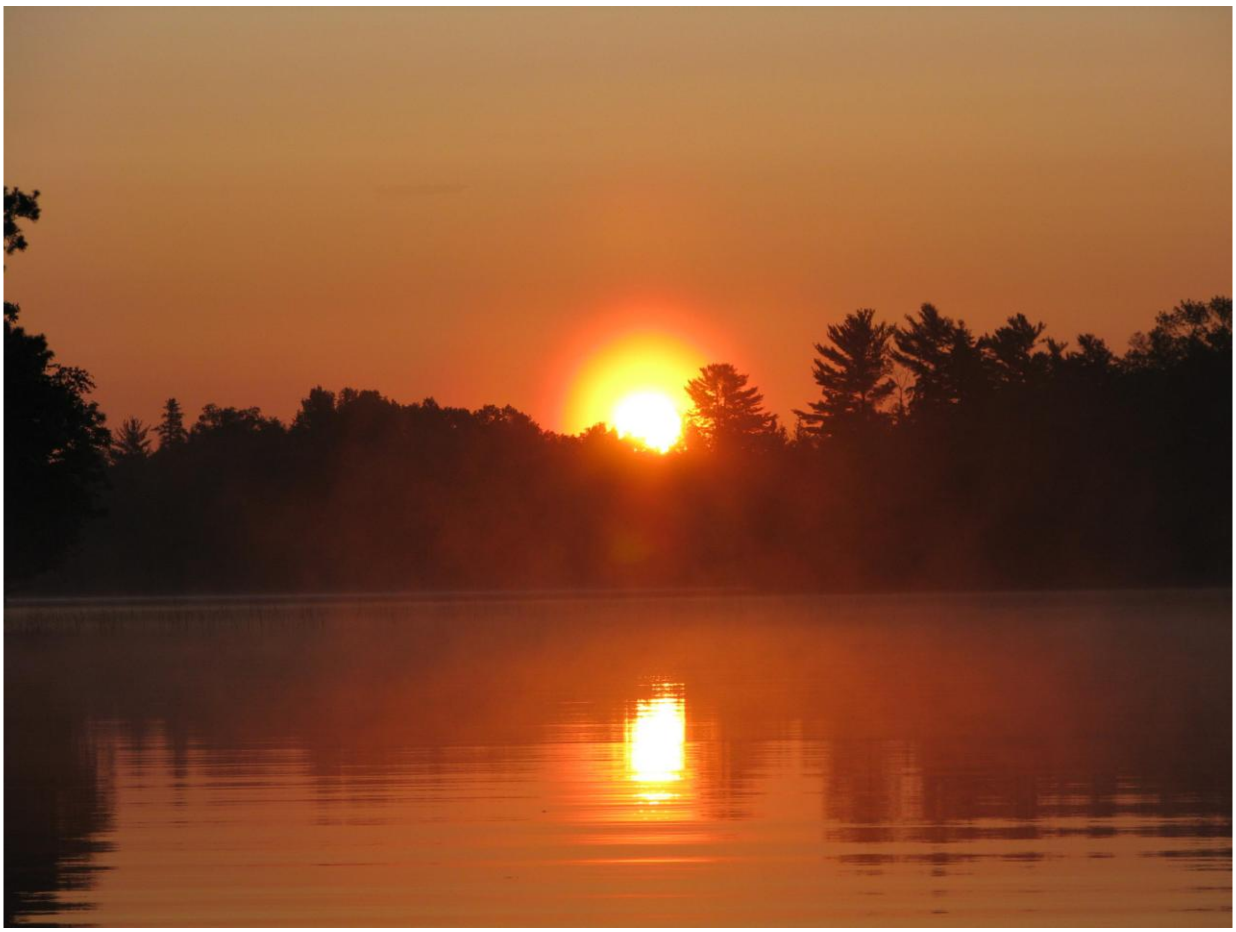
Final Report
Sensitive Lakeshore Survey
Birch Lake (11-0412-00)
Cass County, Minnesota

May 2009



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

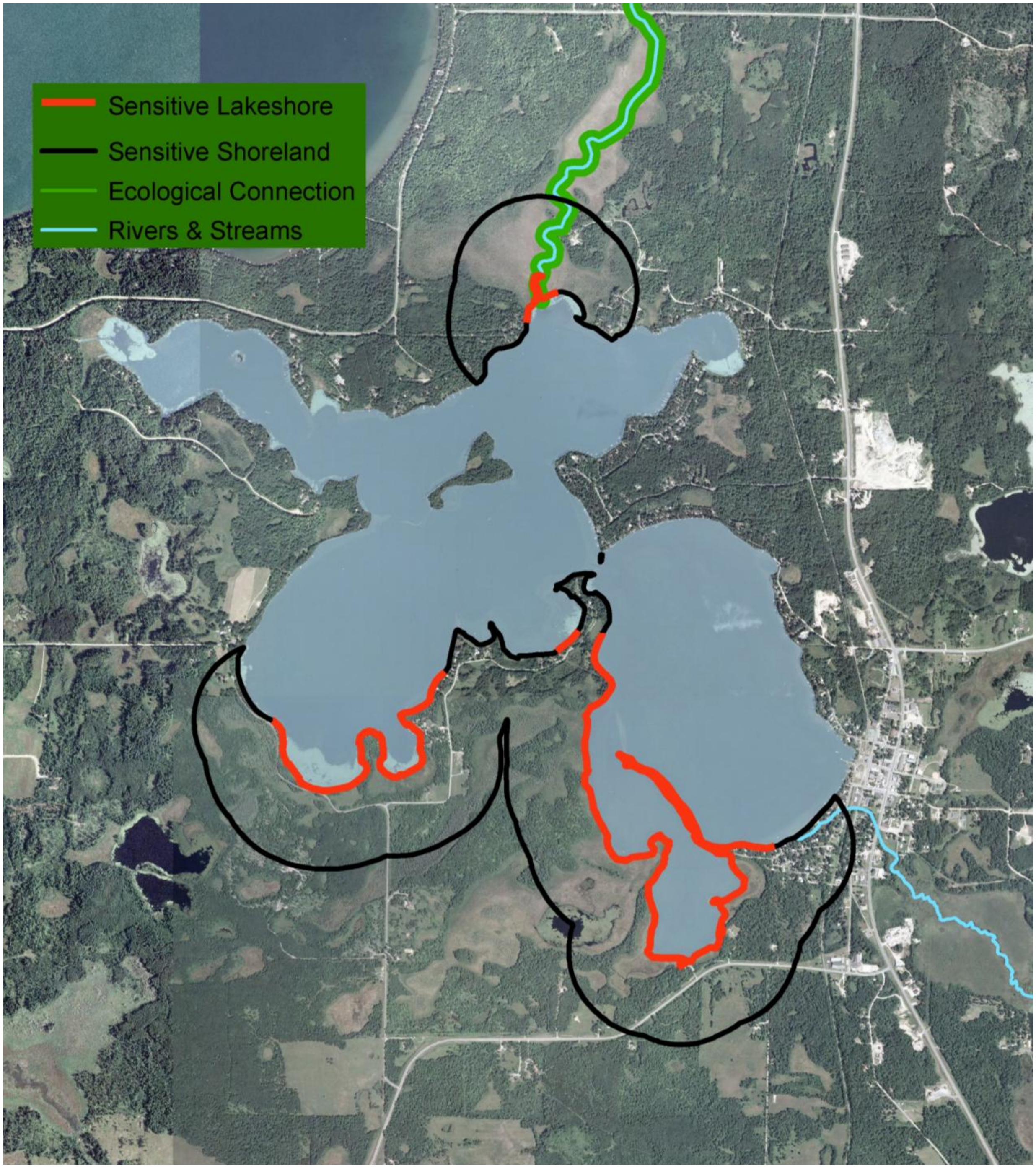
Aquatic plants occurred around the entire perimeter of Birch Lake, with the greatest concentrations in shallow areas, such as the southeast basin and small bays. A total of 48 native aquatic plant taxa were recorded in Birch Lake and included 11 emergent, six floating-leaved and 31 submerged and free-floating plant taxa. Submerged plants occurred to a depth of 29 feet but were most common in the shore to 15 feet depth zone, where 87 percent of the sample sites contained vegetation. Floating-leaf plants occupied about 50 acres and were mostly located in protected bays of the northwest basin. Emergent plants occupied about 47 acres and were located mainly along shallow sandy shorelines. Seven unique plant species were documented during the surveys.

One fish species of greatest conservation need (pugnose shiner) was identified at Birch Lake. Seven fish species previously undocumented in this lake were identified during this study, bringing the total historical observed fish community to 30 species. Bluegills were the most abundant fish species found. Both mink and green frogs were detected; they were closely associated with the presence of waterlily beds.

Surveyors documented 72 species of birds, including 13 species of greatest conservation need. Song sparrows were the most abundant bird species overall, whereas the veery was the most commonly detected species of greatest conservation need. Although distribution of several species was restricted to the bays, others were found along the shoreline of the main basin as well.

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 two primary sensitive lakeshore areas to be considered for potential resource protection districts by Cass County. The Boy River between Birch Lake and Ten Mile Lake was identified as an important ecological connection. 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:


Sensitive Lakeshore
Sensitive Shoreland
Ecological Connection
Rivers & Streams

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 Birch Lake sensitive lakeshore areas.

Lake Description

Birch Lake (DOW 11-0412-00) is located near the city of Hackensack, in Cass County, north-central Minnesota (Figure 1). The lake occurs within the ecological region known as the Laurentian Mixed Forest, which is the true forested region of the state.

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

Birch Lake is part of the Boy River Watershed. The Boy River flows into Birch Lake from Ten Mile Lake, and outlets to Poquet Lake. The majority of land within this watershed remains forested and contains extensive wetland areas. The shoreline of Birch Lake is primarily forested, but also heavily developed with residential homes. There is a public boat launch and fishing pier on the southeast shore (Figure 2).

Birch Lake has a surface area of about 1,250 acres and consists of two basins. The east basin (Lower Birch) is shallow with a maximum depth of 25 feet and a mean depth of about seven feet (Figure 3). The west basin (Upper Birch) has a maximum depth of 45 feet and a mean depth of approximately 20 feet (Heiskary 1990). A 13 acre island is located in the west basin. In 1940, a dredge was used to deepen a man-made channel between the east and west basins (Heiskary 1990).

A 1989 study determined that the water quality of Birch Lake was within the range typical of representative, minimally impacted lakes in northern Minnesota (Heiskary 1990). The average Secchi depth (which measures water transparency) between 1990 and 2008 was nearly 14 feet, indicating relatively high water clarity (MPCA 2008). The Minnesota DNR Section of Fisheries manages the lake primarily for northern pike and walleye and secondarily for bluegill, largemouth bass, black crappie, and yellow perch (MN DNR 2003).

Figure 2. Features of Birch Lake.

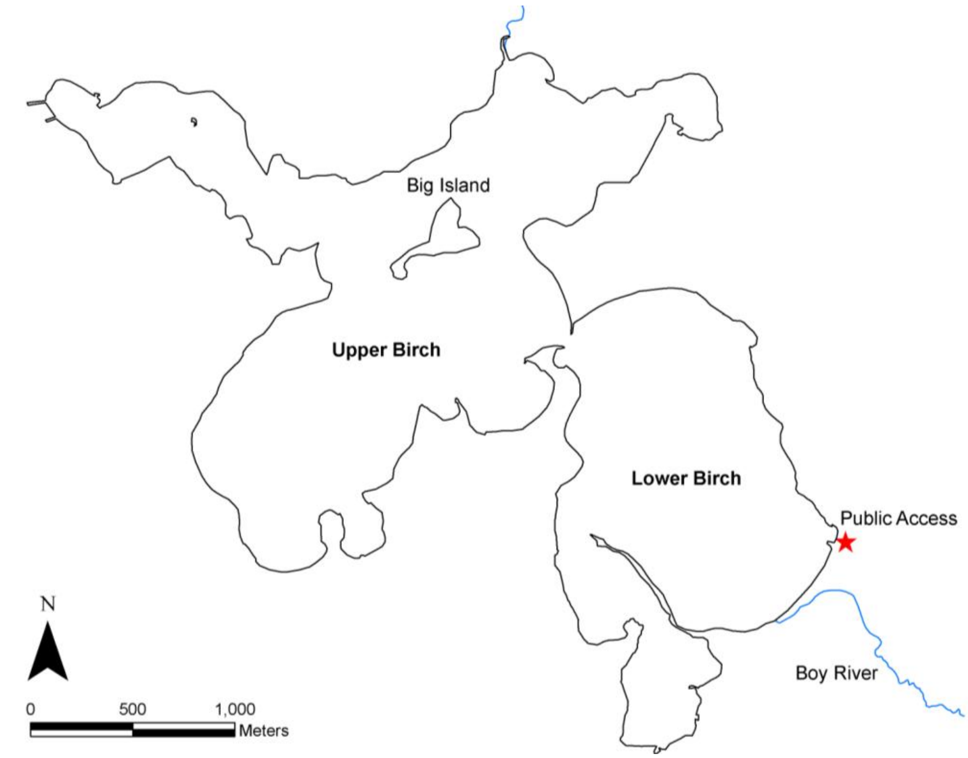
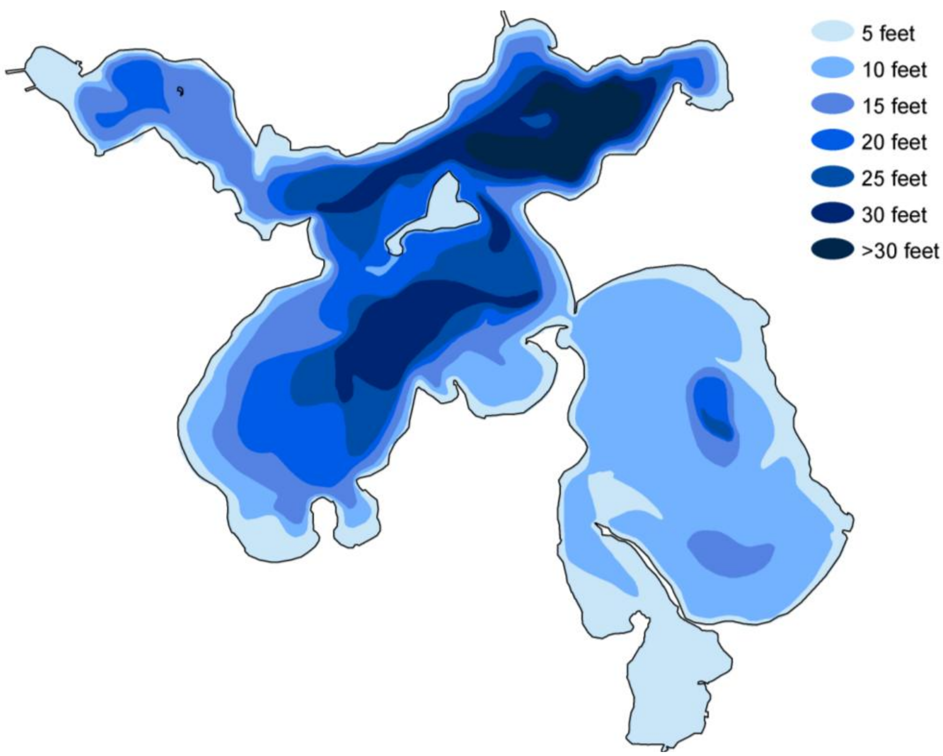


Figure 3. Depth contours of Birch Lake.



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

Objectives

1. Map wetlands within the extended state-defined shoreland area of Birch Lake

Introduction

Birch Lake wetland area

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 Birch Lake ordinary high water mark were excluded from this analysis.

Results

Approximately 375 acres, or about 20 percent of the Birch Lake shoreland (the area within 1320 feet of the shoreline), are described as wetlands by NWI. About three miles, or one fifth of the Birch Lake shoreline, is directly connected to wetlands. The largest wetlands occurred at the inlet from Ten Mile Lake, along the southeastern side of Upper Birch, and along the southwestern side of Lower Birch (Figure 4).

Figure 4. Distribution of wetlands within 1320 feet of Birch Lake shoreline.

The dominant wetland types were emergent wetland (Cowardin et al. 1979) or marsh (MN DNR 2003) systems, characterized by herbaceous, emergent wetland vegetation, and palustrine scrub shrub (Cowardin et al. 1979) or wetland shrubland systems (MN DNR 2003), dominated by deciduous or evergreen shrubs. The water regime varied among wetlands and included saturated, seasonally flooded and semi-permanently flooded soils.

Northern alder swamp on Birch Lake shoreline.

Hydric Soils

Objectives

1. Map hydric soils within the extended state-defined shoreland area of Birch 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.

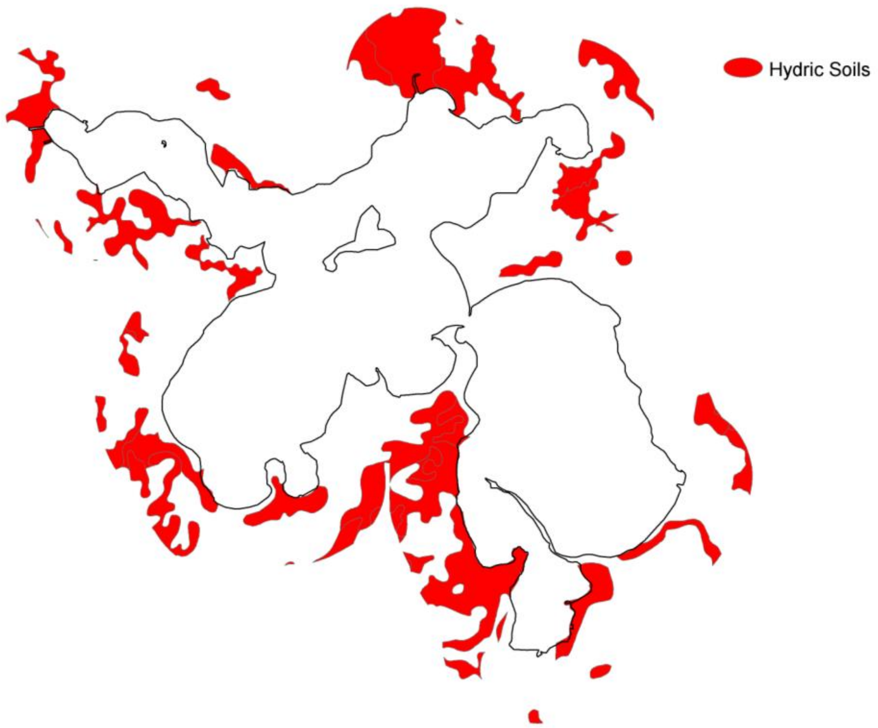
Methods

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

Hydric soils were widespread along the shoreline of Birch Lake (Figure 5), and encompassed nearly 440 acres within the shoreland district. Large areas of hydric soils were located along the northeast side of Upper Birch Lake and along the southwestern edge of Lower Birch. Specific hydric soil types varied, from muck to loamy sand to peat. The organic matter content of the majority of these soils was very high, and most were very poorly drained.

Figure 5. Distribution of hydric soils within 1320 feet of Birch Lake shoreline.



Plant Surveys

Objectives

1. Record presence and abundance of all plant taxa
2. Describe distribution of vegetation in Birch 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

Aquatic plants occurred around the entire perimeter of Birch Lake and the widest bands of vegetation occurred in shallow areas, such as the southeast basin and small bays. Vegetation was sparse in the southern-most bay. A total of 48 native aquatic plant taxa were recorded in Birch Lake including 11 emergent, six floating-leaved and 31 submerged and free-floating taxa.

Submerged plants occurred to a depth of 29 feet but were most common in the shore to 15 feet depth zone, where 87 percent of the sample sites contained vegetation. The large algae muskgrass (*Chara* sp.) was the most common submerged plant. Common rooted submerged plants included flat-stem pondweed (*Potamogeton zosteriformis),* bushy pondweed (*Najas flexilis* and *N. guadalupensis*), Canada waterweed (*Elodea canadensis*), coontail (*Ceratophyllum demersum*), and northern watermilfoil (*Myriophyllum sibiricum*).

Floating-leaf plants occupied about 50 acres and were mainly located in protected bays of the northwest basin. Common species were watershield (*Brasenia schreberi*), white waterlily (*Nymphaea odorata*) and yellow waterlily (*Nuphar variegata*). Emergent beds of bulrush (*Schoenoplectus* spp.) and spikerush (*Eleocharis* spp.) occupied about 47 acres and were mostly located along shallow sandy shorelines.

Unique submerged aquatic plants documented during the surveys were humped bladderwort (*Utricularia gibba*), lesser bladderwort (*U. minor*) and flat-leaved bladderwort (*U. intermedia*). Other unique species included floating-leaved burreed (*Sparganium fluctuans*), water arum (*Calla palustris*), three-way sedge (*Dulichium arundinaceum*), and the bog shrub, leatherleaf (*Chamaedaphne calyculata*).

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 and wave activity. Deep or wind-swept areas may lack 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 Birch 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.

Large algae, mosses and fern-like aquatic plants resemble higher plants but do not form flowers or true leaves, stems and roots. These plants grow entirely submerged, or may be found in shallow water as well as at the deep edge of the rooted plant zone (Arber 1920). Some of these plants may form thick "carpets" on the lake bottom that provide important habitat for fish spawning and nesting.

Figure 6. Bed of muskgrass

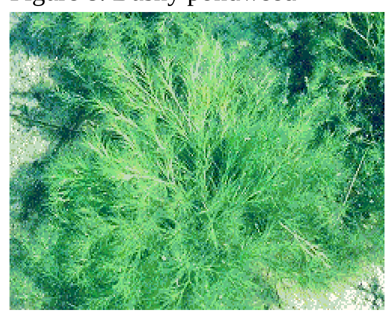
Muskgrass (*Chara* sp.; Figure 6) is a large algae that is common in many hard water Minnesota lakes. It has a brittle texture and a characteristic "musky" odor. Muskgrass is adapted to a variety of substrates and is often the first species to colonize open areas of lake bottom where it can act as a sediment stabilizer.

Pondweeds (*Potamogeton* spp. and *Stuckenia* spp.) are one of the largest groups of rooted submerged plants in Minnesota lakes. These plants are 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 over-winter 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 differ 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.

Figure 7. Flat-stem pondweed

Flat-stem pondweed (*Potamogeton zosteriformis*; Figure 7) is one of eleven pondweed (*Potamogeton*) species found in Birch Lake. It is a perennial plant that is anchored to the lake bottom by underground rhizomes and can overwinter by winter buds. It is named for its flattened, grass-like leaves. Depending on water clarity and depth, flat-stem pondweed may reach the water surface and produce flowers that extend above the water.

Figure 8. Bushy pondweed



Bushy pondweed (*Najas flexilis*; Figure 8) is unusual because it is one of the few annual submerged species in Minnesota and must re-establish every year from seed. Bushy pondweed grows entirely below the water surface. It prefers hard substrates and is not tolerant of turbidity (Nichols 1999b). Southern bushy pondweed (*Najas guadalupensis*) is a closely related species but is less widespread throughout Minnesota. It can be difficult to distinguish the two species. The seeds and foliage of these plants are important duck foods and beds of these plants provide good fish cover.

Figure 9. Canada waterweed

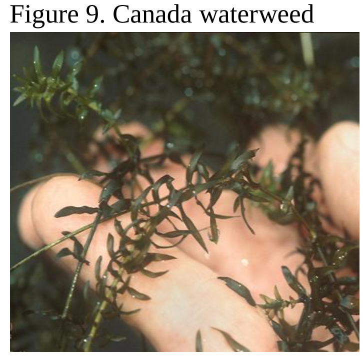


Photo: Vic Ramey, U. of Florida

Canada waterweed (*Elodea canadensis*) is a rooted perennial submerged species that is widespread throughout Minnesota (Ownbey and Morley 1991) and is adapted to a variety of conditions. It is tolerant of low light and prefers soft substrates (Nichols 1999b). This species can overwinter as an evergreen plant and spreads primarily by fragments. The branching stems of this plant (Figure 9) can form thick underwater plant beds that provide valuable habitat for a variety of fish and invertebrates.

Figure 10. Coontail

Coontail (*Ceratophyllum demersum*; Figure 10) 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.

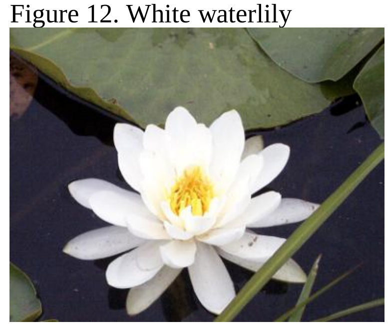
Figure 11. Northern watermilfoil

There are several native watermilfoil species in Minnesota and the most common is northern watermilfoil (*Myriophyllum sibiricum*; Figure 11) which is found statewide. Whorled watermilfoil (*Myriophyllum verticillatum*) has primarily been found in northern Minnesota lakes. Both species are rooted, perennial submerged plants with finely dissected leaves. These plants may reach the water surface, particularly in depths less than ten feet and their flower stalks extend above the water surface. Watermilfoil plants spread primarily by stem fragments and over-winter by hardy rootstalks and winter buds. Neither northern nor whorled watermilfoil is tolerant of turbidity (Nichols 1999b) and both species grow best in clear water lakes. These native plants provide fish shelter and insect habitat and their extensive root systems help stabilize near-shore substrates.

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 12. White waterlily



Floating-leaf plants include white waterlily (*Nymphaea odorata),* yellow waterlily (*Nuphar variegata*) and watershield (*Brasenia schreberi)*. These are perennial plants that can reproduce by seed and by vegetative growth.

White and yellow waterlilies can be found in lakes in both northern and southern Minnesota. White waterlily (Figure 12) has showy white flowers and round leaves with radiating veins. Yellow waterlily (Figure 13) 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 and white waterlily may occur to depths of ten feet (Nichols 1999b).

Figure 13. Yellow waterlily

Watershield is most often found in soft-water lakes (Borman et al. 2001) in northern Minnesota. It has relatively small, floating oval leaves and small reddish flowers (Figure 14). The leaves are green on top, while the underside of the leaves and stems are reddish-purple. The leaves and stems of watershield have a slippery, gelatinous coating. Watershield may produce winterbuds, whereas waterlilies typically over-winter by hardy rhizomes.

Figure 14. Watershield

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.

Narrow-leaved emergent plants include bulrush (*Schoenoplectus* spp.; Figure 15) and spikerush (*Eleocharis* spp.; Figure 16). These are emergent, perennial plants that occur in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). These plants have narrow stems that are typically round in cross section and lack showy leaves. Clusters of small flowers form near the tips of long, narrow stalks. Most of these plants occur as emergents, from shore to water depths of about six feet, and their stems may extend several feet above the water surface. Some species may also grow as submerged forms. Bulrush and spikerush stands are particularly susceptible to destruction by excess herbivory and direct removal by humans.

Figure 15. Bulrush bed in Birch Lake, 2006

Figure 16. Spikerush bed in Birch Lake, 2006

There are also several types of broad-leaved emergent plants and these often occur close to the shoreline. While these plants most often occur as emergents, several species may grow as floating-leaved plants for all or part of their life cycle.

Arrowhead (*Sagittaria* spp.; Figure 17) are broad-leaf, perennial plants that may form emergent, floating and/or submerged leaves. These plants may be found submerged in several feet of water or growing emergent along shore and in wetlands. These plants form small but attractive white flowers that later develop into green seed heads. Arrowhead seeds and tubers are valuable food for waterfowl and marsh birds and leaves and tubers may be eaten by muskrats (Newmaster et al. 1997).

Figure 17. Arrowhead

Burreed (*Sparganium* spp.; Figure 18) are perennial, emergent plants with leaves that resemble cattails but are shorter in height with triangular leaves. Burreed grows in shallow water (less than 4 feet) along shorelines and in wetlands throughout Minnesota. Some burreed species form only floating-leaves, some are only emergent, and some can form both types of leaves. The plants produce fruits with nut-like achenes that are eaten by ducks, common snipe and rails; the stems and leaves are a preferred food of muskrats and deer (Newmaster et al. 1997).

Figure 18. Giant burreed

Unique aquatic plants

Unique aquatic plant species are of high conservation importance. These species may include:

- Plant species that are not listed as rare but are uncommon in the state or locally. These may include species that are proposed for rare listing.
- Plant 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.

Floating-leaved burreed (*Sparganium fluctuans*; Figure 19) is a floating-leaved, perennial plant that has flat and wide floating leaves. The flower stalks are branched and usually contain two to four fruiting heads. The fruits on floating-leaved burreed are reddish-brown in color with a curved beak (Borman et al. 2001). This plant is found in marshes, rivers and ponds throughout northern Minnesota (Ownbey and Morley 1991, Newmaster et al. 1997).

Figure 19. Floating-leaved burreed

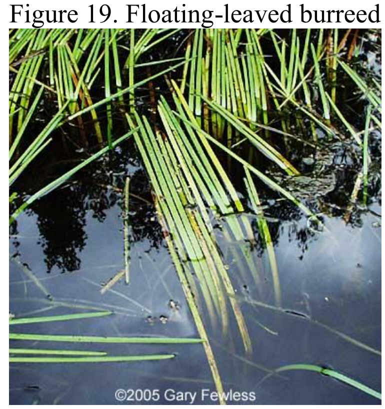


Photo by: Gary Fewless, U. of WI – Green Bay, Coffrin Center for Biodiversity, Herbarium, Copyright 2005

Bladderworts (*Utricularia* spp.) are a group of submerged plants that produce roots but do not firmly anchor to the lake bottom. Greater bladderwort (*U. vulgaris)* is found in lakes and ponds throughout Minnesota but several other species are much less common. Unique bladderwort species include humped bladderwort (*Utricularia gibba*), lesser bladderwort (*U. minor*) and flat-leaved bladderwort (*U. intermedia*). These small, submerged plants are often confused as algae because of their fine stems and leaves. 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 20) 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. They are found in protected, shallow lake areas and have been documented at scattered locations throughout northern Minnesota (Ownbey and Morley 1991).

Figure 20. Bladderwort in flower among watershield

Water arum (*Calla palustris*; Figure 21) is an emergent, perennial wetland plant that may grow along marshy lakeshores as well as in wooded swamps, marshes and bogs (Nichols 1999b). The plant is recognizable by its heart-shaped leaves and the showy, white petal-like spathe. This is a species of northern latitudes and Minnesota is the southwestern limit of its range (Flora of North America 1993+). Within Minnesota, water arum primarily occurs in the northeast half of the state (Ownbey and Morley 1991).

Figure 21. Water arum

Three-way sedge (*Dulichium arundinaceum*; Figure 22) is an emergent, perennial plant that grows along soft bottom lakeshores and in marshes. This plant does not produce a showy flower but can be identified by its unique three-ranked leaf arrangement that resembles an airplane propeller from above (Newmaster et al. 1997). Three-way sedge is found along shores of lower alkalinity lakes (Nichols 1999b) throughout central and northern Minnesota (Ownbey and Morley 1991).

Figure 22. Three-way sedge

Photo by: A. Murray, U. of Florida, Center for Aquatic Plants. Copyright 2003.

Leatherleaf (*Chamaedaphne calyculata*; Figure 23) is a low growing evergreen shrub and is often found in dense clumps. The leaves are alternate, have a leathery feel and become progressively smaller toward the top of the branch. Leatherleaf has nodding flowers with petals fused into a white urn in one-sided clusters at the branch tips (Newmaster et al. 1997). It is found in bogs, fens, conifer swamps and lakeshores throughout northeastern Minnesota (Ownbey and Morley 1991). Leatherleaf is a good food source for grouse, deer and moose in the winter months in Minnesota (Newmaster et al. 1997).

Figure 23. Leatherleaf

Photo by: Kier Morse, U. of WI – Stevens Point, Robert Freckman Herbarium

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 potentially occur in a lake (Moyle 1945), and thus, indirectly influences lakewide species richness. The trophic status of a lake also influences plant species richness, and eutrophic and hypertrophic 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 because 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.

Methods

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

Grid point-intercept survey

A grid point-intercept survey was conducted on Birch Lake between July 13 and July 20, 2006 (Perleberg 2006). 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 30 feet. Points were spaced 65 meters apart and 1,046 sites were sampled. Surveyors navigated to each site using a handheld Global Positioning System (GPS) unit. At each sample site, water depth was recorded 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 at 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 2005). 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 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. Field mapping focused on bulrush beds, which were difficult to see on aerial photos. Bulrush beds were mapped in 2006 using handheld GPS technology and reconnaissance surveys of other plant beds were conducted to verify species composition and if needed, modify boundary lines.

Near-shore in-lake vegetation survey plots

Near-shore vegetation surveys were conducted at 22 shoreland plots and at six near-shore plots. Plots were selected based on the presence of nongame 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 Birch Lake from the Rare Features Database of the Minnesota 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 Birch Lake.

Surveyors searched for unique and rare plant species in 2006 during the lakewide point-intercept surveys and in 2007 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.

A targeted search for rare aquatic vascular plants in Birch Lake was conducted by the Minnesota County Biological Survey Program on July 14, 2008 (Myhre 2008). This search focused on sites that were most likely to contain rare plant species. Botanists used professional experience to select rare species search sites and included factors such as shoreline development, substrate type, water depth, and native plant community type in their site selection. To gain access to shallow vegetated areas, searches were conducted by slowly kayaking, canoeing and/or wading through the site.

A brief habitat description and a list of all plant taxa found in the search area were recorded. When necessary, plant specimens were sent to the authority in the field for identification verification and annotation. Voucher specimens were made to document county records and several additional species, and were submitted to The Herbarium of the University of Minnesota Bell Museum of Natural History, St. Paul, MN.

Results

Distribution of plants by water depth

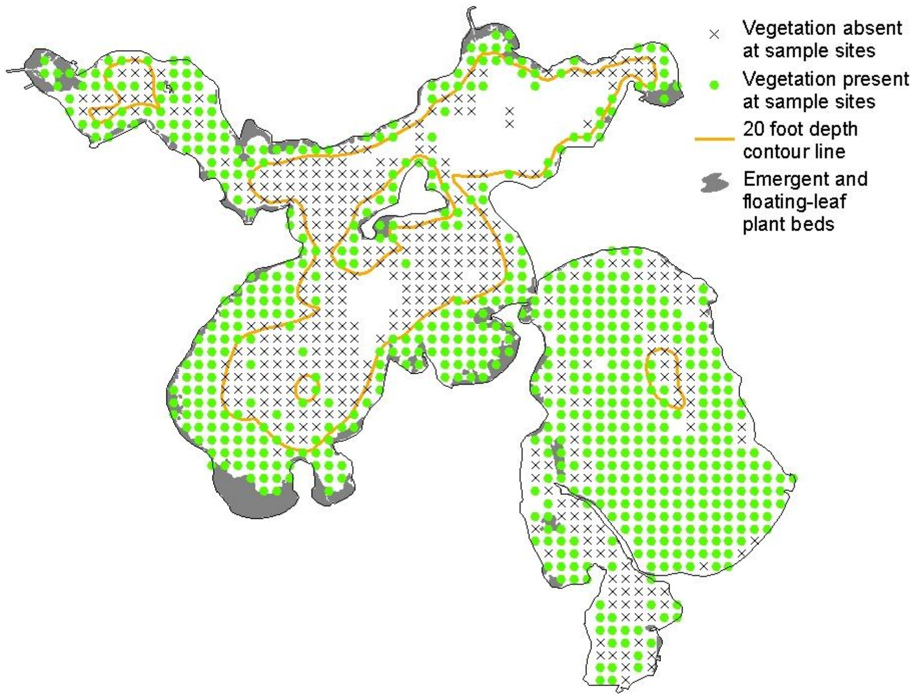
Plants were found to a maximum depth of 29 feet in Birch Lake and 64 percent of all sample sites contained vegetation. Plant occurrence was greatest from shore to a water depth of 15 feet, where vegetation was found in 87 percent of the sample sites. In depths of 16 to 30 feet, only 16 percent of the sites were vegetated.

Emergent plants were restricted to water depths of five feet and less, and floating-leaf plants were found up to six feet in depth. Free-floating plant species were not found in water depths greater than one foot. Only submerged plant taxa were found beyond the six feet depth. The majority of submerged taxa were restricted to depths less than 11 feet, and only five submerged taxa were found in depths greater than 20 feet.

Distribution of plants in main basin versus bays

Aquatic plants occurred around the entire perimeter of Birch Lake and the widest bands of vegetation occurred in shallow areas, such as the southeast basin and small bays (Figure 24). Vegetation was sparse in the southern-most bay.

Figure 24. Distribution of aquatic plants in Birch Lake, 2006.



Aquatic plant species observed
A total of 48 native aquatic plant taxa were recorded in Birch Lake, including 31 submerged or free-floating (Table 1), six floating-leaved and 11 emergent plants (Table 2). Additional shoreline plants observed are listed in Appendix 1.

Submerged plants
Submerged plants occurred in 64 percent of Birch 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 or drift freely with the currents.

Muskgrass was the most frequently documented submerged plant and it occurred in 29 percent of all survey sites. It was found around the entire lake, excluding the southwest bay of Lower Birch Lake (Figure 25a). Muskgrass occurred to a maximum depth of 15 feet but was most common in depths from shore to ten feet where it occurred in 87 percent of the sites.

Flat-stem pondweed was the most abundant pondweed in Birch Lake and was found in 27 percent of all sample sites (Figure 25b). Other common pondweeds included Robbins' pondweed (*Potamogeton robbinsii*), Fries' pondweed (*P. friesii*), and clasping-leaf pondweed (*P. richardsonii*).

Table 1. Submerged and free-floating aquatic plants recorded in Birch Lake, 2006 – 2008.

Description		Common name	Scientific name	Frequency[a] N=1046
Large algae, moss, and fern-like plants		Muskgrass	*Chara* sp.	29
		Stonewort	*Nitella* sp.	1
		Watermoss	Not identified to genus	<1
		Quillwort	*Isoetes* sp.	<1
Rooted Submerged	Grass-leaved plants	Flat-stem pondweed	*Potamogeton zosteriformis*	27
		Wild celery	*Vallisneria americana*	6
		Water stargrass	*Heteranthera dubia*	1
	Small-leaved plants	Bushy pondweed	*Najas flexilis*	26
		Southern bushy pondweed	*Najas guadalupensis*[b,c]	
		Canada waterweed	*Elodea canadensis*	25
	Dissected or fine-leaved plants	Coontail	*Ceratophyllum demersum*	17
		Northern watermilfoil	*Myriophyllum sibiricum*	16
		Whorled watermilfoil	*Myriophyllum verticillatum*[b,d]	
		Water marigold	*Megalodonta beckii*	2
		White water buttercup	*Ranunculus aquatilis*	<1
		Greater bladderwort	*Utricularia vulgaris*	<1
		Flat-leaved bladderwort	*Utricularia intermedia*	<1
		Lesser bladderwort	*Utricularia minor*	<1
		Humped bladderwort	*Utricularia gibba*[b]	Present
	Broad-leaved plants "cabbage"	Robbins' pondweed	*Potamogeton robbinsii*	15
		Clasping-leaf pondweed	*Potamogeton richardsonii*	9
		Large-leaf pondweed	*Potamogeton amplifolius*	6
		Illinois pondweed	*Potamogeton illinoensis*	6
		White-stem pondweed	*Potamogeton praelongus*	6
		Variable pondweed	*Potamogeton gramineus*	2
	Narrow-leaved plants	Fries' pondweed	*Potamogeton friesii*	15
		Narrow-leaf pondweed	*Potamogeton* sp. [e]	10
		Very small pondweed	*Potamogeton pusillus*[b]	
		Straight leaved pondweed	*Potamogeton strictifolius*[b]	
		Sago pondweed	*Stuckenia pectinata*	1
Free-floating		Star duckweed	*Lemna trisulca*	<1
		Greater duckweed	*Spirodela polyrhiza*	<1

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations, and represent the percent of sample sites in which taxa occurred.

[b]Located only during Minnesota County Biological Survey, 14 July 2008.

[c]Two species of "bushy pondweed" *Najas flexilis* and *Najas guadalupensis* were found in the lake but because these species can be difficult to distinguish in the field, they were grouped together for analysis.

[d]Two species of "watermilfoil" *Myriophyllum sibiricum* and *Myriophyllum verticillatum* were found in the lake but because these species can be difficult to distinguish in the field, they were grouped together for analysis.

[e]Three species of "narrow-leaved pondweeds" (*Potamogeton friesii*, *P. pusillus*, and *P. strictifolius*) were found in the lake. If a plant could not be identified to the species level, it was recorded as "unidentified narrow-leaf pondweed" (*Potamogeton* sp.) and grouped together with *P. pusillus* and *P. strictifolius* for analysis. "*Potamogeton* sp." is not included in the taxa tally.

Nomenclature follows MNTaxa 2009.

Table 2. Floating-leaved and emergent aquatic plants documented in Birch Lake, July 2006 – 2008.

Description		**Common Name**	**Scientific Name**	**Frequency**[a]
Floating-leaved		White waterlily	*Nymphaea odorata*	2
		Yellow waterlily	*Nuphar variegata*	1
		Floating-leaf pondweed	*Potamogeton natans*	1
		Watershield	*Brasenia schreberi*	<1
		Floating-leaf burreed	*Sparganium fluctuans*	<1
		Floating-leaf smartweed	*Persicara amphibia*	Present[b]
Emergent	Narrow-leaved	Hard-stem bulrush	*Schoenoplectus acutus*	3
		Three-square bulrush	*Schoenoplectus pungens*	Present[c]
		Small spikerush	*Eleocharis palustris*	1
		Needlerush	*Eleocharis* sp.	<1
	Broad-leaved	Broad-leaf arrowhead	*Sagittaria latifolia*	<1
		Arum-leaved arrowhead	*Sagittaria cuneata*	Present[b]
		Water arum	*Calla palustris*	Present[b]
		Green-fruited burreed	*Sparganium emersum*	Present[c]
		Giant burreed	*Sparganium eurycarpum*	Present[b]
		Wild rice	*Zizania palustris*	Present[b]
		Cattail	*Typha* sp.	Present[c]

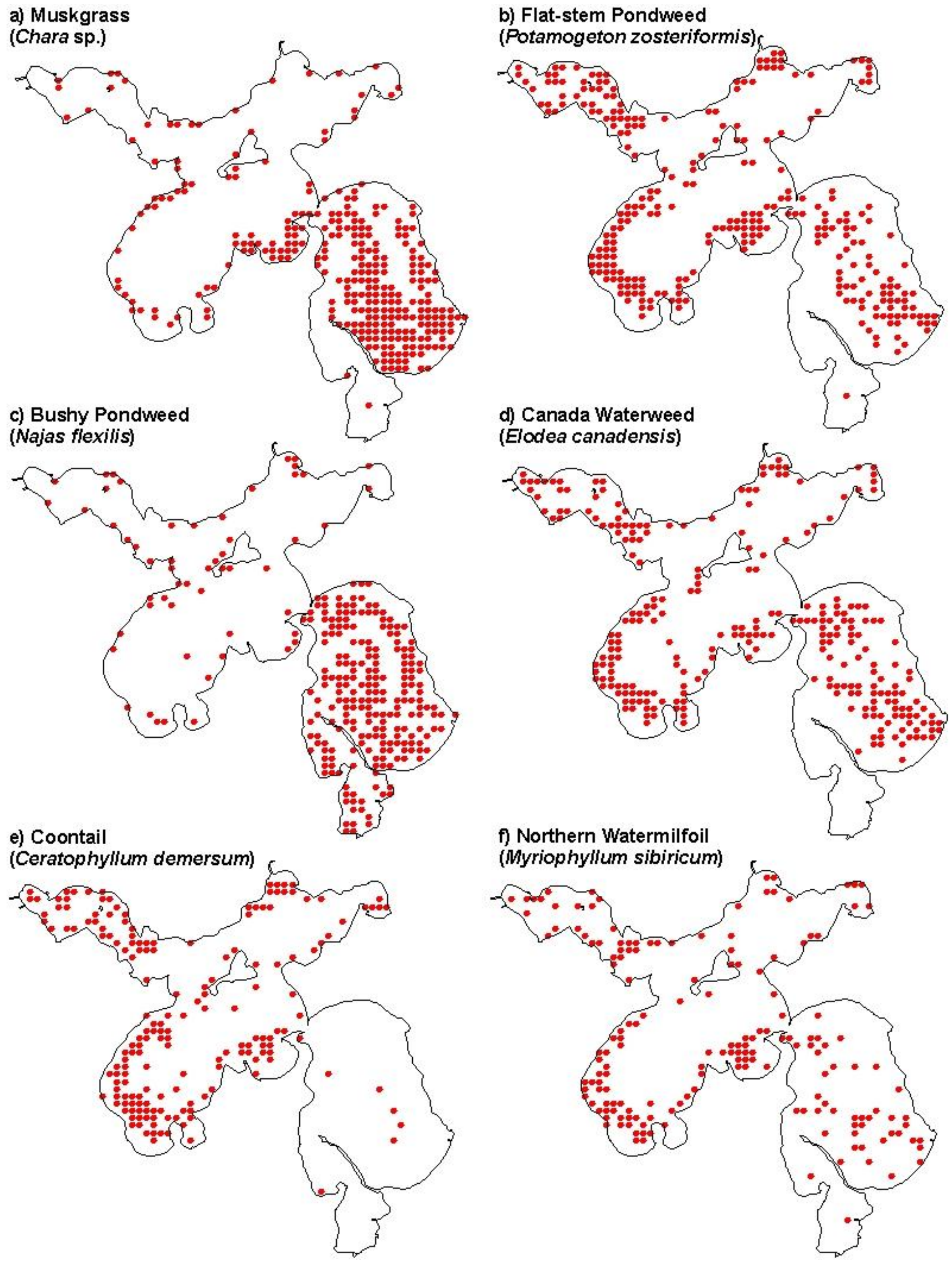
[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations, and represent the percent of sample sites in which taxa occurred.

[b]Present = located in lake in 2007 but not located at point-intercept locations.

[c]Located only during Minnesota County Biological Survey, 14 July 2008.

Nomenclature follows MNTaxa 2009.

Figure 25. Distribution of common aquatic plants in Birch Lake, 2006.



Bushy pondweed (*Najas flexilis* and/or *N. guadalupensis*) occurred in 26 percent of the sites and was most frequent in depths of 15 feet and less. This was the dominant taxa in the south bay of Lower Birch Lake and was often the only plant found at sample sites within this bay (Figure 25c.). It likely occurred there because it does not strongly root to the lake bottom and was able to survive in the flocculent sediments of that bay.

Canada waterweed occurred in both Birch Lake basins (Figure 25d), and was found in 25 percent of the sample sites. It was one of the few species found at all water depths (shore to 29 feet deep), but most occurrences were in water depths of 10 feet or less.

Coontail occurred in 17 percent of the sites and was most common in depths of six to 15 feet. Coontail was mainly restricted to Upper Birch Lake (Figure 25e). Native watermilfoil plants (*Myriophyllum sibiricum* and/or *M. verticillatum*) were found in 16 percent of the Birch Lake sample sites. This taxa was found throughout Birch Lake (Figure 25f), but was most often found in water depths less than 15 feet.

Floating-leaf and emergent plants

About 50 acres of floating-leaf plant beds were mapped and most beds occurred in Upper Birch Lake (Figure 26). The most common species were watershield, white waterlily, and yellow waterlily. Because surveyors avoided motoring into floating-leaf plant beds, the frequency values obtained for these taxa (Table 2) were lower than the actual occurrence. Frequency values for floating-leaf taxa represent the occurrence of these taxa only within the sites that were surveyed. Waterlily beds often contained scattered bulrush plants as well as submerged plants and were usually associated with muck sediments.

Surveyors delineated approximately 47 acres of emergent plants. Bulrush and spikerush were the most common emergent plants. Bulrush plants occurred to a maximum depth of five feet and the largest stands occurred on the sandy shoals in the north basin (Figure 26). Large stands of spikerush were not present, but scattered patches were located around the shoreline. Other emergent plants occurred at scattered locations around the lake and included arrowhead and burreed. Many of these emergent plants occupied the transitional zone between upland and lake, and several taxa extended into the water up to a depth of six feet.

Unique plants

In addition to the commonly occurring plants in Birch Lake, seven unique plant species were documented at ten locations during the surveys (Figure 27). These species are not widespread in Minnesota but their presence is indicative of relatively undisturbed native plant beds in Birch Lake. Unique plants found in Birch Lake included humped bladderwort, lesser bladderwort, flat-leaved bladderwort, floating-leaved burreed, water arum, three-way sedge, and leatherleaf.

All seven species were located in protected bays or channels and occurred with floating-leaf and emergent plants. Unique plants in the southern bay were emergent plants that occurred in wetlands adjacent to the lake.

Figure 26. Distribution of emergent and floating-leaf plant beds in Birch Lake, 2006.

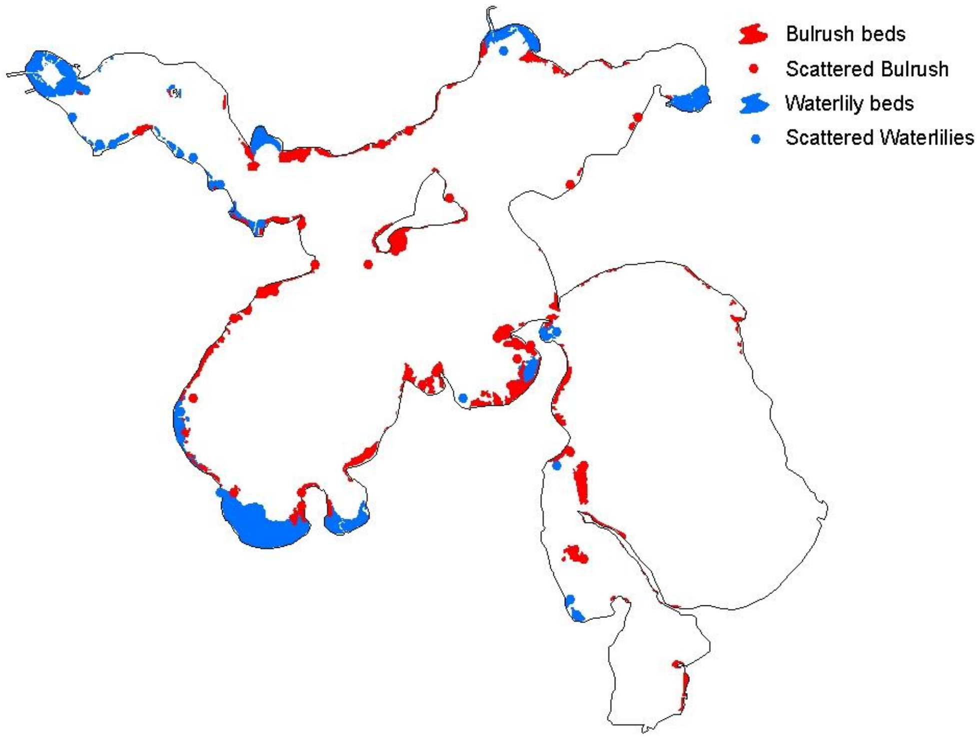
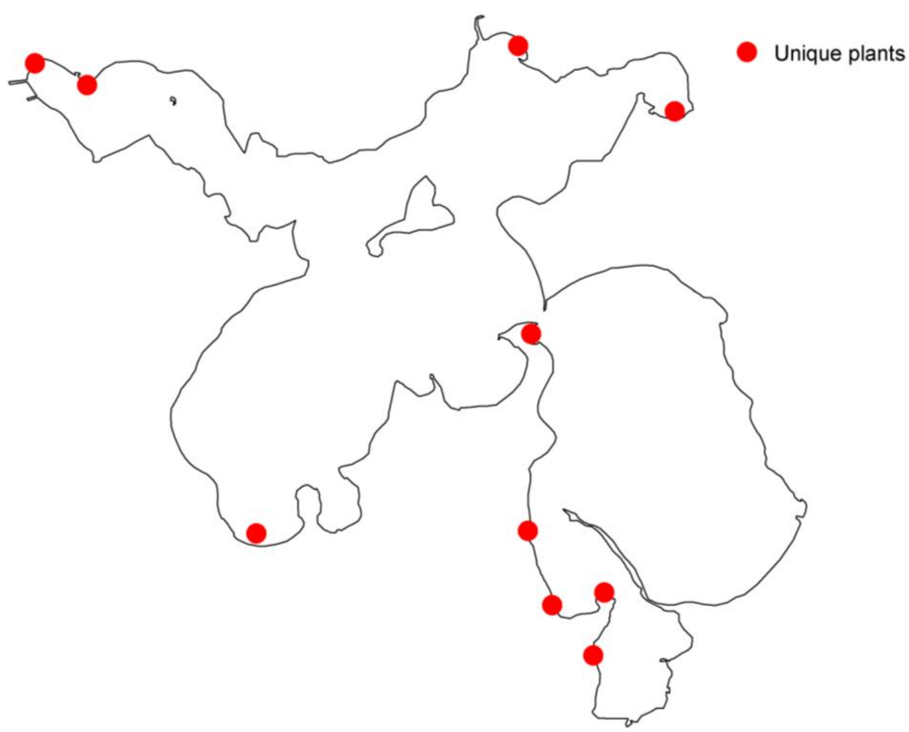


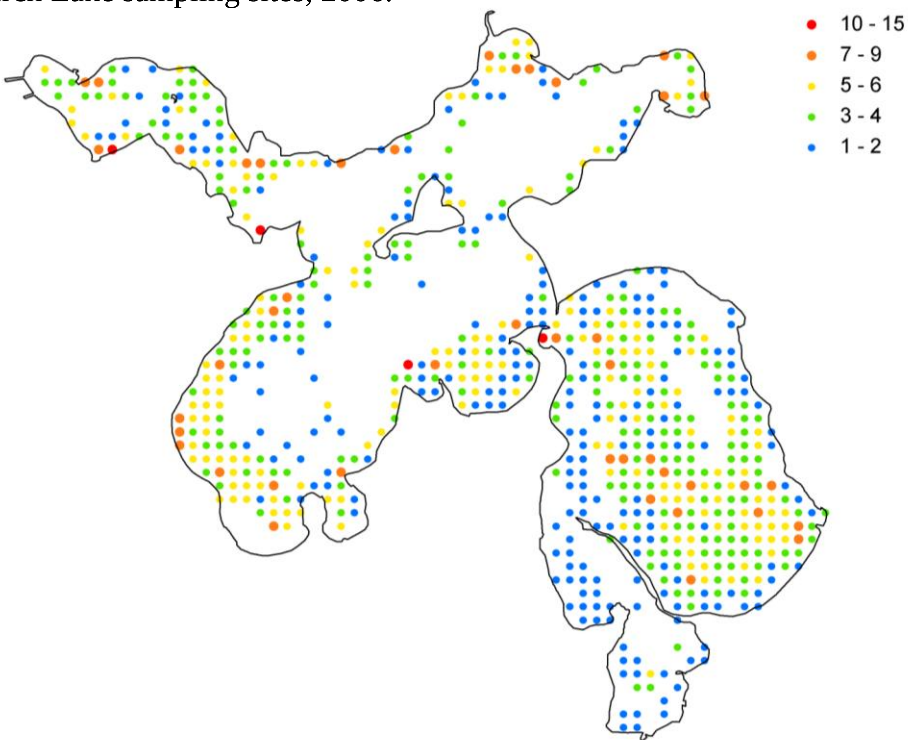
Figure 27. Distribution of unique plants in Birch Lake, 2006 – 2008.



Species richness

The number of plant taxa found in each one square meter sample site ranged from zero to 15 (Figure 28). Sites in water depths less than ten feet contained the greatest number of plant taxa, and in water depths greater than 15 feet most sites contained one or no taxa. The southern bay of Lower Birch contained sites with low species richness. In Upper Birch Lake, sites with high species richness were most often found near shore, whereas in Lower Birch Lake, species-rich sites were located in the center of the lake.

Figure 28. Aquatic plant taxa richness (number of taxa per sample site) at Birch Lake sampling sites, 2006.



Near-shore Substrates

Objectives

1. Describe and map the near-shore substrates of Birch 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 that range from soft to hard, 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, gravel or marl while yellow waterlily prefers soft substrates (Nichols 1999b).

Silt shoreline of Birch Lake

Methods

Near-shore substrate in Birch Lake was evaluated at a total of 502 sampling stations set up in the grid point-intercept aquatic plant and near-shore fish surveys. Plant point-intercept sample stations were 65 meters apart and occurred in a grid from shore to a depth of 20 feet. Surveyors described substrate at 464 of these sites that were located between the shore and the six foot water depth. 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 38 of these stations.

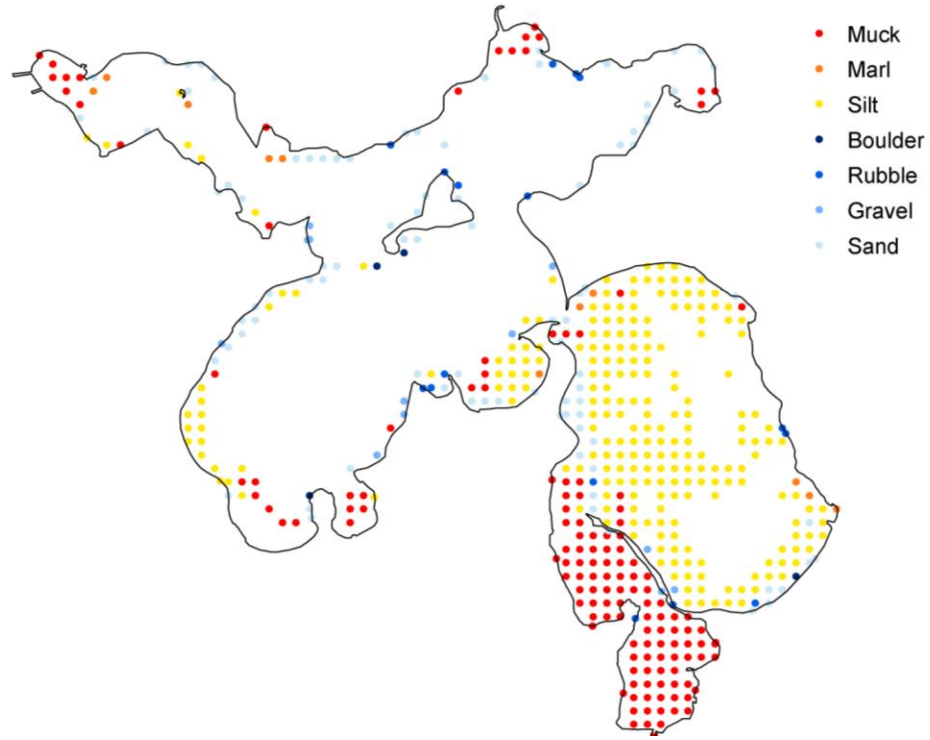
Surveyors evaluated substrate by tapping a pole into the lake bottom; soft substrate could usually be brought to the surface on the pole or sampling rake for evaluation. If this was not feasible, substrate was evaluated by visual observation of the lake bottom. Standard lake substrate classes were based on the DNR Lake 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

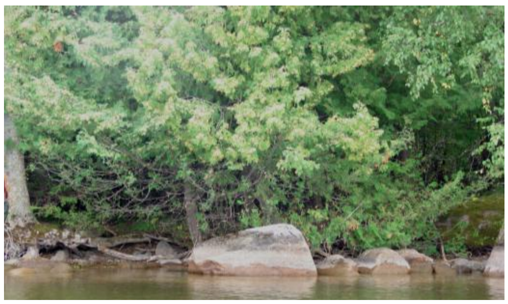
Substrate type varied somewhat between the two basins of Birch Lake. The upper basin contained a variety of substrate types. Hard bottom substrates, particularly sand, occurred along straight shorelines and the island, whereas the protected bays were characterized by muck substrates (Figure 29). The south bay of the lower basin was also comprised of muck sediments. The main basin of Lower Birch Lake was primarily silt, with some scattered boulders and rubble. Overall, the dominant near-shore substrate type was silt, which occurred at nearly 50 percent of the sampling sites.

Figure 29. Distribution of near-shore substrates around Birch Lake, 2006 - 2007.



Rock shoreline of Birch Lake

Boulder shoreline of Birch Lake



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). Thirteen of these species were identified at Birch Lake.

Figure 30. American bittern

Photo by: Dave Herr

American bitterns (*Botaurus lentiginosus*; Figure 30) 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.

Figure 31. Bald eagle

Photo by: Carrol Henderson

Bald eagles (*Haliaeetus leucocephalus*; Figure 31) 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.

Common loons (*Gavia immer*; Figure 32) 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. This large diving bird possesses 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 32. Common loon

Photo by: Carrol Henderson

Common nighthawks (*Chordeiles minor*; Figure 33) 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 rituals include 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 will even nest 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 33. Common nighthawk

Photo by: Carrol Henderson

Common terns (*Sterna hirundo*; Figure 34) 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 sandy substrates of islands or peninsulas of large lakes. Populations of common terns declined in the 1970s, likely due to poisoning by pesticides. Habitat loss, nest predation, and disturbance by humans may also negatively affect common terns.

Figure 34. Common tern

Photo by: Carrol Henderson

Eastern wood-pewees (*Contopus virens*; Figure 35) are medium-sized, nondescript birds common in Eastern forests. They are grayish-olive above, with a paler throat and belly and whitish wingbars. Eastern wood-pewees are named after their call, a whistled "pee-a-wee." 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 35. Eastern wood-pewee

Photo by: J.A. Spendelow

Golden-winged warblers (*Vermivora chrysoptera*; Figure 36) are small, active, insectivorous warblers. They possess a distinctive yellow crown and yellow patch on the wings. A black mask and throat contrast with the gray and white plumage on the back and breast. They often inhabit forest edges, such as those along marshes, bogs, and fields, and are also common abandoned farmlands and in alder shrub swamps. Regional declines of the golden-winged warbler are considerable. Human-caused disturbance and hybridization with increasing numbers of blue-winged warblers are correlated with the declines.

Figure 36. Golden-winged warbler

Photo by: Carrol Henderson

Ovenbirds (*Seiurus aurocapillus*; Figure 37) are rarely seen birds of the forest. However, their loud "teacher, teacher, teacher" song is commonly heard during summer months. Ovenbirds dwell on the ground, and build a covered nest that resembles a Dutch oven. The birds 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, and often forage on the ground, looking for insects in the leaf litter. Ovenbird numbers appear to be stable, but the birds are vulnerable to forest fragmentation and parasitism by brown-headed cowbirds (*Molothrus ater*).

Figure 37. Ovenbird

Photo source: U.S. Fish and Wildlife Service

Rose-breasted grosbeaks (*Pheucticus ludovicianus*; Figure 38) 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.

Figure 38. Rose-breasted grosbeak

Photo by: J.A. Spendelow

The swamp sparrow's (*Melospiza georgiana*; Figure 39) 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 39. Swamp sparrow

Photo by: Jim Stasz

The veery (*Catharus fuscescens*; Figure 40) 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, but the birds also produce a flute-like descending song. 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 40. Veery

Photo by: Deanna Dawson

White-throated sparrows (*Zonotrichia albicollis*; Figure 41) 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. White-throated sparrows inhabit coniferous or mixed forests, and prefer areas with multiple openings and abundant low-growing vegetation. Although white-throated sparrows are widespread, they are declining over portions of their breeding range. Research into this decline will be important for the future of this species.

Figure 41. White-throated sparrow

Photo by: Dave Herr

The yellow-bellied sapsucker’s (*Sphyrapicus varius*; Figure 42) 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 42. Yellow-bellied sapsucker

Photo by: J.A. Spendelow

Methods

Surveyors used several techniques to collect information on bird species. Point counts were conducted at 59 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

Surveyors identified 13 species of greatest conservation need at Birch Lake. The veery was found at the greatest number of locations, with surveyors identifying this species at 16 stations.

Bald eagles, common loons, ovenbirds, and swamp sparrows were all documented at 5 or more survey stations. The other species of greatest conservation need found at Birch Lake were: American bittern, common tern, common nighthawk, Eastern wood-pewee, golden-winged warbler, rose-breasted grosbeak, white-throated sparrow, and yellow-bellied sapsucker.

Species of greatest conservation need were distributed around a variety of areas of the shoreline. Those species that were mainly aquatic in nature were found primarily in Upper Birch Lake (Figure 43), whereas forest habitat species were located at survey stations along much of the shoreline of both basins (Figure 44). Those species that depend on marsh habitat were found mainly in bays (Figure 45). Species occupying a variety of habitats (Figure 46) were found scattered around the east and west basins of Birch Lake.

Surveyors recorded 66 bird species during the point count and call-playback surveys at Birch Lake (Table 3). Six additional species were recorded through casual observation, for a total of 72 species (Appendix 2). Song sparrows were the most common species overall, and were found at nearly 75 percent of the survey sites. Red-winged blackbirds were second in abundance, and were identified at 34 of the 59 stations. Red-eyed vireos, yellow warblers, and common grackles rounded out the top five most common species.

Figure 43. Distribution of aquatic habitat-dependent bird species of greatest conservation need at Birch Lake, May – June 2008.

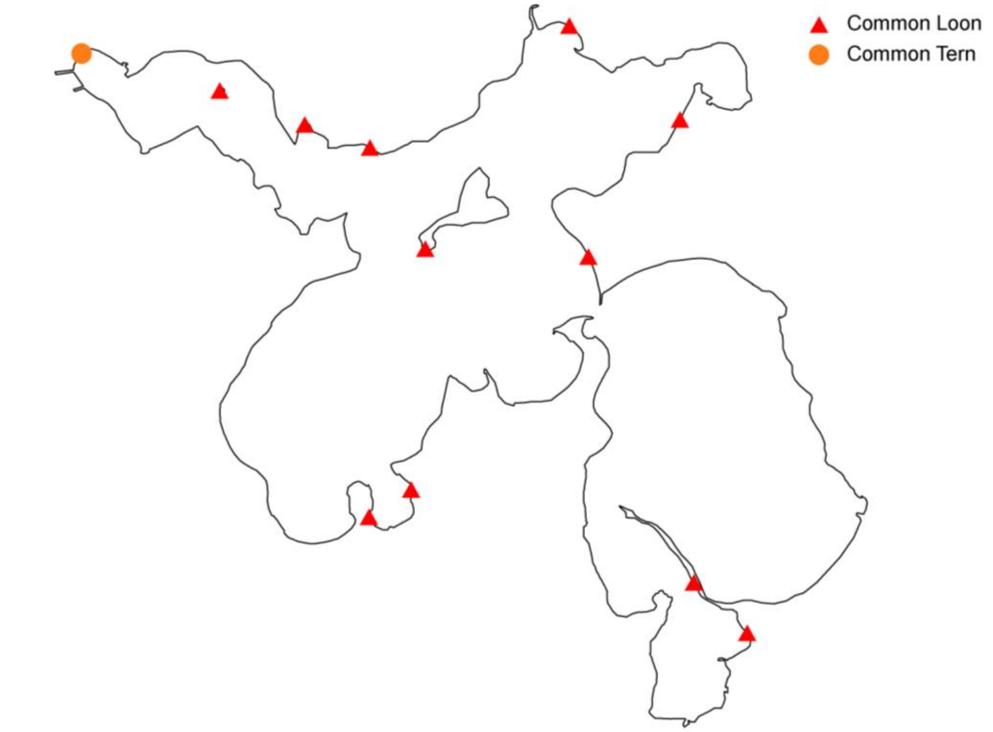


Figure 44. Distribution of forest habitat-dependent bird species of greatest conservation need at Birch Lake, May – June 2008.

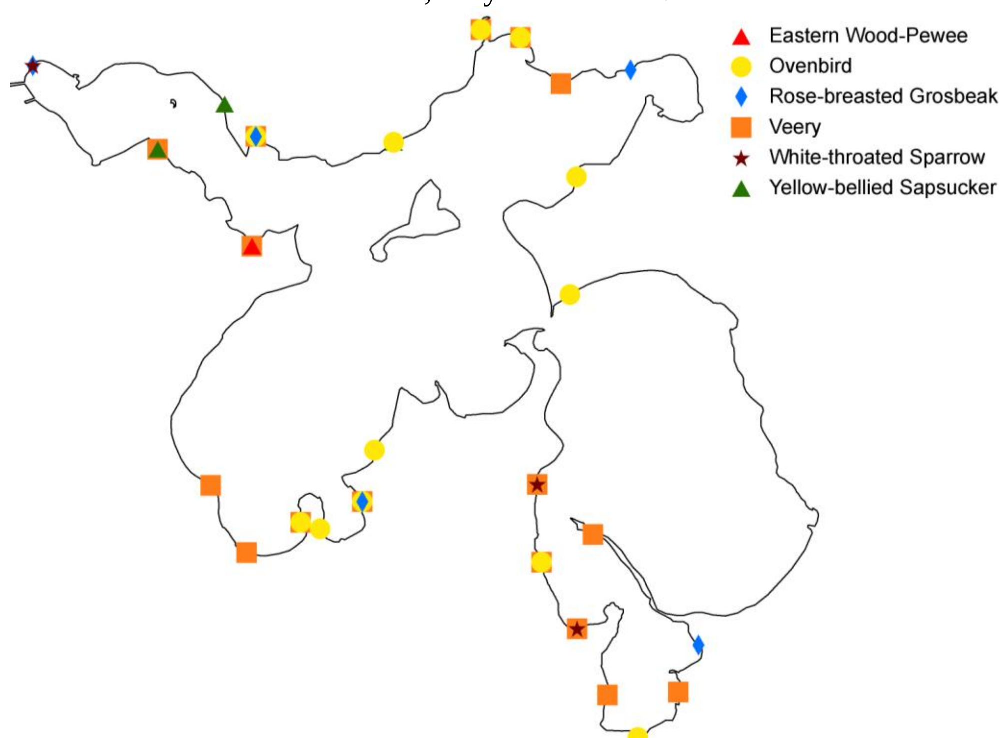


Figure 45. Distribution of wetland habitat-dependent bird species of greatest conservation need at Birch Lake, May – June 2008.

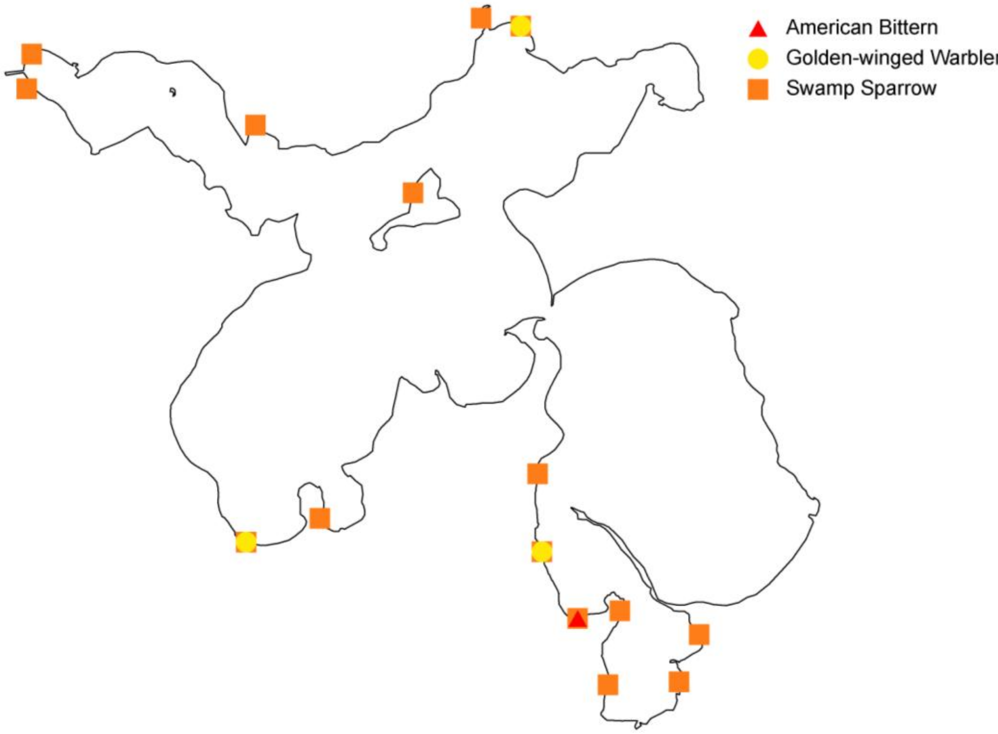


Figure 46. Distribution of bird species of greatest conservation need that occupy a variety of habitats at Birch Lake, May – June 2008.

Table 3. Species list and frequency of occurrence of bird species identified during Birch Lake bird surveys, May – June 2008. * denotes a species of greatest conservation need.

Description	**Common Name**	**Scientific Name**	**%** [a]
Waterfowl	Canada Goose	*Branta canadensis*	5
	Wood Duck	*Aix sponsa*	2
	Mallard	*Anas platyrhynchos*	31
	Hooded Merganser	*Lophodytes cucullatus*	3
	Common Merganser	*Mergus merganser*	5
Loons	Common Loon*	*Gavia immer*	19
Herons/bitterns	American Bittern*	*Botaurus lentiginosus*	2
	Great Blue Heron	*Ardea herodias*	2
	Green Heron	*Butorides virescens*	8
Hawks/eagles	Osprey	*Pandion haliaetus*	5
	Bald Eagle*	*Haliaeetus leucocephalus*	5
	Cooper's Hawk	*Accipiter cooperii*	2
Plovers	Killdeer	*Charadrius vociferus*	2
Sandpipers/allies	Spotted Sandpiper	*Actitis macularius*	2
Gulls/terns	Ring-billed Gull	*Larus delawarensis*	5
	Common Tern*	*Sterna hirundo*	2
Pigeons/doves	Mourning Dove	*Zenaida macroura*	8
Owls	Barred Owl	*Strix varia*	3
Goatsuckers	Common Nighthawk*	*Chordeiles minor*	2
Hummingbirds	Ruby-throated Hummingbird	*Archilochus colubris*	3
Kingfishers	Belted Kingfisher	*Megaceryle alcyon*	7
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*	8
	Yellow-bellied Sapsucker*	*Sphyrapicus varius*	5
	Downy Woodpecker	*Picoides pubescens*	5
	Hairy Woodpecker	*Picoides villosus*	3
	Northern Flicker	*Colaptes auratus*	3
	Pileated Woodpecker	*Dryocopus pileatus*	10
Flycatchers	Eastern Wood-Pewee*	*Contopus virens*	2
	Alder Flycatcher	*Empidonax alnorum*	10
	Eastern Phoebe	*Sayornis phoebe*	12
	Eastern Kingbird	*Tyrannus tyrannus*	2
Vireos	Warbling Vireo	*Vireo gilvus*	7
	Red-eyed Vireo	*Vireo olivaceus*	53
Jays/crows	Blue Jay	*Cyanocitta cristata*	27
	American Crow	*Corvus brachyrhynchos*	34

Table 3, continued.

Description	Common Name	Scientific Name	%[a]
Swallows	Purple Martin	*Progne subis*	2
	Tree Swallow	*Tachycineta bicolor*	14
	Barn Swallow	*Hirundo rustica*	2
Chickadees	Black-capped Chickadee	*Poecile atricapillus*	31
Nuthatches	Red-breasted Nuthatch	*Sitta canadensis*	24
	White-breasted Nuthatch	*Sitta carolinensis*	7
Wrens	House Wren	*Troglodytes aedon*	3
Thrushes	Veery*	*Catharus fuscescens*	27
	American Robin	*Turdus migratorius*	39
Mockingbirds	Gray Catbird	*Dumetella carolinensis*	10
Waxwings	Cedar Waxwing	*Bombycilla cedrorum*	10
Warblers	Golden-winged Warbler*	*Vermivora chrysoptera*	5
	Nashville Warbler	*Vermivora ruficapilla*	2
	Yellow Warbler	*Dendroica petechia*	47
	Chestnut-sided Warbler	*Dendroica pensylvanica*	7
	Black-and-white Warbler	*Mniotilta varia*	14
	American Redstart	*Setophaga ruticilla*	3
	Ovenbird*	*Seiurus aurocapilla*	20
	Common Yellowthroat	*Geothlypis trichas*	14
Sparrows	Chipping Sparrow	*Spizella passerina*	31
	Song Sparrow	*Melospiza melodia*	73
	Swamp Sparrow*	*Melospiza georgiana*	25
	White-throated Sparrow*	*Zonitrichia albicollis*	5
Cardinals/grosbeaks	Rose-breasted Grosbeak*	*Pheucticus ludovicianus*	8
Blackbirds/orioles	Red-winged Blackbird	*Agelaius phoeniceus*	58
	Common Grackle	*Quiscalus quiscula*	44
	Baltimore Oriole	*Icterus galbula*	14
Finches	Purple Finch	*Carpodacus purpureus*	2
	Pine Siskin	*Carduelis pinus*	2
	American Goldfinch	*Carduelis tristis*	39
Old World Sparrows	House Sparrow	*Passer domesticus*	2

[a] % – Percent of surveyed sample sites in which a bird species occurred (N=59)

Bird Species Richness

Objectives

1. Calculate and map bird richness around the shoreline of Birch 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.

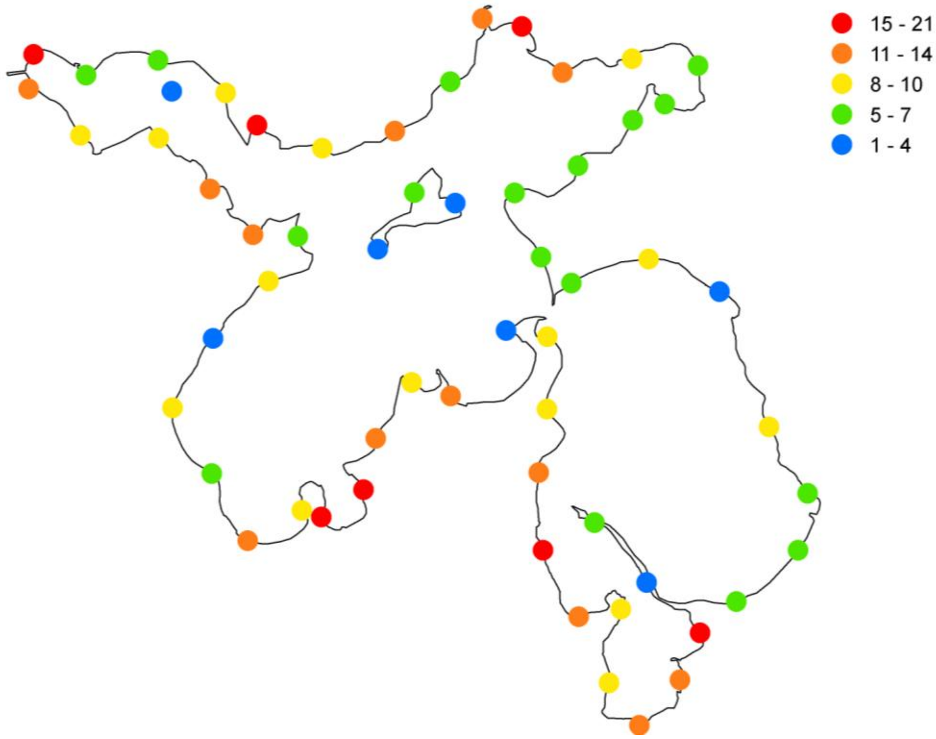
Methods

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 species diversity was 21 species at a single sample location. Twenty-four additional sites contained 10 or more species. Less than five percent of the stations contained only one species. The maximum number of species of greatest conservation need at a single sample site was five. Species richness varied along the shoreline, but was generally highest in the smaller bays (Figure 47).

Figure 47. Bird species richness (number of species per sample site) at Birch Lake sample sites, May – June 2008.



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 nest on Birch Lake

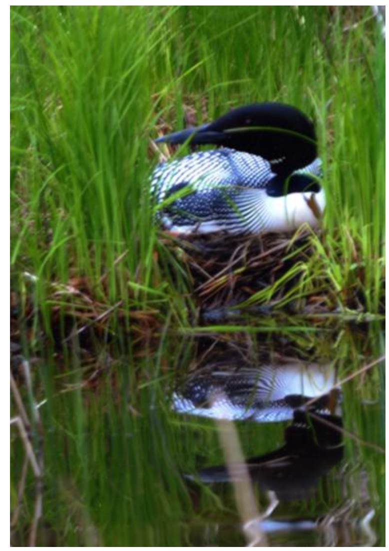


Photo by: Charles Swanum

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.

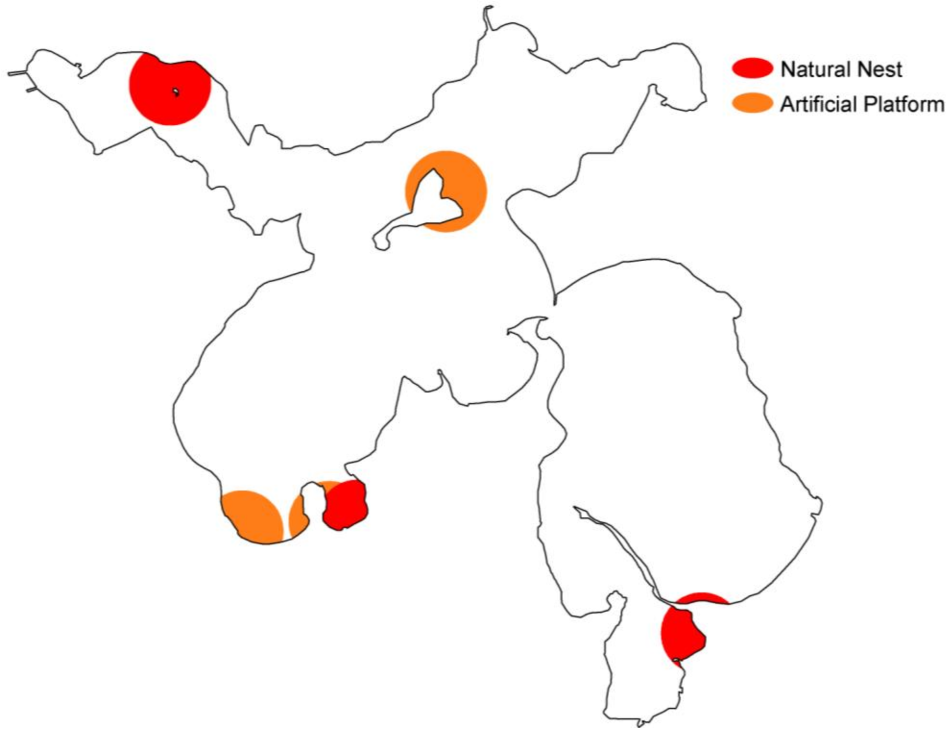
Methods

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 have been reporting on Birch Lake loons since 1980.

Results

Between 1980 and 2008, six probable nesting areas were identified on Birch Lake (Figure 48). Of these, three were natural loon nests and three were artificial platforms. All three artificial platforms used by loons and two natural nests were located in the upper basin of Birch Lake; the other natural nest was in a bay in the southern basin. In 2008, three active nests were identified on Birch Lake. All of these active nests were natural loon nests.

Figure 48. Location of natural loon nests and manmade loon platforms recorded on Birch Lake between 1980 and 2008.



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 49. Mink frog

Photo by: Jeff LeClere, www.herpnet.net

Mink frogs (Figure 49) 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 50. Green frog

Photo by: Jeff LeClere, www.herpnet.net

Green frogs (Figure 50) 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. 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 calling index was recorded. If survey conditions such as rain or wind noticeably affected listening ability, the survey was terminated.

Results

Target species

Green frogs were the most common frog species found during the surveys, detected at 18 of the 63 sites. Estimates of abundance for green frogs ranged from 1 individual (at 4 sites) to 20 – 100 individuals (at 4 sites; Figure 51). Index values were 1 or 2 (distinct individuals could be counted with no overlap of calls, to individual calls could be detected but with some overlap of calls). Surveyors heard mink frogs at 6 sites. Abundance estimates varied from 1 individual (at 8 sites) to 10 – 20 individuals (at 3 sites; Figure 52), and index values ranged from 1 to 2. Green frogs occurred in both basins of the lake, and were heard along most stretches of shoreline with the exception of the eastern shoreline of Lower Birch. Five of the six mink frog locations were in Upper Birch Lake; only one mink frog was heard in Lower Birch Lake (Figure 53). Both mink and green frog detections were closely associated with the presence of waterlily beds.

Other species

The only additional anuran species heard during the surveys was the gray treefrog (*Hyla versicolor*). This species was detected at 18 stations, and index values ranged from one to three. Other frog or toad species that may be found near Birch Lake, such as wood frog (*Rana sylvatica*), spring peeper (*Pseudacris crucifer*), chorus frog (*Pseudacris triseriata*), leopard frog (*Rana pipiens*), and American toad (*Bufo americanus*), breed earlier in the year and are not strongly associated with larger lakes.

Figure 51. Abundance of green frogs heard during Birch Lake frog surveys, June 2007.

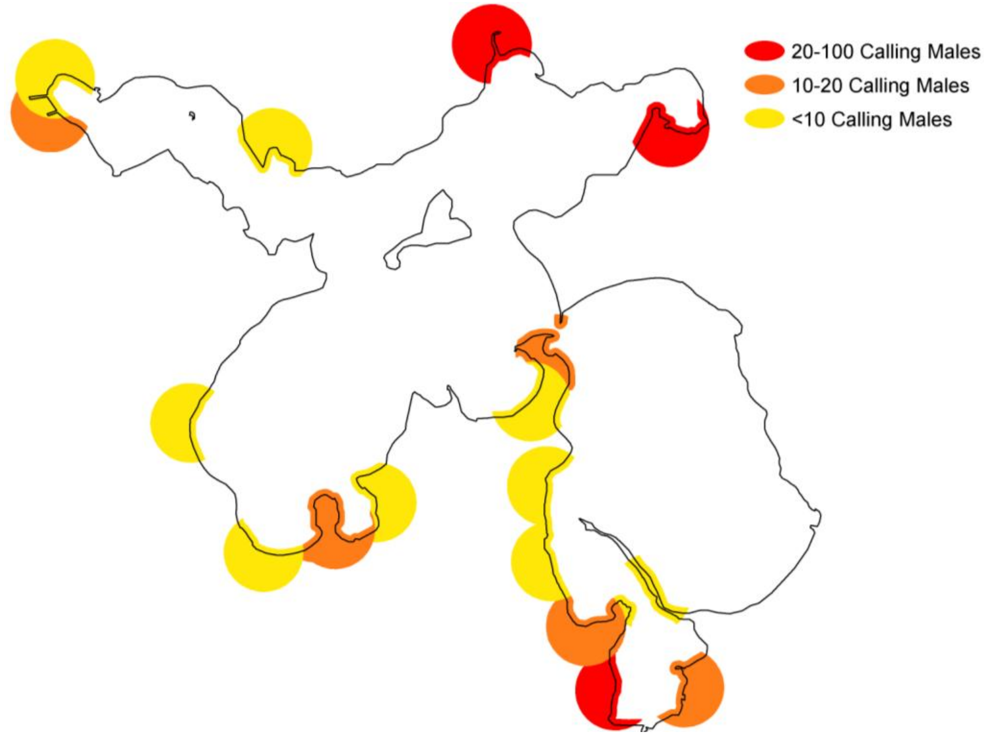


Figure 52. Abundance of mink frogs heard during Birch Lake frog surveys, June 2007.

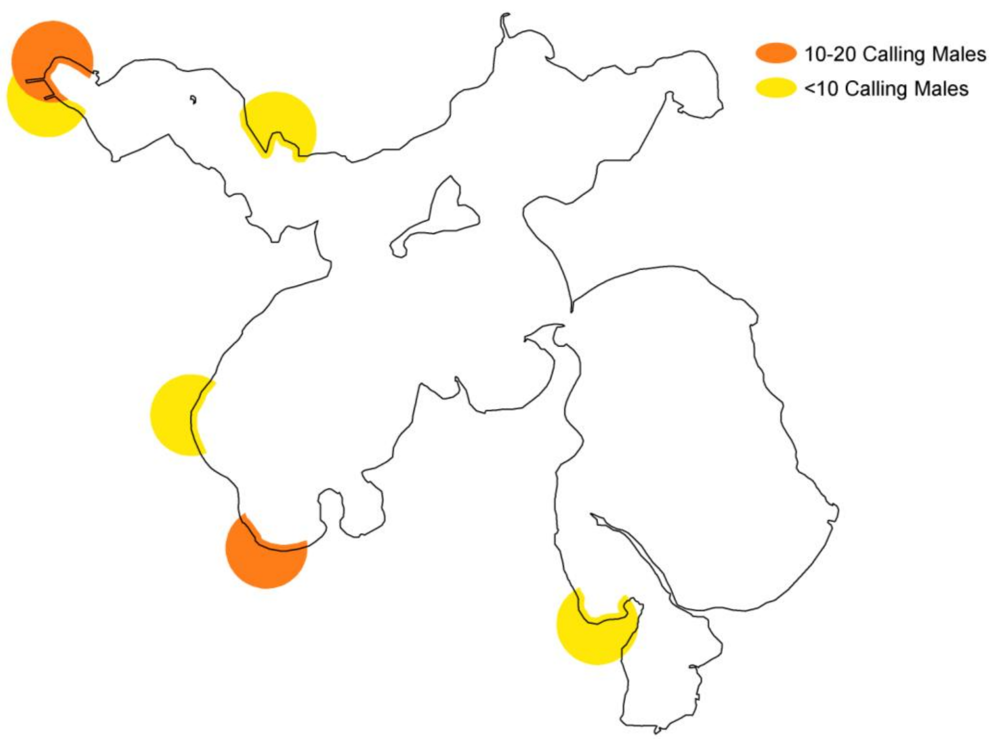
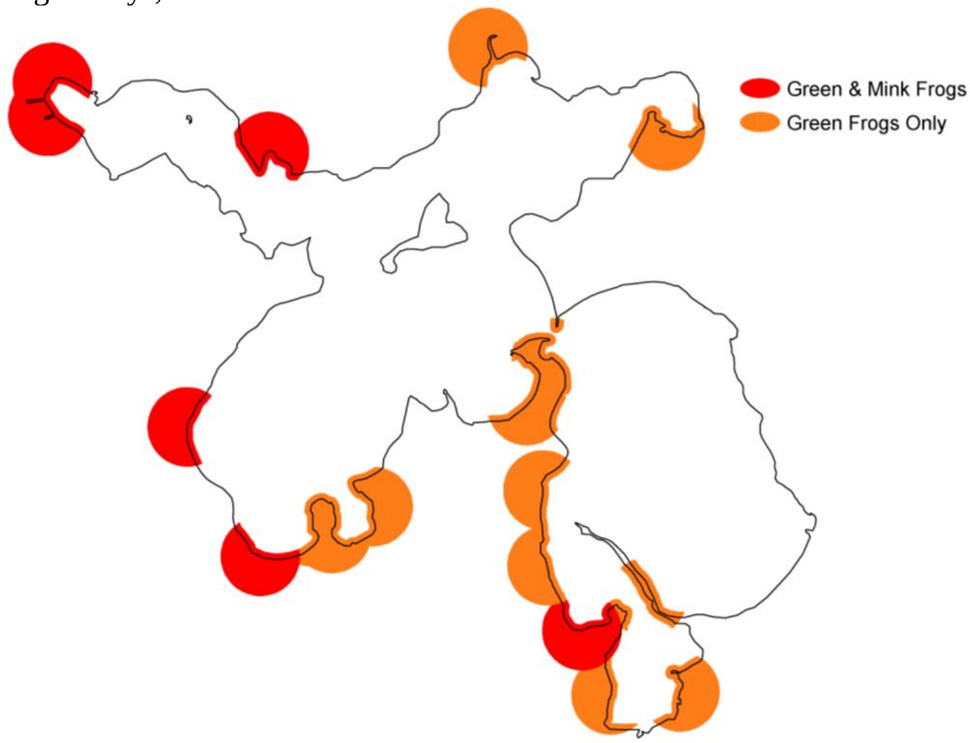


Figure 53. Distribution of mink and green frogs heard during Birch Lake frog surveys, June 2007.



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

Figure 54. Pugnose shiner

Photo by: Konrad Schmidt

Least darters (*Etheostoma microperca*; Figure 55) 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 55. Least darter

Photo by: Konrad Schmidt

Longear sunfish (*Lepomis megalotis*; Figure 56) 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 56. 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 SGCNs.

Blackchin shiners (*Notropis heterodon*; Figure 57) 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 57. Blackchin shiner

Photo by: Konrad Schmidt

Blacknose shiners (*Notropis heterolepis*; Figure 58) 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 58. Blacknose shiner

Photo by: Konrad Schmidt

Banded killifish (*Fundulus diaphanus*; Figure 59) 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 59. 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. All species captured using the different sampling methods were identified and counted. Target fish species included 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 of a sampling area that contained submerged aquatic vegetation.

Results

Only one fish species of greatest conservation need was identified at Birch Lake. Surveyors found four pugnose shiners at three sampling stations (Figure 60). Least darters and longear sunfish were not found at Birch Lake. All three proxy species were documented during the surveys (Figure 61). Blacknose shiners were by far the most abundant proxy species. Surveyors counted 71 individuals at 10 sampling locations. Banded killifish were less abundant; 4 sites contained 15 individuals. Blackchin shiners were found least frequently, with four sites containing a total of four specimens.

Species of greatest conservation need and their proxies were found in sites with varying substrate types. They were found equally in hard bottom substrates, such as sand and gravel, and soft bottom substrates, particularly muck. Sites containing species of greatest conservation need or proxies had similar amounts of submerged aquatic vegetation than those without.

The presence of several sensitive fish species (pugnose shiner, blackchin shiner, blacknose shiner, banded killifish) indicates minimal disturbance in several areas of the lake. However, because populations of these species are vulnerable across their ranges, continued monitoring and maintenance of these shoreline habitats is 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. These conditions will also benefit multiple game fishes, including bass, muskellunge, and northern pike.

In total, 27 different species were identified at the 38 sampling stations (Table 4). Bluegills were most abundant, with surveyors counting over 600 specimens. Yellow bullhead, rock bass, and mimic shiners were also present in numbers greater than 100. Seven fish species not previously documented in the lake were collected for this survey, bringing the total observed fish community to 30 species. Newly documented species in Birch Lake were central mudminnow, common shiner, golden shiner, green sunfish, Iowa darter, pugnose shiner, and tadpole madtom. Species richness varied among the sites. Two sites contained 14 species, and 90 percent of the surveyed sites had five or more species.

Figure 60. Distribution of fish species of greatest conservation need documented during Birch Lake fish surveys, May – June 2007.

Figure 61. Distribution of proxy species documented during Birch Lake fish surveys, May – June 2007.

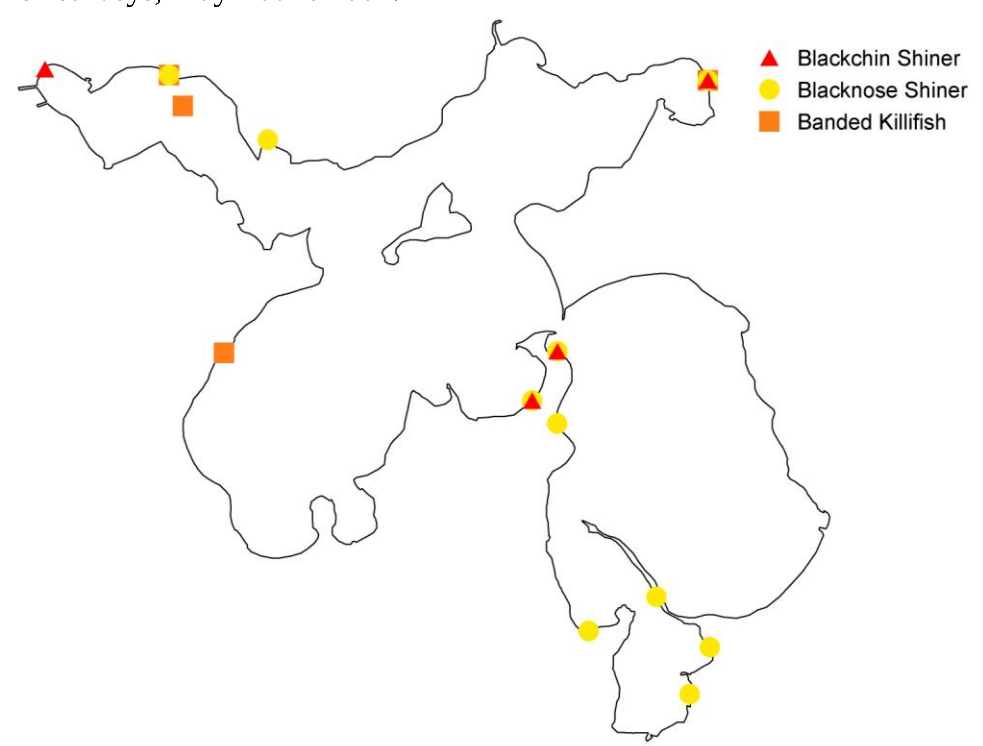


Table 4. Abundance and frequency of fish species identified during Birch Lake fish surveys, May – June 2007. * denotes species of greatest conservation need

Description	Common Name	Scientific Name	#[a]	%[b]
Bowfins	Bowfin	*Amia calva*	4	10
Minnows/carps	Common shiner	*Luxilus cornutus*	1	2
	Golden shiner	*Notemigonus crysoleucas*	67	12
	Pugnose shiner*	*Notropis anogenus*	4	7
	Blackchin shiner	*Notropis heterodon*	4	10
	Blacknose shiner	*Notropis heterolepis*	71	25
	Spottail shiner	*Notropis hudsonius*	1	2
	Mimic shiner	*Notropis volucellus*	145	22
	Bluntnose minnow	*Pimephales notatus*	124	44
Suckers	White sucker	*Catostomus commersonii*	2	5
North American freshwater catfishes	Black bullhead	*Ameiurus melas*	3	5
	Yellow bullhead	*Ameiurus natalis*	401	80
	Brown bullhead	*Ameiurus nebulosus*	26	22
	Tadpole madtom	*Noturus gyrinus*	2	5
Pikes	Northern pike	*Esox lucius*	15	24
Mudminnows	Central mudminnow	*Umbra limi*	336	31
Killifishes	Banded killifish	*Fundulus diaphanus*	15	10
Sunfishes	Rock bass	*Ambloplites rupestris*	227	71
	Green sunfish	*Lepomis cyanellus*	3	2
	Pumpkinseed	*Lepomis gibbosus*	77	71
	Bluegill	*Lepomis macrochirus*	603	90
	Largemouth bass	*Micropterus salmoides*	27	29
	Black crappie	*Pomoxis nigromaculatus*	45	54
Perches	Iowa darter	*Etheostoma exile*	17	27
	Johnny darter	*Etheostoma nigrum*	12	20
	Yellow perch	*Perca flavescens*	18	15
	Walleye	*Sander vitreus*	8	17

[a] # – Total number of individuals found

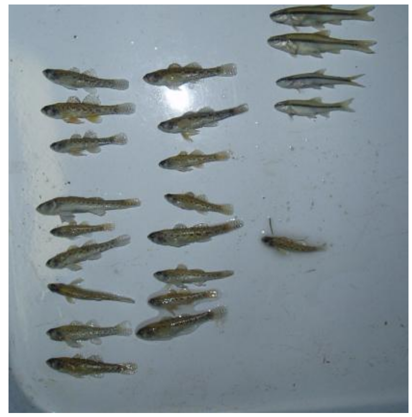
[b] % – Percent of surveyed sample sites in which a species occurred (N=38)

Aquatic Vertebrate Richness

Objectives

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

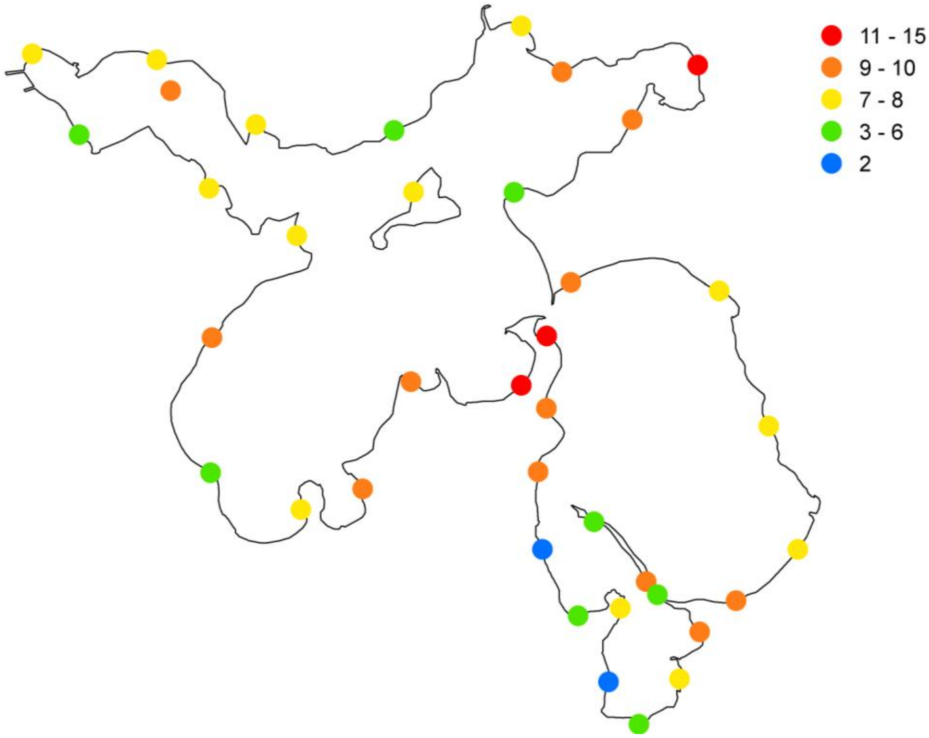
Methods

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.

Results

Species richness varied among the sites. Maximum aquatic vertebrate species richness at a sampling station was 15 species, and six stations had 10 or more species (Figure 62). The majority of the documented species were fish, although painted turtles, snapping turtles, and green frogs were also identified. All of the aquatic vertebrate species identified during the surveys were native.

Figure 62. Aquatic vertebrate species richness (number of species per sample site) at Birch Lake sample sites, May – June 2007.



Other Rare Features

Objectives

1. Map rare features occurring within the extended state-defined shoreland area of Birch 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

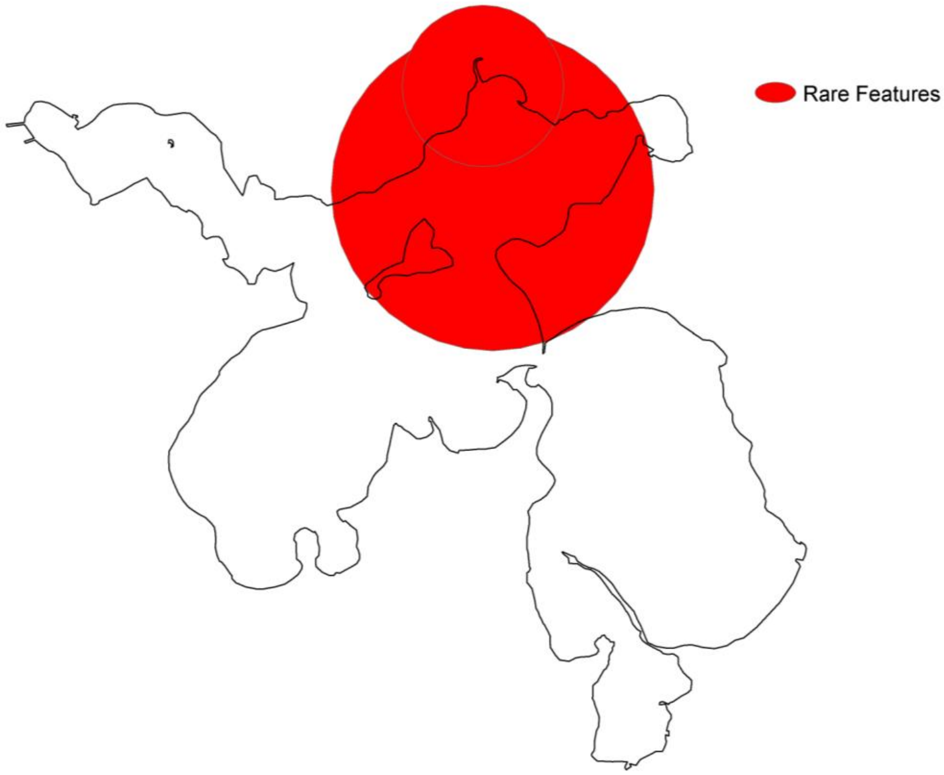
Researchers obtained locations of rare features from the Rare Features Database. Only "listed" plant and animal species (Federal or State endangered, threatened, or special concern) were considered in this project; non-listed unique plant species were included in the "Unique Plant Species" section of 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

Two rare features have been identified on Birch Lake (Figure 63). These features are a bird species of Special Concern and reptile species of 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 Birch Lake, practices that maintain good water quality and the integrity of the shoreline will be beneficial to all species involved.

Figure 63. Natural Heritage Database rare features (Federal or State-listed endangered, threatened, or special concern species) located within 1320 feet of Birch Lake shoreline.



 Rare features data have been provided by the Division of Ecological Resources, Minnesota Department of Natural Resources (MNDNR) and were current as of February 15, 2009. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Bay Delineation

Objectives

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.

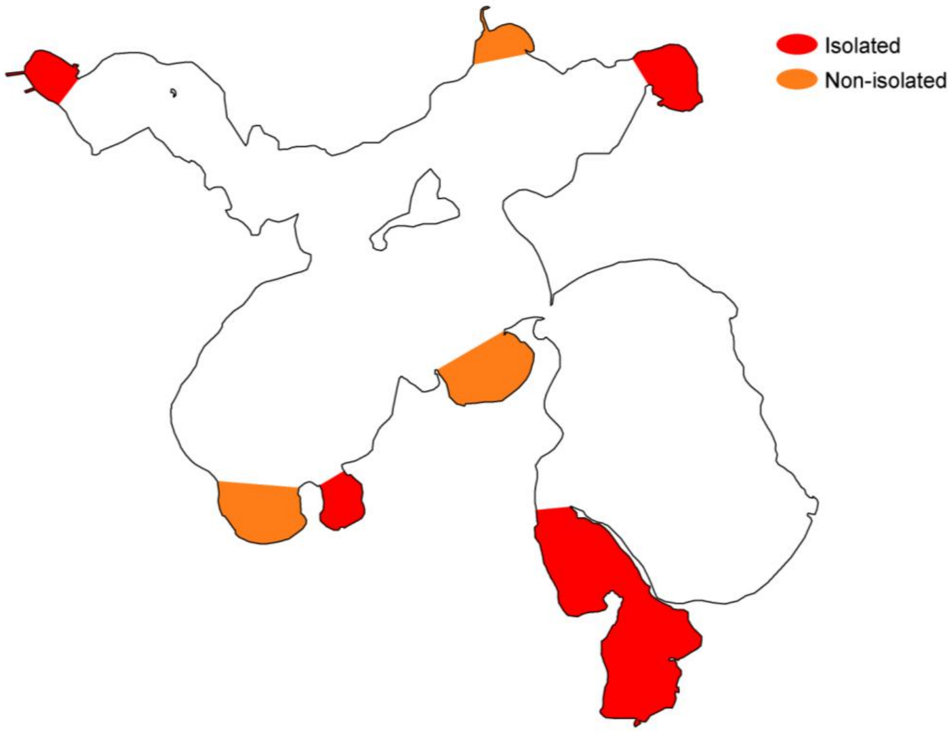
Methods

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 identified 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

Four isolated bays and three non-isolated bays were identified on Birch Lake (Figure 64). All three non-isolated bays and three of the isolated bays are located in Upper Birch; only one (isolated) bay was identified in Lower Birch. Several bird and fish species of greatest conservation need, as well as mink and green frogs, were located mainly within or near delineated bays. The largest beds of emergent and floating-leaf vegetation also occurred within the bays.

Figure 64. Location of isolated and non-isolated bays in Birch 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 for each variable 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 65). 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 66). 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 67).

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

Variable	Score	Criteria
Wetlands	3	> 25% of analysis window is in wetlands
	2	12.5 – 25% is in wetlands
	1	< 12.5% is in wetlands
	0	No wetlands present
Hydric Soils	3	> 25% of analysis window is 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

Table 5, continued.

Variable	Score	Criteria
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 Plants 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 (i.e., > 50% of points within analysis window consisted 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 SGCN within analysis window
	2	Presence of 2 SGCN
	1	Presence of 1 SGCN
	0	No SGCNs present
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 loon nest on artificial platform
	0	No loon nesting observed
Frogs	3	Presence of both mink and green frogs within analysis window
	2	Presence of mink or green frogs
	0	Neither mink nor green frogs present

Table 5, continued.

Variable	Score	Criteria
Fish	3	Presence of one or more SGCN within analysis window
	2	Presence of one or more proxy species
	0	Neither SGCN nor proxies present
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 a Natural Heritage feature
	0	No Natural Heritage feature present
Bays	3	Protected or isolated bay within analysis window
	2	Non-protected or non-isolated bay
	0	Not a distinctive bay

Figure 65. Total score layer created by summing scores of all 15 variables. Highest total scores represent most sensitive areas of shoreline.

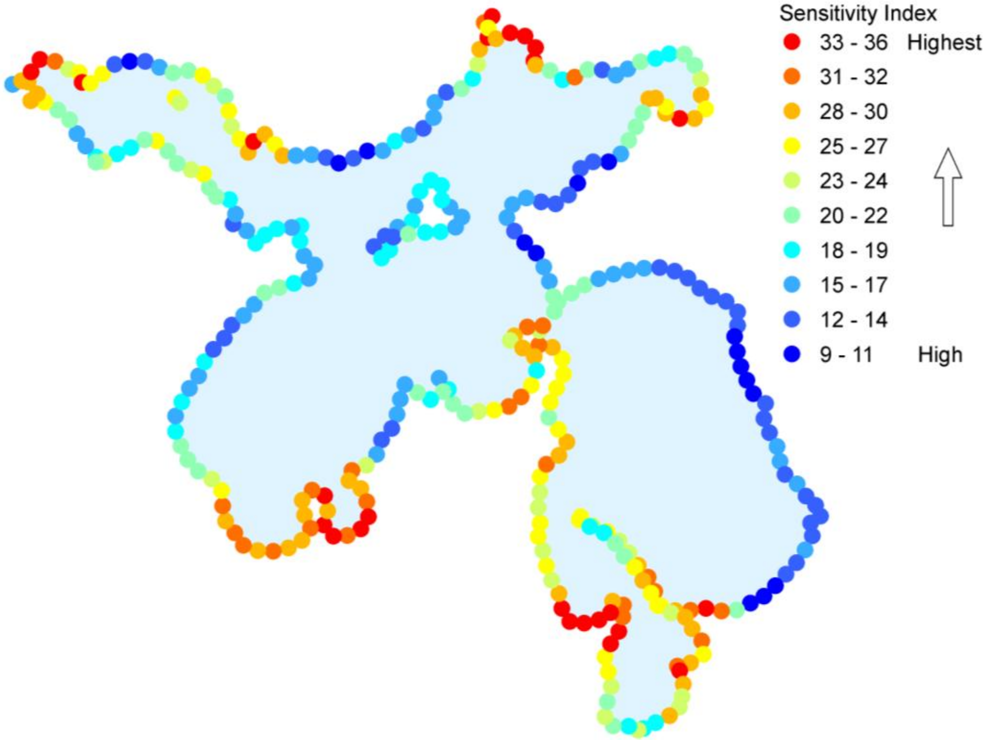


Figure 66. GIS-identified clusters of points with similar total scores. Red areas are those with high scores (i.e., areas of highly sensitive shoreland)

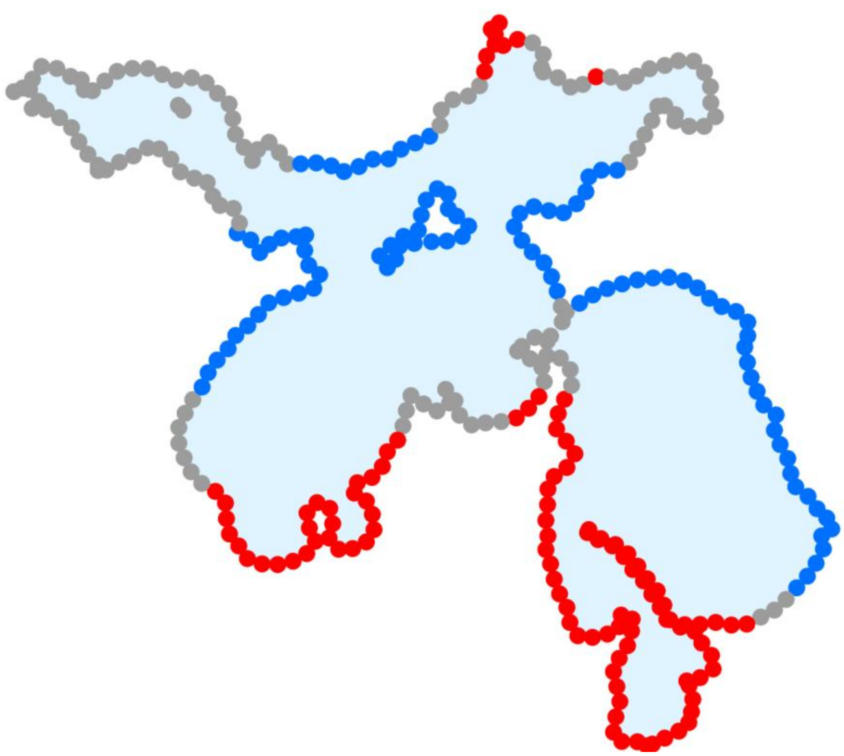
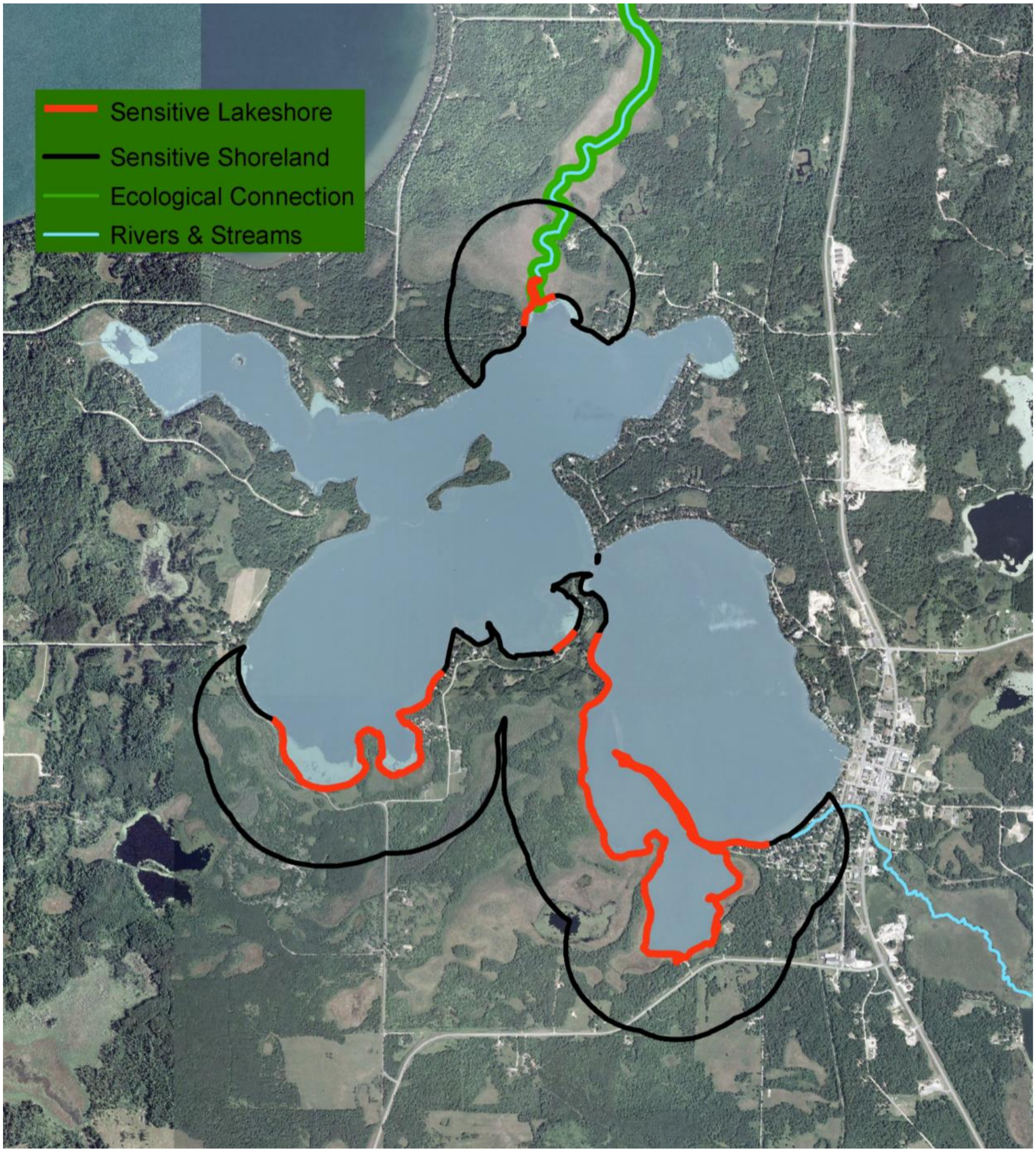


Figure 67. The Birch Lake sensitive lakeshore areas identified by the ecological model, and an ecological connection.



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. In Birch Lake, the Boy River, as it connects with Ten Mile

Lake, was identified as a potential ecological connection. This stretch of river filters water coming out of Ten Mile Lake, and provides critical fish and wildlife habitat for both lakes. Depending on the existing shoreland classification of this river, the County may use this recommendation to consider reclassifying to a more protective class.

Other Areas of Ecological Significance

There are additional aquatic areas of ecological significance in Birch 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 Birch Lake, sites containing a high diversity of native submerged plants are considered sites of ecological significance. In many lakes, plant diversity decreases with increasing water depth. But, in Birch Lake, there are broad, off-shore zones containing 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.

Other Birch Lake sites of ecological significance are emergent and floating-leaf plant beds that may occur outside of the 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

Both Upper Birch and Lower Birch included sections of shoreline that supported a great diversity of plant and wildlife species, including species of greatest conservation need. These areas also contained critical habitat, such as wetlands and emergent and floating-leaf vegetation. 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 on the nearby shorelands have significant negative effects on many species. Fragmented habitats often contain high numbers of invasive, non-native plants and animals that may outcompete 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 Boy River between Birch Lake and Ten Mile Lake is also an important part of the lake ecosystem. It provides connectivity between Birch Lake and nearby habitat. 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 Birch Lake, and the value of the lake itself.

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Appendix 1. Shoreline plants found in Birch Lake, 2006 – 2008. *Indicates species is not native to Minnesota.

Description	Common Name	Scientific Name
Upland Trees, Shrubs and Vines	Balsam fir	*Abies balsamea*
	Juneberry	*Amelanchier* sp.
	Birch seedling	*Betula papyrifera*
	Green ash seedling	*Fraxinus americana*
	Virginia creeper	*Parthenocissus* sp.
	White spruce seedling	*Picea glauca*
	Red pine	*Pinus resinosa*
	White pine	*Pinus strobus*
	Black cherry sapling	*Prunus serotina*
	Oak seedling	*Quercus rubra*
	Staghorn sumac	*Rhus hirta*
	Gooseberry	*Ribes* sp.
	Raspberry	*Rubus* sp.
	Wild rose	*Rosa* sp.
	Basswood	*Tilia americana*
	Elm seedling	*Ulmus* sp.
	Poison ivy	*Toxicodendron* sp.
	Wild grape	*Vitis* sp.
Wetland shrubs	Alder	*Alnus incana*
	Bog birch	*Betula pumila*
	Leatherleaf	*Chamaedaphne calyculata*
	Red-osier dogwood	*Cornus sericea*
	Willow seedlings	*Salix* spp.
	White cedar seedling	*Thuja occidentalis*
Grasses and Sedges	Canada bluejoint grass	*Calamagrostis canadensis*
	Sedges	*Carex* spp.
	Buxbaum's sedge	*Carex buxbaumii*
	Bottlebrush sedge	*Carex hystricina*
	Wiregrass sedge	*Carex oligosperma*
	Pennsylvania sedge	*Carex pensylvanica*
	Wild rye	*Elymus* sp.
	Northern manna-grass	*Glyceria borealis*
	Reed canary grass	*Phalaris arundinacea**
	Bluegrass	*Poa* sp.
	Kentucky bluegrass	*Poa pratensis**

Appendix 1, continued.

Description	Common Name	Scientific Name
Upland wildflowers	Hog peanut	*Amhicarpa bracteata*
	Columbine	*Aquilegia canadensis*
	Wild sarsaparilla	*Aralia nudicaulis*
	Aster	*Aster* sp.
	Purple bellflower	*Campanula rotundifolia*
	Thistle	*Cirsium* sp.
	Wild strawberry	*Fragaria virginiana*
	Wild pea	*Lathyrus venosa*
	Canada mayflower	*Maianthemum canadense*
	Sweet clover	*Melilotus* sp.*
	Evening nightshade	*Oenothera biennis*
	Sweet cicily	*Osmorhiza claytonii*
	Pyrola	*Pyrola* sp.
	Goldenrod	*Solidago* sp.
	Dandelion	*Taraxacum* sp.*
	Meadow rue	*Thalictrum* sp.
	Star flower	*Trientalis borealis*
	Violet	*Viola* sp.
Wetland wildflowers	Swamp milkweed	*Asclepias incarnata*
	White aster	*Aster cf. borealis*
	Beggarticks	*Bidens* sp.
	White bellflower	*Campanula aparinoides*
	Bulb-bearing water hemlock	*Cicuta bulbifera*
	Spotted Joe-Pye weed	*Eutrochium maculatum*
	Bedstraw	*Galium* sp.
	Gentian	*Gentiana andrewsii*
	Jewelweed	*Impatiens capensis*
	Blue flag iris	*Iris versicolor*
	Water horehound	*Lycopus uniflorus*
	Tufted loosestrife	*Lysimachia thyrsiflora*
	Purple loosestrife	*Lythrum salicaria**
	Wild mint	*Mentha arvensis*
	Smartweed	*Persicaria* sp.
	False dragon's head	*Physostegia virginiana*
	Swamp five finger	*Potentilla palustris*
	Water dock	*Rumex* sp.
	Marsh skullcap	*Scutellaria galericulata*
	St. John's wort	*Triadenum fraseri*
	Stinging nettle	*Urtica dioica*
Ferns	Lady fern	*Athyrium felix-femina*
	Horsetail	*Equisetum* sp.
	Marsh fern	*Thelypteris palustris*

Nomenclature follows MNTaxa 2009.

Appendix 2. Bird species list. Includes all species within Birch Lake and shoreland recorded during surveys and casual observation, May – June 2008.

Common Name	**Scientific Name**
Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Ring-necked Duck	*Aythya collaris*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Common Loon	*Gavia immer*
Double-crested Cormorant	*Phalacrocorax auritus*
American Bittern	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Cooper's Hawk	*Accipiter cooperii*
Broad-winged Hawk	*Buteo platypterus*
Killdeer	*Charadrius vociferus*
Spotted Sandpiper	*Actitis macularius*
Ring-billed Gull	*Larus delawarensis*
Common Tern	*Sterna hirundo*
Mourning Dove	*Zenaida macroura*
Barred Owl	*Strix varia*
Common Nighthawk	*Chordeiles minor*
Ruby-throated Hummingbird	*Archilochus colubris*
Belted Kingfisher	*Megaceryle alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Wood-Pewee	*Contopus virens*
Alder Flycatcher	*Empidonax alnorum*
Eastern Phoebe	*Sayornis phoebe*
Eastern Kingbird	*Tyrannus tyrannus*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*

Appendix 2, continued.

Common Name	Scientific Name
Purple Martin	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapillus*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
House Wren	*Troglodytes aedon*
Veery	*Catharus fuscescens*
American Robin	*Turdus migratorius*
Gray Catbird	*Dumetella carolinensis*
Cedar Waxwing	*Bombycilla cedrorum*
Golden-winged Warbler	*Vermivora chrysoptera*
Nashville Warbler	*Vermivora ruficapilla*
Yellow Warbler	*Dendroica petechia*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Black-and-white Warbler	*Mniotilta varia*
American Redstart	*Setophaga ruticilla*
Ovenbird	*Seiurus aurocapilla*
Common Yellowthroat	*Geothlypis trichas*
Chipping Sparrow	*Spizella passerina*
Song Sparrow	*Melospiza melodia*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Baltimore Oriole	*Icterus galbula*
Purple Finch	*Carpodacus purpureus*
Pine Siskin	*Carduelis pinus*
American Goldfinch	*Carduelis tristis*
House Sparrow	*Passer domesticus*