total number of plant taxa 5 – 10
	1	Total number of plant taxa 1 – 4
	0	No vegetation present
Presence of Emergent and Floating-leaf Plant Beds	3	Emergent and/or floating-leaf plant stands occupy > 25% of the aquatic portion of the analysis window
	2	Stands occupy 5 – 25%
	1	Stands present but occupy less than 5%
	0	No emergent or floating-leaf plant beds present
Unique and Rare Plant Species	3	Presence of 2 or more unique or rare plant species within analysis window
	2	Presence of 1 unique plant species
	0	No unique plant species present
Near-shore Substrate	3	Frequency of occurrence is > 50% soft substrate (> 50% of points within analysis window consist of soft substrate)
	2	Frequency of occurrence is 25 – 50% soft substrate
	1	Frequency of occurrence < 25% soft substrate
	0	No soft substrate present
Birds	3	Presence of 3 or more species of greatest conservation need (SGCN) within analysis window
	2	Presence of 2 SGCN
	1	Presence of 1 SGCN
	0	No SGCN present

Table 5, continued.

Variable	Score	Criteria
Bird Richness	3	Total number of bird species within analysis window > 25
	2	Total number of bird species 11 – 25
	1	Total number of bird species 1 – 10
	0	No bird species observed
Loon Nesting Areas	3	Presence of natural loon nest within analysis window
	2	Presence of artificial loon nest (nesting platform)
	0	No loon nesting observed
Frogs	3	Presence of both mink frogs and green frogs within analysis window
	2	Presence of mink frogs or green frogs
	0	Neither mink frogs nor green frogs present
Fish	3	Presence of one or more species of greatest conservation need (SGCN) within analysis window
	2	Presence of one or more proxy species
	0	Neither SGCN nor proxies observed
Aquatic Vertebrate Richness	3	Total number of aquatic vertebrate species within analysis window > 10
	2	Total number of aquatic vertebrate species 5 – 10
	1	Total number of aquatic vertebrate species 1 – 4
	0	No aquatic vertebrate species observed
Rare Features	3	Presence of multiple Natural Heritage features within analysis window
	2	Presence of one Natural Heritage feature
	0	No Natural Heritage feature present
Bays	3	Isolated bay within analysis window
	2	Non-isolated bay
	0	Not a distinctive bay

Figure 77. Total score layer created by summing scores of all 15 variables. Highest total scores represent most sensitive areas of shoreline.

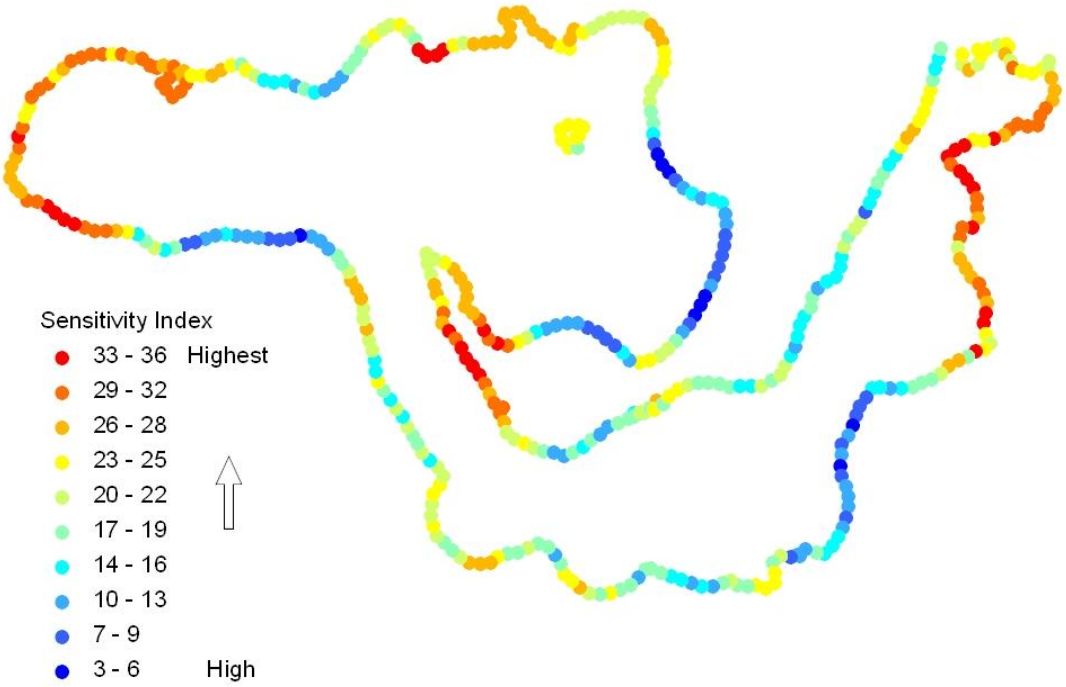


Figure 78. GIS-identified clusters of points with similar total scores. Red areas are those with high scores (i.e., areas of highly sensitive shoreland).

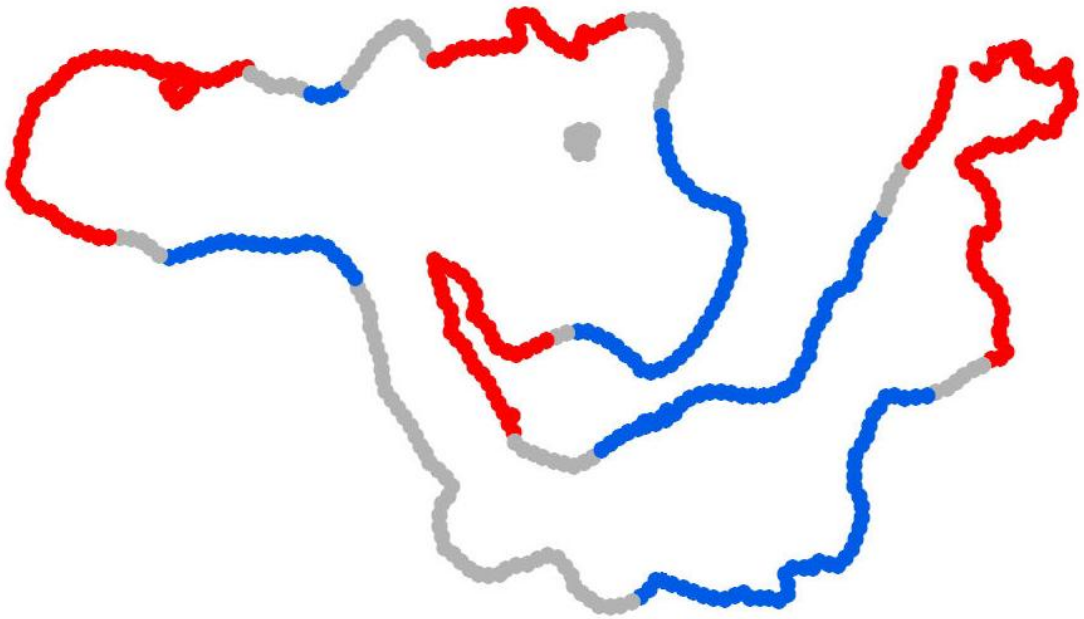
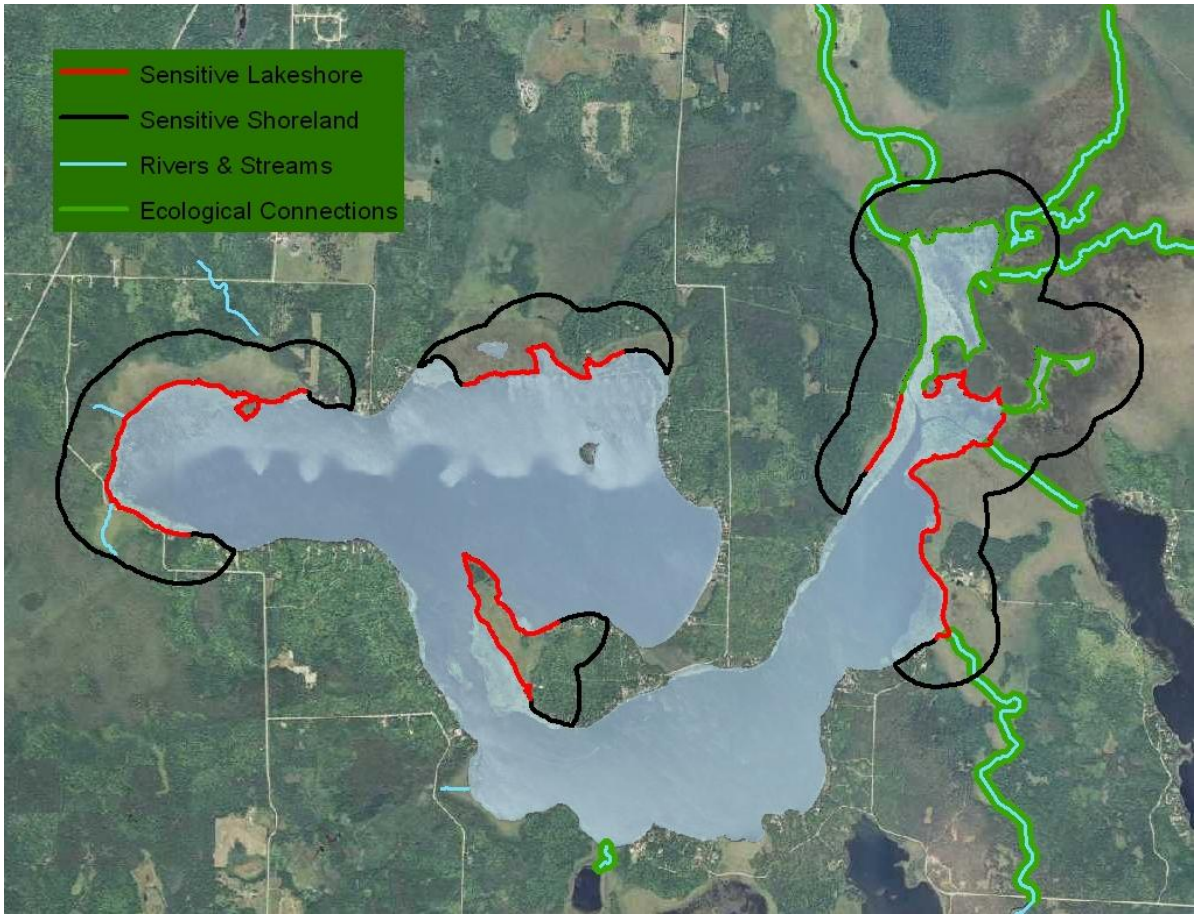


Figure 79. The sensitive lakeshore areas identified by the ecological model.



Habitat Connectivity

In addition to the sensitive shorelands identified through the GIS model, surveyors considered adjacent river shorelines that provide habitat connectivity to and from the lake shorelands. Aquatic habitat connectivity allows for the movement of organisms within a watershed. Organisms can move between existing habitats, colonize new areas, or recolonize former habitat in the wake of local extinctions. The inlets and outlet of Boy Lake were identified as important ecological connections. The Boy River flows through the northeast portion of the lake, with an inlet from Inguadona Lake from the south and the outlet flowing to Leech Lake to the north. Additional connective inlets flow from nearby Rabbit Lake, Swift Lake, and the extensive bog along the northeast shore of Boy Lake. Depending on the existing shoreland classification of these rivers, the County may use the ecological connection recommendation to consider reclassifying to a more protective river class.

Other Areas of Ecological Significance

There are additional aquatic areas of ecological significance in Boy Lake that contain important aquatic plant communities but these sites are not necessarily associated with priority shoreland features. Identifying these sites is important, although exact delineation of their boundaries can be difficult because they occur in the water and may be patchy in distribution.

In Boy Lake, sites containing a high diversity of native submerged plants are considered sites of ecological significance. These include broad underwater zones that contain numerous types of submerged plants. Not only do these species-rich sites provide a diverse habitat mix for fish and wildlife, but they may also help mitigate the potentially harmful impacts if invasive plants occur in the lake.

Submerged beds of muskgrass are also significant in Boy Lake. Muskgrass may form continuous submerged mats where other plant species are not present. Despite the low plant species richness in these sites, this habitat is unique and valuable. Certain rare fish species, such as pugnose shiners, have been associated with muskgrass beds (Becker 1983).

Other Boy Lake sites of ecological significance are emergent and floating-leaf plant beds that may occur outside of the sensitive shoreland districts. Often, these sites are too small to warrant inclusion as part of a shoreline protection district, but their small size is a defining feature that adds to their importance within the lake. Emergent and floating-leaf plant beds continue to be fragmented as shorelines are developed. Protecting remaining areas of these plant communities and preventing further fragmentation is important.

One of the primary threats to these sites is the direct destruction of plant beds through aquatic plant management and recreational boating activities. Planning efforts, such as the development of a Lake Vegetation Management Plan, can be used to set specific management practices within these types of sites.

Sensitive Lakeshore

The northern shorelines and central point between the two basins of Boy Lake contained a great diversity of plant and animal species, including species of greatest conservation need. Critical habitat, such as emergent and floating-leaf vegetation, was also present in high quantities. The ecological model displays these areas both as sensitive shoreline and as high priority shorelands. Although the shoreline itself is important, development and land alteration nearby may have significant negative effects on many species. Fragmented habitats often contain high numbers of invasive, non-native plants and animals that may out-compete native species. The larger a natural area is, the more likely it is to support populations of native plants and animals. Large natural areas that support a diversity of species and habitats help comprise a healthy ecosystem. The inlets and outlet of Boy Lake are also an important part of the lake ecosystem. They provide habitat connectivity between Boy Lake and nearby habitat. They allow movement of animals from various populations, increasing diversity. Habitat connectivity also allows animals with different vegetation requirements during different life stages to access those habitats. Protection of both the shoreline itself and the habitat surrounding the shoreline will be the most effective way to preserve the plant and animal communities in and around Boy Lake, and the value of the lake itself.

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Appendix 1. Shoreline emergent aquatic plants recorded in Boy Lake, 2008.

Description	Common Name	Scientific Name
Shoreline wetland plants	Swamp milkweed	*Asclepias incarnata*
	Bog rosemary	*Andromeda glaucophylla*
	White-flowered aster	*Aster cf. borealis*
	Canada bluejoint grass	*Calamagrostis canadensis*
	White marsh bellflower	*Campanula aparinoides*
	Wiregrass sedge	*Carex cf. oligosperma*
	Bulb-bearing water hemlock	*Cicuta bulbifera*
	Bedstraw	*Galium* sp.
	Jewelweed	*Imapatiens capensis*
	Rice cut-grass	*Leersia oryzoides*
	Water horehound	*Lycopus uniflorus*
	Tufted loosestrife	*Lysimachia thyrsiflora*
	Wild mint	*Mentha arvensis*
	Smartweed	*Persicaria* sp.
	Marsh skullcap	*Scutellaria galericulata*
	Sphagnum moss	*Sphagnum* sp.
	Marsh St. John's wort	*Triadenum fraseri*
	Stinging nettle	*Urtica dioica*
Shoreline upland plants	Hair capped moss	*Polytrichum* sp.
	Columbine	*Aquilegia canadensis*
	Horsetail	*Equisetum* sp.
	Star-flowered solomon's seal	*Maianthemum stellatum*
	Bluegrass	*Poa* sp.
	Goldenrod	*Solidago* sp.
	Meadow rue	*Thallictrium dioicum*
	Clover	*Trifolium* sp.
	Western poison ivy	*Toxicodendron rydbergii*
	Virginia creeper	*Parthenocissus virginiana*
Shoreline vines, shrubs, trees	Alder	*Alnus incana*
	Red-osier dogwood	*Cornus sericea*
	Ash	*Fraxinus* sp.
	Popple	*Populus* sp.
	Bur oak	*Quercus macrocarpa*
	Alder-leaved buckthorn	*Rhamnus alnifolia*
	Gooseberry	*Ribes* sp.
	Basswood	*Tilia americana*
	Elm	*Ulmus* sp.

Nomenclature follows MNTaxa 2009

Appendix 2. Bird species list. Includes all species within Boy Lake and shoreland recorded during surveys and casual observation, May – June 2009.

Common Name	**Scientific Name**
Canada Goose	*Branta canadensis*
Trumpeter Swan	*Cygnus buccinator*
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Green-winged Teal	*Anas crecca*
Ring-necked Duck	*Aythya collaris*
Common Goldeneye	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Ruffed Grouse	*Bonasa umbellus*
Common Loon	*Gavia immer*
Horned Grebe	*Podiceps auritus*
American White Pelican	*Pelecanus erythrorhynchos*
American Bittern	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Cooper's Hawk	*Accipiter cooperii*
Merlin	*Falco columbarius*
Yellow Rail	*Coturnicops noveboracensis*
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
Sandhill Crane	*Grus canadensis*
Solitary Sandpiper	*Tringa solitaria*
Ring-billed Gull	*Larus delawarensis*
Caspian Tern	*Hydroprogne caspia*
Black Tern	*Chlidonias niger*
Common Tern	*Sterna hirundo*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Barred Owl	*Strix varia*
Common Nighthawk	*Chordeiles minor*
Chimney Swift	*Chaetura pelagica*
Ruby-throated Hummingbird	*Archilochus colubris*
Belted Kingfisher	*Megaceryle alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*

Appendix 2, continued.

Common Name	Scientific Name
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Wood-Pewee	*Contopus virens*
Alder Flycatcher	*Empidonax alnorum*
Least Flycatcher	*Empidonax minimus*
Eastern Phoebe	*Sayornis phoebe*
Great Crested Flycatcher	*Myiarchus crinitus*
Eastern Kingbird	*Tyrannus tyrannus*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Purple Martin	*Progne subis*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Tree Swallow	*Tachycineta bicolor*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapilla*
White-breasted Nuthatch	*Sitta carolinensis*
House Wren	*Troglodytes aedon*
Sedge Wren	*Cistothorus platensis*
Marsh Wren	*Cistothorus palustris*
Veery	*Catharus fuscescens*
American Robin	*Turdus migratorius*
Gray Catbird	*Dumetella carolinensis*
Cedar Waxwing	*Bombycilla cedrorum*
Nashville Warbler	*Vermivora ruficapilla*
Yellow Warbler	*Dendroica petechia*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Cape May Warbler	*Dendroica tigrina*
Yellow-rumped Warbler	*Dendroica coronata*
Black-and-white Warbler	*Mniotilta varia*
American Redstart	*Setophaga ruticilla*
Ovenbird	*Seiurus aurocapilla*
Northern Waterthrush	*Seiurus noveboracensis*
Common Yellowthroat	*Geothlypis trichas*
Chipping Sparrow	*Spizella passerina*
Savannah Sparrow	*Passerculus sandwichensis*
Le Conte's Sparrow	*Ammodramus leconteii*

Appendix 2, continued.

Common Name	**Scientific Name**
Nelson's Sparrow	*Ammodramus nelsoni*
Song Sparrow	*Melospiza melodia*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Bobolink	*Dolichonyx oryzivorus*
Red-winged Blackbird	*Agelaius phoeniceus*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Baltimore Oriole	*Icterus galbula*
American Goldfinch	*Spinus tristis*