Final Report
Sensitive Lakeshore Survey
Pelican Lake (18-0308-00)
Crow Wing County, Minnesota

June 2011

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ECOLOGICAL AND WATER RESOURCES

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

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

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Executive Summary

A total of forty-two native aquatic plant taxa were documented in Pelican Lake, including 27 submerged, two free-floating, four floating-leaf and nine emergent taxa. More than 20 additional shoreline emergent plants have also been recorded. Submerged aquatic plants occurred around the entire perimeter of Pelican Lake and plants were found to a depth of 25 feet. Plant occurrence was greatest in depths from 11 to 20 feet, where 72% of the sites were vegetated. Common submerged plants included muskgrass, stonewort, coontail, bushy pondweed, and broad and narrow-leaf pondweeds. Floating-leaf plants, including white waterlily, yellow waterlily, and floating-leaf pondweed, occupied about 41 acres. About 89 acres of bulrush were mapped. Six unique plant taxa were also documented in Pelican Lake.

Surveyors identified 75 bird species at Pelican Lake, including 16 species of greatest conservation need. Three new county nesting records were documented; the common tern, herring gull, and red-breasted merganser. A significant population of nesting ring-billed gulls was found on Gooseberry Island, along with smaller numbers of double-crested cormorants and great blue herons. The common loon was the most commonly recorded species of greatest conservation need, while American crows were the most commonly detected species overall. Bird species diversity was highest in the wetland area south of Stewarts Bay.

One near-shore fish species of greatest conservation need, the least darter, was detected at several locations during the 2010 nongame fish surveys on Pelican Lake. In addition, one offshore-dwelling species of greatest conservation need, the greater redhorse, was also identified. Three proxy species, the blacknose shiner, blackchin shiner, and banded killifish, were noted at multiple survey sites, particularly within the western bays. Total fish species diversity recorded during the nongame fish surveys was 34 species, bringing the total observed historical fish community to 41 species.

Both green frogs and mink frogs were documented during the Pelican Lake frog surveys. Green frogs were recorded more frequently than mink frogs, and were heard at approximately 20% of the survey sites. Frog locations were primarily within the bays, including Stewarts Bay, Cree Bay, Breezy Bay, Moose Bay, and Jones Bay. Other anuran species documented at Pelican Lake included gray tree frogs, American toads, western chorus frogs and spring peepers.

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 14 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 14 attributes. Lakeshore segments were then clustered by sensitivity index values using established geospatial algorithms. Sensitive lakeshore areas were buffered and important ecological connections or linkages mapped. The identification of sensitive lakeshore areas by this method is an objective, repeatable and quantitative approach to the combination of multiple lines of evidence through calculation of weight of evidence. The ecological model results are

lake-specific, in that the model results are intended to recognize the most probable highly sensitive lakeshores for a specific lake. Plant and animal assemblages differ naturally between lakes, and sensitivity scores should not be compared across lakes.

The ecological model identified four primary sensitive lakeshore areas to be considered for potential resource protection districting by Crow Wing County. The County may use this objective, science-based information in making decisions about districting and reclassification of lakeshore areas. The most probable highly sensitive lakeshore areas and the recommended resource protection districts are:

Introduction

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

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

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

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

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

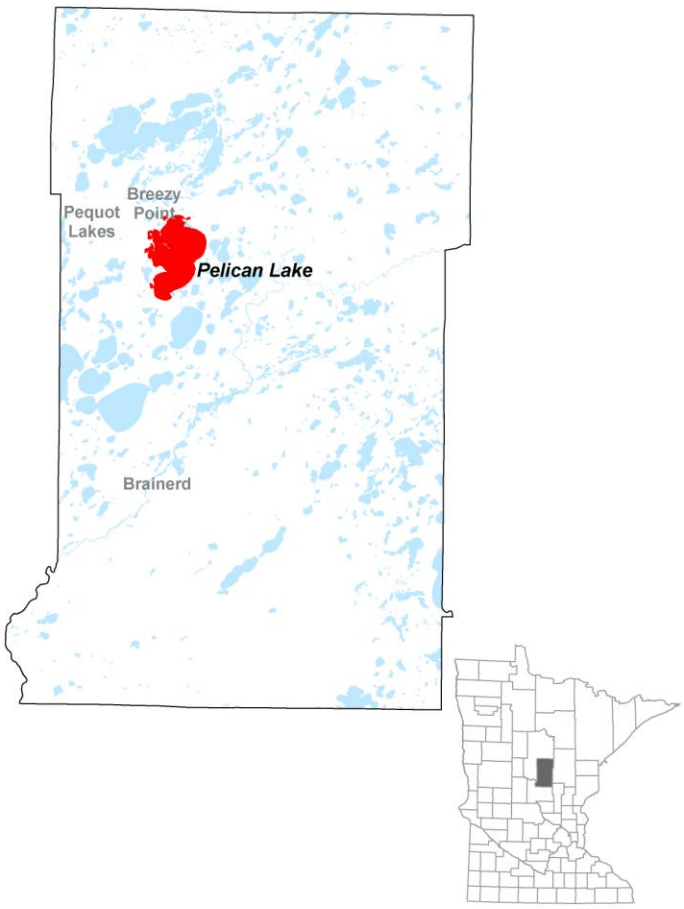
The final component of identifying sensitive lakeshore areas is to deliver advice to local governments and other groups who could use the information to maintain high quality environmental conditions and to protect habitat for species in greatest conservation need.

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

Lake Description

Pelican Lake (DOW 18-0308-00) is located east of the city of Breezy Point in Crow Wing County, north-central Minnesota (Figure 1). It is located within the Laurentian Mixed Forest ecological region, or the true forested region of the state.

Figure 1. Location of Pelican Lake in Crow Wing County, Minnesota.



Pelican Lake occurs within the Pine River Watershed but it is not naturally connected to the Pine River. There are no natural inlets, but a ditch on the north end connects the lake to Lake Ossawinnamakee. Pelican Lake is classified as a seepage lake, and receives most of its flow from groundwater flow and precipitation.

Pelican Lake has a surface area of approximately 8,300 acres, making it the largest lake in Crow Wing County and the Pine River Watershed. The lake stretches about five miles long from north to south, and has about 29 miles of shoreline. There are multiple bays along the west and north shores. Gooseberry Island, located at the northwest end of the lake, is approximately 15 acres in size (Figure 2). The majority of the Pelican Lake shoreline is privately owned and heavily developed. Four public accesses are available for use (Figure 3).

Pelican Lake has a maximum depth of 104 feet but nearly half of the lake is shallow (15 feet or less in depth). Along the east shore, broad shallow zones extend up to one mile from shore, while the southern and western shorelines tend to have much steeper depth contours (Figure 4).

Pelican Lake is characterized as oligotrophic, with low levels of nutrient enrichment. The average Secchi depth (which measures water transparency) between 1973 and 2008 was nearly 15 feet, indicating relatively high water clarity (MPCA 2011).

Figure 2. Gooseberry Island, 2010.

Figure 3. Features of Pelican Lake.

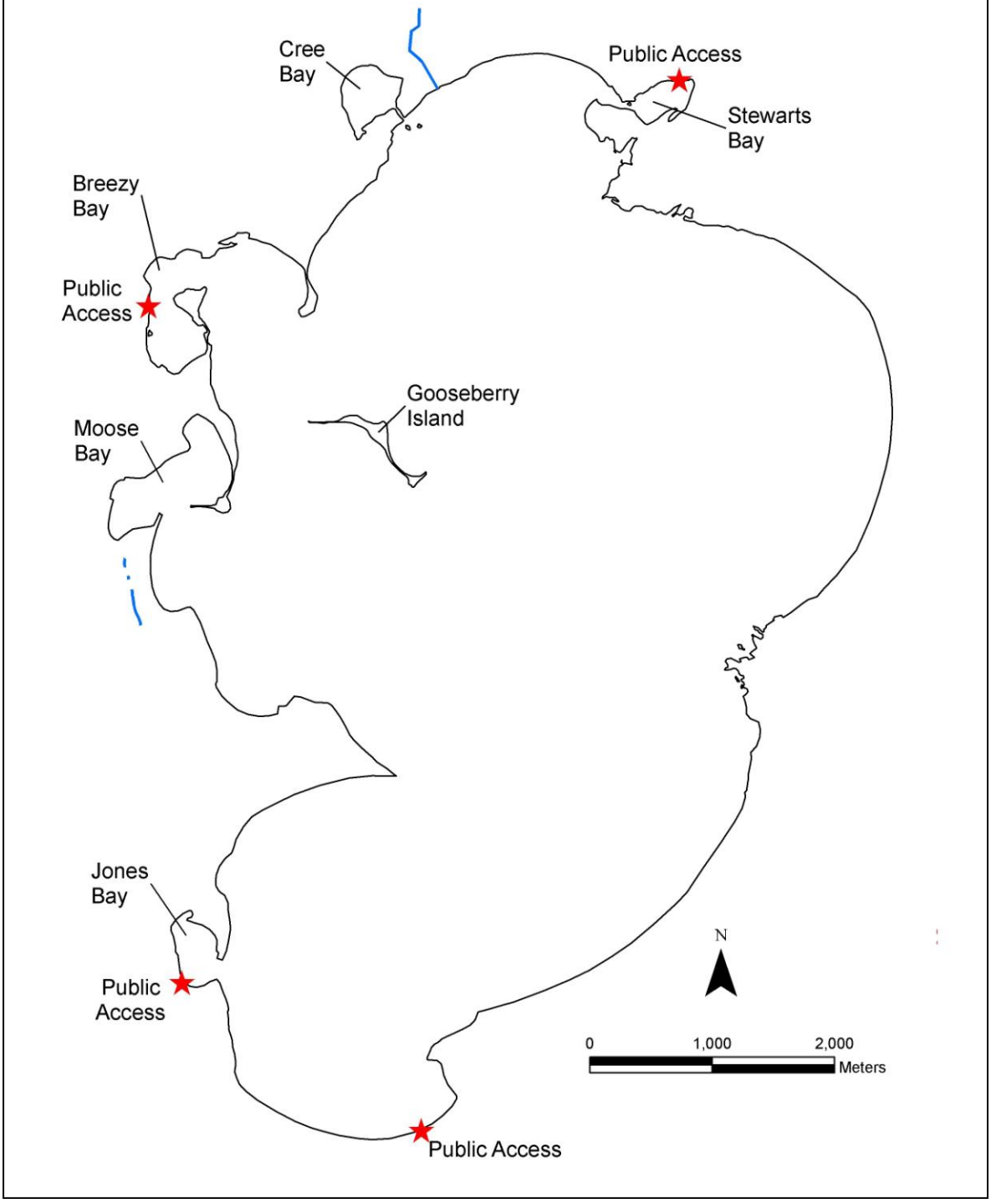
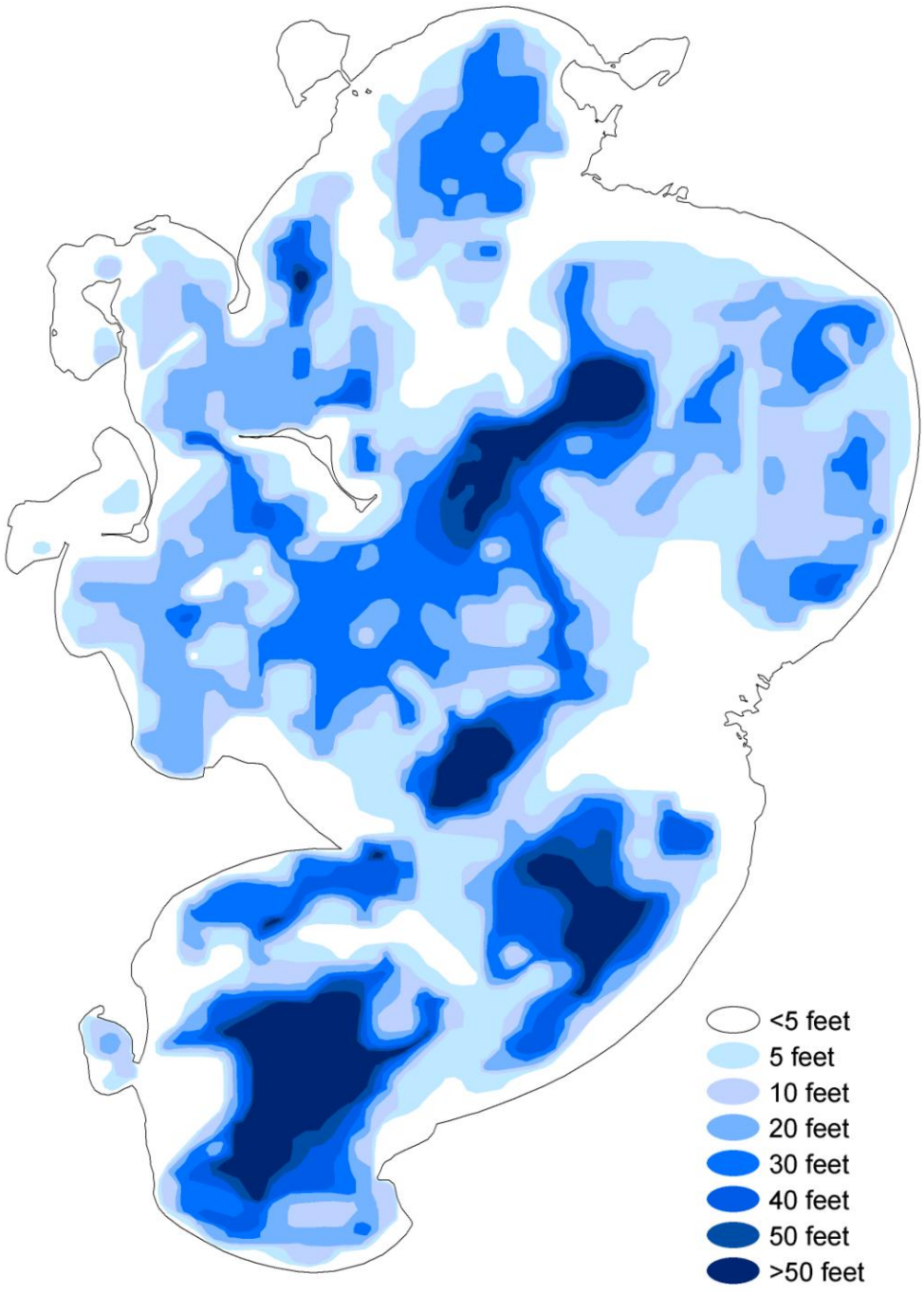


Figure 4. Depth contours of Pelican Lake (based on 2010 data).



I. Field Surveys and Data Collection

Survey and data collection followed Minnesota's Sensitive Lakeshore Identification Manual protocol (MN DNR 2009). Resource managers gathered information on 14 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, near-shore plant occurrence, aquatic plant richness, presence of emergent and floating-leaf plant beds, unique plant species, near-shore substrate, birds, bird species richness, loon nesting areas, frogs, fish, aquatic vertebrate species richness, rare features, and size and shape of natural areas.

Pugnose shiner photo courtesy of Konrad Schmidt

Wetlands

Objective

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

Introduction

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

Results

Approximately 330 acres, or 10%, of the Pelican Lake shoreland area (the area within 1320 feet of the shoreline) are described as wetlands by NWI. Pelican Lake wetlands were fairly patchy in distribution (Figure 5). Many of the wetlands occurred in small pockets scattered along the shoreline. Interspersed among these small pockets were several larger wetland complexes. These larger wetlands occurred south of Stewarts Bay, south and west of Moose Bay, and along the eastern lake shoreline.

The most common wetland type occurring within the Pelican Lake shoreland was the palustrine emergent (Cowardin et al. 1979) or marsh (MN DNR 2003) system. Within this wetland type, the primary water regime was identified as seasonally flooded, meaning that surface water persists through the growing season or the water table is near the ground's surface. Other water regimes included seasonally flooded, intermittently exposed, or saturated substrate. The dominant vegetation within the emergent wetland system was herbaceous vegetation. Scrub-shrub (Cowardin et al. 1979)/wetland shrubland (MN DNR 2003) and unconsolidated bottom wetlands were also present at Pelican Lake.

Figure 5. Wetlands within 1320 feet of Pelican Lake shoreline.

Hydric Soils

Objective

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

Introduction

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

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

Methods

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

Results

At the time of the writing of this report, digitized soil survey data was available for only a portion of Crow Wing County, and did not include the north and west shores of Pelican Lake. Because a complete data layer did not exist, hydric soils were not included in the final analysis.

Plant Surveys

Objectives

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

Forty-two native aquatic plant taxa have been documented in Pelican Lake, including 27 submerged, two free-floating, four floating-leaf and nine emergent taxa. An additional 23 shoreline emergent plants were also recorded.

Submerged aquatic plants occurred around the entire perimeter of Pelican Lake and plants were found to a depth of 25 feet. Plant occurrence was greatest in depths from 11 to 20 feet, where 72% of the sites were vegetated. Common submerged plants included muskgrass (*Chara* sp.), stonewort (*Nitella* sp.), coontail (*Ceratophyllum demersum*), bushy pondweed (*Najas flexilis*), and broad and narrow-leaf pondweeds (*Potamogeton* spp.). The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was present in the lake, but occurred infrequently and was not found in any sample sites.

In the shore to five feet depth zone, 11% of the sample sites contained at least one emergent or floating-leaf plant. Floating-leaf plants, including white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), and floating-leaf pondweed (*Potamogeton natans*), occupied about 41 acres. About 89 acres of bulrush (*Schoenoplectus* spp.) were mapped.

Unique plants documented in Pelican Lake were small burreed (*Sparganium natans*), wild calla (*Calla palustris*), three-way sedge (*Dulichium arundinacium*), wiregrass woolly sedge (*Carex lasiocarpa*), flat-leaved bladderwort (*Utricularia intermedia*), and lesser bladderwort (*Utricularia minor*).

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 in aquatic plant growth, whereas sheltered shallow areas may support an abundant and diverse native aquatic plant community that in turn, provides critical fish and wildlife habitat and other lake benefits. The annual abundance, distribution and composition of aquatic plant communities may change due to environmental factors, predation,

the specific phenology of each plant species, introductions of non-native plant or animal species, and human activities in and around the lake.

Non-native aquatic plant species, such as curly-leaf pondweed (*Potamogeton crispus*), may impact lakes, particularly if they form dense surface mats that shade out native plants. However, the mere presence of an invasive species in a lake may have little or no impact on the native plant community and the presence of a healthy native plant community may help limit the growth of non-natives.

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, wild rice and waterlilies. 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 macroalgae

Algae are primitive forms of plants that do not form true roots, flowers or vascular tissue. They range in size from single cells to giant seaweeds. Freshwater algae that live in Minnesota lakes include tiny, free-floating planktonic algae, filamentous algae, and macroalgae. Macroalgae often resemble rooted plants and provide similar habitat and water quality benefits and were therefore included in this survey.

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

Figure 6. Bed of muskgrass

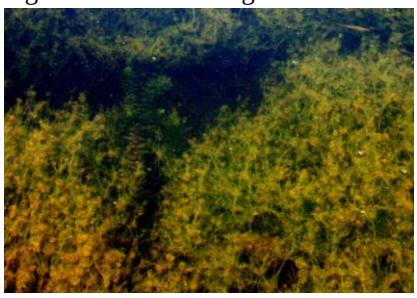


Figure 7. Stonewort on Pelican Lake

Stonewort (*Nitella* sp.; Figures 7) is also a large algae but lacks the brittle texture and musky odor of muskgrass. It is often bright green in color and resembles strands of hair. Stonewort is often found in deeper water than muskgrass.

Submerged rooted 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 non-flowering plants such as large algae, mosses, and fern-like plants, and flowering plants that may produce flowers above or below the

water surface. Submerged plants may form low-growing mats or may grow several feet in the water column with leaf shapes that include broad ovals, long and grass-like, or finely dissected.

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

Figure 8. Coontail

Bushy pondweed (*Najas flexilis*; Figure 9) and southern naiad (*Najas guadalupensis*) are native submerged plants that often grow low in the water column and form inconspicuous flowers. The two species look very similar, but bushy pondweed is unusual because it is one of the few annual submerged species in Minnesota and must re-establish every year from seed. It prefers hard substrates and is not tolerant of turbidity (Nichols 1999b). Southern naiad may overwinter as a perennial plant or sprout from seed. The seeds and foliage of both plants are an important duck food and the foliage provides good fish cover.

Figure 9. Bushy pondweed

Photo by: Gary Fewless (UW Green Bay)

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. Some pondweeds may also form floating leaves. Many pondweed species overwinter as hardy rhizomes while other species produce tubers, specialized winter buds, or remain "evergreen" under the ice. Seeds and tubers of pondweeds are an important source of waterfowl food (Fassett 1957). The foliage of pondweeds is food for a variety of marsh birds, shore birds and wildlife and provides shelter, shade and spawning sites for a range of fish species (Borman et al. 2001). Pondweeds inhabit a wide range of aquatic sites and species vary in their water chemistry and substrate preferences and tolerance to turbidity. There are over 20 species of pondweeds in Minnesota and they vary in leaf shapes and sizes.

Pondweeds can be grouped by their leaf shape and size. Ribbon-leaf pondweeds are plants with long, narrow, grass-like leaves. This group includes flat-stem pondweed (*Potamogeton zosteriformis*) and Robbins' pondweed (*P. robbinsii;* Figure 10). Broad-leaf pondweeds are often referred to as "cabbage" by anglers and include large-leaf pondweed (*P. amplifolius*; Figure 11), Illinois pondweed (*P. illinoensis*), white-stem pondweed (*P. praelongus*), variable pondweed (*Potamogeton gramineus*) and clasping-leaf pondweed (*P. richardsonii*). Narrow-leaf

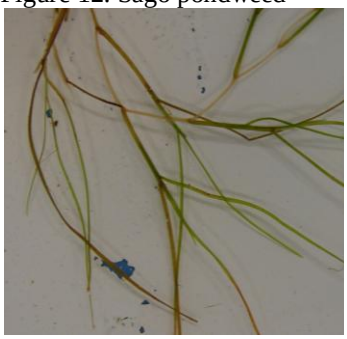
pondweeds, such as sago pondweed (*Stuckenia pectinata;* Figure 12) have very narrow, almost needle-width leaves.

Figure 10. Robbins' pondweed

Figure 11. Large-leaf pondweed

Photo by: Paul Skawindki © 2009

Figure 12. Sago 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 also provide food, cover and nesting material for waterfowl, marsh birds and muskrat. Floating-leaf and emergent plants are most often found in shallow water to depths of about six feet and may extend lake-ward onto mudflats and into adjacent wetlands.

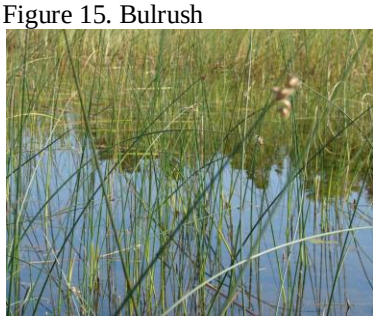
Figure 13. White waterlily

White and yellow waterlilies can be found in lakes in both northern and southern Minnesota. White waterlily (*Nymphaea odorata*; Figure 13) has showy white flowers and round leaves with radiating veins. Yellow waterlily (*Nuphar variegata*; Figure 14) 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 (Nichols1999b).

Figure 14. Yellow waterlily

Emergent aquatic plants have stems and/or leaves that extend well above the water surface. Most emergent plants are flowering plants, though their flowers may be reduced in size. Emergent plants include perennial plants as well as annual plants. Emergent plants can be grouped by leaf width as narrow-leaved, grass-leaved and broad-leaved plants.

Figure 15. Bulrush



Bulrushes (*Schoenoplectus* spp.; Figure 15) are emergent, narrow-leaved, perennial plants that occur in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). Bulrush stems are round in cross section and lack showy

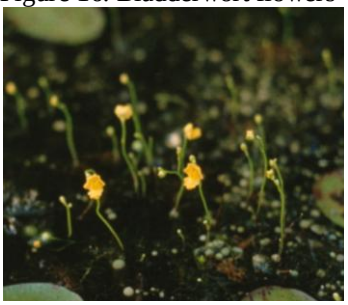
leaves. Clusters of small flowers form near the tips of long, narrow stalks. This emergent may occur from shore to water depths of about six feet and its stems may extend several feet above the water surface. Bulrush stands are particularly susceptible to destruction by excess herbivory and direct removal by humans.

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.
- Plants species with high coefficient of conservatism values (C values). These values range from 0 to 10 and represent the "estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition" (Nichols 1999a, Bourdaghs et al. 2006). Plant species with assigned C values of 9 and 10 were included as unique species.

Figure 16. Bladderwort flowers



Bladderworts (*Utricularia* spp.) are a group of submerged plants with finely divided leaves. They 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 flat-leaved bladderwort (*U. intermedia*) and lesser bladderwort (*U. minor*). 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 16) that emerge above the water surface. They prefer soft substrates (Nichols 1999b) but also float freely in the water column and may be found in protected areas such as waterlily beds. They are found in protected, shallow lake areas and have been documented at scattered locations throughout northern Minnesota (Ownbey and Morley 1991).

Figure 17. Small burreed

Photo by: John Sulman, UW Stevens Point

There are several species of burreed (*Sparganium* spp.) in Minnesota and the genus includes emergent and floating-leaf plants. Burreeds are named for their bur-like cluster of fruits. Small burreed (*Sparganium natans*; Figure 17) is the smallest burreed in the state and occurs in small pools and protected bays of lakes in northeastern Minnesota. This plant forms floating, grass-like leaves that may be up to two feet in length. On mudflats, small burreed may grow as an emergent plant. Flowers are formed in early summer and fruits are formed in middle to late summer.

Figure 18. Water arum

Water arum (*Calla palustris*; Figure 18) 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 (Flora of North America 2007). Within Minnesota, water arum primarily occurs in the northeast half of the state (Ownbey and Morley 1991).

Figure 19. Three-way sedge

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

Three-way sedge (*Dulichium arundinaceum*; Figure 19) is an emergent, perennial plant that grows along soft bottom lakeshores and in marshes. This plant does not produce a showy flower but can be identified by its unique three-ranked leaf arrangement that resembles an airplane propeller from above (Newmaster et al. 1997). Three-way sedge is found along shores of lower alkalinity lakes (Nichols 1999b) throughout central and northern Minnesota (Ownbey and Morley 1991).

Figure 20. Wiregrass-woolly sedge

Wiregrass-woolly sedge (*Carex lasiocarpa*; Figure 20) is an emergent, perennial plant that grows in small tufts with long scaly stolons. It is purplish-red at the base and is usually smooth. The leaves have no midvein and are usually roughened near the tip. The staminate scales are light reddish-brown, erect and can be sessile or subsessile. The pistillate scales are lanceolate and are purplish-brown with a green center. Wiregrass sedge can be found around sloughs and lake shorelines (Mohlenbrock 2005). It is found in northern and central Minnesota at scattered locations (Ownbey and Morley 1991).

Species richness

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

Within a lake, plant species richness generally declines with increasing water depth, as fewer species are tolerant of lower light levels available at deeper depths. Substrate, wind fetch, and other physical site characteristics also influence plant species richness within lakes.

Methods

The aquatic plant communities of Pelican Lake were described and measured using several techniques as found in Minnesota's Sensitive Lakeshore Identification Manual. Plant nomenclature follows MnTaxa 2010.

Grid point-intercept survey
A grid point-intercept survey was conducted in Pelican Lake on June 7, 10, 16, 24, and July 8, 12, 2010 (Simon and Perleberg 2010). A GIS computer program was used to establish aquatic plant survey points throughout the littoral (i.e., vegetated) zone of the lake to a depth of 20 feet. Points were spaced 150 meters apart and 984 sites were sampled within the shore to 25 feet depth interval. An additional 26 sites were surveyed in the 26 to 30 feet depth zone but since no vegetation was found, these deeper water sites were not used in analyses. Frequency was calculated using the survey sites from shore to 25 feet. Surveyors navigated to each site using a handheld Global Positioning (GPS) unit. At each sample site, water depth was measured and all vegetation within a one-meter squared 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.

Emergent and floating-leaf bed delineation
Protocol for mapping plant beds were based on the procedures documented in the DNR draft Aquatic Vegetation Mapping Guidelines (MN DNR 2005). They included a combination of aerial photo delineation and interpretation, field delineation, ground-truthing and site specific surveys. DNR Fisheries biologists mapped bulrush, cattail and wild rice beds in 2009 using handheld GPS units. In 2010, waterlily beds were delineated using 2008 Farm Service Administration (FSA) true color aerial photos. Black and white aerial photos from 1999 were used to help distinguish the true shoreline from mats of perennial vegetation.

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

Surveyors searched for unique and rare plant species in 2010 during the lakewide point-intercept survey. A targeted search for rare aquatic vascular plants was conducted by the Minnesota County Biological Survey Program on September 3, 1998 (Myhre 1998). This search focused on sites that were most likely to contain rare plant species. Botanists used professional experience to select rare species search sites and included factors such as shoreline development, substrate type, water depth, and native plant community type in their site selection. To gain access to shallow vegetated areas, searches were conducted by slowly kayaking, canoeing and/or wading through the site. A brief habitat description and a list of all plant taxa found in the search area were recorded.

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. When necessary, plant specimens were sent to the authority in the field for identification verification and annotation. Voucher specimens were made to document new locations of rare species, county records and some other 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

Aquatic plants were found from shore to a depth of 25 feet and within that zone, 46% of the sites contained vegetation. The greatest occurrence of plants was in the depth zone from 11 to 20 feet, where 72% of the sample sites contained plants. In water depths of 21 to 25 feet, plant frequency was 27%.

Distribution of plants in main basin versus bays

Plants were most common in protected bays, where 82% of the sites were vegetated (Figure 21). Shallow, windswept areas, such as the southeastern and north shore, were sparsely vegetated. Most bays contained beds of emergent and floating-leaved plants.

Aquatic plant species observed

A total of 42 native aquatic plant taxa have been recorded in Pelican Lake, including 33 taxa found in 2010 and an additional nine taxa found during the 1998 rare plant search. These included 27 submerged, two free-floating (Table 1), four floating-leaf and nine emergent taxa (Table 2). Several species that can be difficult to distinguish in the field were grouped together for analysis. One non-native submerged species, curly-leaf pondweed (*Potamogeton crispus*), was documented during the 2010 survey.

Twenty-three shoreline emergent plants have also been documented during surveys of Pelican Lake (Appendix 1).

Figure 21. Aquatic plant distribution in Pelican Lake, 2010.

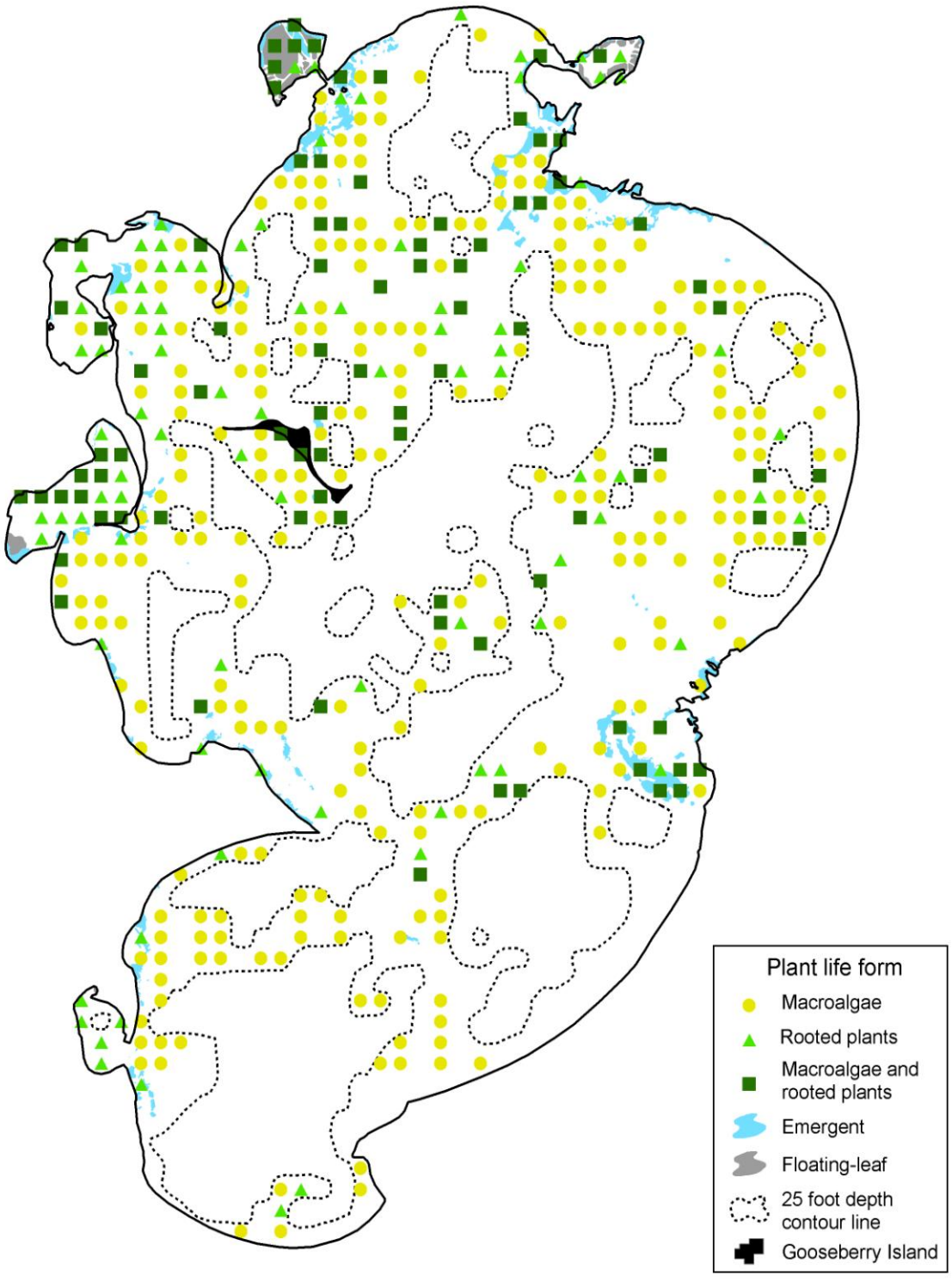


Table 1. Submerged and free-floating aquatic plants recorded in Pelican Lake.

Description			Common name	Scientific name	Frequency[a]
Large algae			Muskgrass	*Chara* sp.	31
			Stonewort	*Nitella* sp.	7
Flowering plants	Small, entire-leaved plants		Bushy pondweed	*Najas flexilis*	5
			Southern naiad	*Najas guadalupensis*	<1
			Canada waterweed	*Elodea canadensis*	3
	Pondweeds	Ribbon-leaved	Flat-stem pondweed	*Potamogeton zosteriformis*	4
			Robbins' pondweed	*Potamogeton robbinsii*	1
		Fine-leaved	Fries' pondweed	*Potamogeton friesii*[b]	5
			Sago pondweed	*Stuckenia pectinata*[b]	
			Small pondweed	*Potamogeton pusillus*	X[c]
			Straight-leaved pondweed	*Potamogeton strictifolius*	X[c]
			Blunt-tipped pondweed	*Stuckenia filiformis*	X[c]
		Broad-leaved	Illinois pondweed	*Potamogeton illinoensis*	**1**
			Variable pondweed	*Potamogeton gramineus*	1
			Clasping-leaf pondweed	*Potamogeton richardsonii*	1
			White-stem pondweed	*Potamogeton praelongus*	2
			Large-leaf pondweed	*Potamogeton amplifolius*	1
			Curly-leaf pondweed	*Potamogeton crispus*	X[d]
	Other ribbon-leaved plants		Wild celery	*Vallisneria americana*	1
			Water stargrass	*Heteranthera dubia*	<1
	Divided-leaved plants		Coontail	*Ceratophyllum demersum*	5
			Northern watermilfoil	*Myriophyllum sibiricum*	2
			Water marigold	*Bidens beckii*	1
			White water buttercup	*Ranunculus aquatilis*	<1
			Greater bladderwort	*Utricularia vulgaris*	<1
			Flat-leaved bladderwort	*Utricularia intermedia*	<1
			Lesser bladderwort	*Utricularia minor*	X[c]
Free-floating			Star duckweed	*Lemna trisulca*	<1
			Turion-forming duckweed	*Lemna turionifera*	X[c]

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations. They represent the percent of the sample stations within the shore to 25 feet depth zone (N = 984) that contained a plant taxon.

[b]Species in this genus were grouped together for analysis because field identification to the species level was difficult.

X[c] = located only during Minnesota County Biological Survey, 3 September 1998 (not found during the 2010 survey).

X[d] = located during the 2010 point-intercept survey but only found outside of sample points.

Table 2. Floating-leaf and emergent aquatic plants recorded in Pelican Lake.

Description		Common Name	Scientific Name	Frequency[a]
Floating-leaf		White waterlily	*Nymphaea odorata*	<1
		Yellow waterlily	*Nuphar variegata*	<1
		Small burreed	*Sparganium natans*	X[c]
		Floating-leaf pondweed	*Potamogeton natans*	X[d]
Emergent	Narrow-leaved	Hard-stem bulrush	*Schoenoplectus acutus*[b]	2
		Soft-stem bulrush	*Schoenoplectus tabernaemontani*[b]	
		Three-square bulrush	*Schoenoplectus pungens*	<1
		Spikerush	*Eleocharis palustris*	1
		Needlegrass	*Eleocharis acicularis*	X[c]
	Grass-leaved	Wild rice	*Zizania palustris*	<1
		Narrow-leaved cattail	*Typha angustifolia*	<1
		Narrow-leaf burreed	*Sparganium emersum*	X[c]
	Broad-leaved	Broad-leaved arrowhead	*Sagittaria latifolia*	X[c]

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations. They represent the percent of the sample stations within the shore to 25 feet depth zone (N = 984) that contained a plant taxon.

[b]Species in this genus were grouped together for analysis because field identification to the species level was difficult.

X[c]= located only during Minnesota County Biological Survey, 3 September 1998 (not found during the 2010 survey).

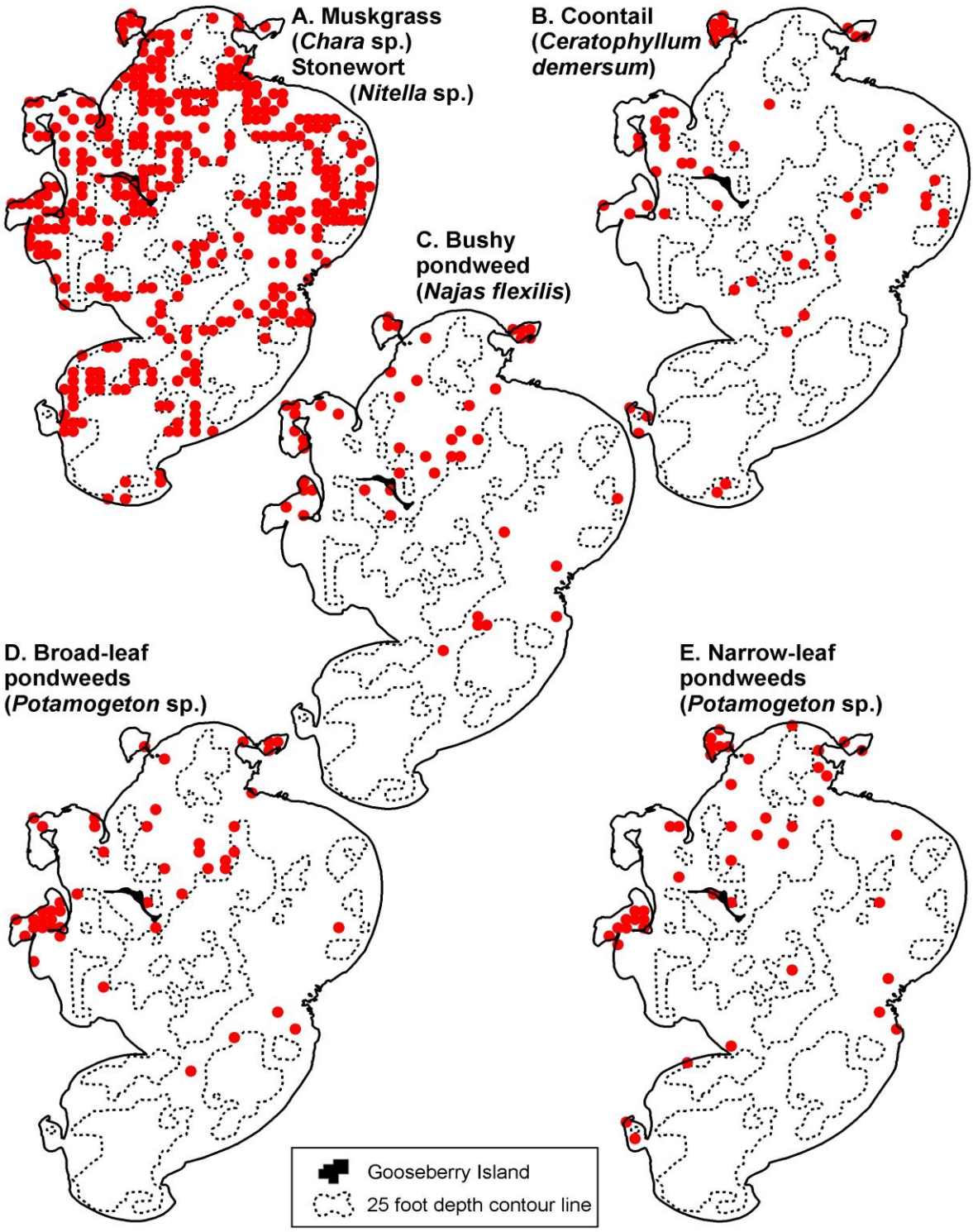
X[d]= located during the 2010 point-intercept survey but only found outside of sample points.

Submerged plants

The plant community included leafy plants that are anchored to the lake bottom by roots as well as large algae that may resemble leafy plants but are weakly anchored to the lake bottom. Low-growing plants were common in Pelican Lake and included muskgrass and stonewort. Muskgrass (*Chara* sp.) was present in 31% of all sample sites and stonewort (*Nitella* sp.) occurred in 7% of the sites (Table 1). These plants were widespread around the shoreline and often occurred together (Figure 22A). Muskgrass dominated the plant community from shore to 15 feet and stonewort was common from 16 to 25 feet.

Coontail was recorded in 5% of the Pelican Lake survey sites, primarily in the protected bays. Bushy pondweed was recorded in 5% of the sites, broad-leaf pondweeds were found in 6% of the sites, and narrow-leaf pondweeds were found in 5% of the sites (Figure 22B, C, D, E).

Figure 22. Distribution of common aquatic plants in Pelican Lake, 2010.



Floating-leaf and emergent plants

Floating-leaf and emergent plants occurred in water depths of five feet and less.

Figure 24. Waterlilies and cattails in Pelican Lake, 2010.

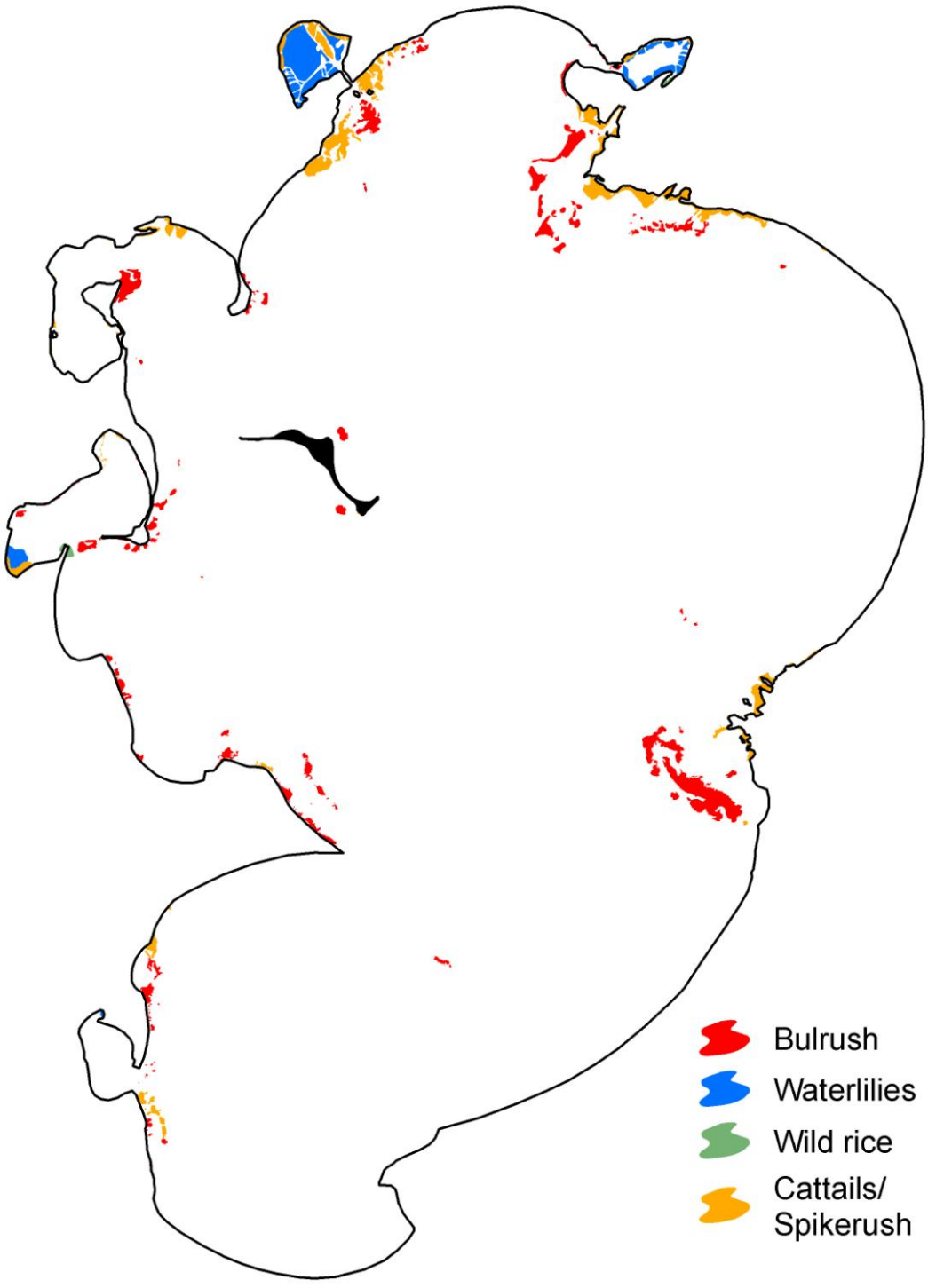
Figure 25. Bulrush bed in Pelican Lake, 2010.

About 41 acres of floating-leaf plant beds were mapped and the largest beds occurred in the protected areas of Cree Bay, and Stewarts Bay (Figure 23). The most common floating-leaf plant 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 scattered bulrush plants as well as submerged plants (Figure 24 – 25) and were usually associated with muck sediments.

Surveyors delineated approximately 166 acres of emergent plants and the most common taxa were bulrush and cattails. About 89 acres of bulrush and mixed bulrush were mapped and about 71 acres of cattails were mapped.

Other emergent plants occurred at scattered locations around the lake and included spikerush and wild rice. Many of these emergent plants occupied the transitional zone between the lake and adjacent wetlands. Numerous additional native emergents occurred in these adjacent wetlands but this survey did not include an exhaustive wetland species inventory.

Figure 23. Distribution of floating-leaf and emergent plant beds in Pelican Lake.



Unique plants
In addition to the commonly occurring plants in Pelican Lake, six unique plant species were located. Flat-leaved bladderwort was found at three sites during the survey and was concentrated in Cree and Moose Bays. Lesser bladderwort, three-way sedge, small burreed, water arum, and wiregrass-woolly sedge were found in Moose Bay (Figure 26). These species are not widespread in Minnesota but their presence is indicative of relatively undisturbed native plant beds in and adjacent to Pelican Lake.

Species richness
The number of plant taxa found in each one square meter sample site ranged from zero to 10 (Figure 27). The greatest number of species was found in protected bays with a mean of three species per site. Most sites in the main lake contained only one plant species or no vegetation.

Figure 26. Unique aquatic plants in Pelican Lake, 2010.

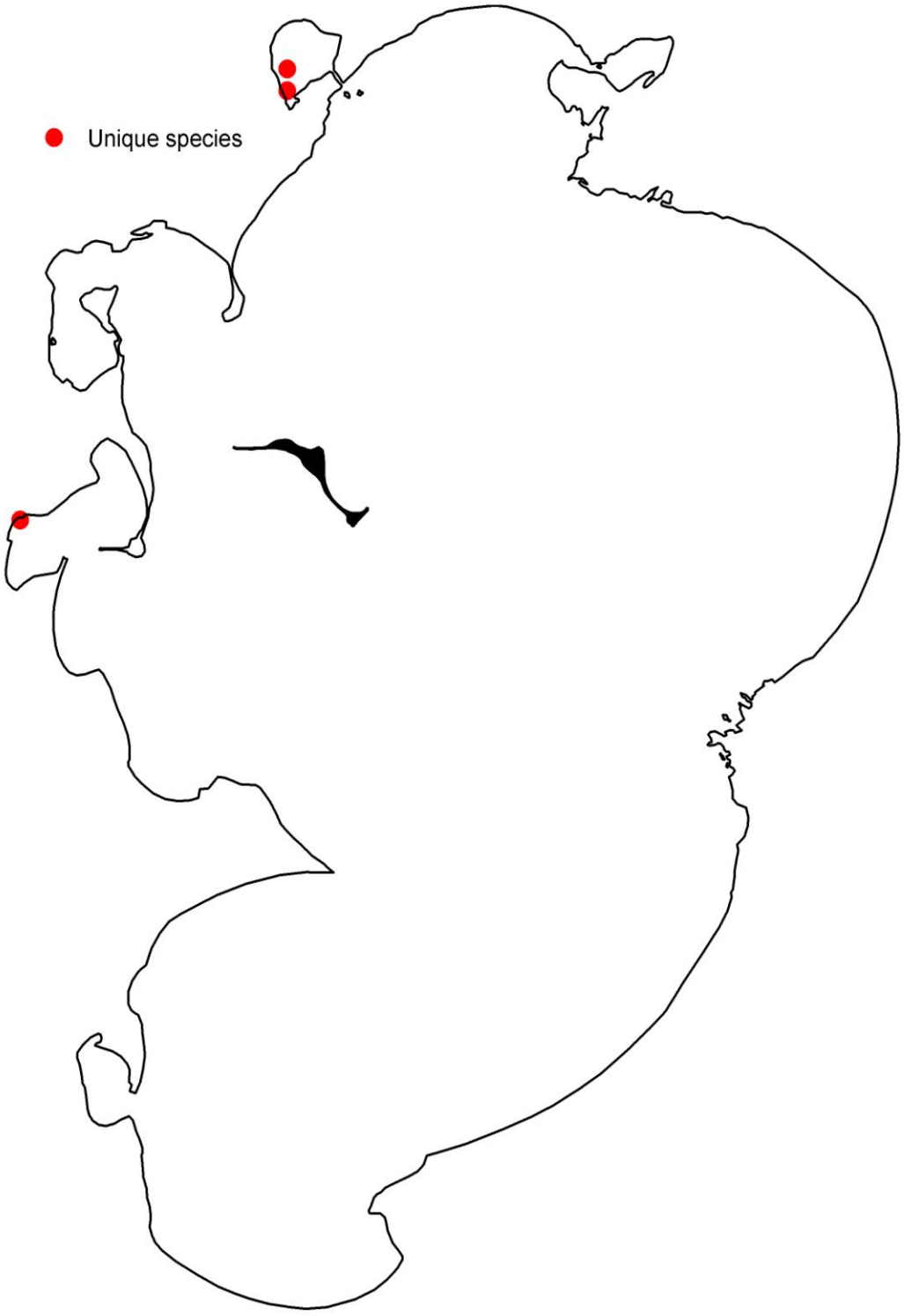
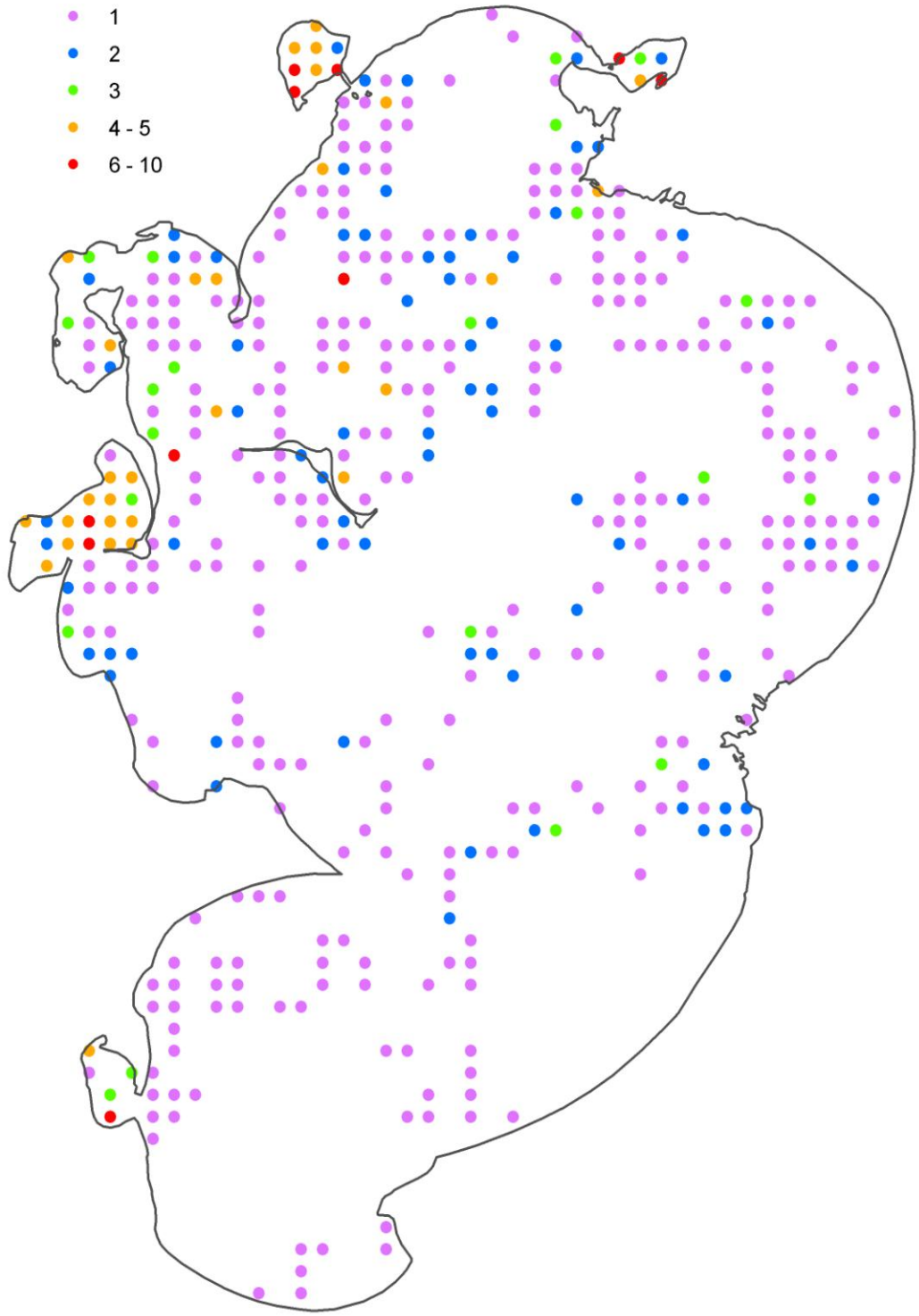


Figure 27. Aquatic plant richness (number of taxa per sampling station), 2010.



Near-shore Substrates

Objective

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

Introduction

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

Rubble substrate along Pelican Lake shoreline

Methods

Near-shore substrate in Pelican Lake was evaluated at a total of 728 sampling stations set up in the grid point-intercept aquatic plant surveys 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; substrate was evaluated at sample sites in seven feet of water or less. 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 109 of these stations.

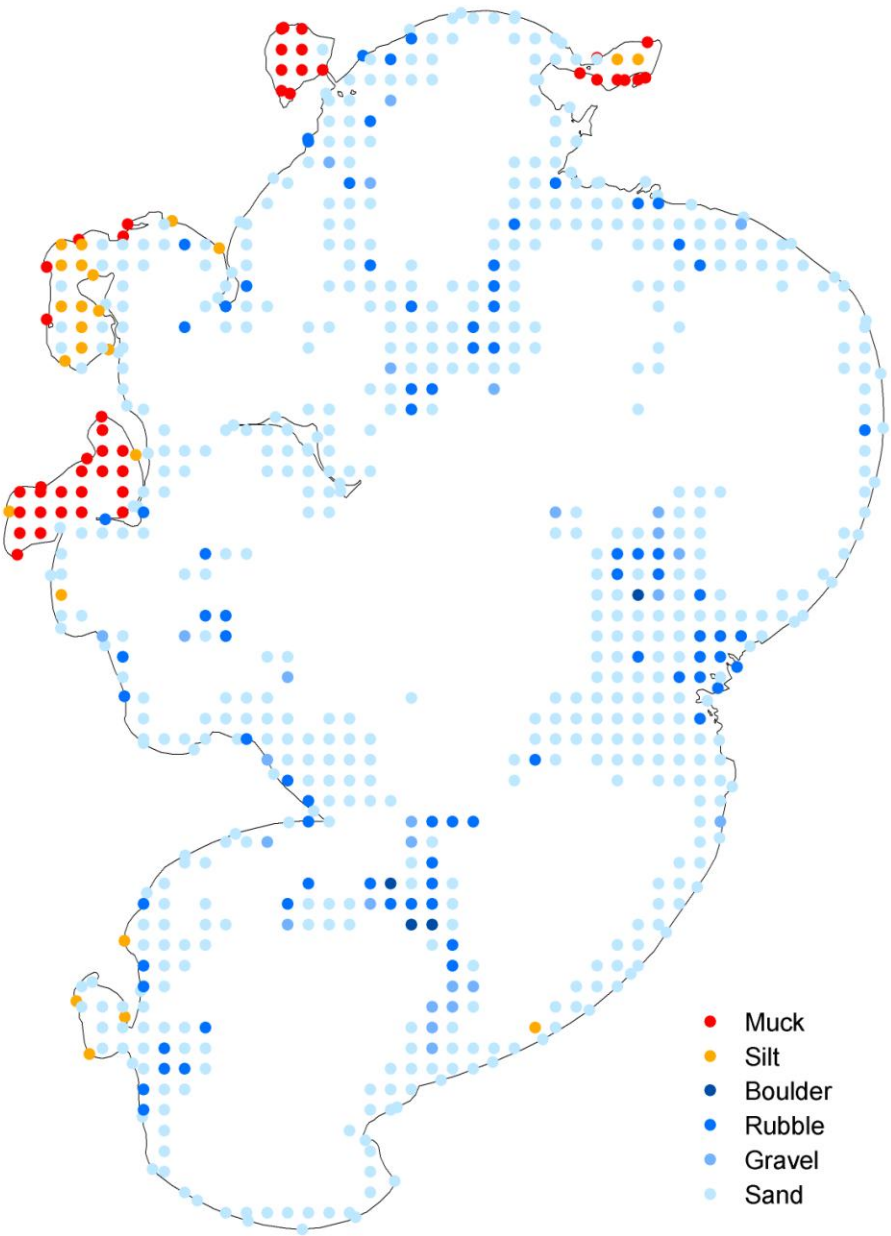
Surveyors evaluated substrate by tapping a pole into the lake bottom; soft substrate could usually be brought to the surface on the pole or sampling rake for evaluation. If this was not feasible, substrate was evaluated by visual observation. Standard lake substrate classes were based on the DNR Fisheries 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 types documented at Pelican Lake ranged from soft (muck and silt) to hard (rubble and boulders) (Figure 28). Muck substrates were present in Stewarts Bay, Cree Bay, Breezy Bay and Moose Bay. Silt substrates were also common in Stewarts Bay, Breezy Bay, and Moose Bay, as well as Jones Bay. Sand substrates occurred all shorelines of the main lake basin, and were interspersed with scattered boulders and rubble. Overall, sand was the most common substrate type, and occurred at nearly 40% of the sample locations.

Figure 28. Distribution of Pelican Lake near-shore substrates, 2010.



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). Sixteen of these species were identified at Pelican Lake.

American white pelicans (*Pelecanus erythrorhynchos*; Figure 29) are one of the largest birds in North America. These white waterbirds have a wingspan of nearly 10 feet, and weigh up to 30 pounds. They have black wingtips and an orange bill with a pouch. Unlike some pelicans, American white pelicans do not dive for their food, but feed while swimming. They nest in colonies on remote freshwater lakes, and depend on wetlands for many stages of their life cycle. Habitat loss is the largest known cause of nesting failure, although predation and boating disturbance can also be factors.

Figure 29. American white pelican

Photo by: Carrol Henderson

Bald eagles (*Haliaeetus leucocephalus*; Figure 30) are an increasingly common sight in Minnesota. Once listed as an endangered species, bald eagle numbers have rebounded due to effective environmental protection laws and conservation efforts. Adult bald eagles are easily identified by the white head and tail, although these colors don't appear until birds are 4 or 5 years old. Prior to that, eagles are generally dark brown with white feathers scattered along the wings, head, tail and back. With a wingspan of up to 7 feet, bald eagles are one of the largest birds in North America. They are found in forested areas near large, open bodies of water. Although bald eagle numbers are increasing, these birds still face threats from environmental contaminants and destruction of habitat. Bald eagles are listed as a species of Special Concern in the state of Minnesota.

Figure 30. Bald eagle

Photo by: Carrol Henderson

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

Figure 31. Black tern

Photo by: Carrol Henderson

Common loons (*Gavia immer*; Figure 32) are one of Minnesota's most recognizable birds. They are found from northeastern to central Minnesota, and numbers are higher here than in any other state except Alaska. These large diving birds possess red eyes and a large, dark pointed bill that is well-adapted for catching fish. Loons spend most of their time in water, and go ashore only to mate and incubate eggs. Summer plumage is spotted black and white, while in winter the colors are gray above and white below. Loon populations are closely monitored in Minnesota; however, these birds still face threats, particularly in the form of human disturbance and lead poisoning.

Figure 32. Common loon

Photo by: Carrol Henderson

Common nighthawks (*Chordeiles minor*; Figure 33) are most often seen in the air, exhibiting an erratic flight pattern as they forage for insects. They are cryptically colored with brown, gray, and white mottling. A white bar is visible across the wing when the bird is in flight. The breeding ritual includes a dramatic display during which the male dives straight toward the ground before quickly turning upward; air rushing through the wings makes a deep booming sound. Originally found in open rural areas, the nighthawk has adapted to urban settings and often nests on gravel rooftops. Despite their adaptability, nighthawks have declined in some areas. Predation and a decreased insect food base due to the use of pesticides may be factors in this decline.

Figure 33. Common nighthawk

Photo by: Carrol Henderson

Common terns (*Sterna hirundo*; Figure 34) are the most widespread terns in North America. In the breeding season common terns have a solid black cap with gray back and underparts. The gray wings have dark edges. The rump is white, and the legs and bill are orange-red in color. Common terns nest in colonies, often on islands or peninsulas of larger lakes with sandy substrates. Populations of common terns declined in the late 1800s, when their feathers were used to adorn clothing, and again in the 1970s, likely due to poisoning by pesticides. Habitat loss, nest predation, and disturbance by humans may also negatively affect common terns.

Figure 34. Common tern

Photo by: Carrol Henderson

Eastern wood-pewees (*Contopus virens*; Figure 35) are medium-sized, nondescript birds common in Eastern forests. They utilize multiple habitat types, including deciduous forests, mixed woods, and suburban areas. This bird gets its name from its call, a slurred "pee-ah-wee." Eastern wood-pewees are grayish-olive above, with a paler throat and belly and whitish wingbars. They forage throughout the canopy, often flying out from their perch to catch insects before returning to the same perch. Populations of eastern wood-pewees are declining throughout much of their range. One possible cause of the decline is the increase in white-tailed deer. Deer browse and decrease the lower-canopy foraging area available to the eastern wood-pewee.

Figure 35. Eastern wood-pewee

Photo by: J.A. Spendelow

Least flycatchers (*Empidonax minimus*; Figure 36) are the smallest flycatchers found in Minnesota. Like many other flycatchers, they are olive to gray in color with two white wingbars and whitish underparts. They have a small bill and a prominent white eye ring. The best way to distinguish least flycatchers from other flycatchers is the call, a harsh "che-bek." These birds are often found along water edges in mature, open woods. Least flycatchers are common throughout most of their range where habitat is suitable. However, they are sensitive to human disturbance and require large areas of forest to survive.

Figure 36. Least flycatcher

Photo by: J.A. Spendelow

Marsh wrens (*Cistothorus palustris*; Figure 37) are small, stocky wrens. Their color is brown with black and white streaks on the back and black barring on the tail. They have a dark brown or black cap and a white eye line. Marsh wrens are noisy birds, and sing almost continually during the breeding season. They often hold their tails in an upright position, in "classic" wren posture. Marsh wrens inhabit a variety of marshes. Emergent vegetation, such as cattails or bulrush, is one of the most important habitat components. While populations of marsh wrens are increasing in some areas, others are threatened by loss and degradation of wetland habitat.

Figure 37. Marsh wren

Photo by: Dave Herr

Ovenbirds (*Seiurus aurocapillus*; Figure 38) are rarely seen birds of the forest. However, their loud "teacher, teacher, teacher" song is commonly heard during the summer months. They dwell on the ground, and build a covered nest that resembles a Dutch oven. Ovenbirds are olive-brown with a boldly streaked breast. Two black stripes border an orange crown. They have a thin bill and a white eye ring. They breed in mature deciduous and mixed forests, especially those with minimal undergrowth. Ovenbird numbers appear to be stable, but the birds are vulnerable to forest fragmentation and parasitism by brown-headed cowbirds (*Molothrus ater*).

Figure 38. Ovenbird

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

Rose-breasted grosbeaks (*Pheucticus ludovicianus*; Figure 39) are summer visitors to Minnesota bird feeders. The males are easily identified by a red triangle on a white breast, with a black head and back and a large bill. Females are more difficult to identify, and resemble a large sparrow with brown and white streaks. Rose-breasted grosbeaks are found in open woodlands near water, edges of marshes, meadows and woodlands, and suburban parks and gardens. The winter range spans from southern Mexico to South America and the Caribbean. Significant regional declines in rose-breasted grosbeak populations have been noted. Protection of large, unfragmented areas of hardwood forest would be beneficial to the rose-breasted grosbeak.

Figure 39. Rose-breasted grosbeak

Photo by: J.A. Spendelow

Northern rough-winged swallows (*Stelgidopteryx serripennis*; Figure 40) are small, fairly common songbirds. They are brown on the head and back with a pale brown throat and white belly. The outer wing feathers, or primaries, have "hooks" on the edge, giving them a rough feel. These swallows are insectivorous and feed in the air, often over water. They will nest either singly or colonially near rocky or exposed banks of clay or sand near streams, rivers and lakes. Open habitat is preferred for breeding. Northern rough-winged swallows are fairly adaptable and are even increasing in parts of their range. Continued monitoring is important to help maintain this trend.

Figure 40. Northern rough-winged swallow

Photo by: Dave Herr

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. Nests are built on marsh vegetation, often with cattail leaves or grass arching over the top. 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. Riparian areas with dense vegetation and wetlands within large forests are good places to find the veery. They spend much of their time on the ground, foraging for insects underneath the leaf litter. 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

Virginia rails (*Rallus limicola*; Figure 43) are a rarely seen, ground-dwelling marsh bird. They have a rusty-colored breast and belly, brown-streaked back, and black and white barring on the flanks. The bill is reddish and slightly curved. The cheeks are gray and the throat is white. The Virginia rail rarely flies, and spends most of its time walking through dense vegetation in freshwater marshes. Like many of the marsh birds, Virginia rails are best detected through their vocalizations, including grunts and a metallic "tic." Population information is limited, but several reports have indicated declines in some areas. Loss of wetland habitat may negatively affect Virginia rail numbers.

Figure 43. Virginia rail

Photo by: David Arbour

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

Results

Surveyors identified 16 species of greatest conservation need at Pelican Lake. The common loon was by far the most commonly recorded species of greatest conservation need, and was documented at 23 survey locations. The veery was second in abundance, found at 12 sites, followed by the ovenbird, which was documented at 11 survey sites. Common terns were observed at nine stations and swamp sparrows were recorded at eight sites. The American white pelican, common nighthawk, Eastern wood-pewee, marsh wren, and Virginia rail were detected rarely; each of these species was found at only one survey station. The remaining species of greatest conservation need identified during the surveys were the bald eagle, black tern, least flycatcher, rose-breasted grosbeak, northern rough-winged swallow, and yellow-bellied sapsucker.

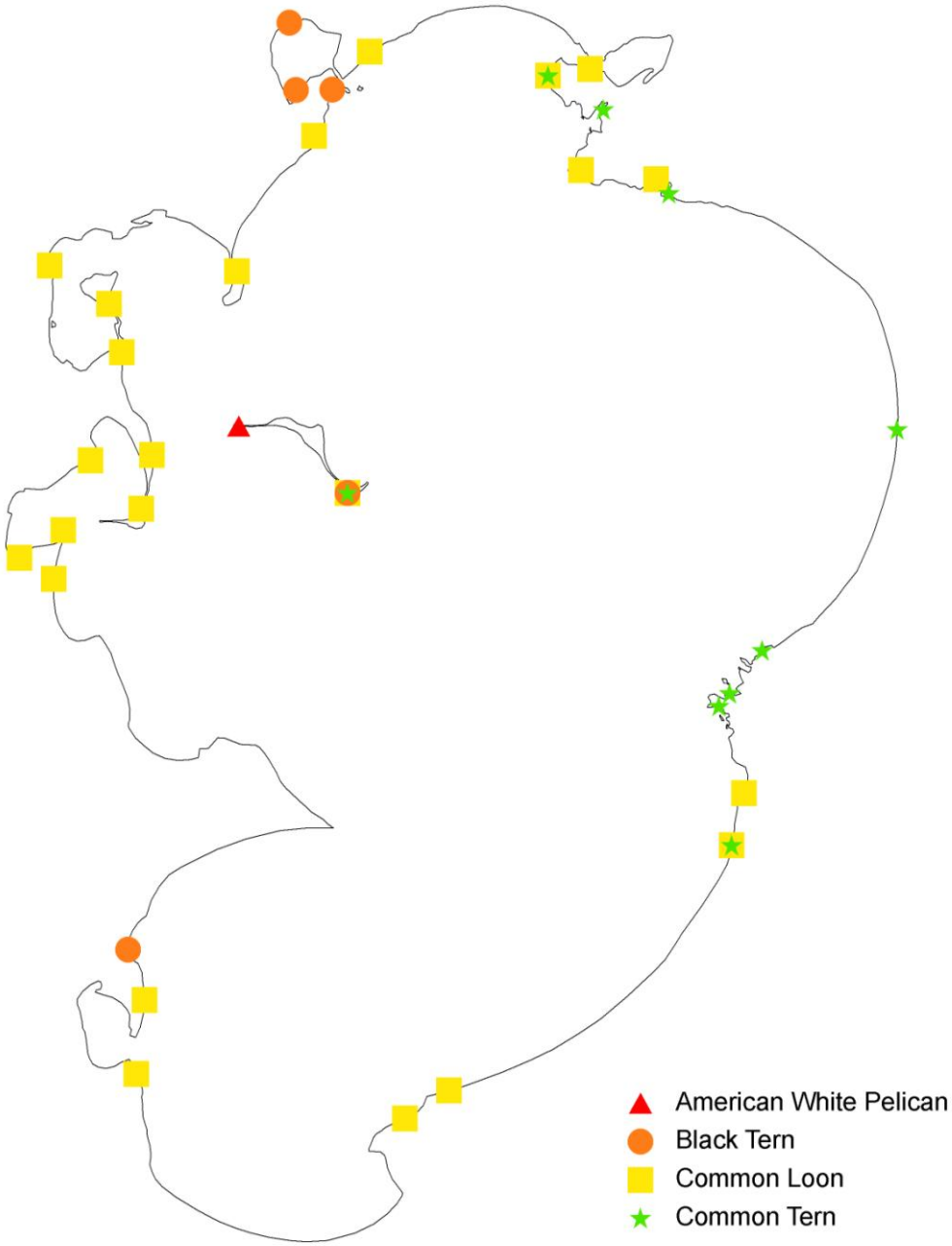
Surveyors recorded 73 bird species during the point count and call-playback surveys at Pelican Lake (Table 3). Two additional species were recorded through casual observation, for a total of 75 species (Appendix 2). American crows and red-winged blackbirds were the most frequently detected species overall, and were each documented at over 50% of the stations surveyed. Rounding out the list of the top five most frequently detected species were song sparrows, American robins, and yellow warblers.

A significant population of nesting ring-billed gulls was found on Gooseberry Island, along with smaller numbers of nesting double-crested cormorants and great blue herons. Surveyors counted 23 active double-crested cormorant nests and 14 nests occupied by great blue herons. The number of ring-billed gull nests was not determined, but estimated to be near 1,000.

Other significant finds included new county nesting records for three species: the herring gull, red-breasted merganser, and common tern. Four pairs of herring gulls were observed on the rocky point at the south end of Gooseberry Island. Chicks were seen with two of the pairs and it is likely that there were more chicks with the other pairs. A single brood of red-breasted mergansers was documented along the southeast shore of Pelican Lake. Common terns were found nesting on the rock island located along the east shore of the lake, with approximately 20 pairs and several chicks present.

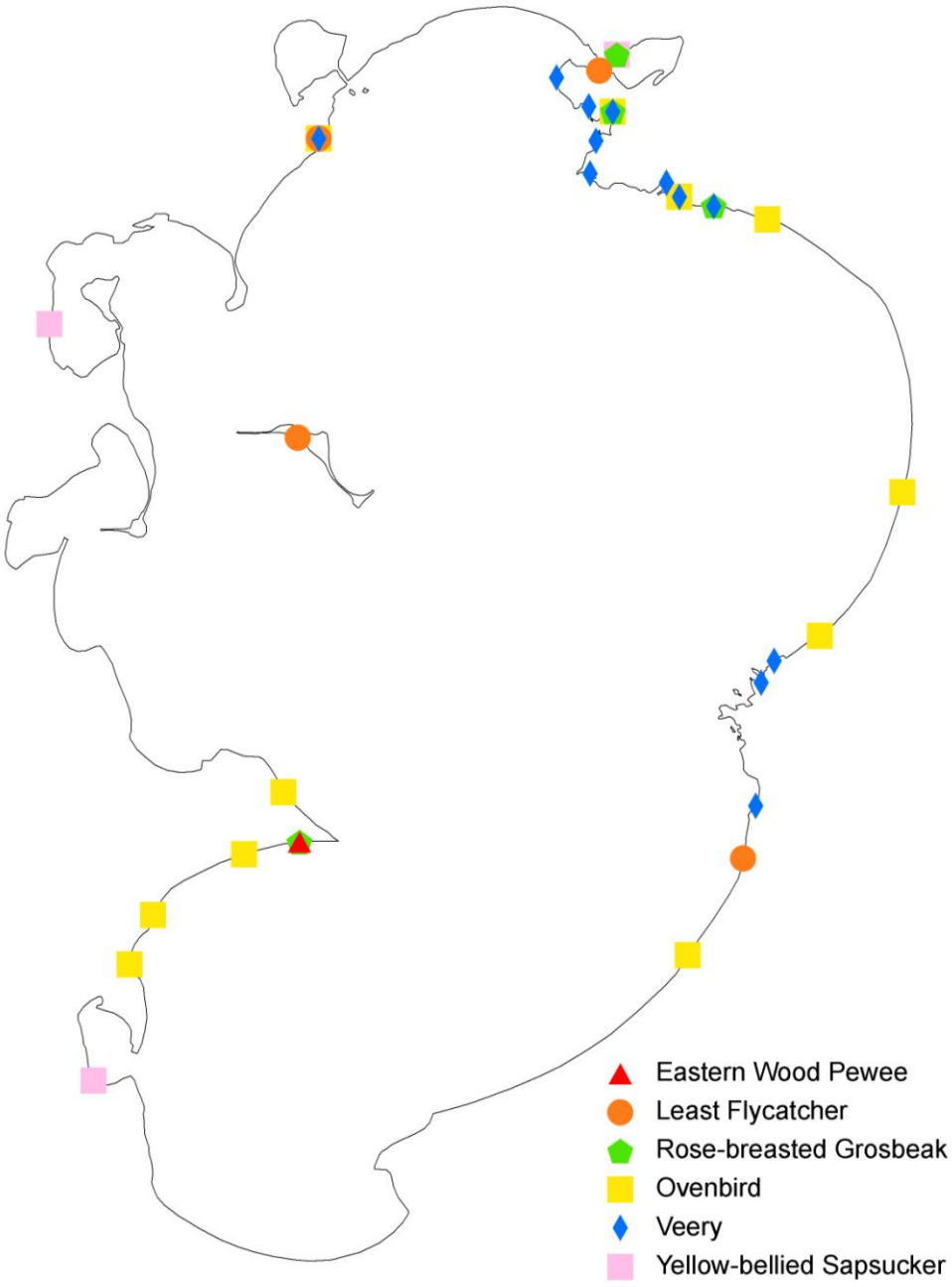
Four aquatic habitat-dependant species of greatest conservation need were documented at Pelican Lake. Common loons were recorded at multiple locations along the shoreline, particularly near the bays, including Moose Bay and Breezy Bay (Figure 45). Common terns were found at nine locations, the majority of which were along the eastern shore of the lake. Common terns, along with black terns and American white pelicans, were also recorded at Gooseberry Island. Black terns were noted at three locations in Cree Bay and at one site north of Jones Bay.

Figure 45. Distribution of aquatic habitat-dependent bird species of greatest conservation need at Pelican Lake, May – June 2010.



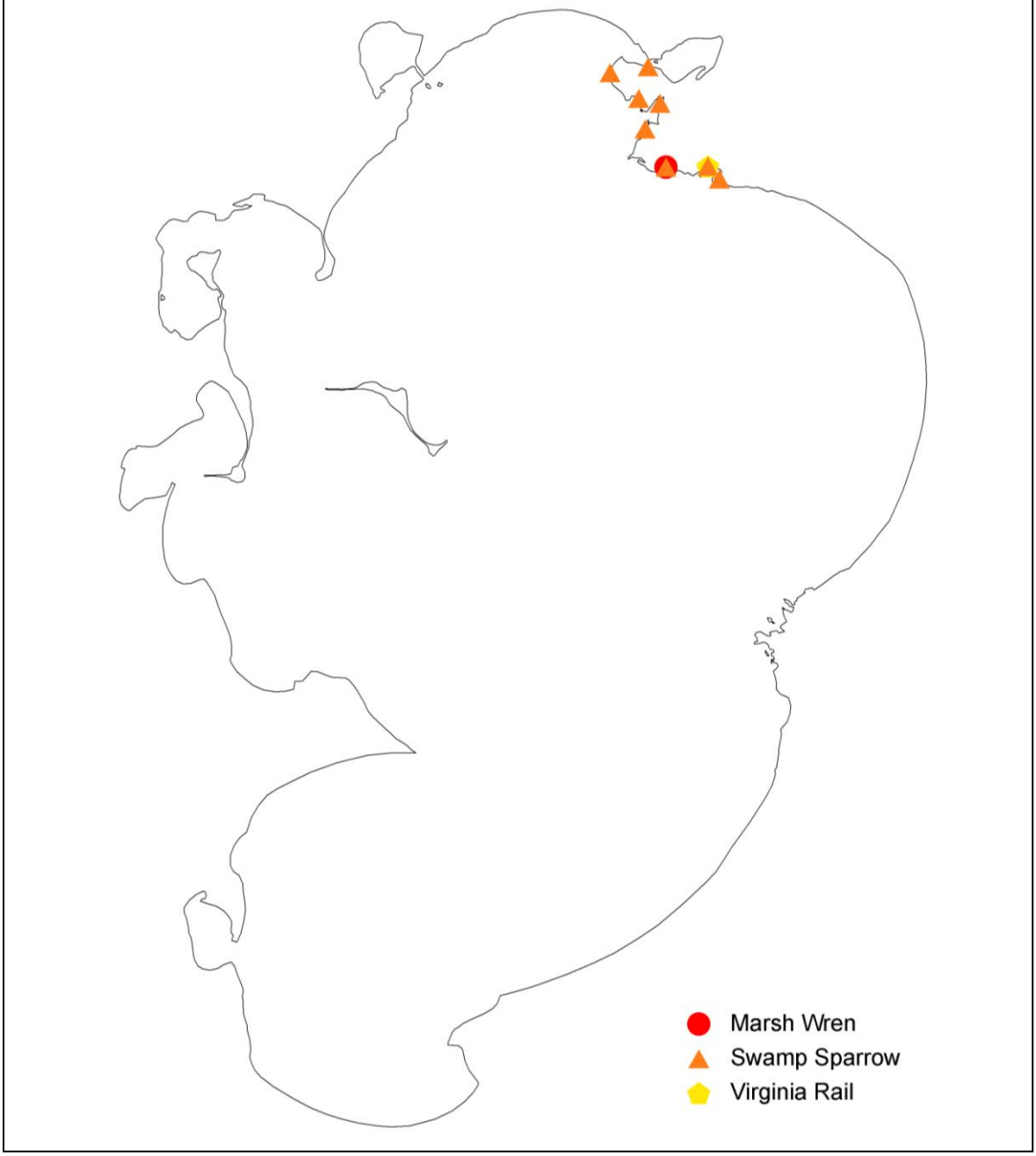
The majority of the bird species of greatest conservation need documented at Pelican Lake were forest-dwelling species (Figure 46). The veery was recorded at twelve locations, ten of which were along the eastern shoreline. Ovenbirds, found at eleven survey sites, were more widely distributed around the entire shoreline. Least flycatchers, though documented at only four stations, were scattered at various locations around the lake. Three of the four rose-breasted grosbeak locations were along the northeastern shore of Pelican Lake. All three yellow-bellied sapsuckers were recorded within bays (Jones Bay, Breezy Bay, and Stewarts Bay). A single Eastern wood pewee was identified along the western shoreline of Pelican Lake.

Figure 46. Distribution of forest habitat-dependent bird species of greatest conservation need at Pelican Lake, May – June 2010.



All three wetland-dependent bird species of greatest conservation need recorded at Pelican Lake were found within or near the same wetland complex (Figure 47). This 75 acre wetland is located on the northeastern corner of Pelican Lake, near Stewarts Bay. Within this area surveyors identified swamp sparrows at eight stations, a marsh wren, and a Virginia rail.

Figure 47. Distribution of wetland habitat-dependent bird species of greatest conservation need at Pelican Lake, May – June 2010.



Species that occupy a variety of habitats were found along the entire shoreline of Pelican Lake (Figure 48). Within this category, bald eagles were recorded most frequently, at six survey stations. Northern rough-winged swallows were documented at three locations on the northern end of the lake. Common nighthawks were observed near the eastern tip of the large wetland south of Stewarts Bay.

Figure 48. Distribution of bird species of greatest conservation need that occupy a variety of habitats at Pelican Lake, May – June 2010.

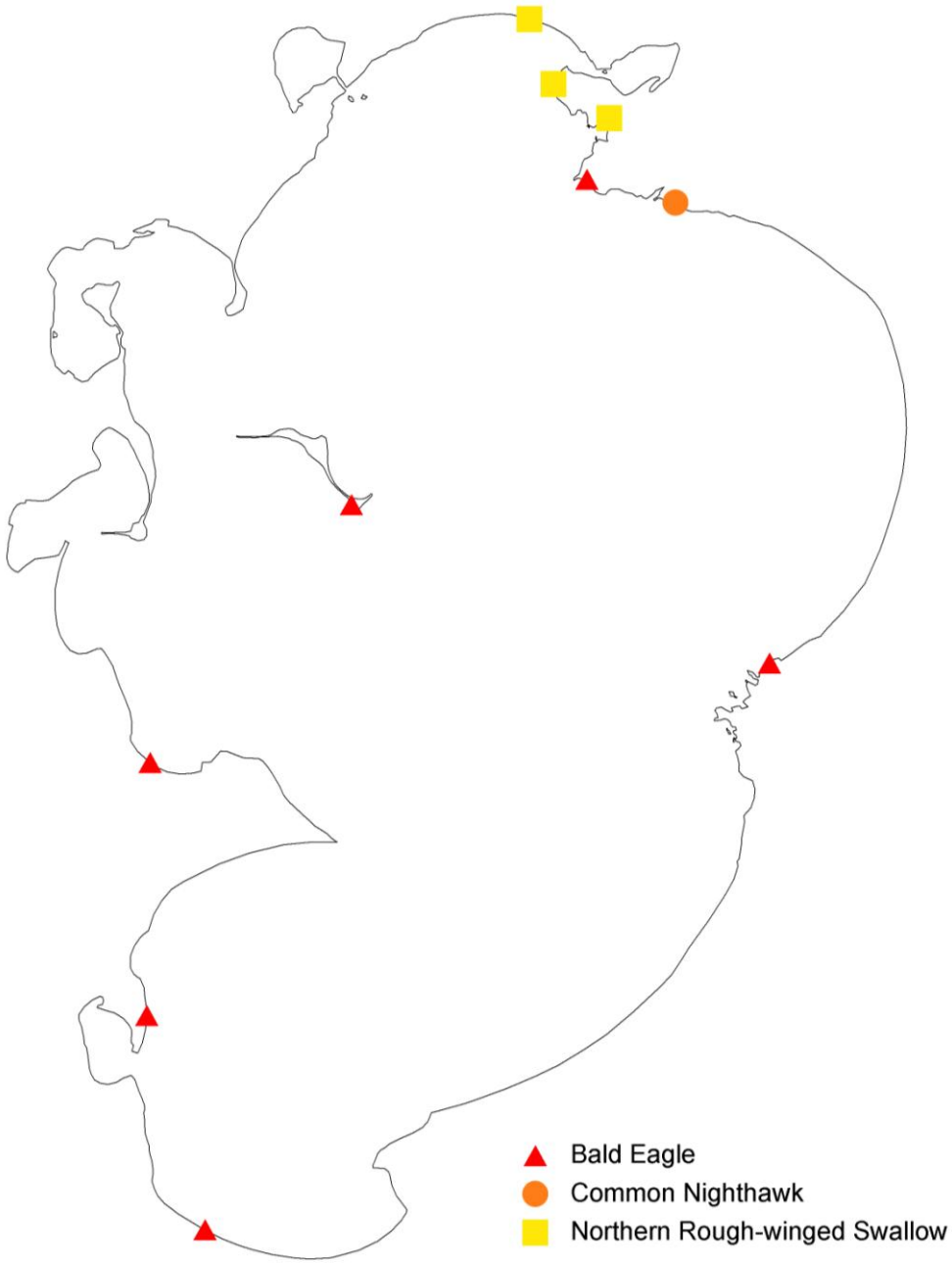


Table 3. Species list and frequency of occurrence of bird species identified during Pelican Lake surveys, May – June 2010. * denotes a species of greatest conservation need.

Description	Common Name	Scientific Name	% [a]
Waterfowl	Canada Goose	*Branta canadensis*	8
	Wood Duck	*Aix sponsa*	3
	Mallard	*Anas platyrhynchos*	21
	Common Goldeneye	*Bucephala clangula*	2
	Hooded Merganser	*Lophodytes cucullatus*	3
	Red-breasted Merganser	*Mergus serrator*	7
Loons	Common Loon*	*Gavia immer*	21
Pelicans	American White Pelican*	*Pelecanus erythrorhynchos*	1
Cormorants	Double-crested Cormorant	*Phalacrocorax auritus*	1
Herons/bitterns	Great Blue Heron	*Ardea herodias*	14
	Green Heron	*Butorides virescens*	3
Hawks/eagles	Osprey	*Pandion haliaetus*	2
	Bald Eagle*	*Haliaeetus leucocephalus*	5
Falcons	Merlin	*Falco columbarius*	2
Rails/coots	Virginia Rail*	*Rallus limicola*	1
Plovers	Killdeer	*Charadrius vociferus*	15
Sandpipers	Spotted Sandpiper	*Actitis macularia*	2
	Wilson's Snipe	*Gallinago delicata*	5
Gulls/terns	Ring-billed Gull	*Larus delawarensis*	13
	Herring Gull	*Larus argentatus*	1
	Caspian Tern	*Sterna caspia*	1
	Black Tern*	*Chlidonias niger*	5
	Common Tern*	*Sterna hirundo*	8
Pigeons/doves	Mourning Dove	*Zenaida macroura*	11
Owls	Great Horned Owl	*Bubo virginianus*	1
Goatsuckers	Common Nighthawk*	*Chordeiles minor*	1
Hummingbirds	Ruby-throated Hummingbird	*Archilochus colubris*	1
Kingfishers	Belted Kingfisher	*Ceryle alcyon*	1
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*	3
	Yellow-bellied Sapsucker*	*Sphyrapicus varius*	3
	Hairy Woodpecker	*Picoides villosus*	2
	Northern Flicker	*Colaptes auratus*	5
	Pileated Woodpecker	*Dryocopus pileatus*	9
Flycatchers	Eastern Wood-Pewee*	*Contopus virens*	1
	Least Flycatcher*	*Empidonax minimus*	4
	Eastern Phoebe	*Sayornis phoebe*	14

Table 3, continued.

Description	Common Name	Scientific Name	% [a]
Flycatchers, cont.	Great Crested Flycatcher	*Myiarchus crinitus*	22
	Eastern Kingbird	*Tyrannus tyrannus*	18
Vireos	Yellow-throated Vireo	*Vireo flavifrons*	2
	Warbling Vireo	*Vireo gilvus*	20
	Red-eyed Vireo	*Vireo olivaceus*	38
Jays/crows	Blue Jay	*Cyanocitta cristata*	27
	American Crow	*Corvus brachyrhynchos*	55
Swallows	Purple Martin	*Progne subis*	1
	Tree Swallow	*Tachycineta bicolor*	37
	N. Rough-winged Swallow*	*Stelgidopteryx serripennis*	3
	Barn Swallow	*Hirundo rustica*	32
Chickadees	Black-capped Chickadee	*Poecile atricapilla*	11
Nuthatches	White-breasted Nuthatch	*Sitta carolinensis*	16
Wrens	House Wren	*Troglodytes aedon*	5
	Marsh Wren*	*Cistothorus palustris*	1
Thrushes	Eastern Bluebird	*Sialia sialis*	2
	Veery*	*Catharus fuscescens*	11
	American Robin	*Turdus migratorius*	44
Mockingbirds	Gray Catbird	*Dumetella carolinensis*	5
Starlings	European Starling	*Sturnus vulgaris*	2
Waxwings	Cedar Waxwing	*Bombycilla cedrorum*	4
Warblers	Yellow Warbler	*Dendroica petechia*	44
	Chestnut-sided Warbler	*Dendroica pensylvanica*	9
	Ovenbird*	*Seiurus aurocapilla*	10
	Common Yellowthroat	*Geothlypis trichas*	37
Sparrows/allies	Chipping Sparrow	*Spizella passerina*	28
	Song Sparrow	*Melospiza melodia*	49
	Swamp Sparrow*	*Melospiza georgiana*	7
Cardinals/allies	Northern Cardinal	*Cardinalis cardinalis*	2
	Rose-breasted Grosbeak*	*Pheucticus ludovicianus*	4
Blackbirds	Red-winged Blackbird	*Agelaius phoeniceus*	54
	Common Grackle	*Quiscalus quiscula*	35
	Brown-headed Cowbird	*Molothrus ater*	5
	Baltimore Oriole	*Icterus galbula*	25
Finches	House Finch	*Carpodacus mexicanus*	3
	American Goldfinch	*Spinus tristis*	10
Old World Sparrows	House Sparrow	*Passer domesticus*	3

[a] % – Percent of surveyed sample sites in which a bird species occurred (N=111)

Bird Species Richness

Objective

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

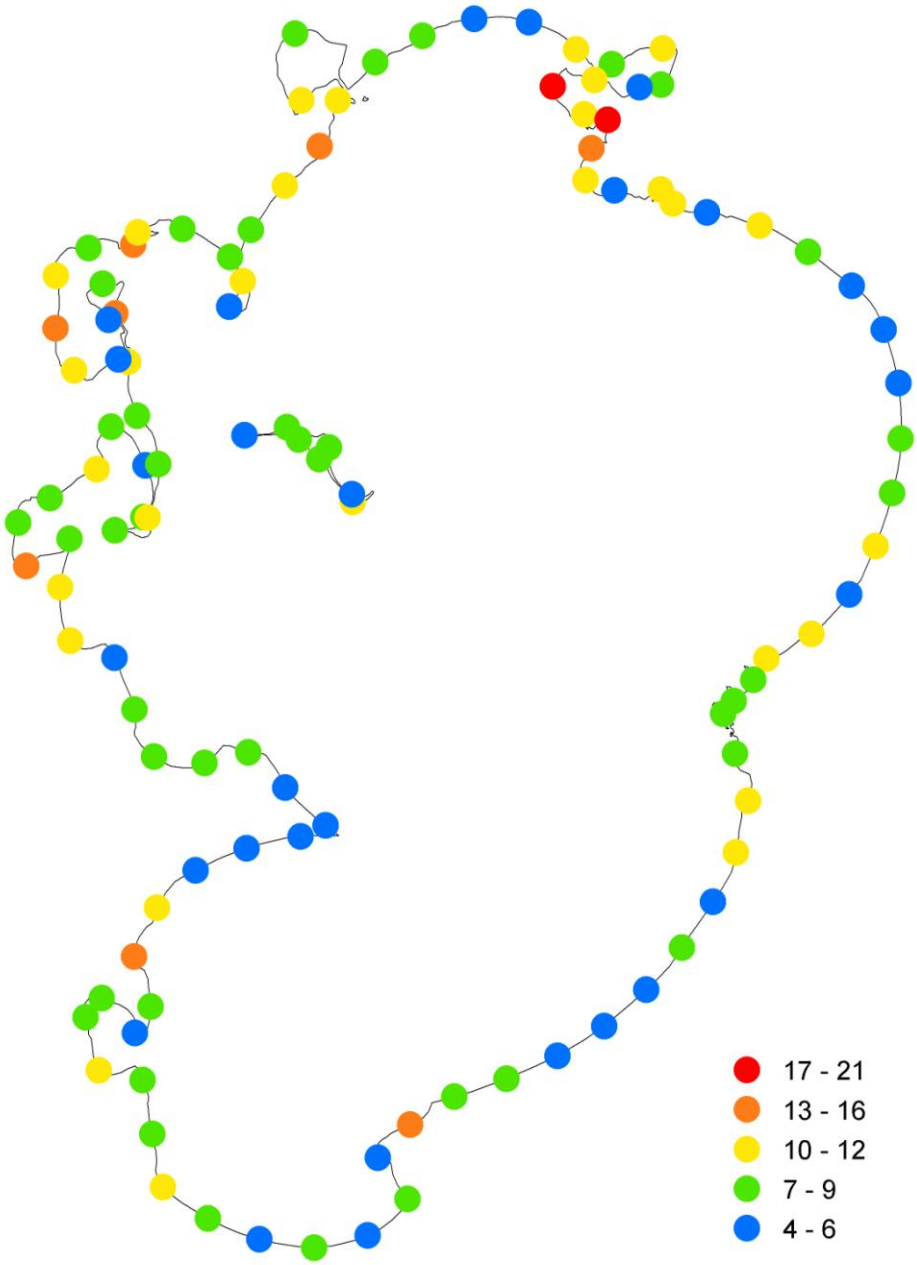
Methods

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

Bird richness (the number of bird species recorded at a single survey point) ranged from four to 21 species at each site surveyed (Figure 49). Approximately one-third of the stations (N = 39) had ten or more bird species documented. Surveyors recorded fewer than five species at only four of the survey locations. The maximum number of species of greatest conservation need recorded at a single survey station was six, and two additional sites had five species of greatest conservation need. The three sites with the maximum number of recorded SGCN were all located within the wetland south of Stewarts Bay. Fifty-eight of the survey stations did not have species of greatest conservation need observed.

Figure 49. Bird species richness (number of species per sample site) at Pelican Lake, May – June 2010.



Loon Nesting Areas

Objectives

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

Introduction

Pelican Lake loon chick, 2010.

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.

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

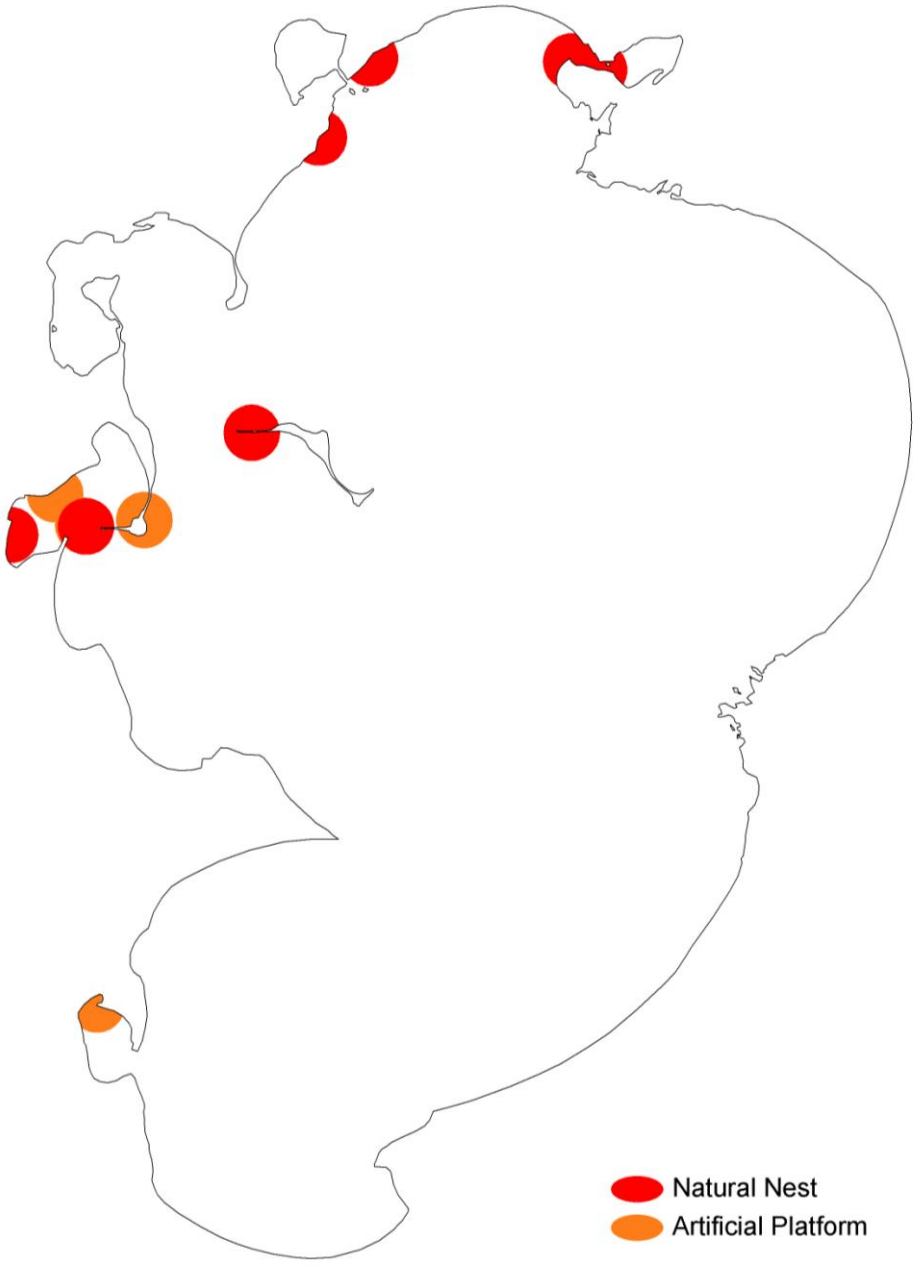
Methods

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

Results

Since 1979, approximately 11 loon nesting areas have been identified on Pelican Lake (Figure 50). Natural nests have been recorded within or near Cree Bay, Stewarts Bay, and Moose Bay. One natural nest is also located on the western edge of Gooseberry Island. Artificial nesting platforms have been placed in multiple locations on Pelican Lake. Active platform nests have been documented near the entrance to Moose Bay, within Moose Bay, and within Jones Bay. Additional natural nesting areas may be/have been present on the lake (e.g., near Lincoln Point), but the actual loon nests were never located.

Figure 50. Location of natural loon nests and manmade loon platforms recorded on Pelican Lake between 1979 and 2010.



Aquatic Frog Surveys

Objectives

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

Introduction

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

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

Figure 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 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 Pelican Lake frog surveys (Figure 53). Green frogs were recorded most frequently; they were heard at 24 of 112 survey stations. In general, green frog locations were confined to the bays, including Stewarts Bay, Cree Bay, Breezy Bay, Moose Bay, and Jones Bay. Green frogs were also heard at several scattered locations on the west shore and at one survey station on the eastern shoreline of Pelican Lake. Mink frogs were heard less frequently than green frogs; surveyors recorded this species at seven survey stations. All seven survey stations were located in the northern part of Pelican Lake, within Stewarts Bay and Jones Bay. Bird surveyors working on Pelican Lake earlier in the year recorded green frogs at an additional four locations and mink frogs at two new stations. These frog locations followed the same distribution patterns as those recorded during the frog surveys.

At survey stations where green frogs were present, abundance estimates ranged from one frog to between 10 and 20 frogs (Figure 54). At the majority of these stations, individual frog calls were easily distinguishable. No more than ten mink frogs were heard at a single Pelican Lake survey station (Figure 55).

Other species

Several additional anuran species were recorded during the Pelican Lake surveys. Gray treefrogs (*Hyla versicolor*) were heard at 49 survey stations located along essentially the entire Pelican Lake shoreline. Index values for gray treefrogs ranged from one (individual frog calls could be distinguished; no overlap) to three (full chorus of calls). American toads (*Bufo americanus*) were heard at 18 survey stations, and were also widespread along the shoreline. Surveyors documented western chorus frogs (*Pseudacris triseriata*) at seven survey sites, all within the wetland south of Stewarts Bay. Spring peepers (*Pseudacris crucifer*) were recorded at three locations. Two of these were within the Stewarts Bay wetland and the third was in Moose Bay. Maximum index values for most of these these anuran species indicated that calls of individual frogs could be distinguished, but did overlap. Other frog species that may be found near Pelican Lake, such as wood frog (*Rana sylvatica*), breed earlier in the year and are not strongly associated with larger lakes.

Figure 53. Distribution of green and mink frogs heard during Pelican Lake frog surveys, July 2010.

Figure 54. Abundance of green frogs heard during Pelican Lake frog surveys, July 2010.

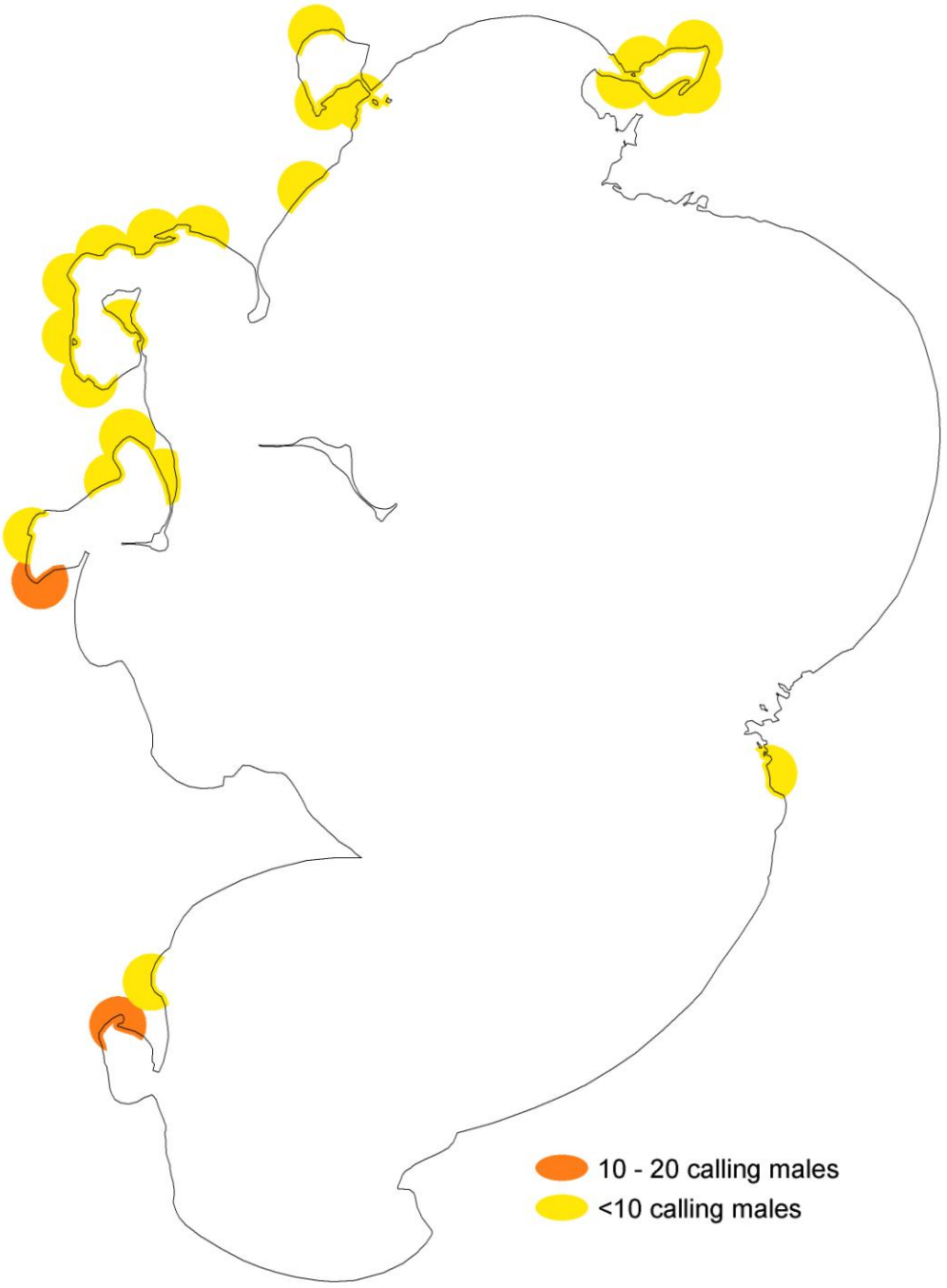
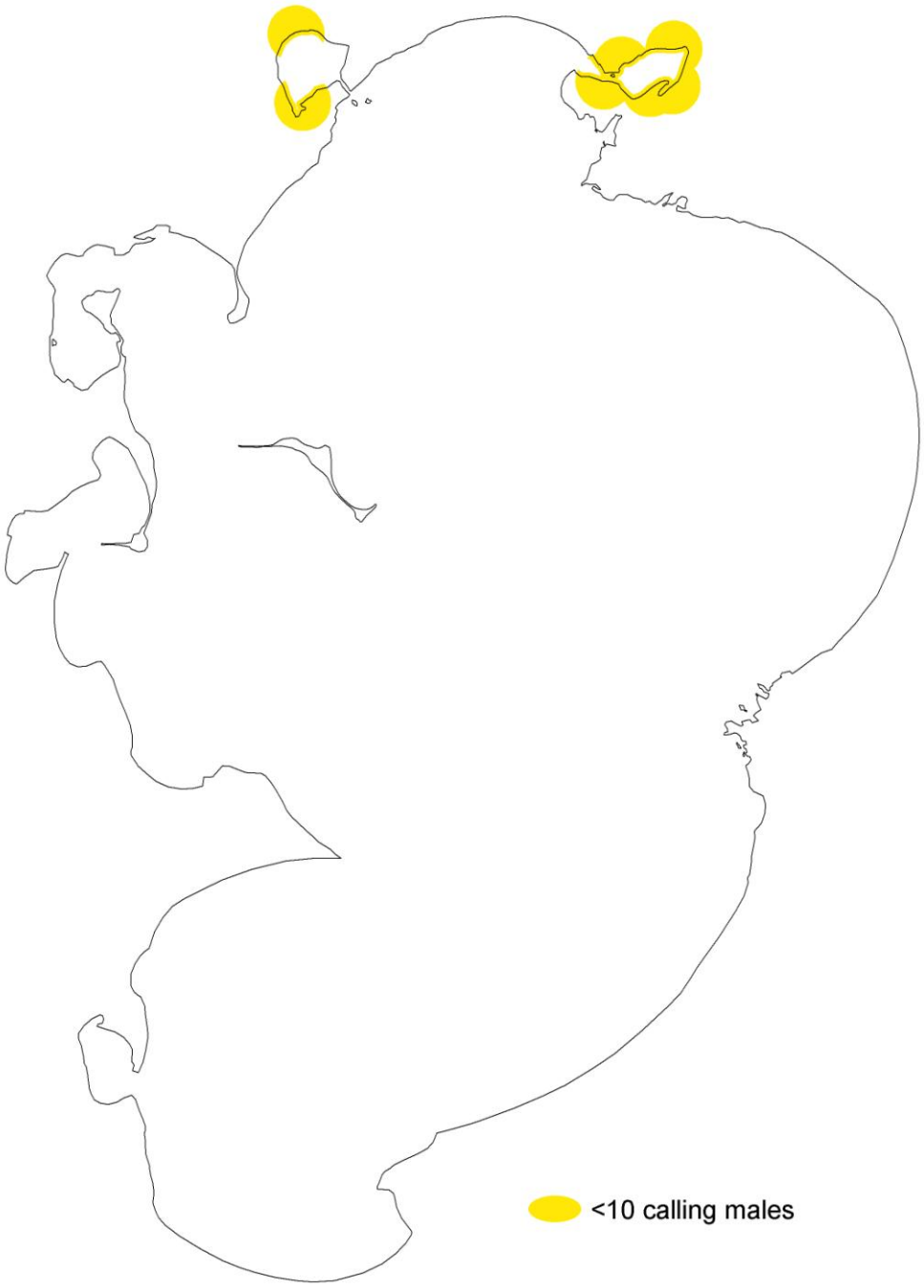


Figure 55. Abundance of mink frogs heard during Pelican Lake frog surveys, July 2010.



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 Crow Wing 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 large eyes and a distinctively upturned mouth that gives them a "pugnose" appearance. They are secretive minnows, and are found often in schools of 15 to 35 individuals. Pugnose minnows inhabit clear lakes and low-gradient streams and are extremely intolerant of turbidity. Vegetation, particularly pondweed, coontail, and bulrush, is an important habitat component.

Figure 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 SGCN.

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

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

Results

There was one near-shore fish species of greatest conservation need detected during the 2010 nongame fish surveys on Pelican Lake. The least darter was documented at two survey locations on the lake, both within Breezy Bay (Figure 63). One least darter was recorded at each of the two stations. In addition, one offshore-dwelling species of greatest conservation need, the greater redhorse (*Moxostoma valenciennesi*; Figure 62), was also identified at Pelican Lake. Greater redhorse were found at eight survey stations, the majority of which were near or within Breezy Bay. Greater redhorse, like the target species of greatest conservation need, are sensitive to chemical pollutants and turbidity, and inhabit clear water rivers and lakes.

Figure 62. Greater redhorse

All three proxy fish species were also documented in Pelican Lake (Figure 64). Blacknose shiners were identified in the greatest numbers; surveyors counted nearly 90 individuals. Blacknose shiners were found within Moose Bay, Breezy Bay, and along the southeastern shoreline. Banded killifish were the most frequently documented proxy species. Over 50 individuals were recorded at 12 survey stations. Eleven blackchin shiners were recorded at three survey stations. Their distribution was limited to Breezy Bay and Moose Bay. Substrate type at sites where species of greatest conservation need and proxy species were present was primarily small-diameter substrate, and included silt, sand and muck. Aquatic vegetation biovolume was over twice as high at sites that contained SGCN and proxy species and sites that did not.

The presence of these sensitive fish species may indicate minimal disturbance in several areas of the lake. However, because populations of these species are vulnerable across their ranges, continued monitoring and maintenance of these shoreline habitats is necessary to ensure continued existence of these populations. Limiting macrophyte removal, pesticide and herbicide use, and modification of the riparian zone will help maintain good water quality and a healthy aquatic plant community.

In total, surveyors identified 34 fish species at Pelican Lake in 2010 (Table 4). Bluegills and yellow perch, each recorded at over 90 (of 111) survey stations, were the most frequently documented species. Largemouth bass and bluntnose minnows were also common, and identified at over 75% of the survey sites. Mimic shiners rounded out the list of the top five most commonly recorded species, and topped the list of most abundant fish; surveyors estimated over 16,000 individuals were captured. Bluntnose minnows, yellow perch, bluegills, spottail shiners, and largemouth bass were all found in numbers greater than 1,000. Common shiners and fathead minnows were detected at only one station each.

Eight fish species previously unrecorded in Pelican Lake were documented during the 2010 surveys. These species were central mudminnow, hornyhead chub, greater redhorse, least darter, mimic shiner, mottled sculpin, and tadpole madtom, and trout-perch. The addition of these species brings the total observed fish community in Pelican Lake to 41 species.

Figure 63. Distribution of fish species of greatest conservation need documented during Pelican Lake fish surveys, July 2010.

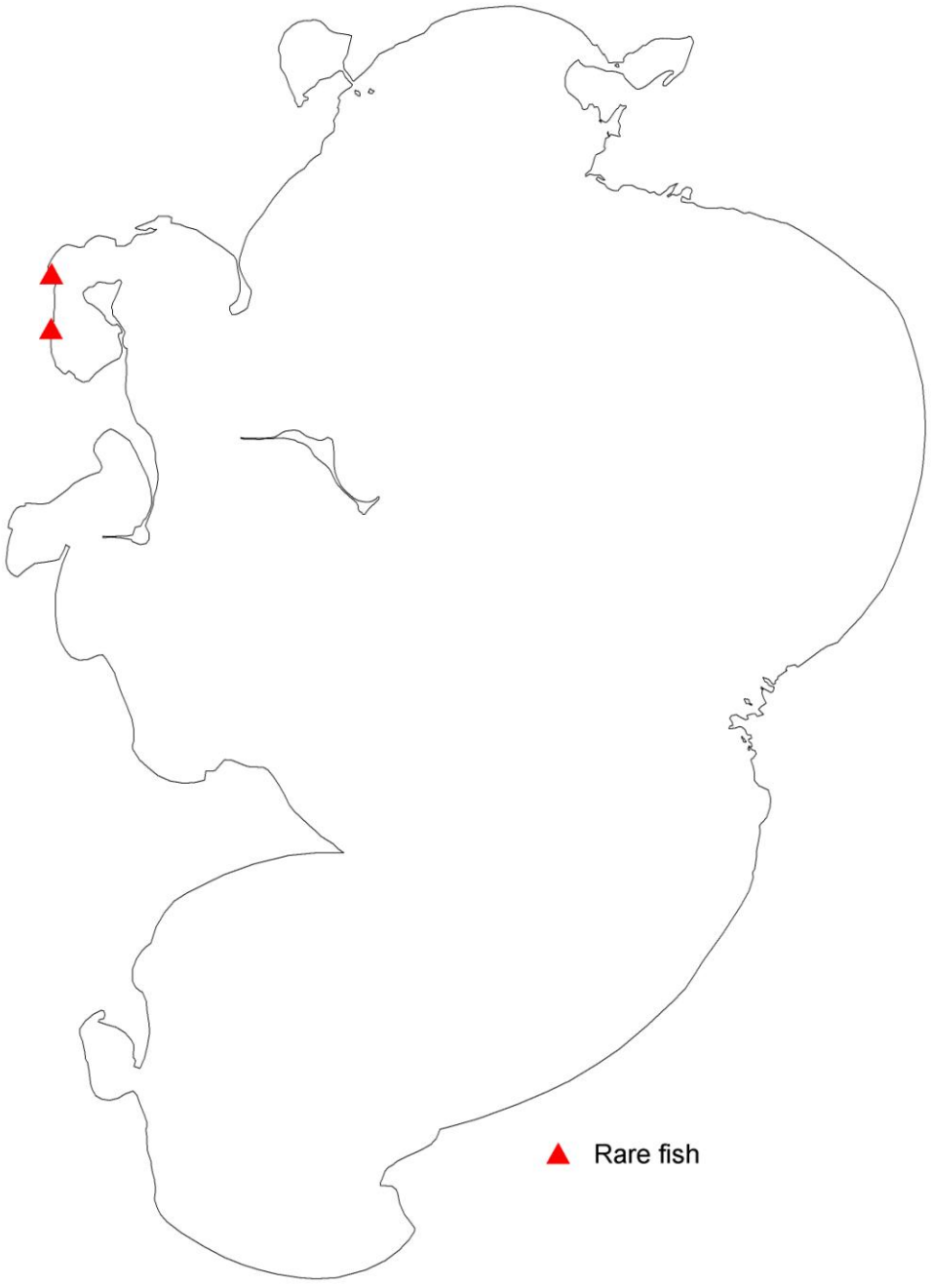


Figure 64. Distribution of fish proxy species documented during Pelican Lake fish surveys, July 2010.

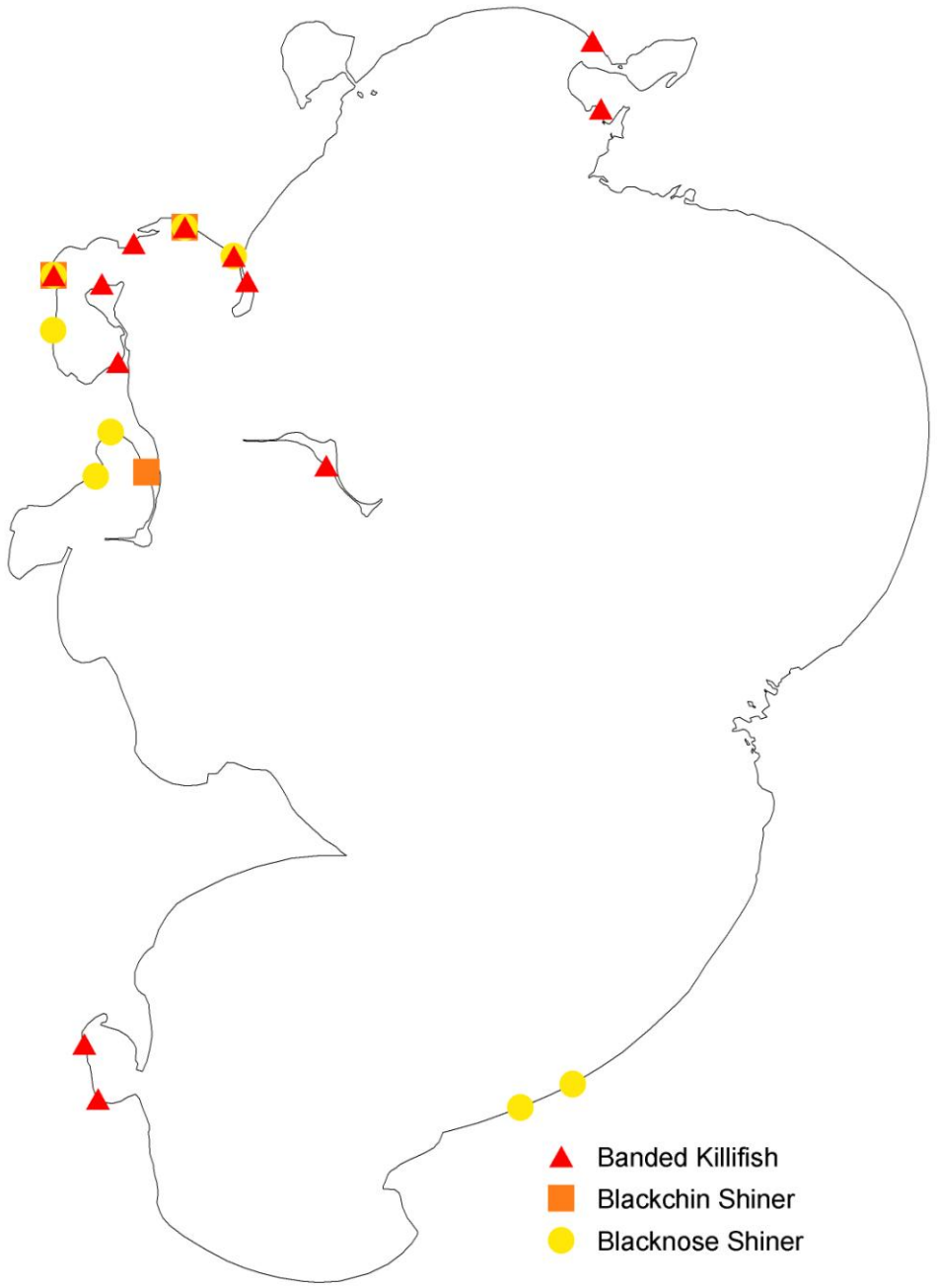


Table 4. Abundance and frequency of fish species identified during Pelican Lake fish surveys, July 2010. * denotes species of greatest conservation need

Description	Common Name	Scientific Name	#[a]	%[b]
Bowfins	Bowfin	*Amia calva*	18	12
Minnows/carps	Common shiner	*Luxilus cornutus*	2	1
	Hornyhead chub	*Nocomis biguttatus*	2	2
	Golden shiner	*Notemigonus crysoleucas*	91	13
	Blackchin shiner	*Notropis heterodon*	10	2
	Blacknose shiner	*Notropis heterolepis*	88	7
	Spottail shiner	*Notropis hudsonius*	~1700	34
	Mimic shiner	*Notropis volucellus*	~16000	73
	Bluntnose minnow	*Pimephales notatus*	~4400	77
	Fathead minnow	*Pimephales promelas*	1	1
Suckers	White sucker	*Catostomus commersoni*	792	45
	Greater redhorse*	*Moxostoma valenciennesi*	16	8
N. American freshwater catfishes	Black bullhead	*Ameiurus melas*	12	5
	Yellow bullhead	*Ameiurus natalis*	68	23
	Tadpole madtom	*Noturus gyrinus*	6	5
Pikes	Northern pike	*Esox lucius*	14	4
Mudminnows	Central mudminnow	*Umbra limi*	21	11
Trout-perches	Trout-perch	*Percopsis omiscomaycus*	4	3
Silversides	Brook silverside	*Labidesthes sicculus*	48	4
Killifishes	Banded killifish	*Fundulus diaphanus*	51	11
Sticklebacks	Brook stickleback	*Culaea inconstans*	10	6
Sculpins	Mottled sculpin	*Cottus bairdi*	17	6
Sunfishes	Rock bass	*Ambloplites rupestris*	281	65
	Green sunfish	*Lepomis cyanellus*	17	7
	Pumpkinseed	*Lepomis gibbosus*	291	46
	Bluegill	*Lepomis macrochirus*	~2500	86
	Largemouth bass	*Macropterus salmoides*	~1400	80
	Black crappie	*Pomoxis nigromaculatus*	109	32
Perches	Iowa darter	*Etheostoma exile*	24	15
	Least darter*	*Etheostoma microperca*	2	2
	Johnny darter	*Etheostoma nigrum*	301	53
	Yellow perch	*Perca flavescens*	~3600	86
	Logperch	*Percina caprodes*	16	7
	Walleye	*Sander vitreus*	101	29

[a] # – Total number of individuals found. Numbers above 1000 were rounded to the nearest 100, numbers above 10000 were rounded to the nearest 1000.

[b] % – Percent of surveyed sample sites in which a species occurred (N=111).

Aquatic Vertebrate Richness

Objective

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

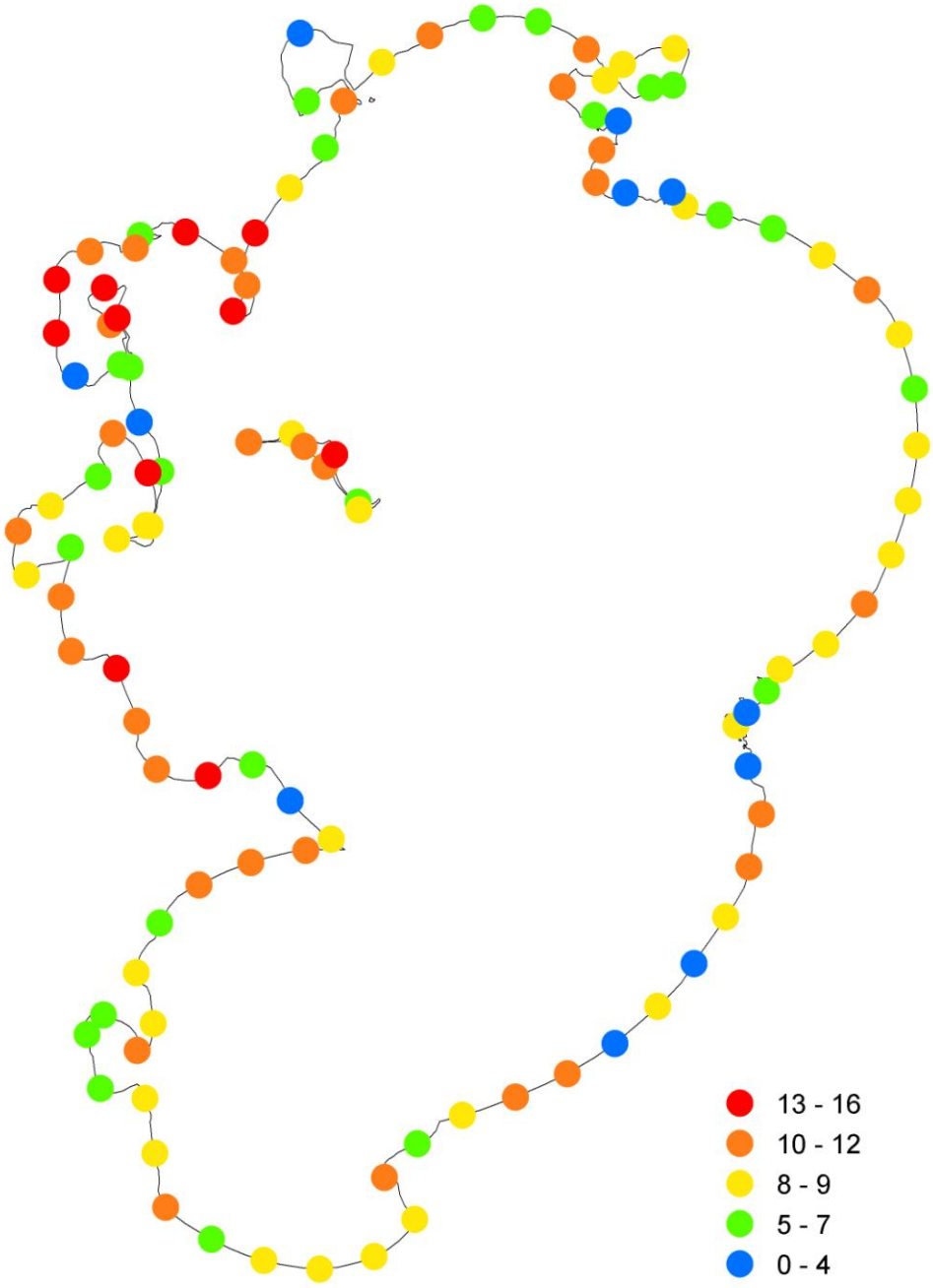
Methods

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 species per Pelican Lake sample site ranged from one to 16 (Figure 65). The sites with the highest recorded aquatic vertebrate diversity (15 or more species documented) were all located within Cree Bay. Over one-third (N = 43 sites) of the surveyed sites had 10 or more species, and only ten of the 111 sites had fewer than five species. The majority of the species observed during the nongame fish surveys were fish, although mink frogs, green frogs and painted turtles were also identified. Hybrid sunfish were also detected at multiple locations in Pelican Lake, but were not included in the analyses.

Figure 65. Aquatic vertebrate species richness (number of species per sample site) in Pelican Lake, July 2010.



Other Rare Features

Objective

1. Map rare features occurring within the extended state-defined shoreland area (within 1320 feet of shoreline) of Pelican 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 Federal and State-listed endangered and threatened species and state species of special concern are tracked by the Natural Heritage program. The program also gathers information on animal aggregations, geologic features, and rare plants with no legal status.

Methods

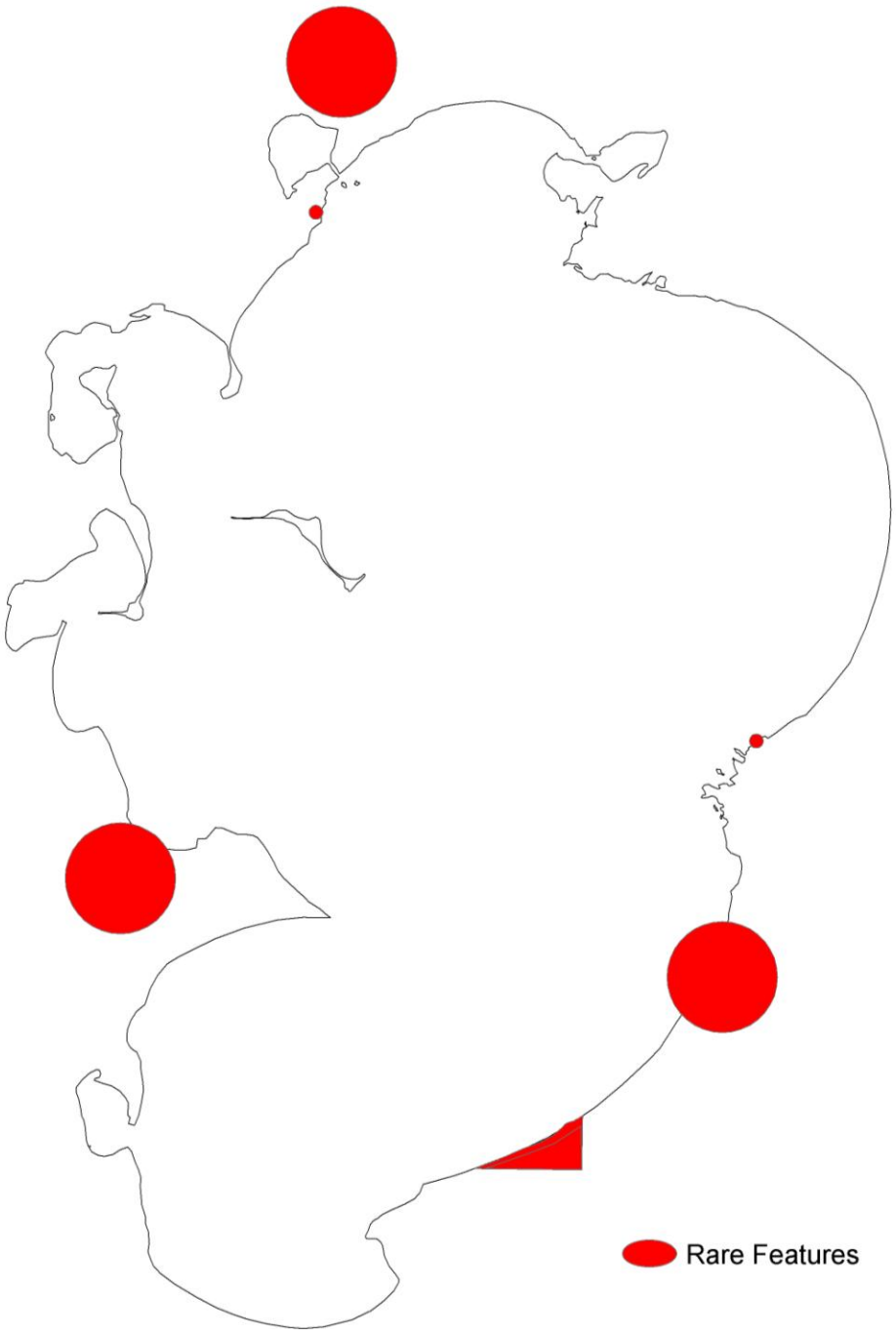
Researchers obtained locations of rare features from the Rare Features Database. Only "listed" plant and animal species (Federal or State endangered, threatened, or special concern) were considered in this project; non-listed unique plant species were included in the "Unique Plant Species" section of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

Results

Six rare feature locations have been identified at Pelican Lake (Figure 66). The rare features include the nesting areas of a bird species of special concern, as well as locations of a threatened turtle species, and special concern fish species, and two fungus species of endangered and special concern 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 Pelican Lake, practices that maintain good water quality and the integrity of the shoreline will be beneficial to all species involved.

Figure 66. Natural Heritage Database rare features (Federal or State-listed endangered, threatened, or special concern species) located within 1320 feet of Pelican Lake shoreline.



 Rare features data have been provided by the Division of Ecological and Water Resources, Minnesota Department of Natural Resources (MNDNR) and were current as of April 7, 2011. 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

Objective

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

Introduction

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

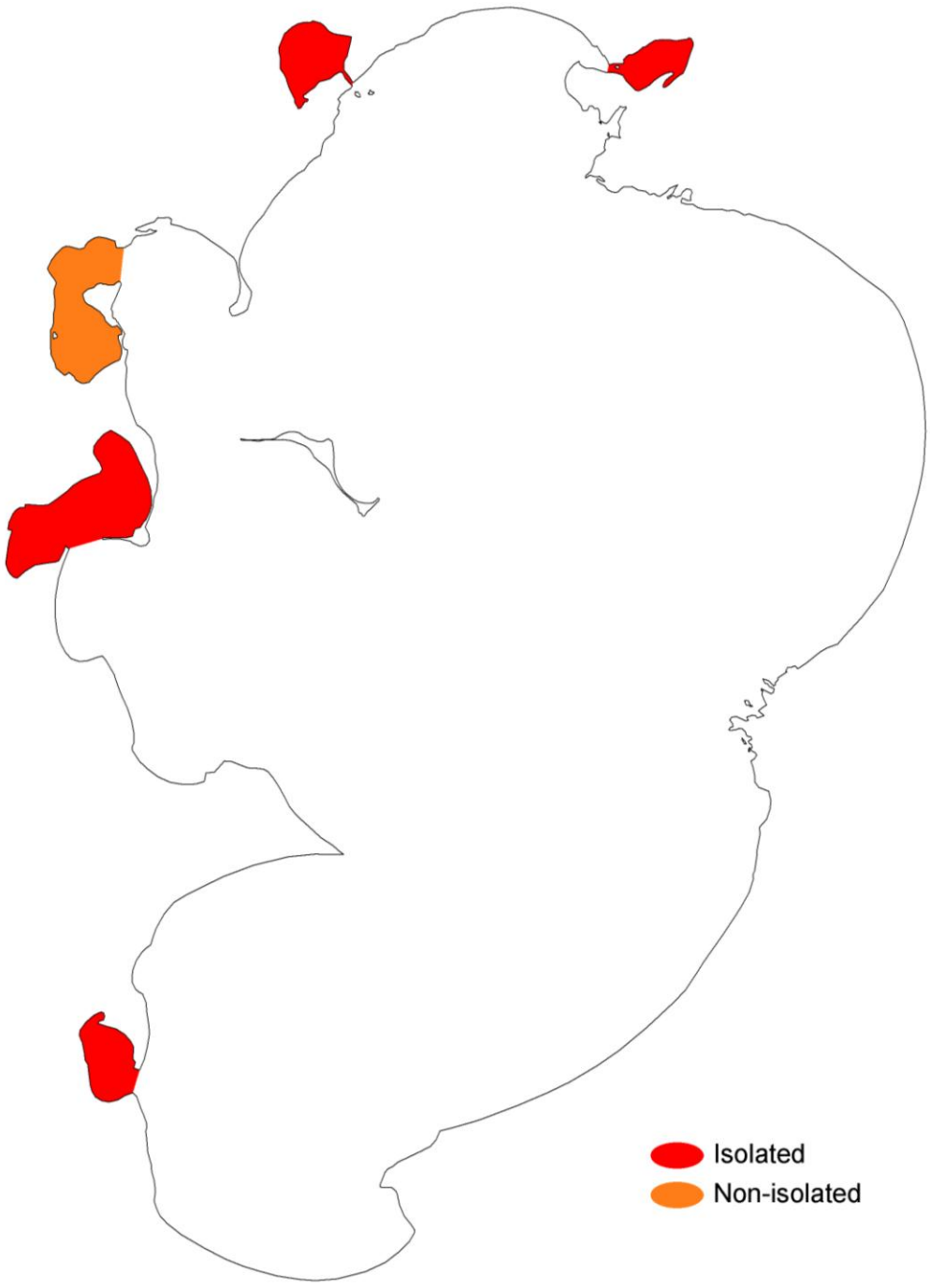
Methods

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

Results

Four isolated bays and one non-isolated bays were identified in Pelican Lake (Figure 67). The isolated bays (Stewarts Bay, Cree Bay, Moose Bay, and Jones Bay) occurred on the north and west sides of the lake, while a single non-isolated bay (Breezy Bay) was found at Breezy Point Resort on the west.

Figure 67. Location of isolated and non-isolated bays in Pelican Lake.



II. Ecological Model Development

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

In order to develop a continuous sensitivity score along the shoreline, the ecological model used a moving analysis window that included both shoreland and near-shore areas. Resource managers developed a system to score each of the 14 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 68). 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 69). 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 70).

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

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

Table 5, continued.

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

Figure 68. Total score layer created by summing scores of all 14 variables. Highest total scores represent most sensitive areas of shoreline.

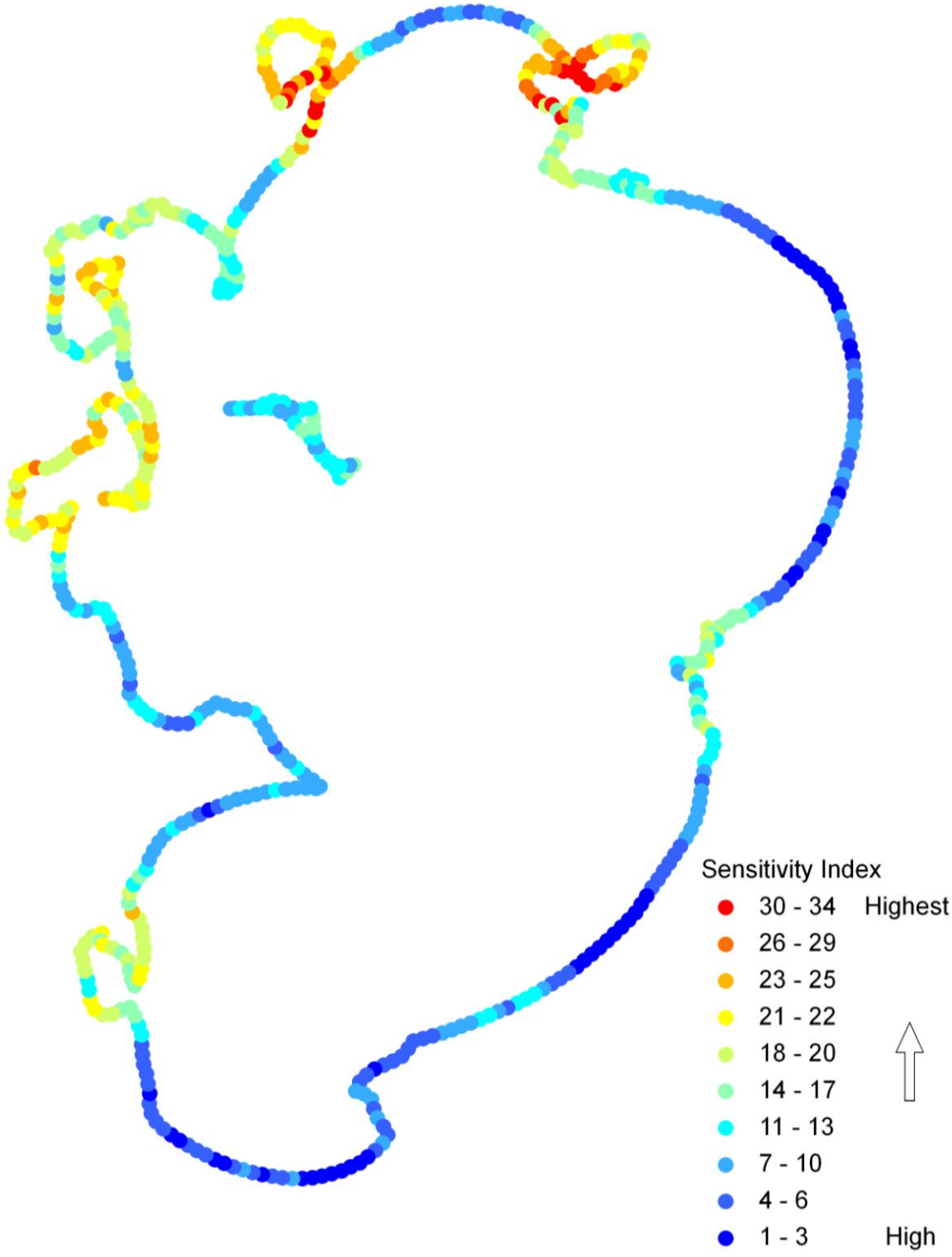


Figure 69. GIS-identified clusters of points with similar total scores. Red areas are those with high scores (i.e., areas of highly sensitive shoreland).

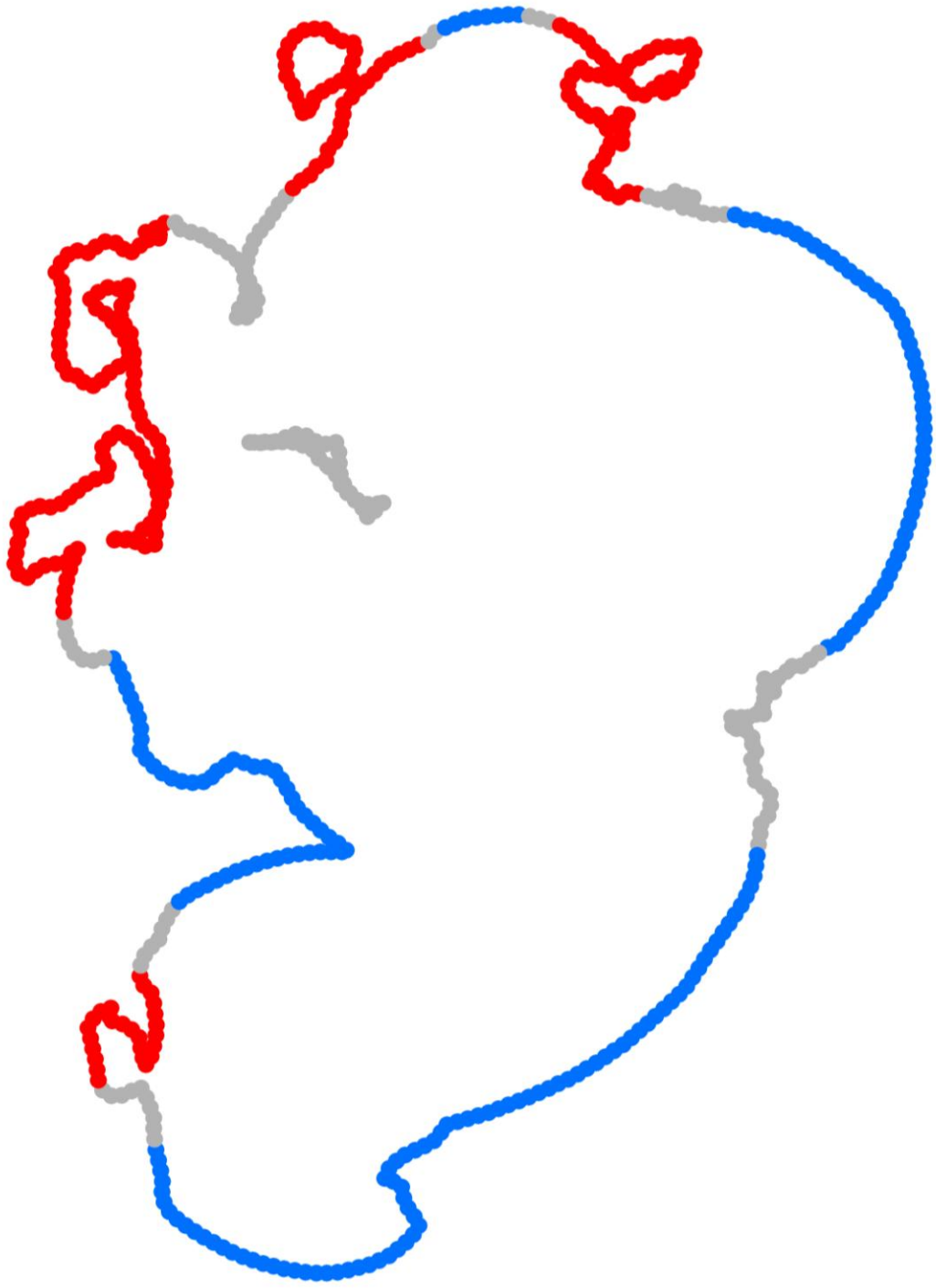


Figure 70. The sensitive lakeshore areas identified by the ecological model.

Habitat Connectivity
In addition to the sensitive shorelands identified through the GIS model, surveyors considered adjacent river shorelines that provide habitat connectivity to and from the lake shorelands. Aquatic habitat connectivity allows for the movement of organisms within a watershed. Organisms can move between existing habitats, colonize new areas, or recolonize former habitat in the wake of local extinctions. Because Pelican Lake has no natural inlets or outlets, there were no ecological connections identified for this waterbody.

Other Areas of Ecological Significance
There are additional aquatic areas of ecological significance in Pelican 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 Pelican 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.

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

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

Sensitive Lakeshore
The bays of Pelican Lake contained a great diversity of plant and animal species, including species of greatest conservation need. Critical habitat, such as emergent and floating-leaf vegetation, was also present in high quantities. The ecological model displays these areas both as sensitive shoreline and as high priority shorelands. Although the shoreline itself is important, development and land alteration nearby may have significant negative effects on many species. Fragmented habitats often contain high numbers of invasive, non-native plants and animals that may out-compete native species. The larger a natural area is, the more likely it is to support populations of native plants and animals. Large natural areas that support a diversity of species and habitats help comprise a healthy ecosystem. 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 Pelican Lake, and the value of the lake itself.

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Appendix 1. Shoreline emergent aquatic plants recorded in Pelican Lake, 1998 – 2010.

Description	Common Name	Scientific Name	Survey[a]
Grasses and Sedges	Bottlebrush sedge	*Carex comosa*	2
	Tussock sedge	*Carex* (*haydenii/stricta*)	2
	Wiregrass sedge	*Carex lasiocarpa* var. *americana*	2
	Three-way sedge	*Dulichium arundinaceum*	2
	Giant cane	*Phragmites australis*	3
Wetland Forbs	Swamp milkweed	*Asclepias incarnata*	2
	Nodding bur-marigold	*Bidens cernua*	2
	Water arum	*Calla palustris*	2
	Bulb-bearing water hemlock	*Cicuta bulbifera*	2
	Willow-herb	*Epilobium* sp.	2
	Common boneset	*Eupatorium perfoliatum*	2
	Grass-leaved goldenrod	*Euthamia perfoliatum*	2
	Small bedstraw	*Galium trifidum*	2
	Touch-me-nots	*Impatiens capensis*	2
	Blue flag iris	*Iris versicolor*	2
	Purple loosestrife	*Lythrum salicaria**	1
	Water smartweed	*Persicaria amphibia*	2
	Dot-leaved smartweed	*Persicaria punctata*	2
	Bushy knotweed	*Polygonum ramosissimum*	3
	Great water dock	*Rumex britannica*	2
	Marsh skullcap	*Scutellaria latiflora*	2
Upland Grasses	Reed canary grass	*Phalaris arundinacea**	3
	Rice cut-grass	*Leersia oryzoides*	2

[a]Survey: 1 = June and July, 2010 (Perleberg and Simon, Point intercept survey), 2 = September 3, 1998 (K. Myhre, MN DNR Minnesota County Biological Survey), 3 = DNR Fisheries lake files.

*Indicates plant is not native to Minnesota

Nomenclature follows MnTaxa 2010.

Appendix 2. Bird species list. Includes all species within Pelican Lake and shoreland recorded during surveys and casual observation, May – June 2010.

Common Name	**Scientific Name**
Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Common Goldeneye	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Red-breasted Merganser	*Mergus serrator*
Common Loon	*Gavia immer*
American White Pelican	*Pelecanus erythrorhynchos*
Double-crested Cormorant	*Phalacrocorax auritus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Merlin	*Falco columbarius*
Virginia Rail	*Rallus limicola*
Killdeer	*Charadrius vociferus*
Spotted Sandpiper	*Actitis macularia*
Wilson's Snipe	*Gallinago delicata*
Ring-billed Gull	*Larus delawarensis*
Herring Gull	*Larus argentatus*
Caspian Tern	*Sterna caspia*
Black Tern	*Chlidonias niger*
Common Tern	*Sterna hirundo*
Mourning Dove	*Zenaida macroura*
Great Horned Owl	*Bubo virginianus*
Common Nighthawk	*Chordeiles minor*
Ruby-throated Hummingbird	*Archilochus colubris*
Belted Kingfisher	*Ceryle alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Wood-Pewee	*Contopus virens*
Least Flycatcher	*Empidonax minimus*
Eastern Phoebe	*Sayornis phoebe*
Great Crested Flycatcher	*Myiarchus crinitus*
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*
Purple Martin	*Progne subis*

Appendix 2, continued.

Common Name	Scientific Name
Tree Swallow	*Tachycineta bicolor*
N. Rough-winged Swallow	*Stelgidopteryx serripennis*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapilla*
White-breasted Nuthatch	*Sitta carolinensis*
House Wren	*Troglodytes aedon*
Marsh Wren	*Cistothorus palustris*
Eastern Bluebird	*Sialia sialis*
Veery	*Catharus fuscescens*
American Robin	*Turdus migratorius*
Gray Catbird	*Dumetella carolinensis*
European Starling	*Sturnus vulgaris*
Cedar Waxwing	*Bombycilla cedrorum*
Yellow Warbler	*Dendroica petechia*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Black-and-white Warbler	*Mniotilta varia*
Ovenbird	*Seiurus aurocapilla*
Common Yellowthroat	*Geothlypis trichas*
Chipping Sparrow	*Spizella passerina*
Song Sparrow	*Melospiza melodia*
Swamp Sparrow	*Melospiza georgiana*
Northern Cardinal	*Cardinalis cardinalis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Baltimore Oriole	*Icterus galbula*
House Finch	*Carpodacus mexicanus*
American Goldfinch	*Spinus tristis*
House Sparrow	*Passer domesticus*