Final Report
Sensitive Lakeshore Survey
Pleasant Lake (11-0383-00)
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

Prepared by
Kristin Thompson, Nongame Wildlife Biologist
Donna Perleberg, Aquatic Plant Ecologist
Stephanie Loso, Aquatic Biologist

Project manager
Paul Radomski

Surveys conducted by
Donna Perleberg, Aquatic Plant Ecologist
Paul Radomski, Project Manager
Kristin Thompson, Nongame Wildlife Biologist
Kevin Woizeschke, Nongame Wildlife Technician
Stephanie Loso, Aquatic Biologist/Intern
Lucas Wandrie, Natural Resources Specialist/Intern
Jesse Amo, Intern
Matthew Brinkman, Intern
Rachel Bulman, Intern
Corey Carpentier, Intern
Michael Kobberdahl, Intern
Kevin Mortenson, Intern
Brent Vacinek, Intern

Rare plant searches (2008): Karen Myhre, Botanist, Minnesota County Biological Survey Program

GIS technical guidance
Kevin Woizeschke, Nongame Wildlife Technician

Funding support:
Funding for this report was provided by the State Wildlife Grants Program, Game and Fish Funds, Heritage Enhancement Funds, and by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

How to cite this document:
Thompson, K., D. Perleberg, and S. Loso. 2009. Final report on the sensitive lakeshore survey for Pleasant Lake (11-0383-00), Cass County, MN. Division of Ecological Resources, Minnesota Department of Natural Resources. 75 pp.

Alternative format available upon request.

Executive Summary

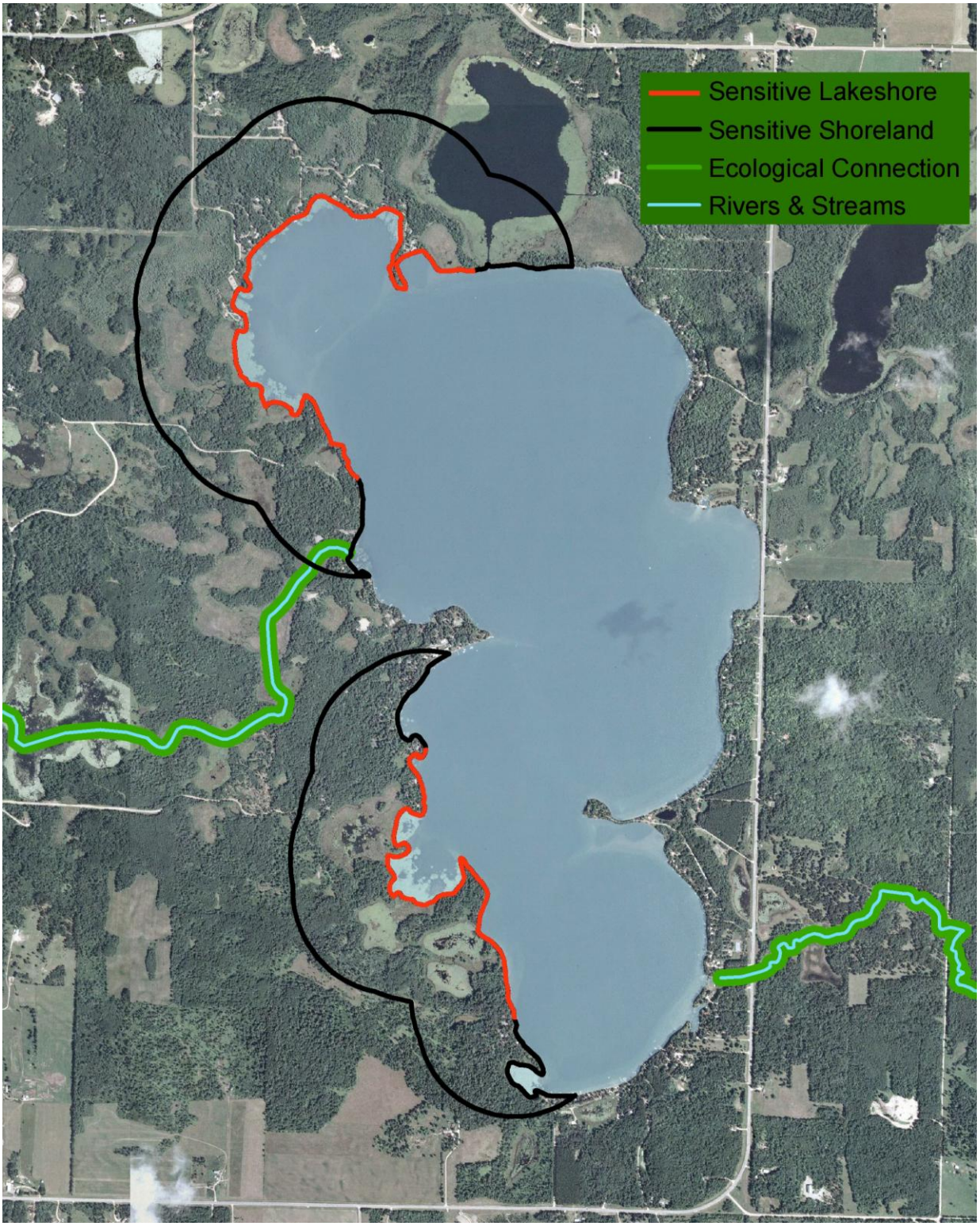
Plant surveyors documented 46 native aquatic plant taxa within Pleasant Lake. These aquatic plants occurred around the entire shoreline of Pleasant Lake and included 11 emergent, five floating-leaved, and 30 submerged and free-floating taxa. Plants were found to a water depth of 20 feet. This vegetated zone includes about two-thirds of the lake and within this area 88 percent of the survey sites contained vegetation. Surveyors mapped over 25 acres of waterlilies and seven acres of emergent plants such as wild rice and bulrush. Six unique plant species were documented during the surveys.

Four fish species not previously recorded in Pleasant Lake were identified during the fish surveys. These newly documented species were central mudminnow, mottled sculpin, pugnose shiner, and tadpole madtom. Twenty-nine species were identified during the nongame fish surveys, bringing the total observed historical fish community to 35 species. Both mink frogs and green frogs were documented on Pleasant Lake.

Surveyors documented 73 species of birds, including 13 species of greatest conservation need. Song sparrows were the most abundant bird species overall, whereas common loons were the most commonly detected species of greatest conservation need. Bird species were distributed both within the bays and along the shoreline of the main basin.

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 as it enters and exits Pleasant 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 data. 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 of 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 Pleasant Lake sensitive lakeshore areas.

Lake Description

Pleasant Lake (DOW 11-0383-00) is located near the city of Hackensack in Cass County, north-central Minnesota (Figure 1). Pleasant Lake is one of several lakes connected by the Boy River, which originates in Ten Mile Lake and flows through Pleasant Lake before continuing north to Leech Lake (Figure 2).

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

Pleasant Lake has a surface area of slightly over 1000 acres, making it the 18th largest lake in Cass County. It has approximately 6.25 miles of shoreline. The maximum depth of Pleasant Lake is 72 feet, but nearly 40 percent of the lake is less than 15 feet deep (Figure 3).

The shoreline of Pleasant Lake is primarily forested with a large wetland on the north end. Much of the shoreline is privately owned and developed with residential homes. There is a public boat launch on the northwest corner of the lake.

The Minnesota DNR has classified Pleasant Lake as a Class 27 lake; lakes in the class are very large, deep, and regularly shaped (MN DNR 2005). The average Secchi depth (which measures water transparency) between 1975 and 2008 was approximately 15 feet, indicating relatively high water clarity (MPCA 2008). Nutrient enrichment is moderate in this hardwater, mesotrophic lake. The Minnesota DNR Section of Fisheries manages the lake primarily for walleye and northern pike (MN DNR 2005).

Figure 2. Features of Pleasant Lake.

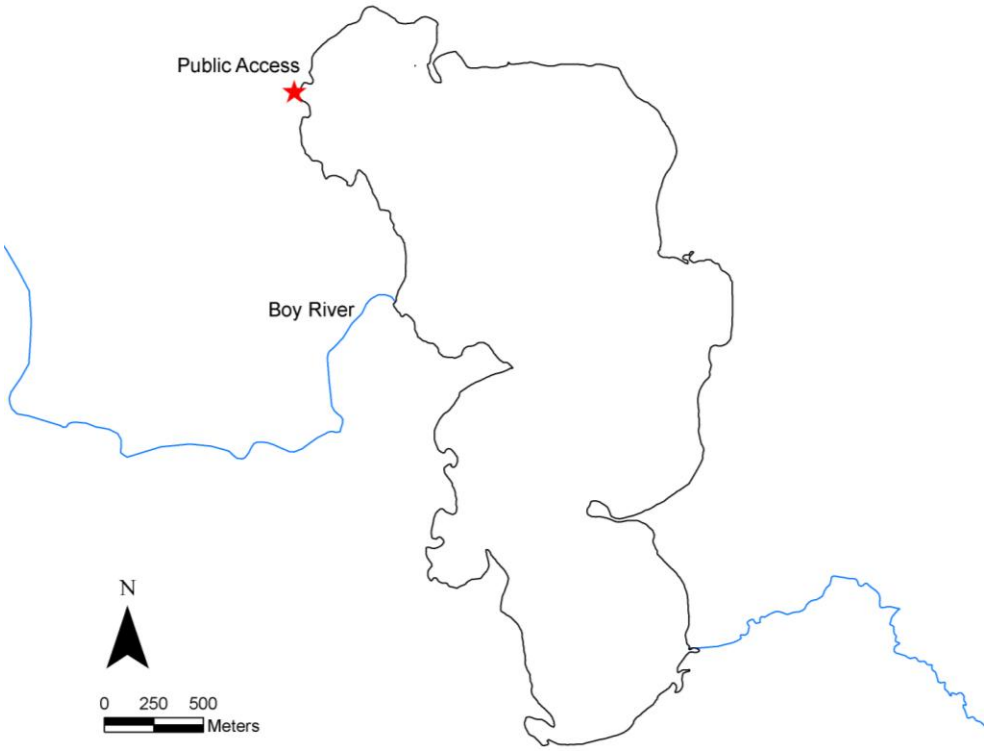
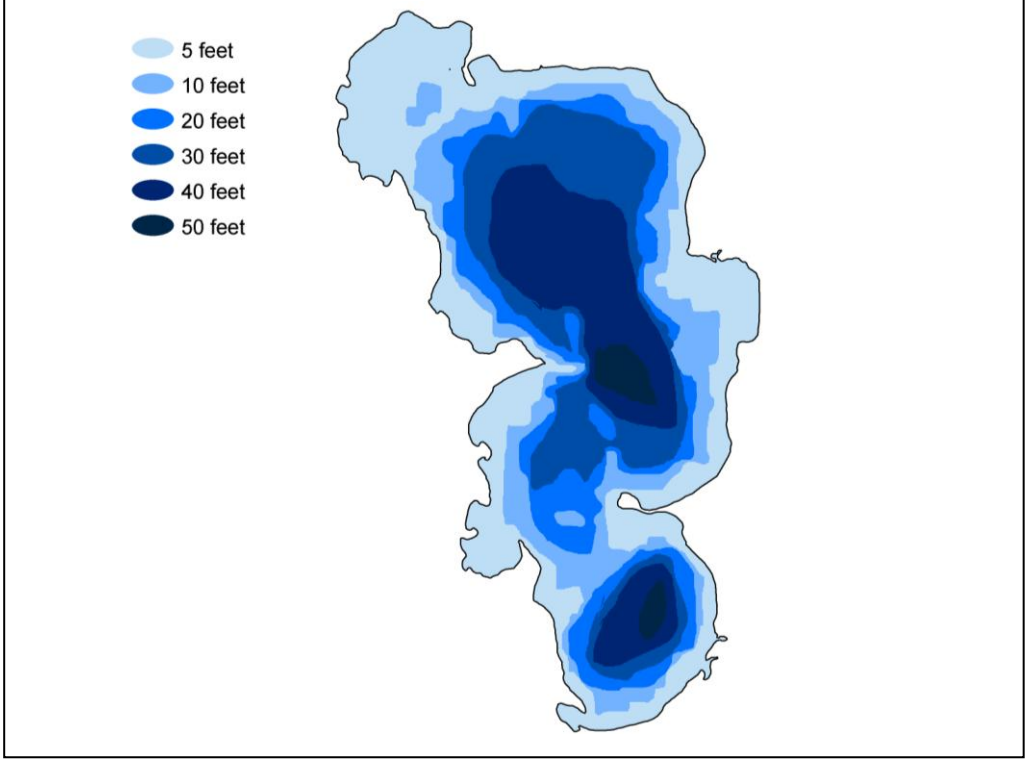


Figure 3. Depth contours of Pleasant Lake (based on 2007 data).



I. Field Surveys and Data Collection

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

Pugnose shiner photo courtesy of Konrad Schmidt

Wetlands

Objectives

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

Introduction

Emergent cattail marsh and wild rice-waterlily mat at edge of Bass Lake (north end of Pleasant Lake wetland)

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

Results

Approximately 260 acres, or just over 20 percent of the Pleasant Lake shoreland (the area within 1320 feet of the shoreline), are described as wetlands by NWI. Wetlands were scattered along much of the shoreline of Pleasant Lake, with the greatest concentration in the northwestern corner of the lake (Figure 4).

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

The largest wetlands can be described as wetland shrubland (MN DNR 2003) or palustrine scrub shrub systems (Cowardin et al. 1979), dominated by deciduous or evergreen shrubs (Figure 5). Marsh systems (MN DNR 2003) or emergent wetlands (Cowardin et al. 1979) were also common and are characterized by herbaceous, emergent wetland vegetation such as cattails and sedges. The water regime of these wetlands included saturated, seasonally flooded, and semi-permanently flooded soils. Several open water wetlands with floating-leaf plant beds were also present; the largest is Bass Lake on the north end of Pleasant Lake. Portions of these open water sites are intermittently exposed during low water.

Figure 5. Wetland shrubland border between Pleasant Lake and a small open water wetland.

Hydric Soils

Objectives

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

Temporarily exposed substrate associated with Pleasant Lake emergent wetland

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.

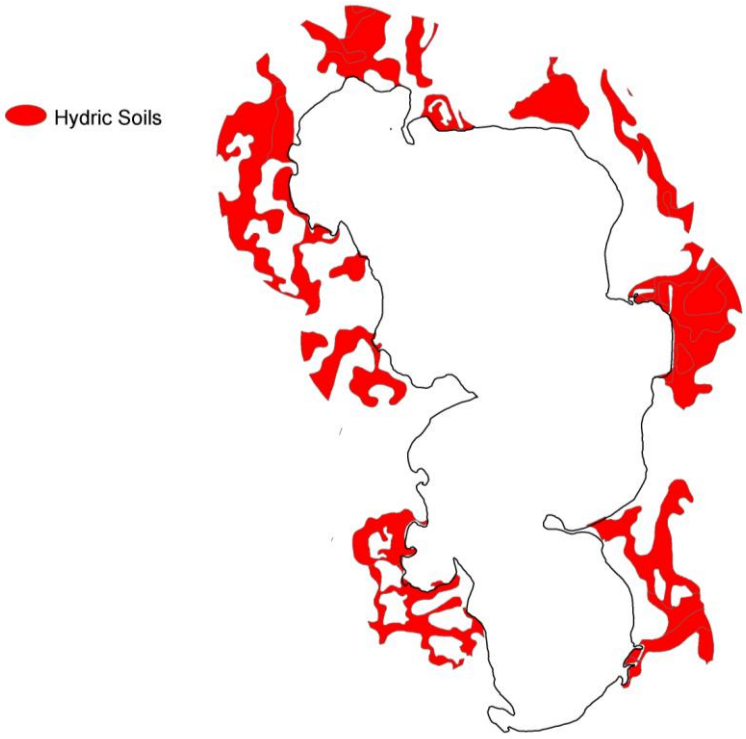
Methods

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 Pleasant Lake (Figure 6), and totaled over 350 acres within the shoreland district. Large areas of hydric soils were located along much of the shoreline of Pleasant Lake, with the exception of the southernmost tip of the lake. Specific hydric soils types varied, from muck to loamy sand to peat. Although some of the soils had low to moderately low organic matter content, most had very high organic matter content and were very poorly drained.

Figure 6. Hydric soils within 1320 feet of Pleasant Lake shoreline.



Plant Surveys

Objectives

1. Record presence and abundance of all aquatic plant taxa
2. Describe distribution of vegetation in Pleasant 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 Pleasant Lake. Forty-six native aquatic plant species were recorded including 11 emergent, five floating-leaved and 30 submerged and free-floating taxa.

Submerged plants occurred to a depth of 20 feet but were most common in the shore to 15 feet depth zone, where 96 percent of the sample sites contained vegetation. Common submerged plants included flat-stem pondweed (*Potamogeton zosteriformis),* muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), northern watermilfoil (*Myriophyllum sibiricum*), Canada waterweed (*Elodea canadensis*), bushy pondweed (*Najas flexilis*) and Illinois pondweed (*Potamogeton illinoensis).*

Within the shore to five feet depth zone, 15 percent of the sample sites contained at least one emergent or floating-leaf plant. Floating-leaf plants, including white waterlily (*Nymphaea odorata*) and yellow waterlily (*Nuphar variegata*), occupied about 25 acres and were mostly located in protected bays of the west and north shores. Four acres of wild rice (*Zizania palustris*) were mapped at the Boy River inlet on the west shore and smaller beds of bulrush (*Schoenoplectus acutus)* occurred at scattered locations along the east and west shores.

Unique aquatic plants documented during the surveys included humped bladderwort (*Utricularia gibba*), lesser bladderwort (*U. minor*), flat-leaved bladderwort (*U. intermedia*), mare's tail (*Hippuris vulgaris*), water bulrush (*Schoenoplectus subterminalis*), and water arum (*Calla palustris*).

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 Pleasant 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 produce flowers above or below the water surface, as well as non-flowering plants such as large algae and mosses.

Pondweeds (*Potamogeton* spp. and *Stuckenia* spp.) are one of the largest groups of submerged plants in Minnesota lakes. These plants are rooted perennials and their rhizomes may form mats on the lake bottom that help consolidate soil (Arber 1920). Pondweeds have opposite, entire leaves and form "cigar-shaped" flowers that emerge above the water surface. Many pondweed species overwinter as hardy rhizomes while other species produce tubers, specialized winter buds, or remain "evergreen" under the ice. Seeds and tubers of pondweeds are an important source of waterfowl food (Fassett 1957). The foliage of pondweeds is food for a variety of marsh birds, shore birds and wildlife and provides shelter, shade and spawning sites for a range of fish species (Borman et al. 2001). Pondweeds inhabit a wide range of aquatic sites and species 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.

Flat-stem pondweed (*Potamogeton zosteriformis*; Figure 7) is a perennial plant that is anchored to the lake bottom by underground rhizomes. It is named for its flattened, grass-like leaves. Depending on water clarity and depth, these plants may reach the water surface and produce flowers that extend above the water. These pondweeds over-winter by winter buds.

Figure 7. Flat-stem pondweed

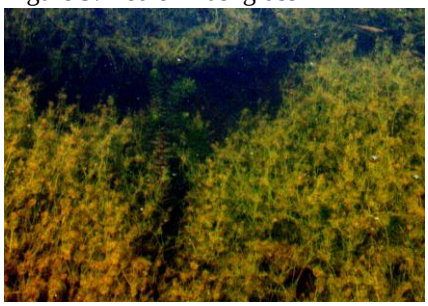
Illinois pondweed (*Potamogeton illinoensis*; Figure 8) is a rooted perennial plant with broad leaves. It is one of several pondweeds that are often called "cabbage" plants by anglers. These plants are primarily submerged but many will form floating leaves in shallower water. The fruits of pondweeds are a favorite duck food and the broad leaves provide food and shelter for fish. Illinois pondweed is found scattered throughout central Minnesota (Ownbey and Morley 1991).

Figure 8. Illinois pondweed

Photo by: Allison Fox, U. of Florida © 1996

Muskgrass (*Chara* sp.; Figure 9) is a large algae that is common in many hardwater Minnesota lakes. This plant does not form flowers or true leaves, stems or roots. Muskgrass grows entirely submerged, is often found at the deep edge of the plant zone (Arber 1920), and may form thick "carpets" on the lake bottom. These beds provide important habitat for fish spawning and nesting. Muskgrass has a brittle texture and a characteristic "musky" odor. It is adapted to a variety of substrates and is often the first species to colonize open areas of lake bottom where it can act as a sediment stabilizer.

Figure 9. Bed of muskgrass



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 over-winter 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 10. Coontail

Northern watermilfoil (*Myriophyllum sibiricum*; Figure 11) is a rooted perennial submerged plant with finely dissected leaves. It may reach the water surface, particularly in depths less than ten feet and its flower stalk extends above the water surface. It spreads primarily by stem fragments and over-winters by hardy rootstalks and winter buds. Northern watermilfoil is not tolerant of turbidity and grows best in clear water lakes. This native plant provides fish shelter and insect habitat and the extensive root systems help stabilize near-shore substrates.

Figure 11. Northern watermilfoil

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 over-winter as an evergreen plant and spreads primarily by fragments. The branching stems of this plant (Figure 12) can form thick underwater plant beds that are valuable habitat for a variety of fish and invertebrates.

Figure 12. Canada waterweed

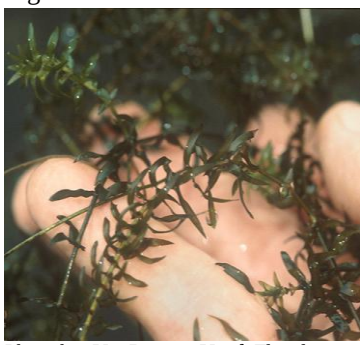


Photo by: Vic Ramey, U. of Florida

Bushy pondweed (*Najas flexilis*; Figure 13) 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). The seeds and foliage of this plant are important duck foods and beds of this plant provide good fish cover.

Figure 13. Bushy pondweed

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 are also areas of 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 14. White waterlily

White and yellow waterlilies can be found in lakes in both northern and southern Minnesota. White waterlily (*Nymphaea odorata*; Figure 14) has showy white flowers and round leaves with radiating veins. Yellow waterlily (*Nuphar variegata*; Figure 15) 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 15. Yellow waterlily

Floating-leaf pondweed (*Potamogeton natans*; Figure 16) also occurs in lakes throughout the state. It may co-occur with other vegetation or be found on the deep end of bulrush beds. This plant forms very narrow submerged

leaves and oval-shaped floating-leaves. The fruits of floating-leaf pondweed are eaten by geese and ducks, including scaup and blue-winged teal (Borman et al. 2001).

Figure 16. Floating-leaf pondweed

Watershield (*Brasenia schreberi*) 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 17). 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.

Figure 17. Watershield

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

Hardstem bulrush (*Schoenoplectus acutus*) is an emergent perennial plant that occurs in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). Bulrush stems are round in cross section and lack showy leaves (Figure 18). Clusters of small flowers form near the tips of long, narrow stalks. This emergent may occur from shore to water depths of about six feet and its stems may extend several feet above the water surface. Bulrush stands are particularly susceptible to destruction by excess herbivory and direct removal by humans.

Figure 18. Bulrush stand

Wild rice (*Zizania palustris*; Figure 19) is an emergent annual plant that reproduces each year from seed set in the previous fall. Wild rice is most commonly found in lakes of central and northern Minnesota. Cass County is one of five Minnesota counties with the highest concentration of lakes supporting natural wild rice stands (MN DNR 2008b). Wild rice generally requires habitat with some water flow, such as lakes with inlets and outlets. This plant most often is found in water depths of 0.5 to three feet in soft substrates (MN DNR 2008b). Wild rice is one of the most important waterfowl foods in North America and is used by more than 17 species of wildlife listed by the Minnesota Department of Natural Resources as "species of greatest conservation need" (MN DNR 2008b). Other ecological benefits associated with wild rice stands include habitat for fish and aquatic invertebrates, shoreline protection and stabilization, and nutrient uptake. This plant also has special

Figure 19. Wild rice

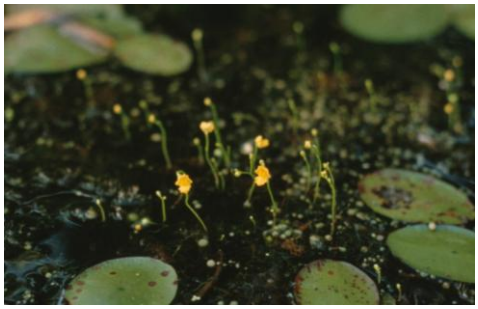
cultural and spiritual significance to the Ojibwe people and wild rice harvest provides important economic benefits to local economies (MN DNR 2008b).

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.

Figure 20. Bladderwort in flower among watershield.



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 with 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 shallow lake areas and have been documented at scattered locations throughout northern Minnesota (Ownbey and Morley 1991).

Figure 21. Mare's tail

Mare's tail (*Hippuris vulgaris*) is a submerged plant that can emerge above the water in shallow depths (Figure 21). This plant occurs primarily in northern Minnesota lakes but is relatively uncommon. It is often associated with cold-water streams or springs (Voss 1985) and its presence in a waterbody may be indicative of relatively good water quality. This submerged plant may form emergent leaves and stems in shallow water. The plant is named because the whorls of leaves resemble a horse's tail.

Water bulrush (*Schoenoplectus subterminalis*) is a submerged, perennial plant with fine, grass-like leaves that may form mats and float near the water surface (Figure 22). In mid to late summer its leaf tips and flower stalk may emerge above the water surface. This species once had a patchy distribution throughout North America but may now be extirpated from Illinois (Flora

of North America 1993+) and its conservation status is listed as critically impaired in several other states (NatureServe 2008). It is infrequently found in Wisconsin (Nichols 1999b) and Minnesota (Ownbey and Morley 1991) lakes.

Figure 22. Water bulrush

Photo by: D.W. Taylor. Copyright 1996.

Water arum (*Calla palustris*; Figure 23) 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 northeastern half of the state (Ownbey and Morley 1991).

Figure 23. Water arum

Species richness

Species richness is defined as the number of species present in a community and is often used as a simple measure of biodiversity (Magurran 2004). In aquatic plant communities, species richness is influenced by many complex factors (Pip 1987) including water chemistry, transparency, habitat area and habitat diversity (Vestergaard and Sand-Jensen 2000, Rolon et al. 2008). In Minnesota, water chemistry strongly influences which plant species can 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, as fewer species are tolerant of lower light levels available at deeper depths. Substrate, wind fetch, and other physical site characteristics also influence plant species richness within lakes.

Methods

The aquatic plant communities of Pleasant 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 Pleasant Lake in late August 2007 (Perleberg and Loso 2008). Aquatic plant survey points were established throughout the littoral (i.e.,

vegetated) zone of the lake to a depth of 20 feet. Points were spaced 65 meters apart and 503 sites were sampled within the shore to 20 feet depth interval. An additional 18 sites were surveyed in the 21 to 30 feet depth zone but since no vegetation was found, these deeper water sites were not used in analyses. 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 of the University of Minnesota Bell Museum of Natural History, St. Paul, MN.

Emergent and floating-leaf bed delineation

Protocol for mapping plant beds were based on the procedures documented in the DNR draft Aquatic Vegetation Mapping Guidelines (MN DNR 2005b). They included a combination of aerial photo delineation and interpretation, field delineation, ground-truthing and site specific surveys. Waterlily beds were delineated using 2003-2004 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 2008 using handheld GPS technology.

Near-shore vegetation survey

Near-shore vegetation surveys were conducted at three 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 Pleasant 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 Pleasant Lake.

Surveyors searched for unique and rare plant species in 2007 during the lakewide point-intercept surveys and in 2008 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.

A targeted search for rare aquatic vascular plants in Pleasant Lake was conducted by the Minnesota County Biological Survey Program on July 15, 2008 (Myhre 2008). This search focused on sites that were most likely to contain rare plant species. Botanists used professional experience to select search sites and included factors such as shoreline development, substrate type, water depth, and native plant communities in their site selection. To gain access to shallow

vegetated areas, searches were conducted by slowly kayaking, canoeing and/or wading through the site.

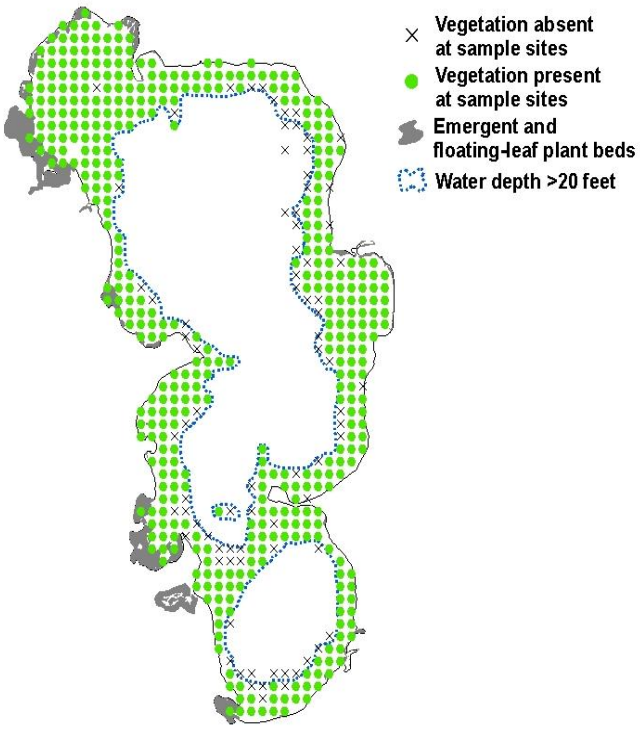
A brief habitat description and a list of all plant taxa found in the search area were recorded. When necessary, plant specimens were sent to the authority in the field for identification verification and annotation. Voucher specimens were made to document locations of county records and a few additional 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

Submerged plants were found to a depth of 20 feet (Figure 24). This vegetated zone includes about two-thirds of the lake and within this area, 88 percent of the survey sites contained vegetation. Plant occurrence was greatest in depths from shore to 15 feet, where 96 percent of the sites were vegetated. In water depths of 16 to 20 feet, only 46 percent of the sites contained plants. Emergent and floating-leaf plants occurred in water depths of five feet and less.

Figure 24. Aquatic plant distribution in Pleasant Lake, 2007.



Distribution of plants in main basin versus bays
Aquatic plants occurred around the entire lake perimeter and emergent and floating-leaved plant beds occurred in the western and northern bays.

Figure 25. Wetland plants of Pleasant Lake including blue-flowered Great Lobelia (*Lobelia siphilitica*)

Aquatic plant species observed
A total of 46 native aquatic plant taxa were recorded in Pleasant Lake. These included 30 submerged or free-floating taxa (Table 1), five floating-leaved and 11 emergent taxa (Table 2). Twenty-one additional shoreline plants were recorded (Figure 25, Appendix 1).

Submerged plants
Submerged plants occurred in 88 percent of Pleasant Lake sample sites. Submerged plants included leafy plants that are anchored to the lake bottom by roots, free-drifting bladderworts, and large algae that are weakly anchored to the lake bottom.

Eleven different submerged pondweed taxa (*Potamogeton* and *Stuckenia*) were found in Pleasant Lake. Flat-stem pondweed was the most abundant and was found in 42 percent of all sample sites (Table 1). It was most frequent in depths of six to 15 feet. Flat-stem pondweed occurred around the entire lake (Figure 26A) and was common in the northwest bay where it co-occurred with coontail, northern watermilfoil and Canada waterweed. Illinois pondweed was the second-most commonly occurring pondweed species. It was present in 13 percent of all sample sites and occurred in depths of 10 feet and less (Figure 27C).

Muskgrass was found in 39 percent of all sample sites. It occurred at all depths sampled but was the most frequent plant within the shore to 5 feet depth zone where it occurred in 56 percent of the sites (Figure 26B). Muskgrass was not frequent within the northwest bay.

Two submerged plants with finely dissected leaves were common in Pleasant Lake. Coontail was found in 38 percent of all sample sites and was most frequent in the 11 to 20 feet depth zone (Figure 26C). Northern watermilfoil was found in 36 percent of all sample sites (Figure 26D) and was most abundant from six to ten feet in depth.

Two bushy-leaved submerged plants, Canada waterweed and bushy pondweed, were common in depths less than six feet. Canada waterweed occurred in 15 percent of all sample sites and was most common in the northwest bay (Figure 27A). Bushy pondweed was present in 13 percent of all sample sites and was most common along the western shore (Figure 27B).

Table 1. Submerged and free-floating aquatic plants recorded in Pleasant Lake, 2007 and 2008.

Description		Common Name	Scientific Name	Frequency[a] N = 503
SUBMERGED and/or FREE-FLOATING	Algae	Muskgrass	*Chara* sp.	39
		Stonewort	*Nitella* sp.	1
	Grass-leaf plants	Flat-stem pondweed	*Potamogeton zosteriformis*	42
		Robbin's pondweed	*Potamogeton robbinsii*	9
		Water stargrass	*Zosterella dubia*	<1
		Wild celery	*Vallisneria americana*	<1
		Water bulrush	*Schoenoplectus subterminalis*	Present[c]
	Dissected-leaf plants	Coontail	*Ceratophyllum demersum*	38
		Northern watermilfoil	*Myriophyllum sibiricum*	36
		Water marigold	*Bidens beckii*	2
		White water buttercup	*Ranunculus aquatilis*	<1
	Bushy-leaf plants	Canada waterweed	*Elodea canadensis*	15
		Bushy pondweed	*Najas flexilis*	13
		Mare's tail	*Hippuris vulgaris*	Present[c]
	Broad-leaf pondweeds	Illinois pondweed	*Potamogeton illinoensis*	13
		White-stem pondweed	*Potamogeton praelongus*	6
		Variable pondweed	*Potamogeton gramineus*	5
		Clasping-leaf pondweed	*Potamogeton richardsonii*	3
		Large-leaf pondweed	*Potamogeton amplifolius*	Present[d]
	Narrow-leaf pondweeds	Narrow-leaf pondweed	*Potamogeton* sp.[b]	8
		Fries' pondweed	*Potamogeton friesii*	4
		Small pondweed	*Potamogeton pusillus*	<1
		Leafy pondweed	*Potamogeton foliosus*	Present[d]
		Sago pondweed	*Stuckenia pectinata*	2
	Free-drifting bladderworts	Greater bladderwort	*Utricularia vulgaris*	1
		Humped bladderwort	*Utricularia gibba*	<1
		Flat-leaved bladderwort	*Utricularia intermedia*	Present[c]
		Lesser bladderwort	*Utricularia minor*	Present[c]
	Free- floating duckweeds	Star duckweed	*Lemna trisulca*	1
		Common duckweed	*Lemna minor*	Present[d]
		Greater duckweed	*Spirodela polyrhiza*	Present[d]

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

[b]Some specimens of "narrow-leaved pondweeds" were positively identified as *Potamogeton friesii* (Fries' pondweed) , *P. pusillus* (small pondweed) or *P. foliosus* (leafy pondweed). However, some sterile specimens could not be identified to the species level and were grouped as "narrow-leaf pondweeds" (*Potamogeton* sp.). This group is reported in the table but not counted in the species tally.

[c]Present in lake in 2007 but not found at point-intercept sample stations.

[d]Located only during Minnesota County Biological Survey, 15 July 2008.

Table 2. Floating-leaved and emergent aquatic plants recorded in Pleasant Lake, 2007 and 2008.

Description		Common Name	Scientific Name	Frequency[a] N = 503
FLOATING-LEAF		Yellow waterlily	*Nuphar variegata*	2
		White waterlily	*Nymphaea odorata*	2
		Floating-leaf pondweed	*Potamogeton natans*	2
		Watershield	*Brasenia schreberi*	Present[c]
		Water smartweed	*Persicaria amphibia*	Present[d]
EMERGENT	Narrow-leaf	Hard-stem bulrush	*Schoenoplectus acutus*	<1
		Spikerush	*Eleocharis* sp.	<1
		Needlegrass	*Eleocharis acicularis*[b]	Present[c]
		Soft rush	*Juncus effusus*	Present[c]
		Brown-fruited rush	*Juncus pelocarpus*[b]	Present[d]
	Broad-leaf	Wild rice	*Zizania palustris*	<1
		Broad-leaved arrowhead	*Sagittaria latifolia*	<1
		Water arum	*Calla palustris*	Present[c]
		Giant burreed	*Sparganium eurycarpum*	Present[c]
		Narrow-leaved cattail	*Typha angustifolia*	Present[d]
		Broad-leaved cattail	*Typha latifolia*	Present[d]

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

[b]This species may also occur as a submerged plant.

[c]Present in lake in 2007 but not found at point-intercept sample stations.

[d]Located only during Minnesota County Biological Survey, 15 July 2008.

Nomenclature follows MNTaxa 2009.

Figure 26. Distribution of common aquatic plants in Pleasant Lake, 2007.

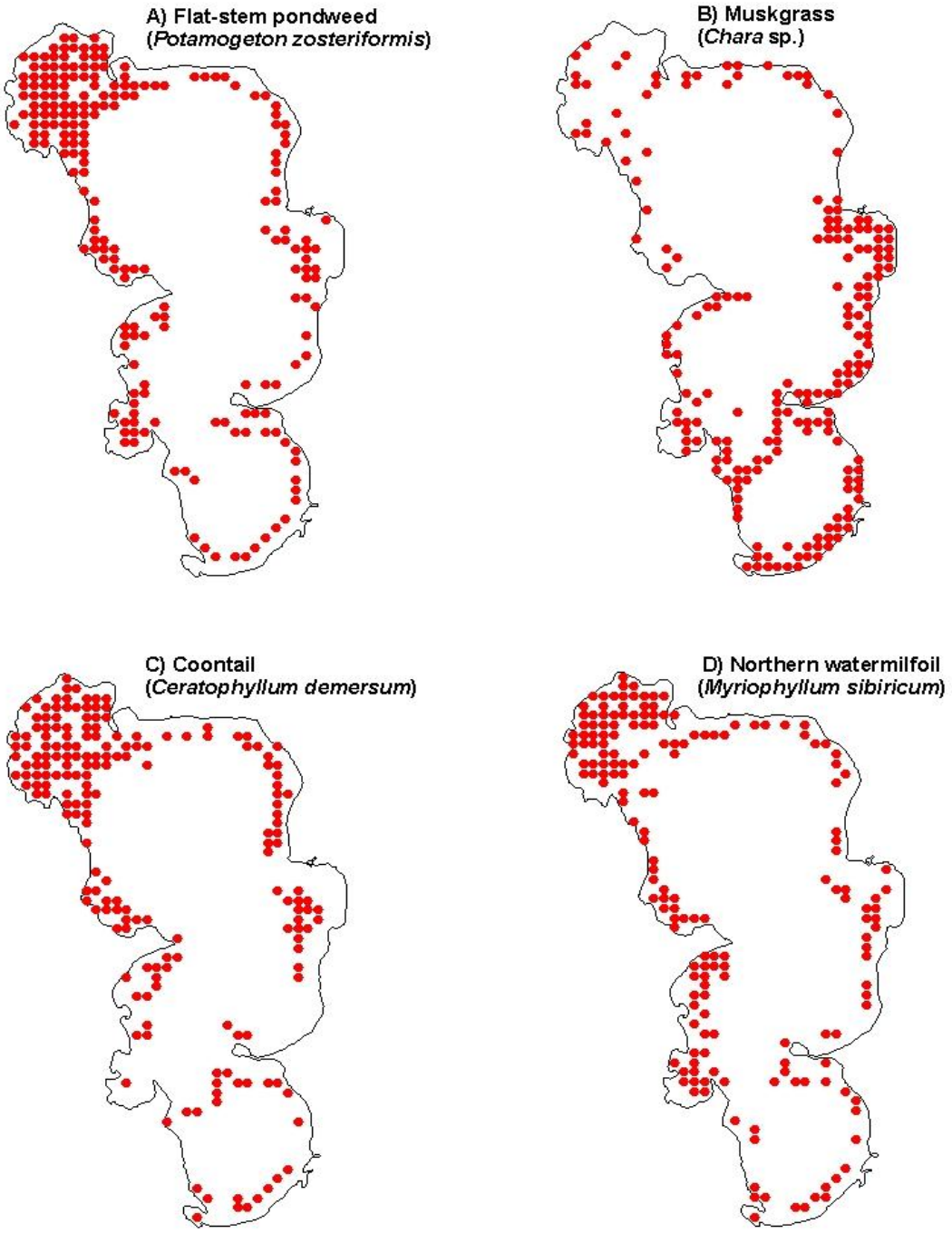
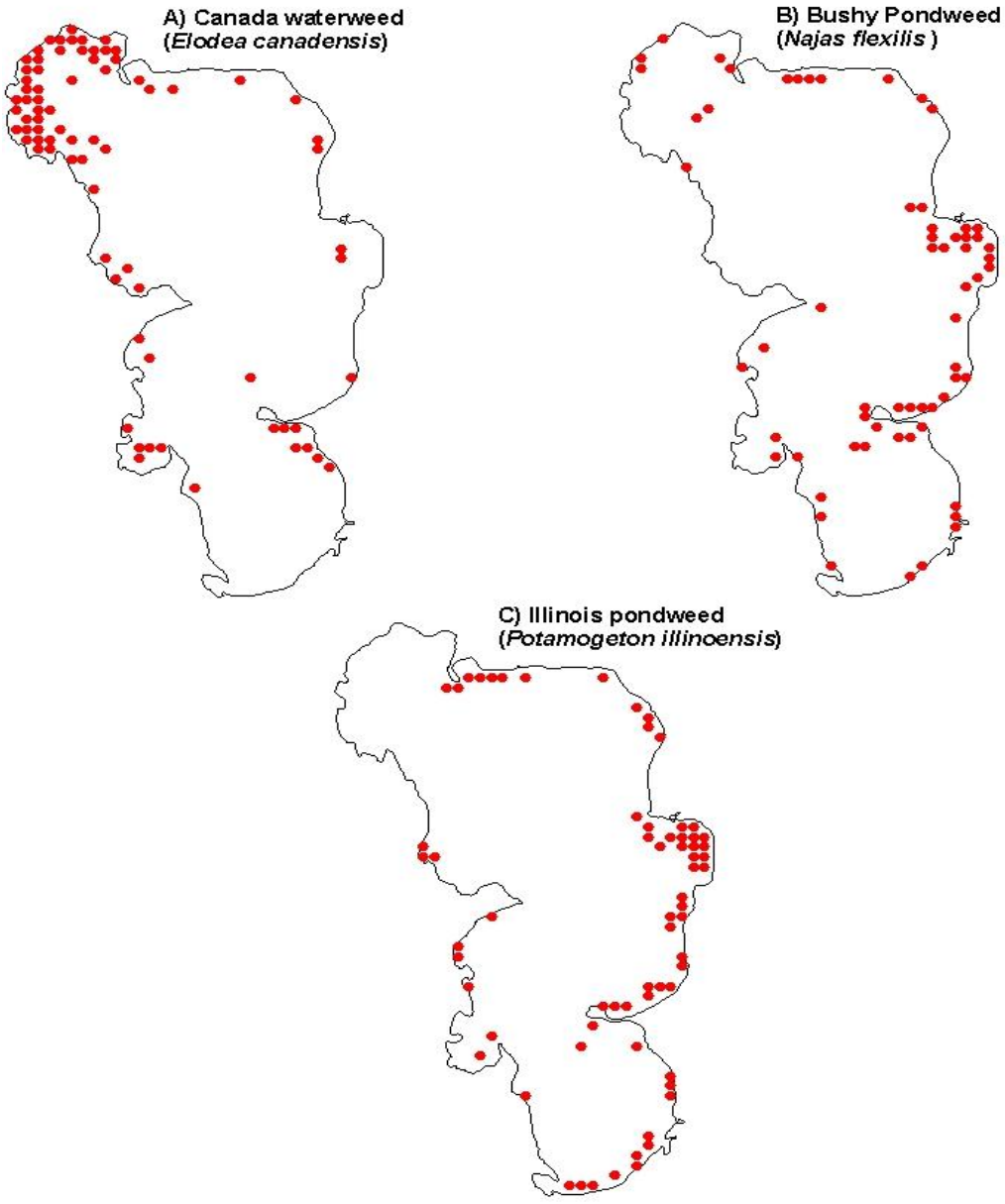


Figure 27. Distribution of common aquatic plants in Pleasant Lake, 2007.

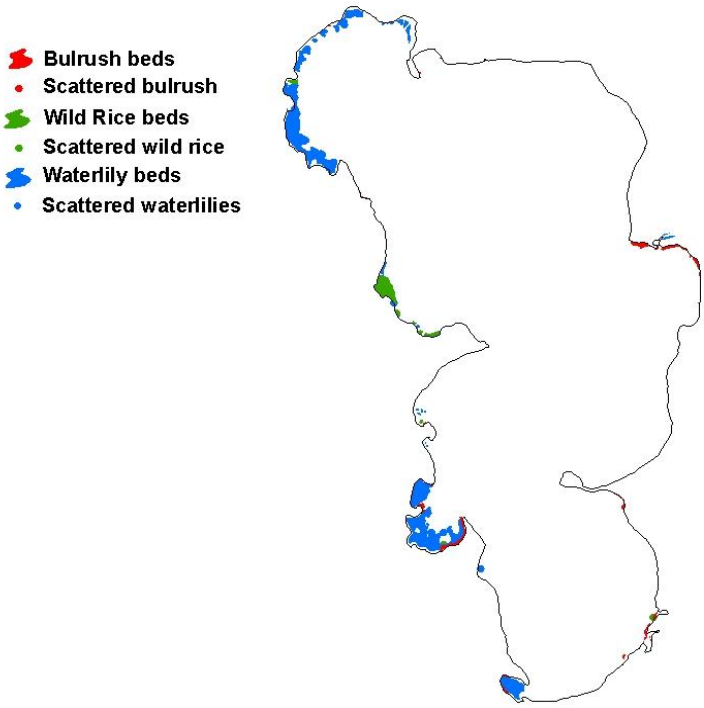


Floating-leaf and emergent plants

Waterlilies in north bay of Pleasant Lake, 2007

About 25 acres of floating-leaf plant beds were mapped and the largest beds occurred along the protected, shallow stretches of the west and north shores (Figure 28). The most common species were white waterlily, yellow waterlily and floating-leaf pondweed. Because surveyors avoided motoring into floating-leaf plant beds, the frequency values obtained for these taxa (Table 2) were lower than the actual lakewide occurrence. Frequency values for floating-leaf taxa represent the occurrence of these taxa only within the sites that were surveyed. Waterlily beds often contained submerged plants and scattered emergents and were usually associated with muck sediments.

Figure 28. Distribution of emergent and floating-leaf plant beds in Pleasant Lake, 2008.



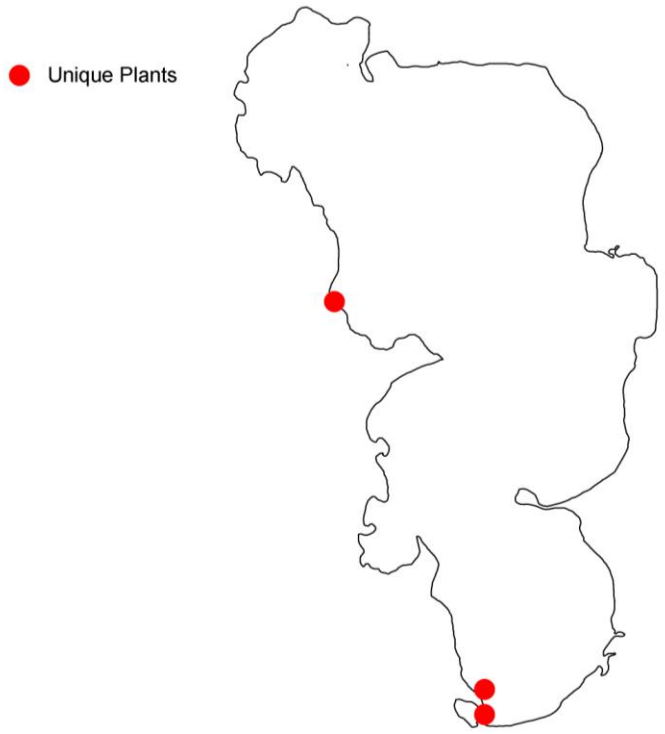
Surveyors delineated approximately seven acres of emergent plants and the most common taxa were wild rice, bulrush and spikerush. About four acres of wild rice were mapped in silt substrates along the western shore near the Boy River inlet and smaller beds of bulrush occurred at scattered locations along the east and west shores.

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 the lake and adjacent wetlands. Additional native emergents occurred in these adjacent wetlands but this survey did not include an exhaustive wetland species inventory.

Unique plants
In addition to the commonly occurring plants in Pleasant Lake, six unique plant species were documented at three locations during the survey (Figure 29). These species are not widespread in Minnesota but their presence is indicative of relatively undisturbed native plant communities in Pleasant Lake. Unique aquatic plants found in Pleasant Lake included humped bladderwort, lesser bladderwort, flat-leaved bladderwort, mare's tail, water bulrush, and water arum.

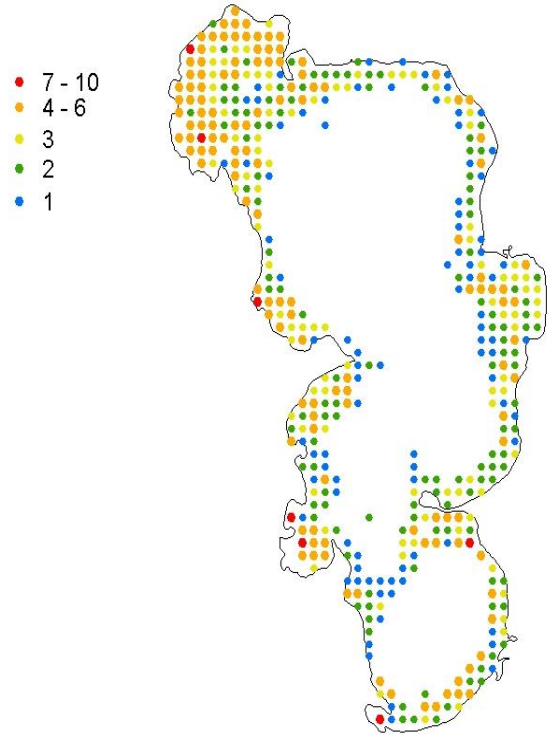
Mare's tail was located in the western bay of Pleasant Lake. The other unique plants were located in the southern tip of the lake.

Figure 29. Unique aquatic plants in Pleasant Lake, 2007.



Species richness
The number of plant taxa found in each one square meter sample site ranged from zero to ten (Figure 30). Sites near shore, in shallow water, contained the greatest number of plant taxa and in water depths greater than 15 feet, most sites contained one or no taxa.

Figure 30. Aquatic plant richness (number of plant taxa per sampling station) in Pleasant Lake, 2007.



Near-shore Substrates

Objectives

1. Describe and map the near-shore substrates of Pleasant 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 or gravel whereas yellow waterlily prefers soft substrates (Nichols 1999b).

Natural sand shoreline of Pleasant Lake

Methods

Near-shore substrate in Pleasant Lake was evaluated at a total of 271 sampling stations set up in the grid point-intercept aquatic plant and near-shore fish surveys. Plant sample stations were 65 meters apart and occurred in a grid from shore to a depth of 20 feet. Surveyors described substrate at 234 of these sites that were located between the shore and the seven 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 37 of these stations.

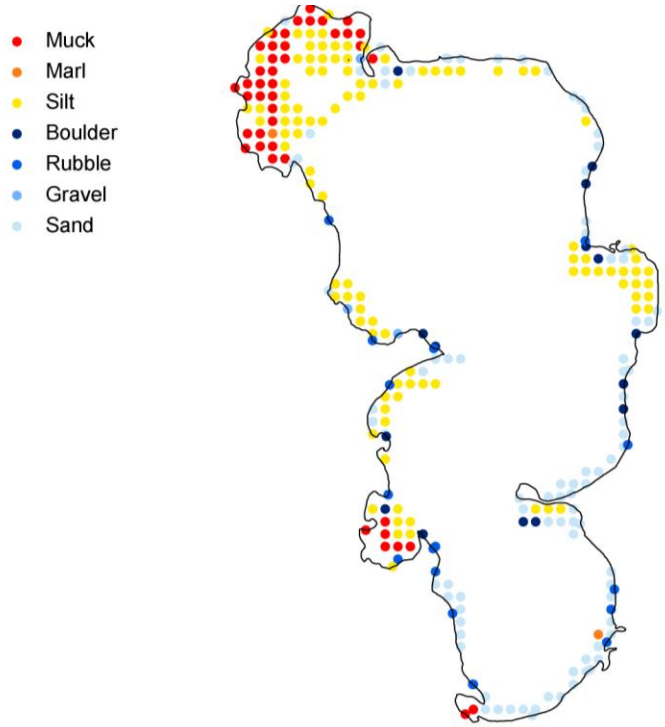
Surveyors evaluated substrate by tapping a pole into the lake bottom; soft substrate could usually be brought to the surface on the pole or sampling rake for evaluation. If this was not feasible, substrate was evaluated by visual observation of the lake bottom. Standard lake substrate classes were based on the DNR Fisheries Survey Manual (MN DNR 1993):

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

Results

Substrate type in Pleasant Lake ranged from soft (muck and silt) to hard (rubble and boulders) (Figure 31). Muck substrates were present in the northwest and western bays, and in the small isolated bay at the southern end of the lake. Silt substrates were also common in these bays, as well as along portions of the western and eastern shorelines. Sand substrates occurred along the eastern shoreline, and were interspersed with scattered boulders and rubble. Overall, silt was the most common substrate type, and occurred at nearly 40 percent of the sample locations.

Figure 31. Near-shore substrates at Pleasant Lake, 2007.



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 Pleasant Lake.

Figure 32. American white pelican

Photo by: Carrol Henderson

American white pelicans (*Pelecanus erythrorhynchos*; Figure 32) are large, white waterbirds weighing up to 30 pounds. They have black wingtips and an orange bill with a pouch. They don't dive for fish like some pelicans, but dip their heads underwater while swimming. Pelicans nest in colonies on remote freshwater lakes, and depend on wetlands for many stages of their life cycle. Habitat loss is the largest known cause of nesting failure, although predation and boating disturbance can also be factors.

Figure 33. Bald eagle

Photo by: Carrol Henderson

Bald eagles (*Haliaeetus leucocephalus*; Figure 33) 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 34) are one of Minnesota's most recognizable birds. They are found from northeastern to central Minnesota, and numbers are higher here than in any other state except Alaska. 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 34. Common loon

Photo by: Carrol Henderson

Common nighthawks (*Chordeiles minor*; Figure 35) are most often seen in the air, exhibiting an erratic flight pattern as they forage for insects. They are cryptically colored with brown, gray, and white mottling. A white bar is visible across the wing when the bird is in flight. The breeding rituals include a dramatic display during which males dive straight toward the ground before turning quickly 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 35. Common nighthawk

Photo by: Carrol Henderson

Common terns (*Sterna hirundo*; Figure 36) are the most widespread terns in North America. In the breeding season common terns have a solid black cap with gray back and underparts. The gray wings have dark edges. The rump is white, and the legs and bill are orange-red in color. Common terns nest in colonies, often on sandy substrates of islands or peninsulas of larger 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 36. Common tern

Photo by: Carrol Henderson

Eastern wood-pewees (*Contopus virens*; Figure 37) are medium-sized, nondescript birds common in Eastern forests. They are grayish-olive above, with a paler throat and belly and whitish wingbars. They forage throughout the canopy, often flying out from their perch to catch insects before returning to the same perch. Eastern wood-pewees are named after their call, a whistled "pee-a-wee." Populations of eastern wood-pewees are declining throughout much of their range. Possible causes of the decline include the increase in white-tailed deer, who browse and decrease the lower-canopy foraging area available to the pewee, and loss of forest habitat in the winter range.

Figure 37. Eastern wood-pewee

Photo by: J.A. Spendelow

Least flycatchers (*Empidonax minimus*; Figure 38) are the smallest flycatchers found in Minnesota. Like many other flycatchers, they are olive to gray in color with two white wingbars and whitish underparts. They have a small bill and a prominent white eye ring. The best way to distinguish least flycatchers from other flycatchers is their call, a harsh "che-bek." These birds are often found along water edges in mature, open woods. Least flycatchers are common throughout most of their range where habitat is suitable. However, they are sensitive to human disturbance and require large areas of forest to survive.

Figure 38. Least flycatcher

Photo by: J.A. Spendelow

The olive-sided flycatcher (*Contopus cooperi*; Figure 39) is one of the larger, more distinctive members of the flycatcher family. This stocky bird has a large head and short tail; the dark olive sides contrast with the white breast, and give the bird a vested appearance. A faint eye-ring is present, as are pale wing bars. Olive-sided flycatchers feed mainly on flying insects, especially bees, and defend their nests aggressively. Olive-sided flycatchers are frequently associated with burned forests, but breed anywhere from coniferous forests to open meadows. Loss of wintering habitat may be one of the primary reasons for the serious declines in populations of this species.

Figure 39. Olive-sided flycatcher

Photo by: Dennis Garrison

Ovenbirds (*Seiurus aurocapillus*; Figure 40) are rarely seen birds of the forest. However, their loud "teacher, teacher, teacher" song is commonly heard during the summer months. They dwell on the ground, and build a covered nest that resembles a Dutch oven. Ovenbirds are olive-brown with a boldly streaked breast. Two black stripes border an orange crown. They have a thin bill and a white eye ring. They breed in mature deciduous and mixed forests, especially those with minimal undergrowth, 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 40. Ovenbird

Photo source: U.S. Fish and Wildlife Service

The swamp sparrow's (*Melospiza georgiana*; Figure 41) 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 41. Swamp sparrow

Photo by: Jim Stasz

The veery (*Catharus fuscescens*; Figure 42) 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, although the birds also have a melodic, descending flute-like 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 42. Veery

Photo by: Deanna Dawson

White-throated sparrows (*Zonotrichia albicollis*; Figure 43) are common in Minnesota during their spring and fall migrations. They are recognizable by the white patch on the throat and their characteristic "Old Sam Peabody Peabody Peabody" song. The head is striped with black and tan or white, and has a yellow spot above the eye. The chest is gray and the back is streaked with brown and black. They inhabit coniferous or mixed forests, and prefer areas with multiple openings and abundant low-growing vegetation. 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 43. White-throated sparrow

Photo by: Dave Herr

The yellow-bellied sapsucker's (*Sphyrapicus varius*; Figure 44) 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 44. Yellow-bellied sapsucker

Photo by: J.A. Spendelow

Methods

Surveyors used several techniques to collect information on bird species. Point counts were conducted at 36 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

Thirteen bird species of greatest conservation need were documented at Pleasant Lake. Common loons were the most abundant; surveyors detected loons at 15 different stations. Eastern wood-pewees, ovenbirds, swamp sparrows, yellow-bellied sapsuckers, and the veery were all documented at five or more survey stations. The other species of greatest conservation need found at Pleasant Lake were: American white pelican, bald eagle, common nighthawk, common tern, least flycatcher, olive-sided flycatcher, and white-throated sparrow.

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 the southern half of the lake, though there were several occurrences in the northern part of the lake as well (Figure 45). Forest dwelling species were located at survey stations around much of the shoreline (Figure 46). However, distribution of individual species did vary. The veery was found only along the northern shoreline of Pleasant Lake, whereas the flycatchers were found along the eastern shoreline (Figure 46). The only wetland-dwelling species of greatest conservation need documented on Pleasant Lake, the swamp sparrow, was found in multiple bays around the lake (Figure 47). Bald eagles were seen in both the northern and southern sections of the lake (Figure 48).

Surveyors recorded 68 bird species during the point count and call-playback surveys at Pleasant Lake (Table 3). Five additional species were recorded through casual observation, for a total of 73 species (Appendix 2). Song sparrows were the most common species overall, and were found at over 80 percent of the survey sites. Red-winged blackbirds were second in abundance, and were identified at 27 of the 36 stations. Red-eyed vireos, yellow warblers, common loons, and chipping sparrows rounded out the most common species.

Figure 45. Distribution of aquatic habitat-dependent bird species of greatest conservation need in Pleasant Lake, May – June 2008.

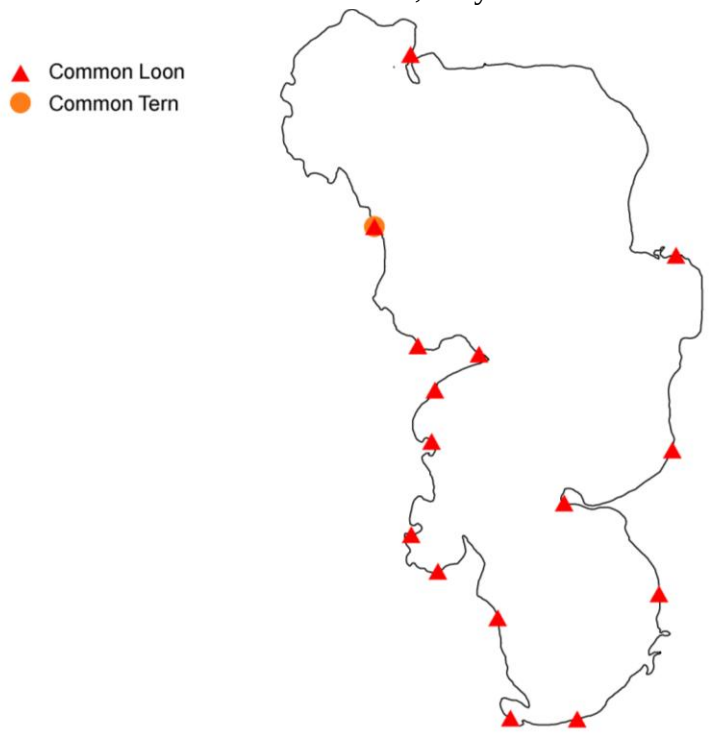


Figure 46. Distribution of forest habitat-dependent bird species of greatest conservation need in Pleasant Lake, May – June 2008.

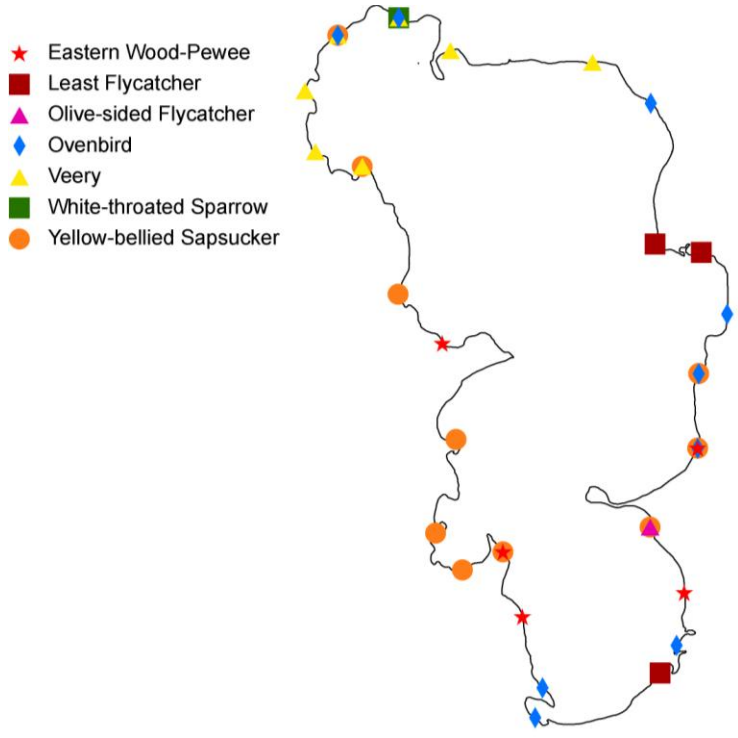


Figure 47. Distribution of wetland habitat-dependent bird species of greatest conservation need in Pleasant Lake, May – June 2008.

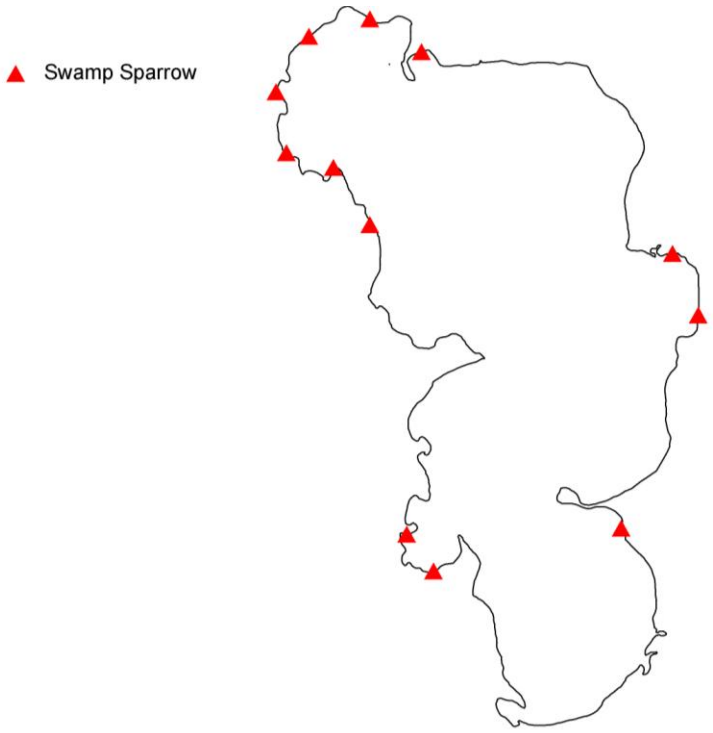


Figure 48. Distribution of bird species of greatest conservation need that occupy a variety of habitats in Pleasant Lake, May – June 2008.

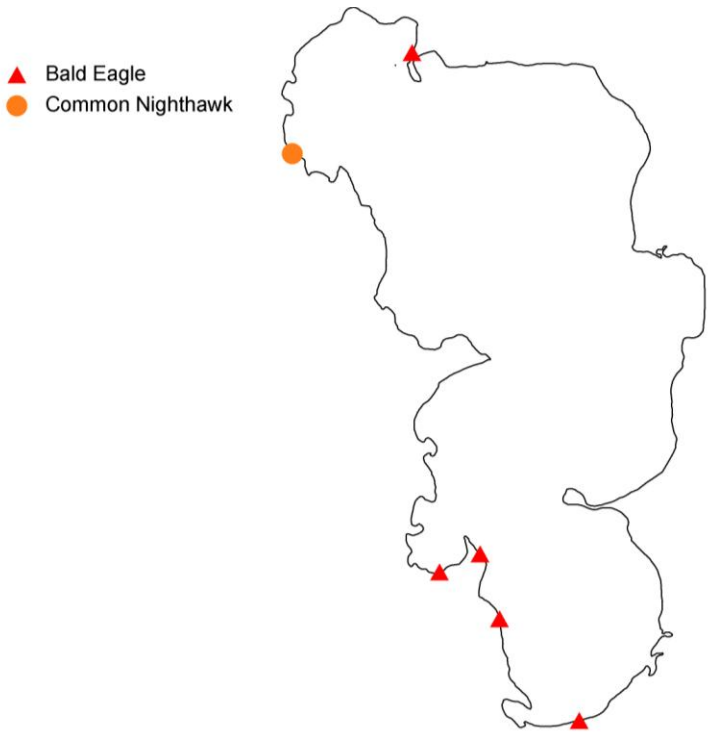


Table 3. Species list and frequency of occurrence of bird species identified during Pleasant Lake bird surveys, May – June 2008. * denotes a species of greatest conservation need.

Description	Common Name	Scientific Name	%[a]
Waterfowl	Canada Goose	*Branta canadensis*	14
	Wood Duck	*Aix sponsa*	11
	Mallard	*Anas platyrhynchos*	25
	Blue-winged Teal	*Anas discors*	3
	Ring-necked Duck	*Aythya collaris*	3
	Common Goldeneye	*Bucephala clangula*	3
	Hooded Merganser	*Lophodytes cucullatus*	6
	Common Merganser	*Mergus merganser*	3
Loons	Common Loon*	*Gavia immer*	42
Herons/bitterns	Great Blue Heron	*Ardea herodias*	22
	Green Heron	*Butorides virescens*	17
Hawks/eagles	Bald Eagle*	*Haliaeetus leucocephalus*	14
Rails	Sora	*Porzana carolina*	3
Gulls/terns	Common Tern*	*Sterna hirundo*	3
	Ring-billed Gull	*Larus delawarensis*	11
Pigeons/doves	Mourning Dove	*Zenaida macroura*	6
Goatsuckers	Common Nighthawk*	*Chordeiles minor*	3
Hummingbirds	Ruby-throated Hummingbird	*Archilochus colubris*	11
Kingfishers	Belted Kingfisher	*Megaceryle alcyon*	25
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*	14
	Yellow-bellied Sapsucker*	*Sphyrapicus varius*	28
	Downy Woodpecker	*Picoides pubescens*	8
	Hairy Woodpecker	*Picoides villosus*	8
	Northern Flicker	*Colaptes auratus*	11
	Pileated Woodpecker	*Dryocopus pileatus*	8
Flycatchers	Olive-sided Flycatcher*	*Contopus cooperi*	3
	Eastern Wood-Pewee*	*Contopus virens*	14
	Alder Flycatcher	*Empidonax alnorum*	11
	Least Flycatcher*	*Empidonax minimus*	8
	Eastern Phoebe	*Sayornis phoebe*	19
	Eastern Kingbird	*Tyrannus tyrannus*	14
Vireos	Yellow-throated Vireo	*Vireo flavifrons*	3
	Warbling Vireo	*Vireo gilvus*	14
	Red-eyed Vireo	*Vireo olivaceus*	53
Jays/crows	Blue Jay	*Cyanocitta cristata*	36
	American Crow	*Corvus brachyrhynchos*	33
	Common Raven	*Corvus corax*	11

Table 3, continued.

Description	Common Name	Scientific Name	% [a]
Swallows	Tree Swallow	*Tachycineta bicolor*	22
	Barn Swallow	*Hirundo rustica*	6
Chickadees	Black-capped Chickadee	*Poecile atricapillus*	28
Nuthatches	Red-breasted Nuthatch	*Sitta canadensis*	17
	White-breasted Nuthatch	*Sitta carolinensis*	6
Thrushes	Veery*	*Catharus fuscescens*	19
	American Robin	*Turdus migratorius*	28
Mockingbirds	Gray Catbird	*Dumetella carolinensis*	11
Waxwings	Cedar Waxwing	*Bombycilla cedrorum*	6
Warblers	Nashville Warbler	*Vermivora ruficapilla*	8
	Yellow Warbler	*Dendroica petechia*	44
	Chestnut-sided Warbler	*Dendroica pensylvanica*	6
	Yellow-rumped Warbler	*Dendroica coronata*	3
	Pine Warbler	*Dendroica pinus*	3
	Blackpoll Warbler	*Dendroica striata*	3
	Black-and-white Warbler	*Mniotilta varia*	3
	American Redstart	*Setophaga ruticilla*	3
	Ovenbird*	*Seiurus aurocapilla*	25
	Common Yellowthroat	*Geothlypis trichas*	36
Sparrows	Chipping Sparrow	*Spizella passerina*	42
	Song Sparrow	*Melospiza melodia*	83
	Swamp Sparrow*	*Melospiza georgiana*	33
	White-throated Sparrow*	*Zonotrichia albicollis*	3
Blackbirds/orioles	Red-winged Blackbird	*Agelaius phoeniceus*	75
	Common Grackle	*Quiscalus quiscula*	36
	Brown-headed Cowbird	*Molothrus ater*	6
	Baltimore Oriole	*Icterus galbula*	31
Finches	Purple Finch	*Carpodacus purpureus*	6
	House Finch	*Carpodacus mexicanus*	3
	Pine Siskin	*Carduelis pinus*	3
	American Goldfinch	*Carduelis tristis*	31

[a] % – Percent of surveyed sample sites in which a bird species occurred (N=36).

Bird Species Richness

Objectives

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

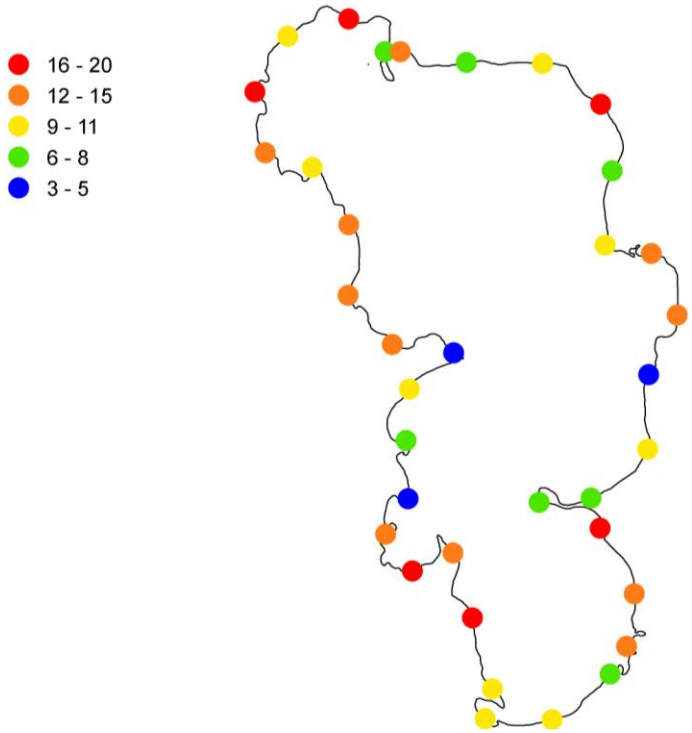
Methods

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 20 species at a single sample location. Twenty-one additional sites contained 10 or more species. Less than 10 percent of the stations contained five or fewer species. The maximum number of species of greatest conservation need at a single sample site was four. Species richness did not appear to be strongly associated with shoreline structure, as both bays and the main shoreline contained areas of high species diversity (Figure 49).

Figure 49. Bird species richness (number of species per sample site) at Pleasant Lake, 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 pair with chick

Photo by: Paul Bolstad

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

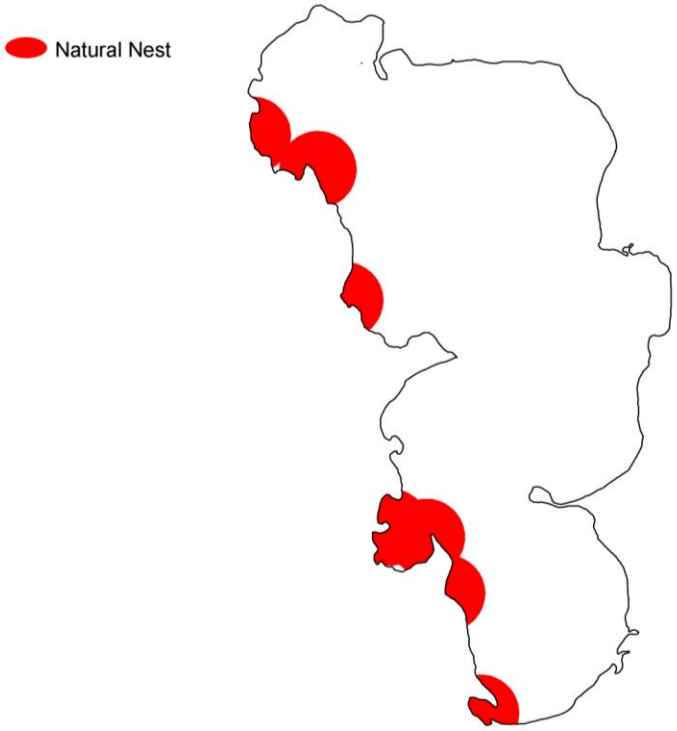
Methods

Using information from LoonWatcher reports and bird, fish, and vegetation survey crews, researchers mapped loon nesting locations in GIS. Mapped nests were buffered by 200 meters to account for locational uncertainty. Nests were identified as either natural or manmade (artificial platforms). All former and current natural nesting locations and artificial platforms used by loons were included in the maps and analysis; artificial platforms not utilized by loons were not included. Volunteers have been reporting on Pleasant Lake loons since 1980.

Results

Between 1980 and 2008 seven probable loon nesting areas were identified on Pleasant Lake (Figure 50). All nesting areas were located along the western shoreline of Pleasant Lake. All nests were natural nests; no artificial nesting platforms have been installed. Five nests were described as active nests in 2008.

Figure 50. Location of natural loon nests and manmade loon platforms recorded on Pleasant 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 have all 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 51. Mink frog

Photo by: Jeff LeClere, www.herpnet.net

Mink frogs (Figure 51) 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 52. Green frog

Photo by: Jeff LeClere, www.herpnet.net

Green frogs (Figure 52) 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 a calling index was recorded. If survey conditions such as rain or wind noticeably affected listening ability, the survey was terminated.

Results

Target species

Both green frogs and mink frogs were documented during the Pleasant Lake calling surveys. Green frogs were heard more frequently than mink frogs; surveyors heard green frogs calling at 14 stations, whereas mink frogs were heard at only four stations. At stations with frogs, both green and mink frog numbers ranged from one to between 21 – 100 individuals (Figure 53, Figure 54). The majority of the frog locations were along the western shoreline of Pleasant Lake, and were closely associated with beds of emergent and floating-leaf vegetation. All stations with mink frogs also had green frogs (Figure 55).

Other species

Gray treefrogs (*Hyla versicolor*) were the only other anuran species documented in Pleasant Lake. Surveyors heard them calling at five different locations, mainly in the northwestern corner of the lake. Index values for gray treefrogs ranged from 1 (individual frogs could be distinguished, calls did not overlap) to 2 (frog calls overlapped, but individuals could still be differentiated). Other frog or toad species that may be found near Pleasant Lake, such as wood frog (*Rana sylvatica*), spring peeper (*Pseudacris crucifer*), chorus frog (*Pseudacris triseriata*), leopard frog (*Rana pipiens*), and American toad (*Bufo americanus*), usually breed earlier in the year and are not strongly associated with larger lakes.

Figure 53. Abundance of green frogs heard during Pleasant Lake frog surveys, July 2008.

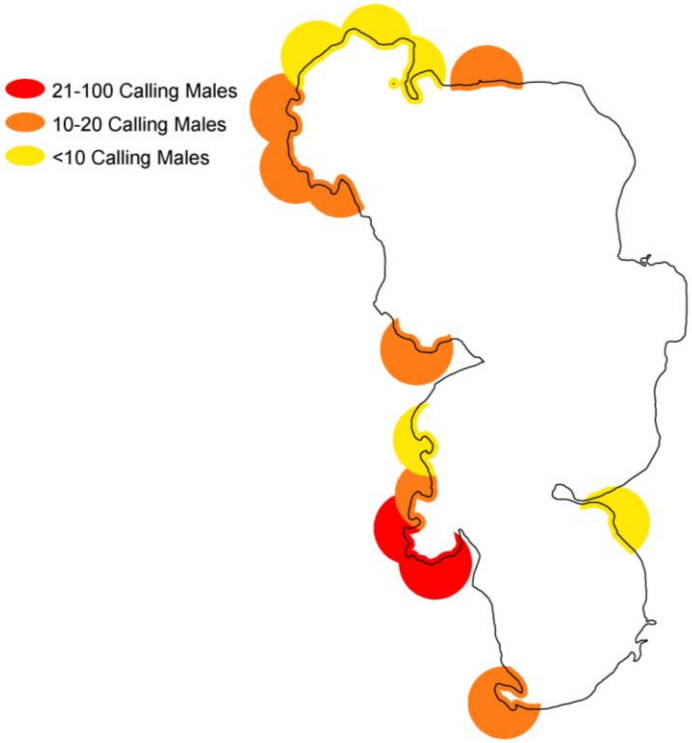


Figure 54. Abundance of mink frogs heard during Pleasant Lake frog surveys, July 2008.

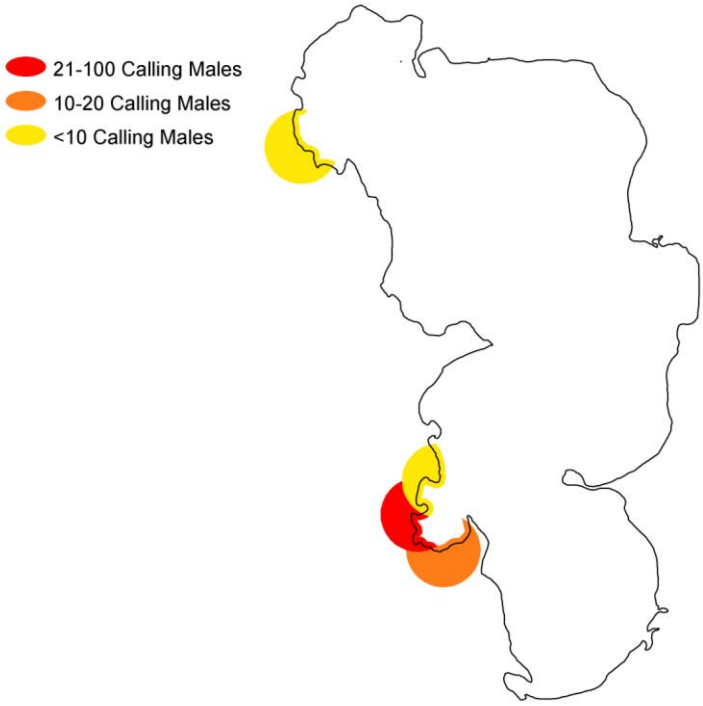
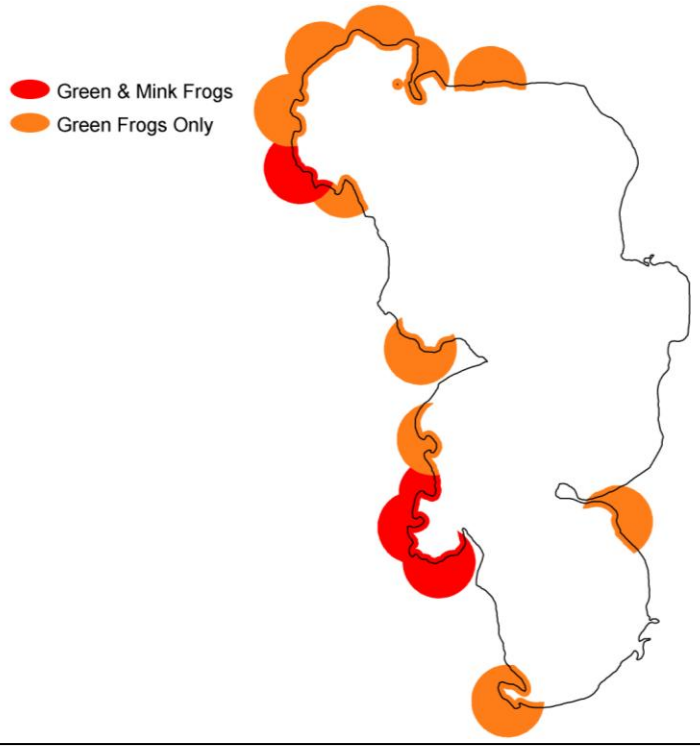


Figure 55. Distribution of green and mink frogs in Pleasant Lake, July 2008.



Nongame Fish Surveys

Objectives

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

Introduction

Fish Species of Greatest Conservation Need

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

Pugnose shiners (*Notropis anogenus*; Figure 56) 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 found often 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 56. Pugnose shiner

Photo by: Konrad Schmidt

Least darters (*Etheostoma microperca*; Figure 57) 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 57. Least darter

Photo by: Konrad Schmidt

Longear sunfish (*Lepomis megalotis*; Figure 58) 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 58. 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 59) 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 59. Blackchin shiner

Photo by: Konrad Schmidt

Blacknose shiners (*Notropis heterolepis*; Figure 60) 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 60. Blacknose shiner

Photo by: Konrad Schmidt

Banded killifish (*Fundulus diaphanus*; Figure 61) 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 61. 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 near-shore species of greatest conservation need (pugnose shiner, least darter, and longear sunfish) and proxy species (blackchin shiner, blacknose shiner, and banded killifish). These species are associated with large, near-shore stands of aquatic grasses and macrophytes. They are intolerant to disturbance, and have been extirpated from lakes where extensive watershed and lakeshore development has occurred.

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

Results

One fish species of conservation need was identified at Pleasant Lake. The pugnose shiner was found at five (of 37) sampling stations. Pugnose shiner locations were in both the northern and southern areas of the lake (Figure 62). Least darters and longear sunfish were not documented in Pleasant Lake during the nongame fish surveys. Surveyors also documented two of three proxy species (Figure 63). Blackchin shiners were found at over one-third of the sampling stations, and numbered greater than 200. Blacknose shiners were found at nine stations, but numbered less than 25. Banded killifish were not documented during the surveys.

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

Species richness at the sample sites ranged from five species (at two sites) to 17 species (at three sites). Twenty-five of the 37 stations contained 10 or more fish species.

Figure 62. Distribution of fish species of greatest conservation need in Pleasant Lake, August – September 2007.

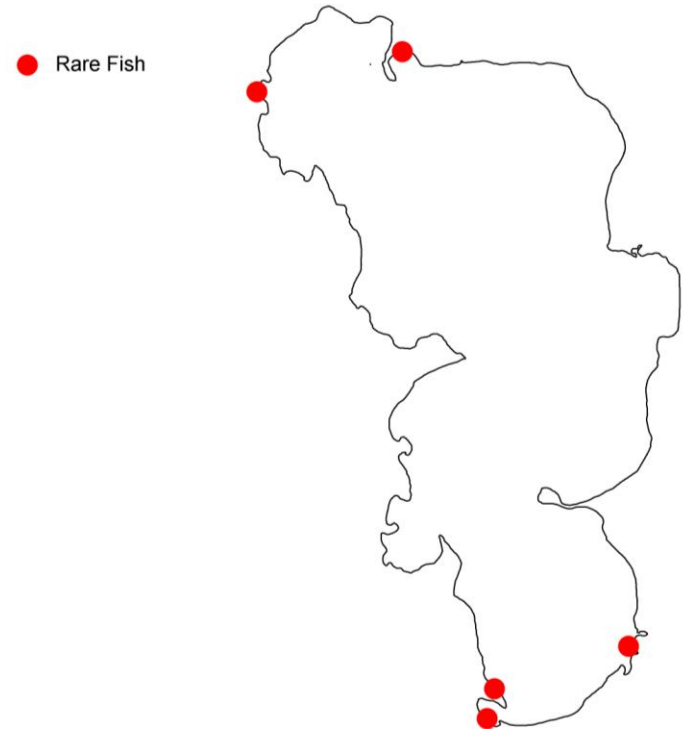
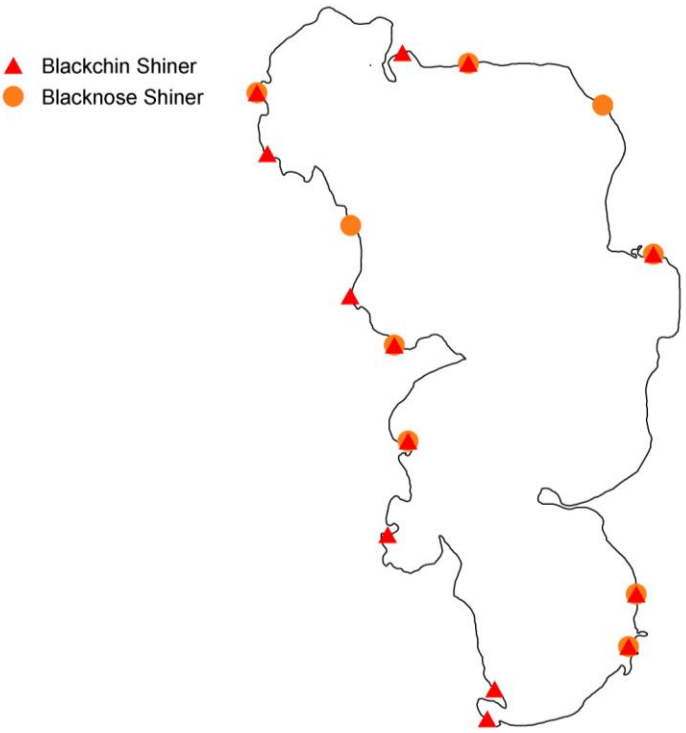


Figure 63. Distribution of fish proxy species in Pleasant Lake, August – September 2007.



Surveyors identified a total of 29 fish species during the 2007 surveys (Table 4). The most abundant species was the bluntnose minnow, which was found at 30 stations in numbers over 3000. Mimic shiners, bluegills, and yellow perch were also present in numbers greater than 1000. Bluegills were the most frequently found species, and were documented at all 37 stations. Four fish species not previously documented at Pleasant Lake were identified during the surveys, bringing the total historical observed fish community to 35 species. The newly documented species were central mudminnow, mottled sculpin, pugnose shiner, and tadpole madtom.

Table 4. Abundance and frequency of fish species identified during surveys, August – September 2007. * denotes species of greatest conservation need

Description	**Common Name**	**Scientific Name**	**#** [a]	**%** [b]
Bowfins	Bowfin	*Amia calva*	4	11
Minnows/carps	Spotfin shiner	*Cyprinella spiloptera*	200	30
	Golden shiner	*Notemigonus crysoleucas*	4	8
	Pugnose shiner*	*Notropis anogenus*	13	14
	Emerald shiner	*Notropis atherinoides*	1	3
	Blackchin shiner	*Notropis heterodon*	208	35
	Blacknose shiner	*Notropis heterolepis*	24	24
	Spottail shiner	*Notropis hudsonius*	212	38
	Mimic shiner	*Notropis volucellus*	~2100	76
	Bluntnose minnow	*Pimephales notatus*	~3100	81
Suckers	White sucker	*Catostomus commersonii*	9	22
North American freshwater catfishes	Black bullhead	*Ameiurus melas*	20	22
	Yellow bullhead	*Ameiurus natalis*	72	57
	Brown bullhead	*Ameiurus nebulosus*	2	3
	Tadpole madtom	*Noturus gyrinus*	1	3
Pikes	Northern pike	*Esox lucius*	24	46
Mudminnows	Central mudminnow	*Umbra limi*	15	14
Sculpins	Mottled sculpin	*Cottus bairdii*	10	19
Sunfishes	Rock bass	*Ambloplites rupestris*	213	81
	Pumpkinseed	*Lepomis gibbosus*	159	70
	Bluegill	*Lepomis macrochirus*	~1800	100
	Smallmouth bass	*Micropterus dolomieu*	9	16
	Largemouth bass	*Micropterus salmoides*	421	81
	Black crappie	*Pomoxis nigromaculatus*	27	38
Perches	Iowa darter	*Etheostoma exile*	76	46
	Johnny darter	*Etheostoma nigrum*	70	54
	Yellow perch	*Perca flavescens*	~1200	86
	Logperch	*Percina caprodes*	289	43
	Walleye	*Sander vitreus*	7	14

[a] # – Total number of individuals found. Numbers above 1000 are rounded to the nearest 100.

[b] % – Percent of surveyed sample sites in which a species occurred (N=37).

Aquatic Vertebrate Richness

Objectives

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

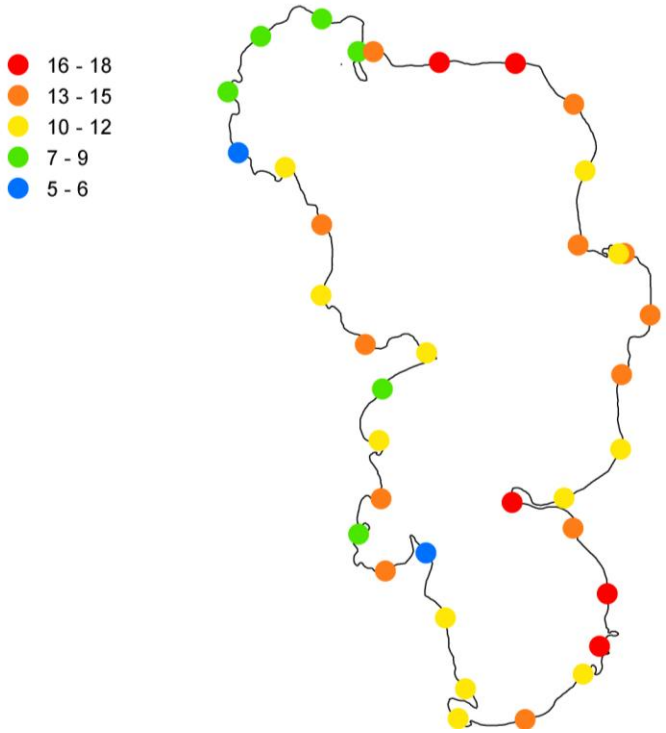
Methods

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

The number of aquatic vertebrate species per sampling station ranged from five to 18 (Figure 64). Twenty-nine of the 37 sampling stations had 10 or more species present. The majority of the documented species were fish, although green frogs, northern leopard frogs (*Rana pipiens*), painted turtles (*Chrysemys picta*), and snapping turtles (*Chelydra serpentina)* were also present. One non-native aquatic invertebrate species, the rusty crayfish (*Orconectes rusticus*), was identified during sampling.

Figure 64. Aquatic vertebrate species richness (number of species per sample site) in Pleasant Lake, August – September 2007.



Other Rare Features

Objectives

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

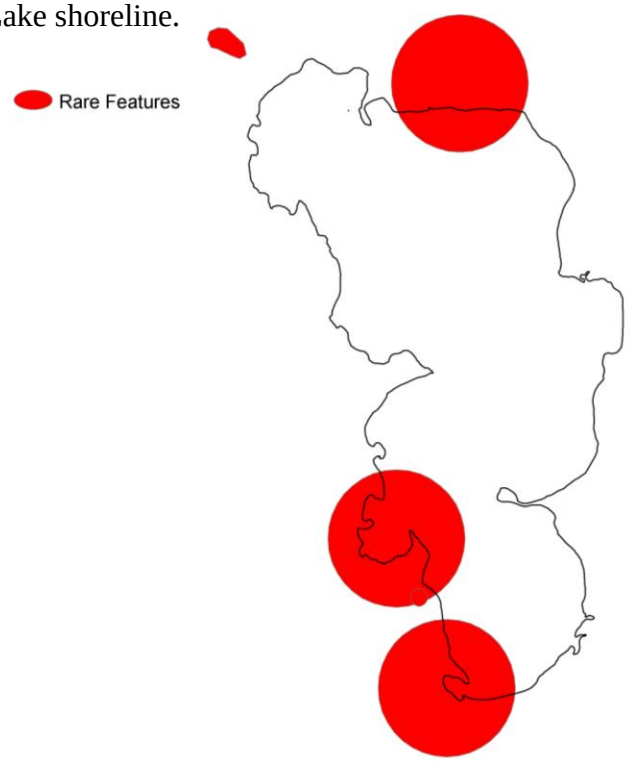
Researchers obtained locations of rare features from the Rare Features Database. Only "listed" animal species (Federal or State endangered, threatened, or special concern) were considered in this project; rare plant species were included in the "Unique Plant Species" section of this report. Rare features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

Five rare features have been identified at Pleasant Lake (Figure 65). These features include locations of two bird species of Special Concern and a bird 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 Pleasant Lake, practices that maintain good water quality and the integrity of the shoreline will be beneficial to all species involved.

Figure 65. Natural Heritage Database rare features (Federal or State-listed endangered, threatened, or special concern species) located within 1320 feet of Pleasant 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

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

Introduction

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

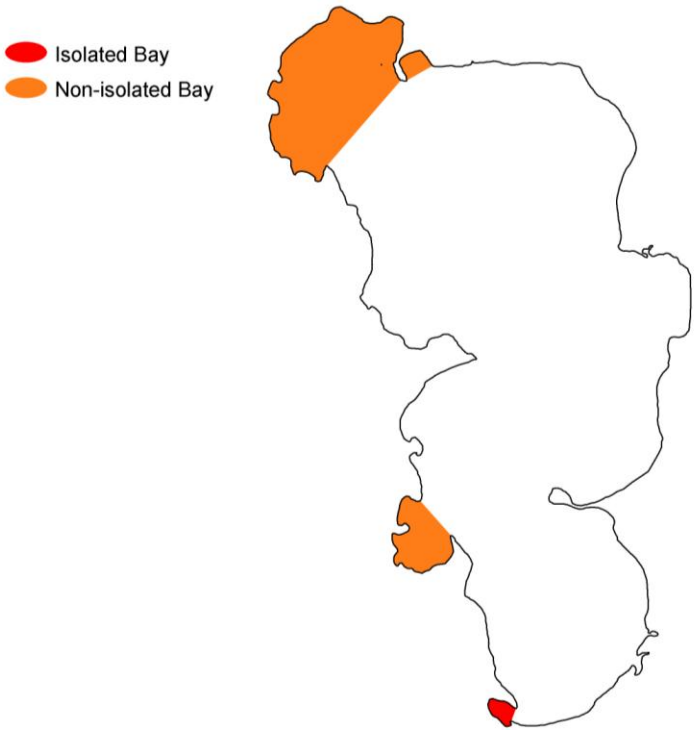
Methods

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

Results

One isolated bay and three non-isolated bays were identified on Pleasant Lake (Figure 66). A small bay on the southern tip of the lake was identified as isolated. Two non-isolated bays were located in the northwestern corner of the lake, and the third non-isolated bay was located along the western edge of Pleasant Lake. Several target wildlife species, including green and mink frogs, loon nests, and unique aquatic plants were found nearly exclusively in and around the delineated bays.

Figure 66. Location of isolated and non-isolated bays in Pleasant Lake.



II. Ecological Model Development

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

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

Scores for each of the layers were summed (Figure 67). 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 68). 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 69).

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 Plant Beds	3	Emergent and/or floating-leaf plant stands occupy > 25% of the aquatic portion of the analysis window
	2	Stands occupy 5 – 25%
	1	Stands present but occupy less than 5%
	0	No emergent or floating-leaf plant beds present
Unique and Rare Plant Species	3	Presence of 2 or more unique or rare plant species within analysis window
	2	Presence of 1 unique plant species
	0	No unique plant species present
Near-shore substrate	3	Frequency of occurrence is > 50% soft substrate (> 50% of points within analysis window consist of soft substrate)
	2	Frequency of occurrence is 25 – 50% soft substrate
	1	Frequency of occurrence < 25% soft substrate
	0	No soft substrate present
Birds	3	Presence of 3 or more SGCN within analysis window
	2	Presence of 2 SGCN
	1	Presence of 1 SGCN
	0	No SGCN 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 artificial loon nest (nesting platform)
	0	No loon nesting observed
Frogs	3	Presence of both mink frogs and green frogs within analysis window
	2	Presence of mink frogs or green frogs
	0	Neither mink frogs nor green frogs present

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 observed
Aquatic Vertebrate Richness	3	Total number of aquatic vertebrate species within analysis window > 10
	2	Total number of aquatic vertebrate species 5 – 10
	1	Total number of aquatic vertebrate species 1 – 4
	0	No aquatic vertebrate species observed
Rare Features	3	Presence of multiple Natural Heritage features within analysis window
	2	Presence of one Natural Heritage feature
	0	No Natural Heritage feature present
Bays	3	Isolated bay within analysis window
	2	Non-isolated bay
	0	Not a distinctive bay

Figure 67. Total score layer created by summing scores of all 15 variables. Highest total scores represent most sensitive areas of shoreline.

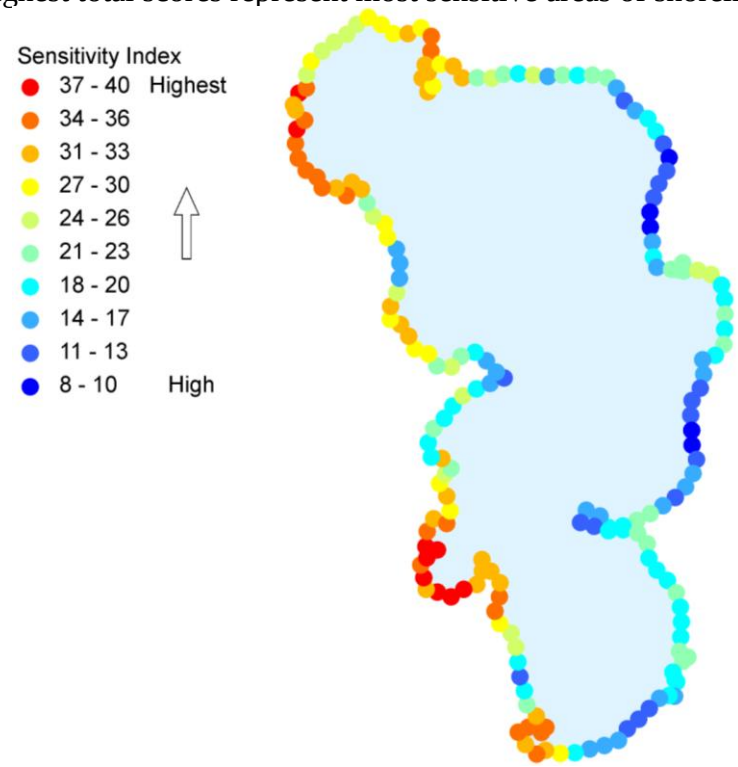


Figure 68. GIS-identified clusters of points with similar total scores. Red areas are those with high scores (i.e., areas of highly sensitive shoreland).

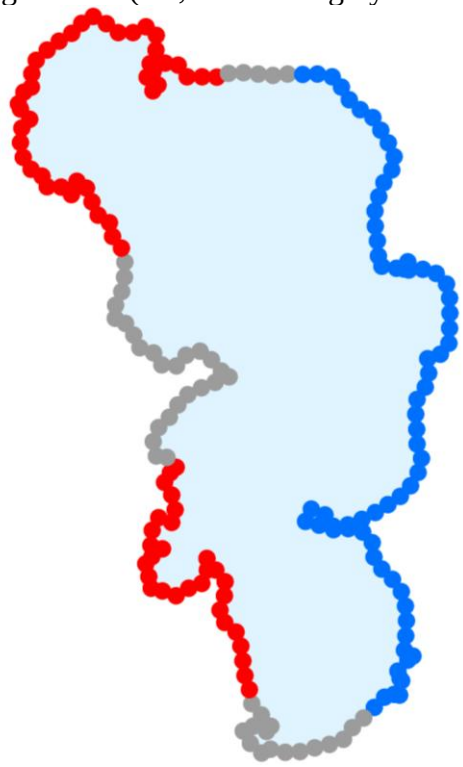
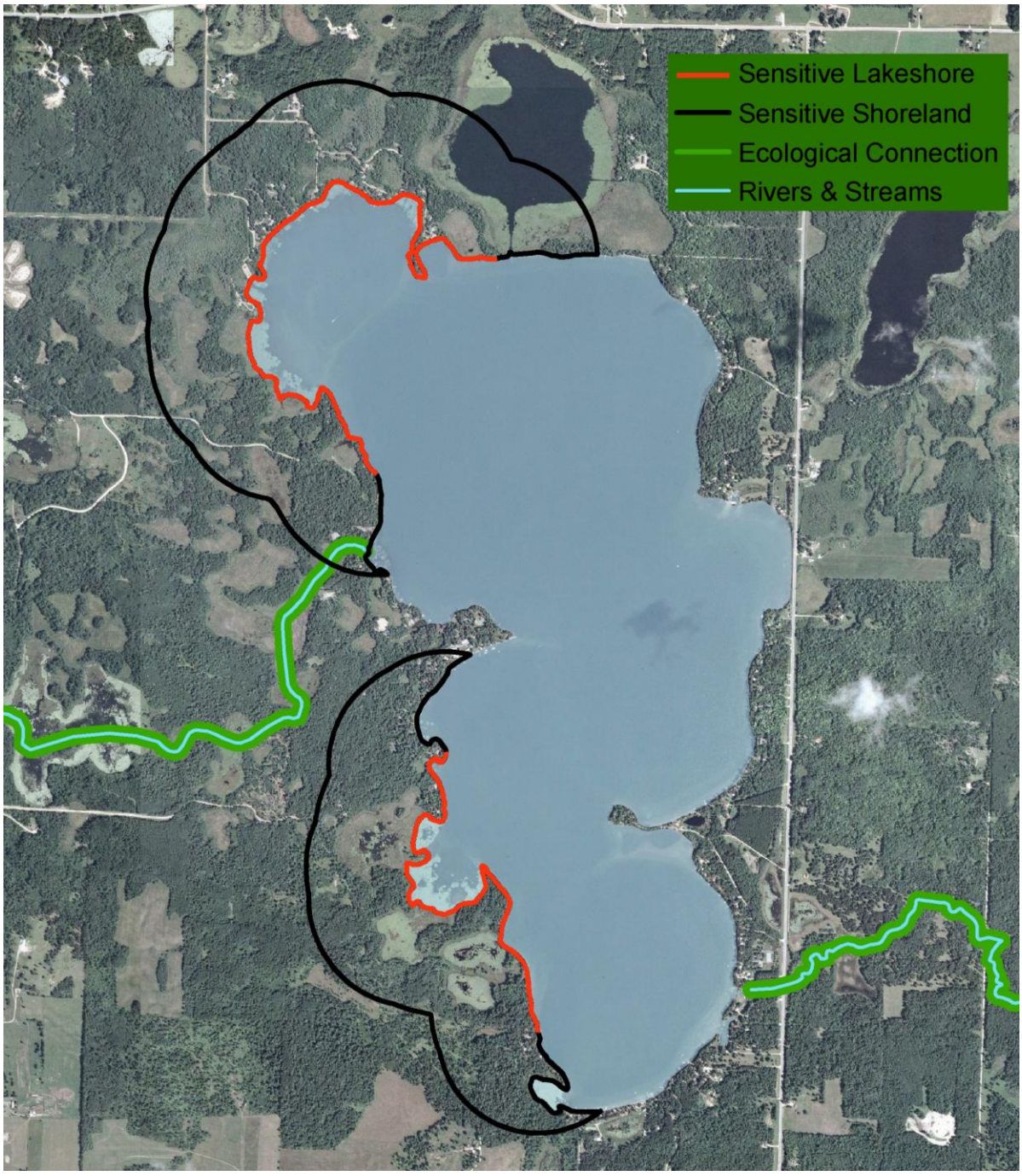


Figure 69. The Pleasant Lake sensitive lakeshore areas identified by the ecological model and ecological connections.



Habitat Connectivity

In addition to the sensitive lakeshore 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. These organisms can move between existing habitats, colonize new areas, or recolonize former habitat

in the wake of local extinctions. The Boy River as it enters and exits Pleasant Lake was identified as an important ecological connection. The inlet supports known spawning movement of northern pike and walleye. Both the inlet and outlet provide important habitat connectivity, allowing movement of organisms between Pleasant Lake and Poquet Lake and Big Deep Lake and many other lakes upstream and downstream. Depending on the existing shoreland classification of this river, the County may use the ecological connection recommendation to consider reclassifying to a more protective river class.

Other Areas of Ecological Significance

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

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

Other Pleasant 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

As the field surveys documented, the bays supported the greatest diversity of plant and wildlife species, including species of greatest conservation need. Critical habitat, such as emergent and floating-leaf vegetation, was also present in the highest quantities near the bays. The ecological model displays these areas both as sensitive shoreline and as high priority shorelands. Although the shoreline itself is important, development and land alteration nearby 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. Pleasant Lake also has two areas identified as important ecological connections. The Boy River, which connects Pleasant Lake to nearby lakes such as Poquet Lake and Big Deep Lake, is an important part of the lake ecosystem. This river allows movement of animals from various populations, increasing diversity. It also allows animals with different vegetation requirements during different life stages to access those habitats. Protection of both the shoreline itself and the habitat surrounding the shoreline will be the most effective way to preserve the plant and animal communities in and around Pleasant Lake, and the value of the lake itself.

References

Arber, A. 1920. Water plants: A study of aquatic angiosperms. Cambridge University Press. 436 pp.

Becker, G.C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison. 1052 pp. http://digital.library.wisc.edu/1711.dl/EcoNatRes.FishesWI

Borman, S., R. Korth and J. Temte. 2001. Through the looking glass: A field guide to aquatic plants. The Wisconsin Lakes Partnership, Stevens Point, Wisconsin. 248 pp.

Bourdaghs, M., C.A. Johnston, and R.R. Regal. 2006. Properties and performance of the floristic quality index in Great Lakes coastal wetlands. Wetlands 26(3):718–735.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 131 pp.

Crow, G.E. and C.B. Hellquist. 2000. Aquatic and wetland plants of Northeastern North America. 2 volumes. The University of Wisconsin Press.

Fassett, N.C. 1957. A manual of aquatic plants. The University of Wisconsin Press. 405 pp.

Flora of North America Editorial Committee, eds. 1993+. Flora of North America north of Mexico. 12+ vols. New York and Oxford. www.efloras.org

Magurran, A.E. 2004. Measuring biological diversity. Blackwell Science, Oxford.

Meredith, T.C. 1983. The effects of shorezone development on the nature of adjacent aquatic plant communities in Lac St. Louis, Quebec.Lake and Reservoir Management Proceedings. 3rd Annual Nalms Conference. North American Lake Management Society. October 1983. Washington, D.C. pp.527-530.

Minnesota Department of Natural Resources. 1993. Lake Survey Manual. Section of Fisheries, St. Paul.

Minnesota Department of Natural Resources. 2003. Field guide to the native plant communities of Minnesota: The Laurentian Mixed Forest province. Ecological Land Classification Program, Minnesota Biological Survey, and Natural Heritage and Nongame Research Program, St. Paul.

Minnesota Department of Natural Resources. 2005. Lake information report, Pleasant Lake. Minnesota Department of Natural Resources, Division of Fish and Wildlife. http://www.dnr.state.mn.us/lakefind.index.html

Minnesota Department of Natural Resources. 2005b. Aquatic vegetation mapping guidelines. Working version, May 2005. Section of Fisheries, St. Paul.

Minnesota Department of Natural Resources. 2006. Tomorrow's habitat for the wild and rare: An action plan for Minnesota wildlife, comprehensive wildlife conservation strategy. Division of Ecological Services, Minnesota Department of Natural Resources.

Minnesota Department of Natural Resources. 2008. Minnesota's sensitive lakeshore identification manual: A conservation strategy for Minnesota lakeshores (version 1). Division of Ecological Resources, Minnesota Department of Natural Resources.

Minnesota Department of Natural Resources. 2008b. Natural wild rice in Minnesota. A wild rice study document submitted to the Minnesota Legislature by the Minnesota Department of Natural Resources, February 15, 2008. 117 pp. http://files.dnr.state.mn.us/fish_wildlife/legislativereports/20080215_wildricestudy.pdf

Minnesota Pollution Control Agency. 2008. Clean lake monitoring program. Minnesota Pollution Control Agency, St. Paul. http://www.pca.state.mn.us/clmp.html

MNTaxa. 2009. Minnesota State checklist of vascular plants. Minnesota Department of Natural Resources, Division of Ecological Resources, St. Paul.

Moyle, J.B. 1945. Some chemical factors influencing the distribution of aquatic plants in Minnesota. American Midland Naturalist 34:402-420.

Myhre, K. 2008. Plant survey of Pleasant Lake (11-0383-00), Cass County, Minnesota, July 15, 2008. Minnesota Department of Natural Resource, Ecological Resources Division. Minnesota County Biological Survey Program. Unpublished data.

NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. http://www.natureserve.org/explorer

Nichols, S.A. 1999a. Floristic quality assessment of Wisconsin lake plant communities with example applications. Lake and Reservoir Management 15(2):133-141.

Nichols, S.A. 1999b. Distribution and habitat descriptions of Wisconsin lake plants. Wisconsin Geological and Natural History Survey. Bulletin 96. Madison. 266 pp.

Nicholson, S.A. 1981. Changes in submersed macrophytes in Chautaqua Lake, 1937-1975. Freshwater Biology 11:523-530.

Niemeier, P.E. and W.A. Hubert. 1986. The 85-year history of the aquatic macrophyte species composition in a eutrophic prairie lake (Unites States). Aquatic Botany 25:83-89.

Ownbey, G.B. and T. Morley. 1991. Vascular plants of Minnesota: A checklist and atlas. University of Minnesota Press, Minneapolis. 307 pp.

Perleberg, D and S. Loso. 2008. Aquatic vegetation of Pleasant Lake (DOW 11-0383-00), Cass County, Minnesota, 2007. Division of Ecological Resources, Minnesota Department of Natural Resources, Brainerd. 24 pp.

Pip, E. 1987. Species richness of aquatic macrophyte communities of Central Canada. Hydrobiological Bulletin 21(2):159-165.

Rolon, A.S., T. Lacerda, L. Maltchik, and D.L. Guadagnin. 2008. Influence of area, habitat and water chemistry on richness and composition of macrophyte assemblages in southern Brazilian wetlands. Journal of Vegetation Science 19:221-228.

Stuckey, R.L. 1971. Changes of vascular aquatic flowering plants during 70 years in Put-in-Bay Harbor, Lake Erie, Ohio. The Ohio Journal of Science 71:321-342.

Vestergaard, O. and K. Sand-Jensen. 2000. Aquatic macrophyte richness in Danish lakes in relation to alkalinity, transparency, and lake area. Canadian Journal of Fisheries and Aquatic Sciences 57:2022-2031.

Voss, E.G. 1985. Michigan Flora: A guide to the identification and occurrence of native and naturalized seed-plants of the state. Part II Dicots (Saururaceae-Cornaceae). Cranbrook Institute of Science Bulletin 59 and University of Michigan Herbarium. 724 pp.

Appendix 1. Shoreline plants recorded in Pleasant Lake, 2008.

Description	Common Name	Scientific Name	Date
Grasses and Sedges	Lake sedge	*Carex lacustris*	2008b
	Giant cane	*Phragmites australis*	2008a
Forbs	Swamp milkweed	*Asclepias incarnata*	2008b
	Beggarticks	*Bidens* sp.	2008a
	Bedstraw	*Galium* sp.	2008a
	Spotted Joe Pye-weed	*Eutrochium maculatum*	2008a
	Jewelweed	*Impatiens capensis*	2008a,b
	Blue lobelia	*Lobelia siphilitica*	2008a
	Water horehound	*Lycopus unifloris*	2008a
	Wild mint	*Mentha arvensis*	2008a
	Evening primrose	*Oenethera biennis*	2008a
	Smartweed	*Persicaria* sp.	2008a
	False dragonhead	*Physostegia virginiana*	2008a
Shrubs	Juneberry	*Amelanchier* sp.	2008a
	Raspberry	*Rubus* sp.	2008a
	Wild rose	*Rosa* sp.	2008a
	Willow	*Salix* sp.	2008a,b
Non-native	Spotted knapweed	*Centaurea biebersteinii*	2008a
	Purple loosestrife	*Lythrum salicaria*	2008a
	Reed canary grass	*Phalaris arundinacea*	2008a,b
	Bittersweet nightshade	*Solanum dulcamara*	2008a

2008a= Located during 2008 nearshore plot surveys.

2008b = Located only during Minnesota County Biological Survey, 15 July 2008.

Nomenclature follows MNTaxa 2009.

Appendix 2. Bird species list. Includes all species within Pleasant 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*
Common Goldeneye	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Common Loon	*Gavia immer*
American White Pelican	*Pelecanus erythrorhynchos*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Sora	*Porzana carolina*
Ring-billed Gull	*Larus delawarensis*
Caspian Tern	*Sterna caspia*
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*
Olive-sided Flycatcher	*Contopus cooperi*
Eastern Wood-Pewee	*Contopus virens*
Alder Flycatcher	*Empidonax alnorum*
Least Flycatcher	*Empidonax minimus*
Eastern Phoebe	*Sayornis phoebe*
Eastern Kingbird	*Tyrannus tyrannus*
Yellow-throated Vireo	*Vireo flavifrons*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*

Appendix 2, continued.

Common Name	Scientific Name
Common Raven	*Corvus corax*
Tree Swallow	*Tachycineta bicolor*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapillus*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
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*
Yellow-rumped Warbler	*Dendroica coronata*
Pine Warbler	*Dendroica pinus*
Blackpoll Warbler	*Dendroica striata*
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*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Baltimore Oriole	*Icterus galbula*
Purple Finch	*Carpodacus purpureus*
House Finch	*Carpodacus mexicanus*
Pine Siskin	*Carduelis pinus*
American Goldfinch	*Carduelis tristis*