Final Report
Sensitive Lakeshore Survey
Leech Lake (11-0203-00)
Cass County, Minnesota

November 2010

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

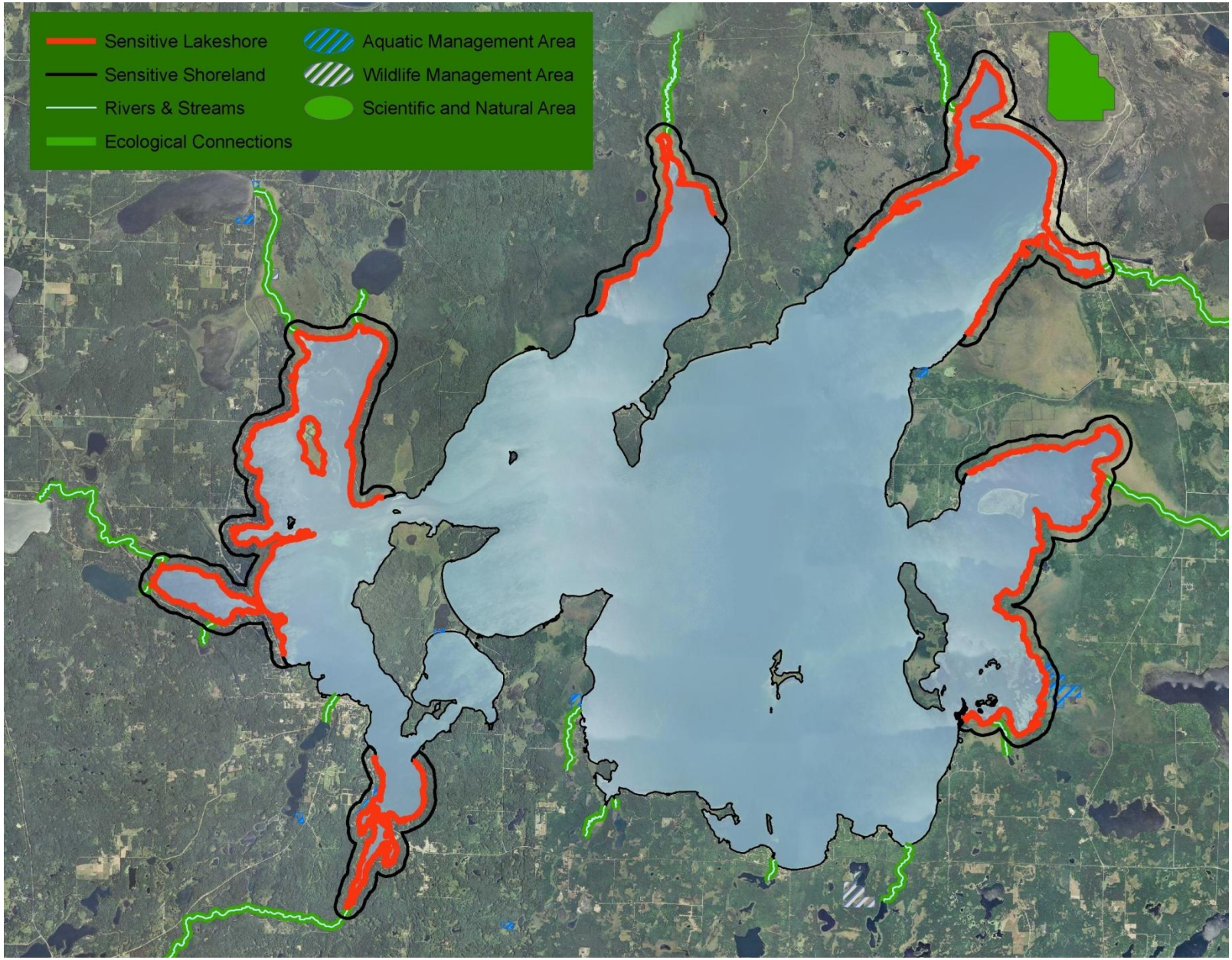
Forty-nine native aquatic plant taxa were identified in Leech Lake, including 15 emergent, three free-floating, four floating-leaf and 27 submerged taxa. Vegetation occurred in 39% of the survey sites and was influenced by water depth and turbulence. Plant growth was concentrated in protected, shallow bays and the windswept main basin contained little vegetation. Emergent and floating-leaf plants were also found primarily in the bays, including Steamboat Bay, Headquarters Bay, Portage Bay, and Boy Bay. Wild rice, bulrush, and other emergent and floating-leaf plants occupied approximately 5,800 acres in Leech Lake.

Bird surveyors recorded 130 bird species at Leech Lake. Of these, 38 were species in greatest conservation need. Two species listed as Threatened in Minnesota (common tern and trumpeter swan) and five Special Concern species (American white pelican, bald eagle, Forster's tern, Franklin's Gull, and yellow rail) were among those documented at the lake. Eighteen loon nesting areas were identified at Leech Lake.

Frog surveys were conducted at 797 stations along the shoreline of Leech Lake, and both mink and green frogs were recorded. Previous fish surveys at Leech Lake documented 42 species, including two species in greatest conservation need (pugnose shiner and least darter).

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


Sensitive Lakeshore
Sensitive Shoreland
Rivers & Streams
Ecological Connections
Aquatic Management Area
Wildlife Management Area
Scientific and Natural Area

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 in greatest conservation need; and
7. Areas that provide habitat connectivity

Species in 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 in 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 and emergent aquatic plant habitats to assess the lake-wide vegetation communities as well as describe unique plant areas. Target animal species include multiple lakeshore-dependent species, including species in greatest conservation need. 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.

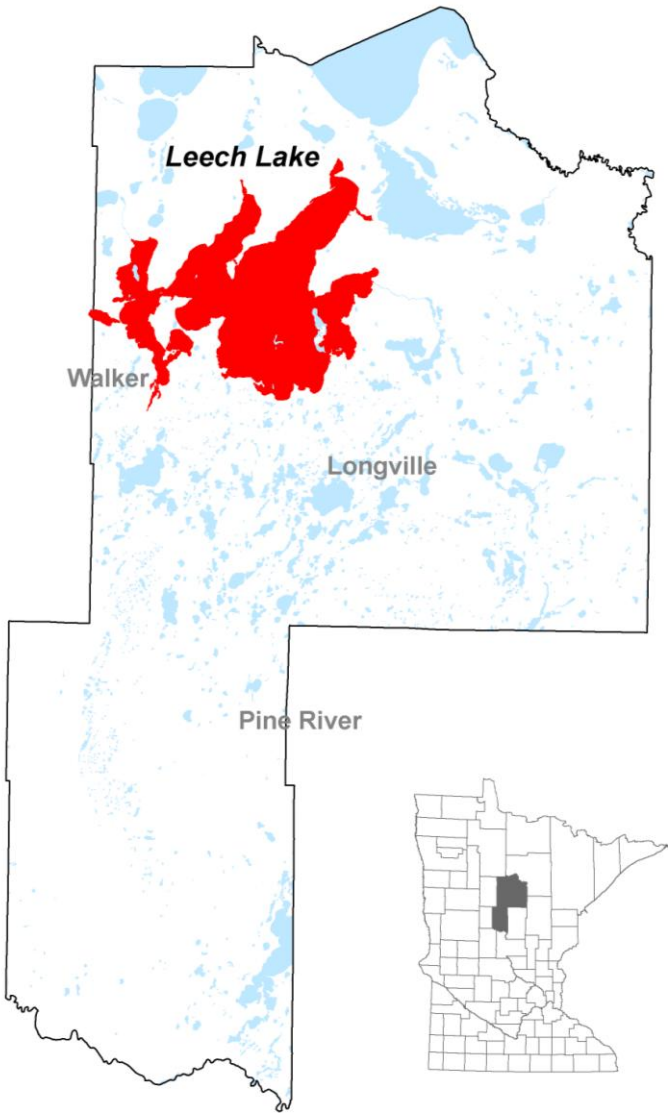
The final component of identifying sensitive lakeshore areas is to deliver advice to local governments and other groups who could use the information to maintain high quality environmental conditions and to protect habitat for species in greatest conservation need.

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 Leech Lake sensitive lakeshore areas.

Lake Description

Leech Lake is located in north-central Minnesota (Figure 1). The lake is located mainly in Cass County, although the western edge of Kabekona Bay falls within Hubbard County.

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



Leech Lake is the third largest lake entirely within the boundaries of Minnesota. Although the measurements vary somewhat depending on where the lake boundary is delineated, it has a surface area of approximately 105,000 acres and nearly 230 miles of shoreline. Leech Lake is irregular in shape and is comprised of a main basin and many bays (Figure 2). There are seven major inlets to Leech Lake (Portage Creek, Sucker Creek, Steamboat River, Kabekona River, Shingobee River, Bishop Creek, and Boy River) and one major outlet (Leech Lake River) (RMB Environmental Lab 2008). Leech Lake is located within the Leech Lake River watershed.

The Chippewa National Forest surrounds the vast majority of Leech Lake. State forests in the vicinity include Battleground State Forest, Bowstring State Forest, and Welsh Lake State Forest in the north and Paul Bunyan State Forest to the west. Much of the lake also falls within the boundaries of the Leech Lake Indian Reservation. The shoreline is primarily forested with minimal development. Large expanses of wetland occur along the northern and eastern shorelines. Several miles of shoreline near the city of Walker are heavily developed with businesses, resorts and homes, and areas of moderate development occur along the southern and eastern shorelines. There are eleven public accesses on Leech Lake.

The mean depth of Leech Lake is approximately 18 feet. The deepest area of the lake is in Walker Bay; water depths here reach nearly 150 feet (Figure 3). Approximately 80% of the lake is less than 35 feet deep. Major islands in the lake include Bear Island, Pelican Island,

Minnesota Island, Goose Island, and Pipe Island. The largest of these, Bear Island, is over 1100 acres in size.

Leech Lake is a mesotrophic lake, meaning it has moderate nutrient enrichment. The average summer Secchi depth (which measures water transparency) in the main lake basin between 1990 and 2009 was approximately nine feet (MPCA 2010), indicating moderate water clarity. Several bays, including Kabekona Bay and Shingobee Bay, displayed more oligotrophic characteristics with mean water transparencies of 10.5 to 12 feet. Other bays, such as Steamboat Bay and Boy Bay, are more eutrophic in nature.

Figure 2. Features of Leech Lake.

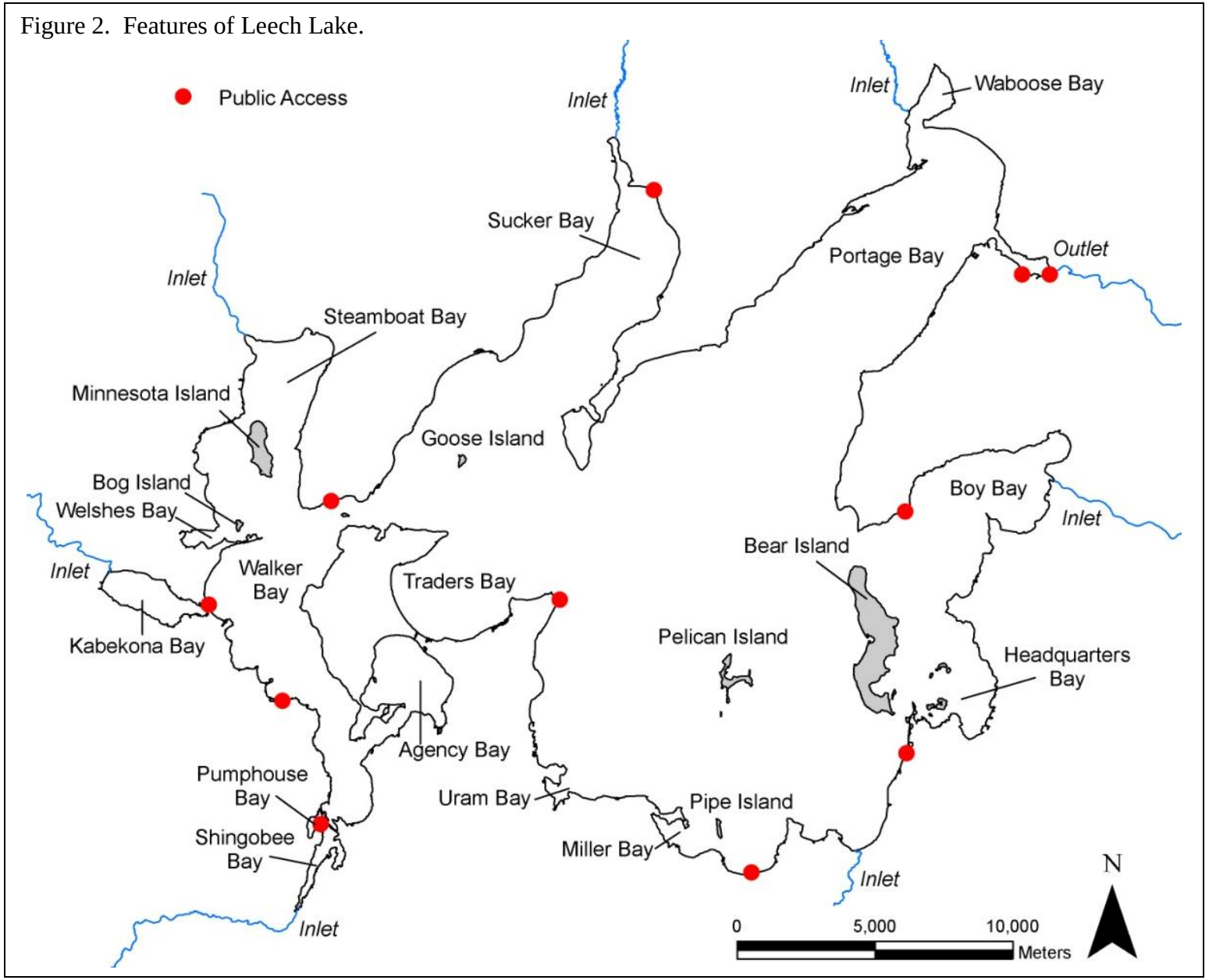
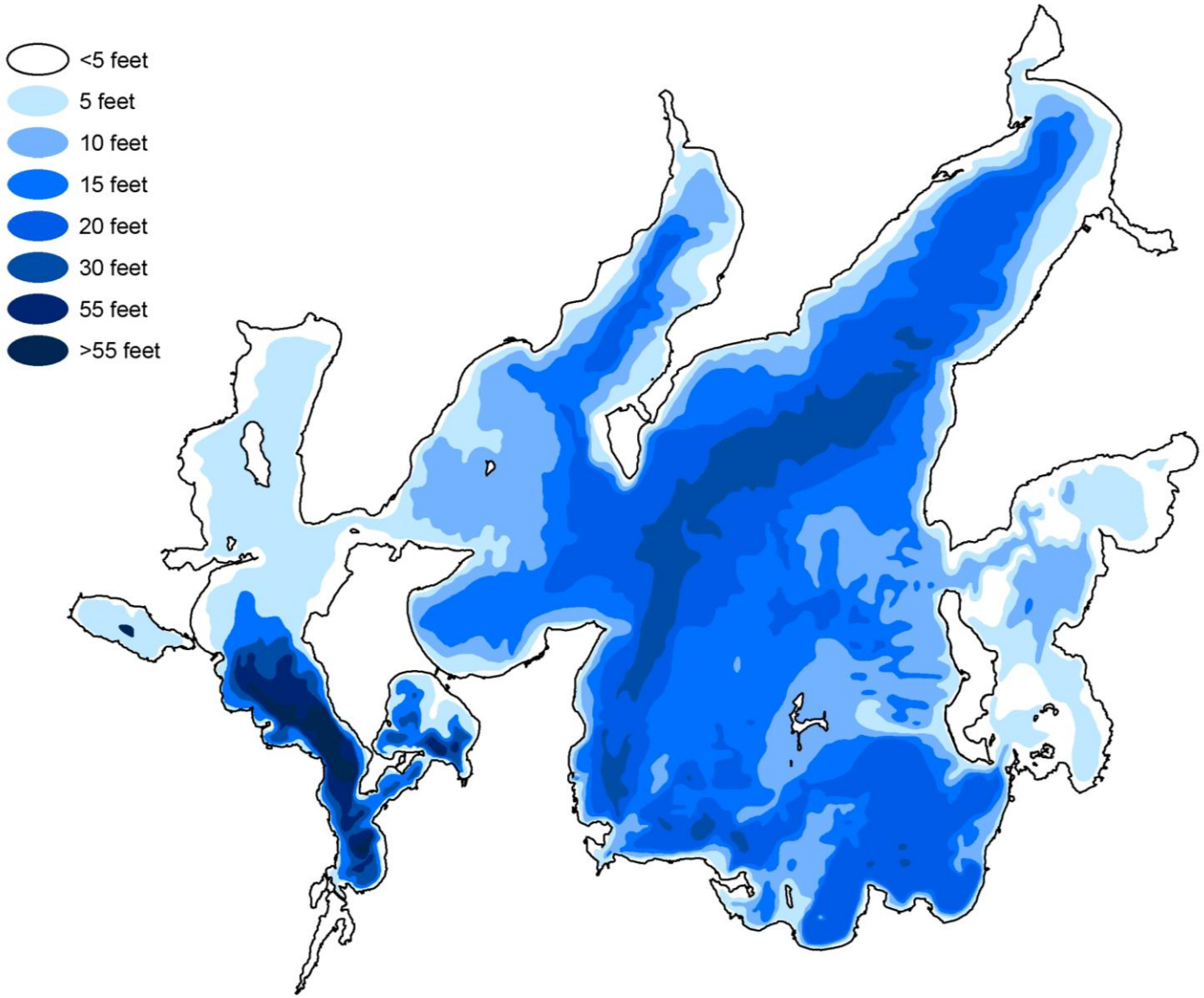


Figure 3. Depth contours of Leech Lake.



I. Field Surveys and Data Collection

Survey and data collection followed Minnesota's Sensitive Lakeshore Identification Manual protocol (MN DNR 2009). The protocol varied slightly for Leech Lake, due to the size of the lake and time constraints in conducting field surveys. Resource managers gathered information on nine[1] different variables in order to develop the sensitive shorelands model. Sources of data included current and historical field surveys, informational databases, aerial photographs, and published literature. The variables used in this project were: wetlands, hydric soils, near-shore plant occurrence, aquatic plant richness, presence of emergent and floating-leaf plant beds, loon nesting areas, frogs, rare features, and size and shape of natural areas.

Pugnose shiner photo courtesy of Konrad Schmidt, MN DNR

[1] The sensitive lakeshore assessment used 15 variables to determine sensitivity on the other study lakes in Cass County. Time constraints and the size of the lake were limiting factors to conducting a full suite of field surveys on Leech Lake. Variables not used in the Leech Lake analysis were unique/rare plants, near-shore substrate, birds, bird richness, fish, and aquatic vertebrate richness.

Wetlands

Objectives

1. Map wetlands within the extended state-defined shoreland area (within 1320 feet of shoreline) of Leech Lake
2. Describe the main wetland community types

Introduction

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

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

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

In northern Minnesota, the presence and depth of peat strongly influences the plant communities of a wetland. Peat is a soil made up of partially decomposed plant remains that accumulate on flat, poorly drained landscapes where anaerobic conditions and low temperatures inhibit plant decomposition. Once peat accumulates to a depth of 30-40 cm, plants are limited in the amount of nutrients they can absorb from the soil (MN DNR 2003). Water level and nutrient input further influence the types of plants that can occur in these conditions. "Rich peatlands" develop where the water table is below the peat surface and where groundwater inputs provide relatively high concentrations of minerals such as calcium and magnesium. "Acid peatlands" develop in peatlands where hydrologic inputs are dominated by precipitation rather than groundwater. Peat-forming sphagnum moss accumulates to levels above the ground water table and surface water flows away from or around the elevated peat surface. These systems are extremely low in nutrients and are acidic (pH<5.5).

Forested wetlands can develop in wetlands where the groundwater table does not remain above the mineral soil surface for long periods during the growing season or where surface peat is elevated above the water table, allowing sufficient aeration of the tree roots. As water levels vary among sites, wetland plant communities may grade from forested to open.

Methods

Only wetlands occurring within the extended state-defined shoreland area (i.e., within 1320 feet of the shoreline) were considered in the GIS analysis portion of this project. Wetlands that extended beyond this zone were considered when determining "Other areas of ecological significance" (see page 70).

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. Wetlands occurring more than 1320 feet from the Leech Lake shoreline and wetlands classified as lacustrine or occurring lakeward of the Leech Lake ordinary high water mark were excluded from the GIS analysis.

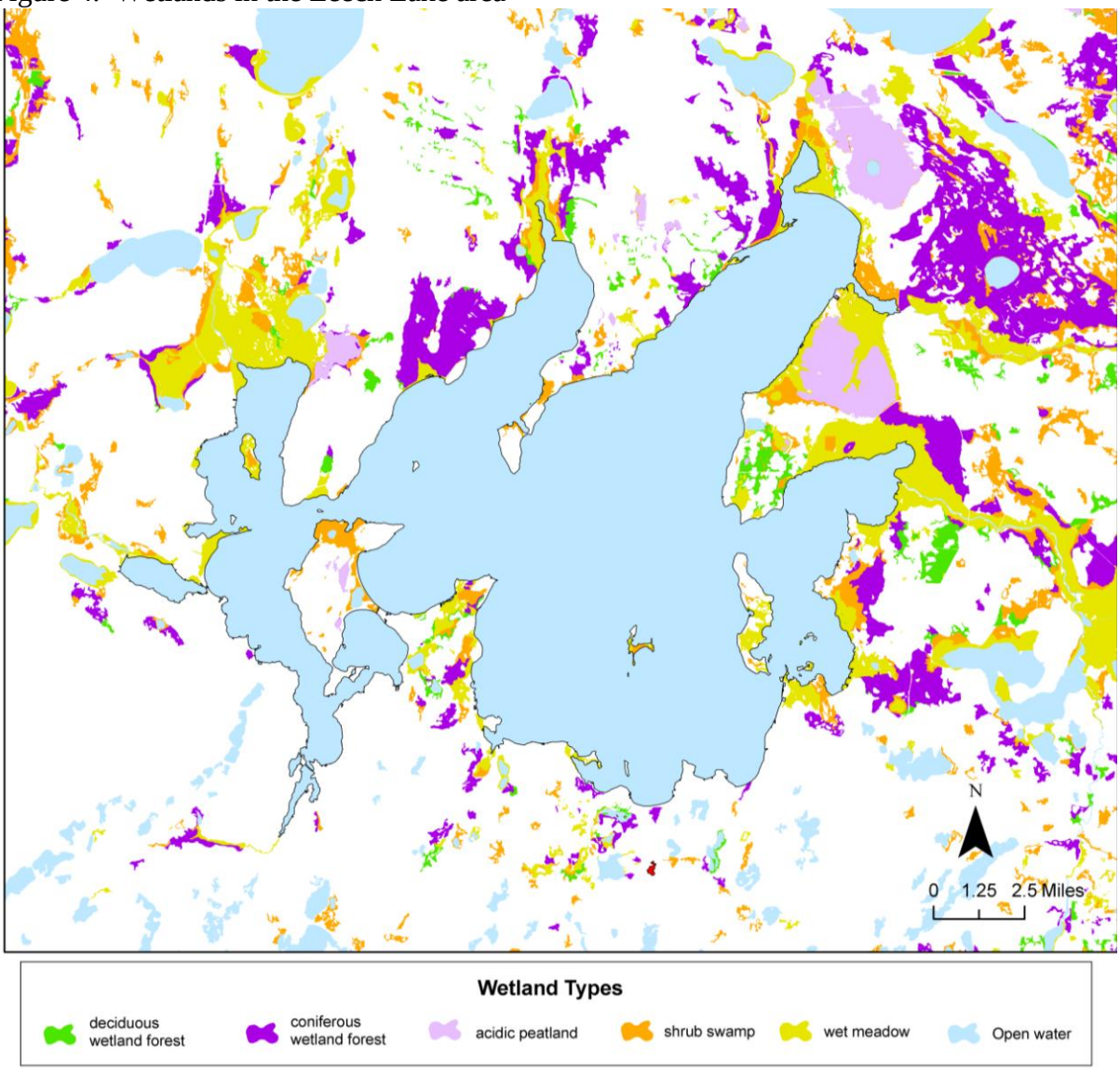
Ecologists in the DNR's Minnesota County Biological Survey (MCBS) Program mapped selected native plant communities, including major wetlands, in the Leech Lake area from 1993 to 2008 using aerial photos and field surveys. Sites were selected for survey based on size, plant community type, extent of human disturbance, landscape context, spatial distribution of native plant communities and availability of critical rare plant or rare animal habitat (MN DNR 1998). Wetlands were classified using the MN DNR Native Plant Community Classification System (MN DNR 2003).

Data from MCBS were used to describe the major wetland plant communities in the Leech Lake area. Since MCBS did not classify all wetlands in the area, NWI data were used as supplemental information and a combination of the two classification systems were used to describe wetland types. Wetlands were classified by the dominant canopy layer (tree, shrub, or grass) as well as their occurrence on peatlands or mineral soils and nutrient availability.

Results

More than 30% of the Leech Lake Watershed is covered by lakes and other wetlands. Around Leech Lake, the largest wetlands occur on the north and east sides of the lake and cover several thousand continuous acres. Wetland types are classified by the dominant canopy layer (tree, shrub or grass) as well as their occurrence on peatlands or mineral soils and nutrient availability. Five types were identified in the Leech Lake area: deciduous wetland forest, coniferous wetland forest (rich peatland), open bog (acidic peatland), shrub swamps and emergent marshes (Figure 4).

Figure 4. Wetlands in the Leech Lake area



Deciduous wetland forests (Figure 5) in the Leech Lake area were primarily Black Ash Swamps. These are minerotrophic wetland communities that are often associated with alluvial soils in floodplains and with saturated soils in former lakebeds and other low-lying landscape features. These sites may include narrow margins of lakes, river and peatlands. Tree cover exceeds 25% and may be interrupted to continuous. Black ash is the dominant tree with moderate amounts of other hardwoods and/or white cedar. The subcanopy is patchy and the shrub layer may range from sparse to continuous. The ground layer may be

Figure 5. Deciduous wetland forest: Black Ash Swamp

moderate to continuous with a mix of wet forest and upland forest herbs and grasses. In the Leech Lake area, the largest black ash swamps were located on the east and west sides of Boy Bay.

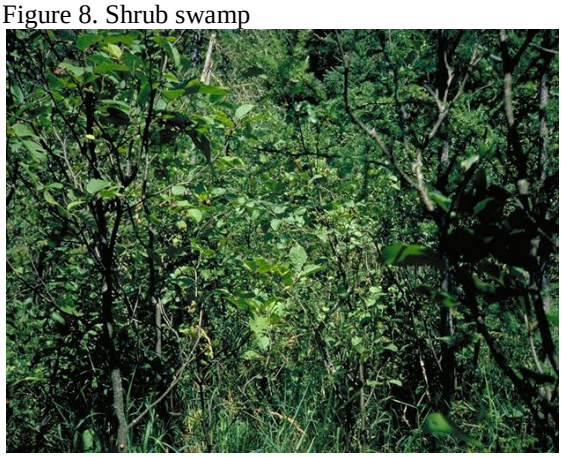
Figure 6. Coniferous wetland forest: Northern Rich Tamarack Swamp

Coniferous wetland forests (Figure 6) in the Leech Lake area include Northern Cedar Swamp and Northern Rich Tamarack Swamp. These wetlands typically have a 25 – 100% tree canopy cover and dominant trees may include white cedar, tamarack and/or black spruce. The shrub layer may be prominent and includes evergreen shrubs such as Labrador tea and leatherleaf. The grass and herb layers are variable but may support a relatively high number of plant species. Extensive coniferous wetland forests occurred along the north and east sides of Leech Lake and included the 8,600 acre Drumbeater Lake wetland on the northeast side of Leech Lake.

Figure 7. Acidic peatland: Northern Open Bog

Acidic peatlands (Figure 7) in the Leech Lake area are forested wetland communities with sparse and often stunted trees (Northern Spruce Bog and Northern Poor Conifer Swamp), and open sites that mostly lack trees (Northern Open Bog and Northern Poor Fen). These communities are characterized by conifer, low-shrub, or grass-dominated communities that develop in association with peat-forming sphagnum. These communities are floristically depauperate with the flora composed primarily of a small subset of species that are able to survive in the harsh, low-nutrient environment. The largest areas of acidic peatlands were on the northeast and east ends of Portage Bay, including the Hole-in-Bog Peatland.

Figure 8. Shrub swamp



Shrub swamps (Figure 8) often occur along the edges of lakes and in lags along peatland and upland borders. Around Leech Lake, many of the shrub swamps were dominated by specked alder and mixed with other shrubs like dogwood, willow, juneberries and currants. Moss cover

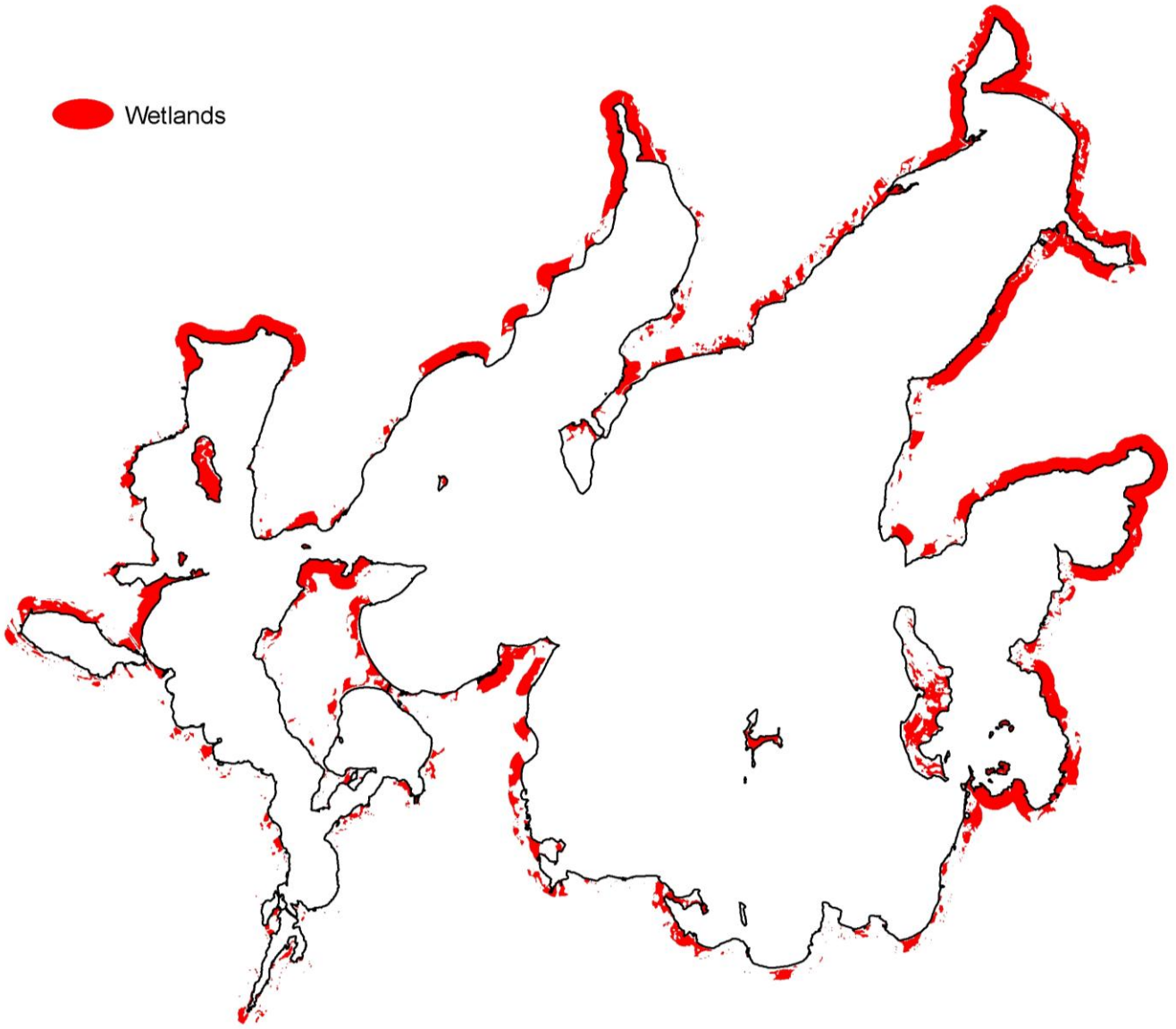
of shrub swamps can range from sparse to continuous. Grass and sedge cover may be variable and is often intermixed with a variety of wetland flowers and ferns. Shrub swamps occurred at many areas around Leech Lake, including sites on the islands.

Figure 9. Wet meadow adjacent to Leech Lake

Wet meadows (Figure 9) occur at sites where peak water levels are high enough and persistent enough to prevent tree and often shrubs from establishing. These sites are often dominated by grasses and sedges that are adapted to survive waterlogged conditions. Many of these plants form dense tussocks that elevate rootlets above the water surface and they often form monotypic stands that produce dense thatch. These mineral and nutrient rich sites typically have luxuriant plant growth. Extensive areas of wet meadow occurred at the north ends of Steamboat Bay, Sucker Bay, Portage Bay and Boy Bay and often integrated into shrub swamp communities.

Over 40% (approximately 11,000 acres) of the Leech Lake shoreland area (the area within 1320 feet of the shoreline) is described as wetlands by NWI. These wetlands occurred along virtually the entire Leech Lake shoreline (Figure 10) and include examples of all five of the major wetland community types.

Figure 10. Wetlands within 1320 feet of Leech Lake shoreline.



Hydric Soils

Objective

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

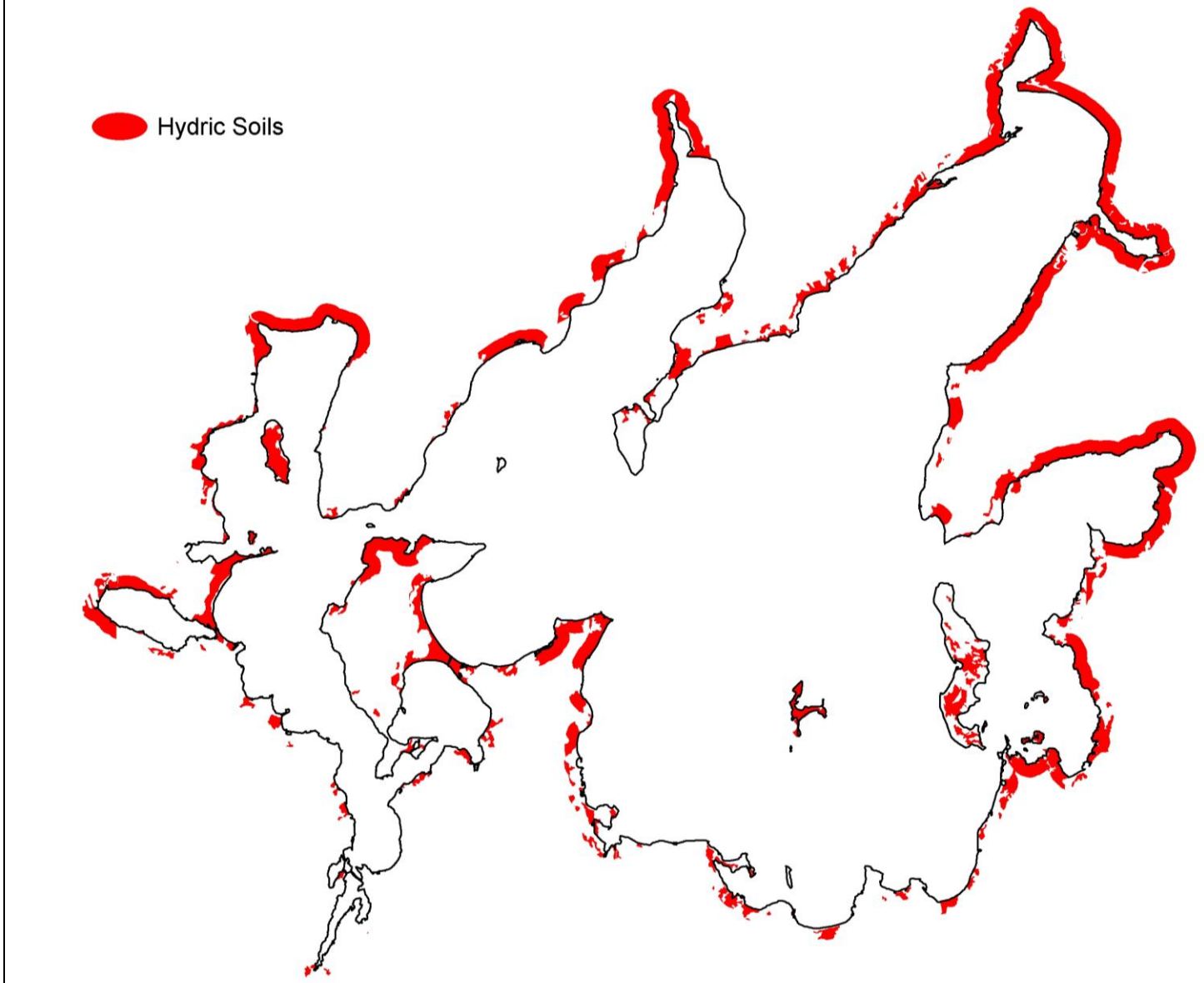
Methods

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

Over 11,000 acres of hydric soils were present within the Leech Lake shoreland district. The largest complexes were several hundred acres in size, and occurred along the northern and eastern lake edges around Steamboat Bay, Sucker Bay, Portage Bay, Boy Bay, and Headquarters Bay (Figure 11). The primary hydric soil types were comprised mainly of muck. These soils have a high proportion of organic matter and are very poorly drained. Other hydric soil types in the Leech Lake shoreland district were loam, sand, and peat, as well as combinations of the soils such as loamy sand and mucky peat. Organic matter content in these soils ranged from moderately low to very high, and most were poorly drained to very poorly drained.

Figure 11. Hydric soils within 1320 feet of Leech Lake shoreline.



Plant Surveys

For detailed survey methods and results, please refer to ***Aquatic Vegetation of Leech Lake, Cass County, Minnesota, 2002 – 2009*** *(Perleberg and Loso 2010). This publication is available at: http://files.dnr.state.mn.us/natural_resources/water/lakes/vegetation_reports/11020300.pdf*

Objectives

1. Record presence and abundance of all aquatic plant taxa in Leech Lake
2. Describe and map distribution of aquatic vegetation
3. Delineate and describe emergent and floating-leaf plant beds
4. Calculate and map aquatic plant taxa richness

Summary

About 30% of Leech Lake supports plant growth and aquatic plants were found to a depth of 24 feet. Vegetation occurred in 39% of the survey sites and was influenced by water depth and turbulence. Plant growth was concentrated in protected, shallow bays and the windswept main basin contained little vegetation.

Forty-nine native plant taxa were identified in Leech Lake, including 15 emergent, three free-floating, four floating-leaf and 27 submerged taxa. The greatest number of plant taxa occurred in depths of six feet and less. The submerged plant muskgrass (*Chara* sp.) was the most frequently recorded taxa and was found in 26% of all sample sites. Other important submerged taxa included bushy pondweed (*Najas flexilis*), flat-stem pondweed (*Potamogeton zosteriformis*), northern watermilfoil (*Myriophyllum sibiricum*), a variety of broad-leaf pondweeds (*Potamogeton* spp.), greater bladderwort (*Utricularia vulgaris*), wild celery (*Vallisneria americana*), Canada waterweed (*Elodea canadensis)* and coontail (*Ceratophyllum demersum*).

Emergent and floating-leaf plants were found primarily in the bays, including Steamboat Bay, Headquarters Bay, Portage Bay, and Boy Bay. Wild rice (*Zizania palustris*), bulrush (*Schoenoplectus* spp.), and other emergent and floating-leaf plants occupied approximately 5,800 acres in Leech Lake.

Introduction

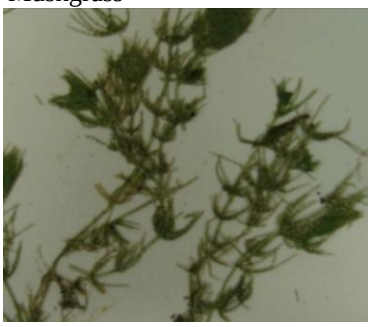
The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity, water chemistry, water depth, substrate, and wave activity. Deep or windswept areas may lack aquatic plant growth, whereas sheltered shallow areas may support an abundant and diverse native aquatic plant community that, in turn, provides critical fish and wildlife habitat and other lake benefits. The annual abundance, distribution and composition of aquatic plant communities may change due to environmental factors, predation, the specific phenology of each plant species, introductions of non-native plant or animal species, and human activities in and around the lake.

Non-native submerged aquatic plant species 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 mechanical means. Motorboat activity in vegetated areas can be particularly harmful for species such as bulrush and wild rice. Shoreline and watershed development can also indirectly influence aquatic plant growth if it results in changes to the overall water quality and clarity. Limiting these types of activities can help protect native aquatic plant species.

Submerged plants

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

Muskgrass



Narrow-leaf pondweed

Bushy pondweed

Floating-leaf and emergent plants

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

Wild rice

Bulrush

Yellow waterlily

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 hypertrophic habitats have been associated with reduced species richness (Pip 1987). Within a region of Minnesota, lakewide aquatic plant species richness can be used as a general indicator of the lake clarity and overall health of the lake plant community. Loss of aquatic plant species has been associated with anthropogenic eutrophication (Stuckey 1971, Nicholson 1981, Niemeier and Hubert 1986) and shoreland development (Meredith 1983).

Within a lake, plant species richness generally declines with decreasing 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.

Rare aquatic plants

Sheathed pondweed (*Stuckenia vaginata*; Figure 11) is a fine-leaved, perennial plant that grows entirely submerged except for a flower stalk that extends above the water surface. It closely resembles the more common sago pondweed, but has been found in only a few Minnesota lakes. This plant is listed as a species of Special Concern in Minnesota and has been documented in only a few lakes in northern Minnesota (MN DNR 2008).

Figure 11. Sheathed pondweed

Clustered burreed (*Sparganium glomeratum;* Figure 12) is an emergent aquatic plant that grows to be about 30 – 60 cm tall. It is one of eight species of burreeds in Minnesota that are named for their spherical bur-like flower clusters. In Minnesota, clustered burreed is listed as a species of Special Concern. This plant has been found in northern Minnesota in shallow water pools and small ponds and only rarely along protected shorelines of lakes (MN DNR 2008).

Figure 12. Clustered burreed growing among waterlilies

Rare wetland plants

White adder's-mouth orchid (*Malaxis monophylla* var. *brachypoda;* Figure 13) is a small bog orchid that grows in conifer swamps in northern Minnesota. This plant is less than nine inches in height and has one oval-shaped leaf at the base of the stem. Minute greenish flowers occur along a slender stalk. There are several small bog orchids native to Minnesota and white adder's-mouth orchid is listed as a state species of Special Concern. This species occurs in unique habitat within forested rich peatlands, typically under a canopy of northern white cedar, black spruce, balsam fir, black ash and tamarack; these forests are usually at the margins of lake basins or

other wetlands (MN DNR 2008). The sensitive and fragile nature of this species' habitat is one reason for its rarity.

Figure 13. White adder's-mouth orchid

Figure 14. Ram's-head Lady's-slipper

Ram's-head Lady's-slipper (*Cypripedium arietinum*; Figure 14) is a rare Minnesota orchid that inhabits a variety of coniferous forests, including coniferous forest wetlands, swamps and bogs. It is one of several lady-slipper orchids that have one petal modified into a pouch or "slipper." This particular orchid has a white and purple pouch that resembles the head of a charging ram. This species was originally listed as an Endangered species in Minnesota in 1984, and was reclassified as Threatened in 1996. Recent surveys of potential habitat and historic sites indicate a decline in the Minnesota population which has been attributed to habitat loss (MN DNR 2008).

Figure 15. Goblin fern

Rare upland plants

There are several species of small, inconspicuous ferns (*Botrychium* spp.) that are designated as rare species in Minnesota (MN DNR 2008). These plants do not form flowers or fruits and reproduce by small spores. Habitat requirements vary among species and include mature hardwood forests. These ferns range in height from about 2.5 to 9 cm tall and can be easily overlooked. Species include an Endangered species: pale moonwort (*B. pallidum*), a Threatened species: St. Lawrence grapefern (*B. rugulosum*), and several species of Special Concern: Mingan moonwort (*B. minganense*), goblin fern (*B. mormo*; Figure 15) and least moonwort (*B. simplex*).

Figure 16. Goldie's fern

Goldie's fern (*Dryopteris goldiana*; Figure 16) is one of the largest ferns in Minnesota and can reach 120 cm in height. This fern has only been found in mesic hardwood forests. This Species of Special Concern occurs with low frequency in the state (MN DNR 2008).

Methods

The aquatic plant communities of Leech Lake were measured using several techniques described in Minnesota's Sensitive Lakeshore Identification Manual (2009). Plant nomenclature follows MNTaxa 2010.

Grid point-intercept survey

Grid point-intercept surveys were completed on Leech Lake between 2002 and 2005. Points were spaced between 40 and 200 meters apart, and a total of 9,859 sites were sampled. At each sample site, surveyors recorded water depth and all vegetation within a one-meter squared sample area. Additional species found outside the sample plots were recorded as present in the lake. Voucher specimens were submitted to The Herbarium at the University of Minnesota Bell Museum of Natural History, St. Paul, MN.

Emergent and floating-leaf plant bed delineation

Emergent and floating-leaf plant beds were mapped between 2005 and 2009 using a combination of aerial photo delineation, field delineation, ground-truthing, and site specific surveys (Knowles et al. 2007, Perleberg and Loso 2010). Wild rice beds were mapped by aerial photo delineation and modified based on field surveys. Waterlily beds were delineated using aerial photos. Field mapping focused on bulrush beds, which were difficult to see on aerial photos.

Rare aquatic plant searches

Surveyors searched for rare aquatic plants during the grid point-intercept surveys and while delineating emergent and floating-leaf plant beds.

Rare wetland and terrestrial plant searches

Surveyors obtained known locations of state and federally listed rare wetland and terrestrial plants within 1320 feet of the Leech Lake shoreline from the Rare Features Database of the MN DNR Natural Heritage Information System.

Results

Aquatic plant species observed

Between 2002 and 2009, 49 native aquatic plant taxa were recorded in Leech Lake. These included 27 submerged, 15 emergent, four floating-leaf, and three free-floating taxa. Two non-native taxa, curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*), were also documented during the surveys.

Distribution of plants

Aquatic plants were found to a depth of 24 feet, but were most common in depths of 0 to 9 feet, where 72% of the sample sites were vegetated (Figure 17). In depths greater than 18 feet, only 4% of the sites contained plants. Plant frequency was highest in the shallow, protected bays, including Steamboat Bay, Headquarters Bay, and Boy Bay. Plant frequency in these bays was approximately 80%. In contrast, only about 30% of the sample sites in the main basin of Leech Lake contained vegetation.

Submerged plants

Submerged plants occurred to a depth of 24 feet, but were sparse in depths greater than 18 feet. Muskgrass, the large algae, was the most frequently occurring submerged plant, and accounted for 37% of all plants recorded. Of the other 26 native submerged taxa, only eight occurred with a lake-wide frequency of 2% or more. These included bushy pondweed (*Najas flexilis*), flat-stem pondweed (*Potamogeton zosteriformis*), clasping-leaf pondweed (*P. richardsonii*), wild celery

(*Vallisneria americana*), Canada waterweed (*Elodea canadensis*), northern watermilfoil (*Myriophyllum sibiricum*), coontail (*Ceratophyllum demersum*), and greater bladderwort (*Utricularia vulgaris*).

Emergent and floating-leaf plants

Approximately 5,800 acres of emergent and floating-leaf plant beds were mapped in Leech Lake (Figure 18). Wild rice was the most frequently found emergent plant, and covered about 4,540 acres. Extensive wild rice beds occurred in Boy Bay, Headquarters Bay, and Steamboat Bay, as well as the northern ends of Sucker, Portage, and Kabekona Bays. Bulrush beds covered approximately 1,315 acres in Leech Lake. Many of the sites that contained bulrush also contained submerged plants, particularly muskgrass. Large bulrush stands were located in Portage Bay, Steamboat Bay, and the southeast shore of Sucker Bay. Other emergent plants documented in Leech Lake were giant cane (*Phragmites australis*), burreed (*Sparganium* spp.), spikerush (*Eleocharis* spp.), cattail (*Typha* spp.), and arrowhead (*Sagittaria* spp.).

Floating-leaf plants recorded in Leech Lake included white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), floating-leaf pondweed (*Potamogeton natans*), and floating-leaf burreed (*Sparganium* sp.). These plants were most common in depths of 0 – 3 feet, and in the protected bays such as Shingobee Bay, Kabekona Bay, and the northern portion of Portage Bay.

Species richness

The number of taxa at each one-meter square sampling site ranged from zero to nine (Figure 19). The greatest number of taxa occurred in water depths from zero to six feet, where a mixture of emergent, floating-leaf, free-floating, and submerged plants were found. Only seven taxa were found beyond a depth of 20 feet.

Rare plants

No rare plants were documented during the 2002 – 2009 aquatic plant surveys of Leech Lake, but 10 different species of rare plants have been previously documented in or near the lake. They include two aquatic plants, clustered bur-reed (*Sparganium glomeratum*) and sheathed pondweed (*Stuckenia vaginata*), two rare wetland orchids, Ram's-head Lady's-slipper (*Cypripedium arietinum*) and White Adder's-mouth orchid (*Malaxis monophyllos* var. *brachypoda*), five different species of small ferns (*Botrychium* spp.) and the larger Goldie's fern (*Dryopteris goldiana*).

Figure 17. Distribution of aquatic plants in Leech Lake, 2002 – 2009.

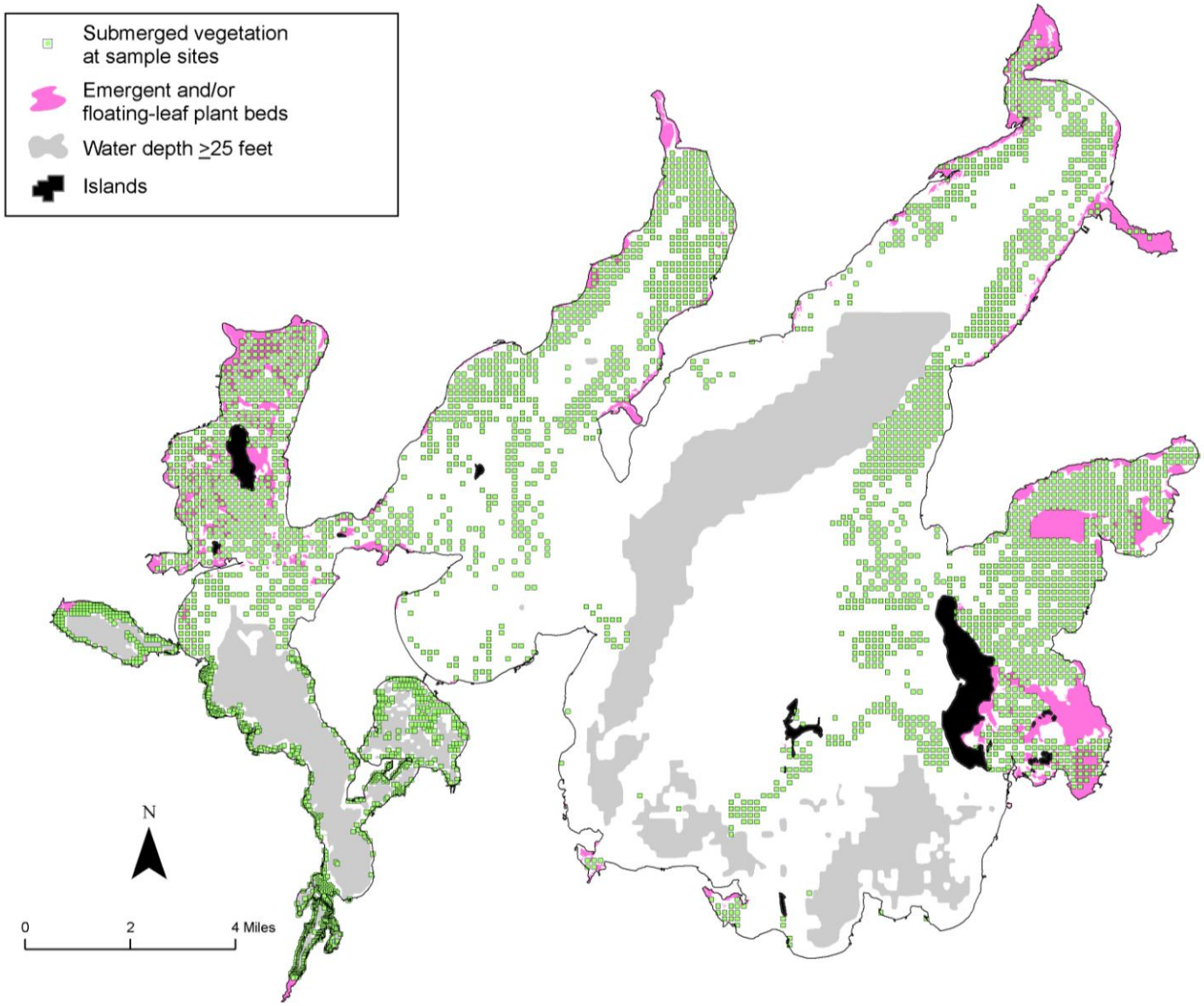


Figure 18. Emergent and floating-leaf plant beds in Leech Lake, 2002 – 2009.

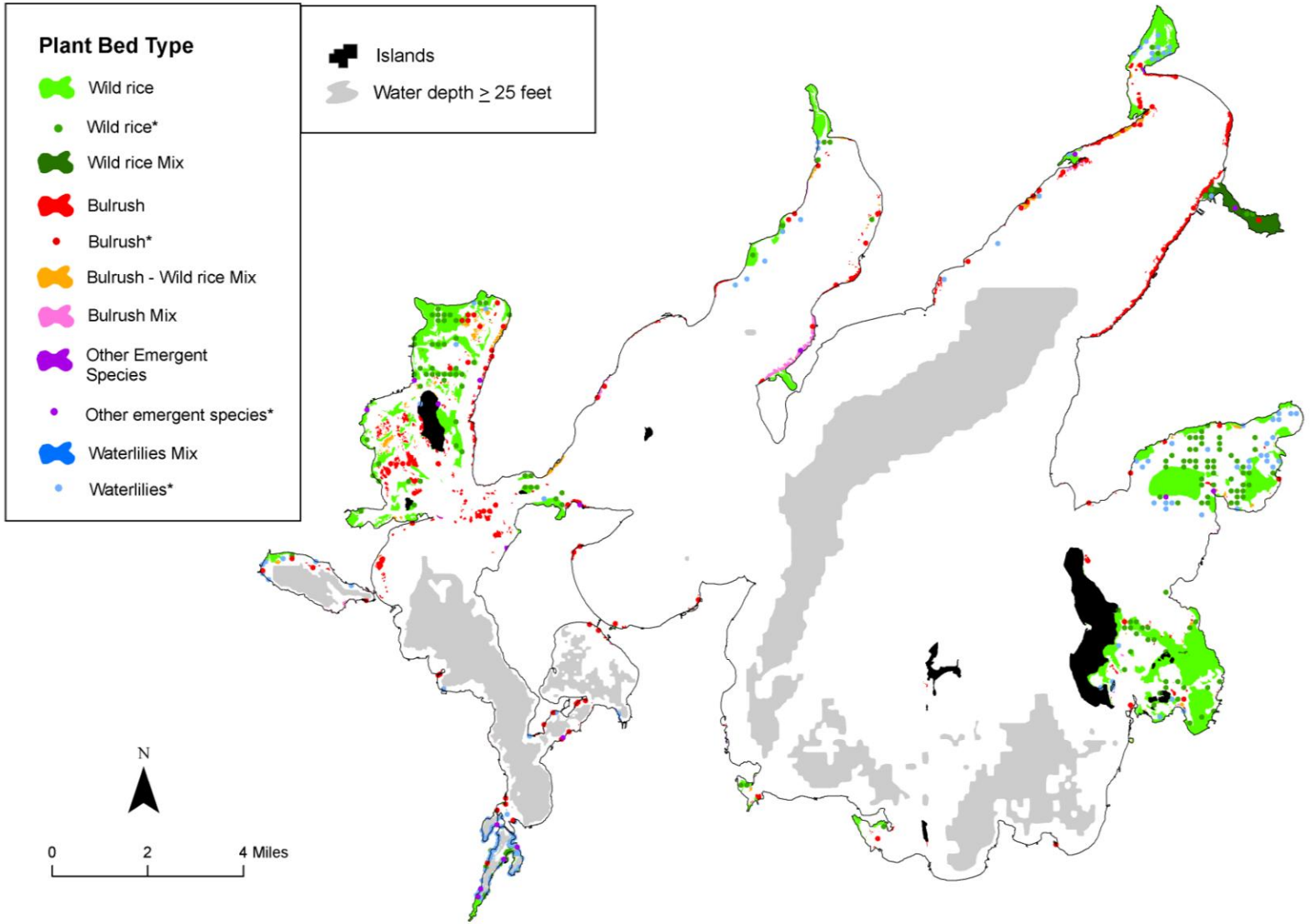
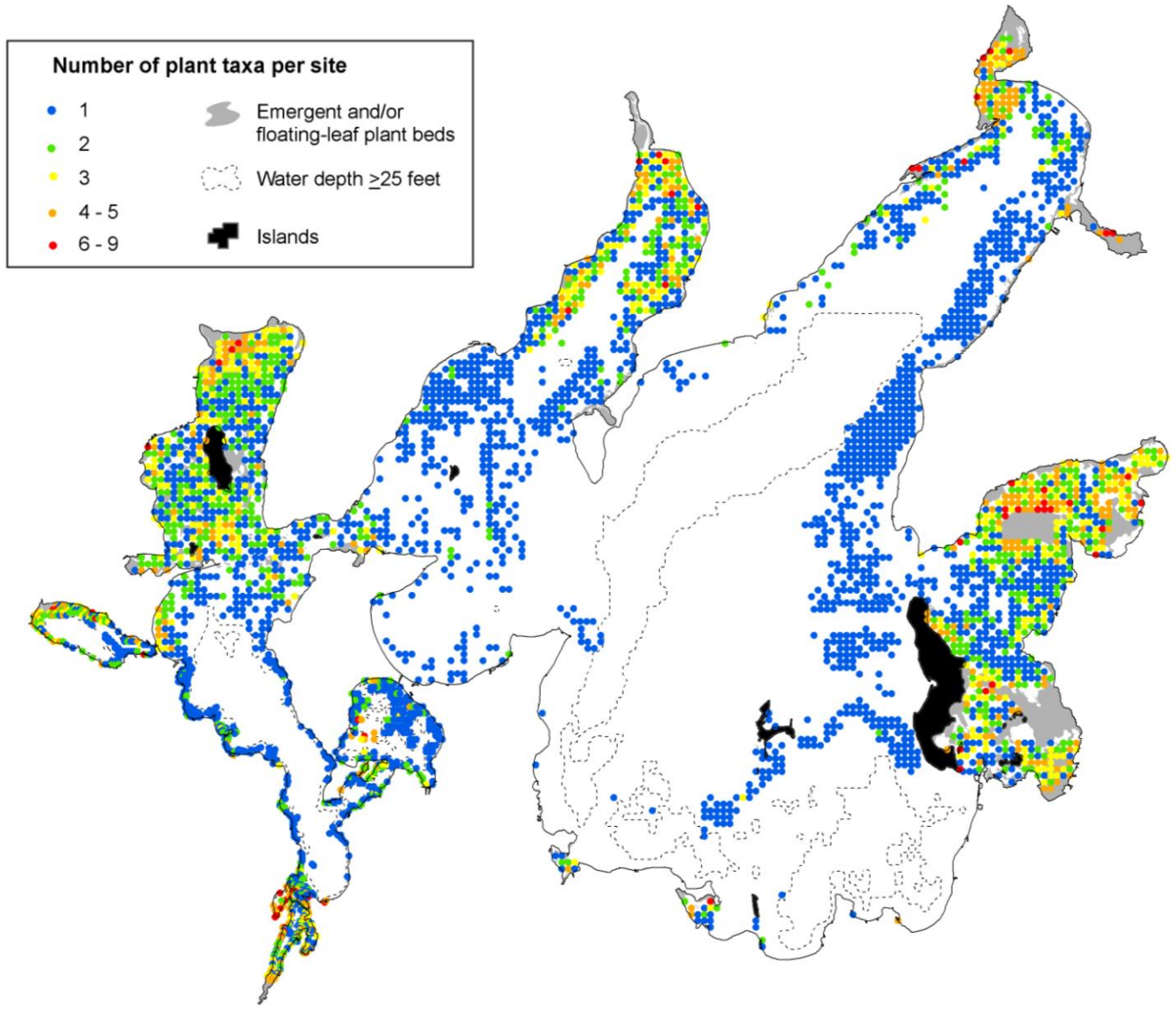


Figure 19. Aquatic plant richness (number of taxa per sampling station) in Leech Lake, 2002 – 2009.



Bird Surveys

Objectives

1. Record presence of all bird species detected during modified point count surveys
2. Record presence of marsh birds detected with call-playback surveys
3. Document all non-survey observations of birds

Introduction

Bird Species in Greatest Conservation Need

There are 97 bird species in greatest conservation need (SGCN) in Minnesota. Species in greatest conservation need are documented in Minnesota's State Wildlife Action Plan, Tomorrow's Habitat for the Wild and Rare (2006). Thirty-eight of these species were identified during the 2010 Leech Lake surveys.

Figure 20. American bittern

Photo by: Andrea Lambrecht

American bitterns (*Botaurus lentiginosus*; Figure 20) are medium-sized wading birds. It is cryptically colored; the upperparts are dark brown, while the neck and body are streaked with brown. Adults have a black patch on either side of the throat. When disturbed, bitterns "freeze" with their bills pointed upward, or sway side to side like the grasses surrounding them, allowing them to blend into the vegetation. Unlike many other colony-nesting herons, American bitterns nest singly on a platform of grasses and reeds. Habitat includes shallow, densely vegetated shorelines and marshes. Habitat loss has been a major factor in the decline of American bittern populations. Habitat degradation and pesticide contamination have also negatively affected bittern numbers.

Figure 21. American white pelican

Photo by: Carrol Henderson, MN DNR

American white pelicans (*Pelecanus erythrorhynchos*; Figure 21) 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 eat mainly small "rough" fish, as well as crayfish and salamanders. American white pelicans nest in colonies on remote freshwater lakes, and depend on wetlands for many stages of their life cycle. Habitat loss is the largest known cause of nesting failure, although predation and boating disturbance can also be factors.

Bald eagles (*Haliaeetus leucocephalus*; Figure 22) 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 22. Bald eagle

Photo by: Carrol Henderson, MN DNR

Black terns (*Chlidonias niger*; Figure 23) 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 terns forage on the wing, catching their prey in flight or at the water's surface. Food items include insects, fish, and amphibians. 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 23. Black tern

Photo by: Carrol Henderson, MN DNR

Black-billed cuckoos (*Coccyzus erythropthalmus*; Figure 24) are one of two cuckoo species regularly found in Minnesota. These slender, long-tailed birds summer and breed in Minnesota and the east-central United States before heading south to spend the winter in South America. Black-billed cuckoos have a brown back and white underside, and may be distinguished by a curved black bill and red ring around the eye. The call is a repetitive "cu-cu-cu," often uttered in flight. This bird inhabits deciduous forests and thickets, and is often found near water. The black-billed cuckoo is listed as a species of Regional Concern on the Partners in Flight watchlist.

Figure 24. Black-billed cuckoo

Photo source: U.S. Fish and Wildlife Service

Bobolinks (*Dolichonyx oryzivorus*; Figure 25) are distinctive, medium-sized birds of the blackbird family. During breeding season, the male possesses a black chest, wings, and tail, while the shoulders and rump are white. The back of the head is yellow. Females and non-breeding males brown streaked appearance resembles that of a sparrow. Bobolinks breed in open grassy fields, including hay fields. They may also utilize freshwater marshes and grain fields. Bobolinks are long-distance migrants, and every year make a round-trip journey of over 12,000 miles. Populations of bobolinks are declining over much of their range. Loss of grassland habitat is the primary cause of this decline.

Figure 25. Bobolink

Photo by: Dave Herr

The brown thrasher (*Toxostoma rufum*; Figure 26) is a medium-sized member of the mimic family. This vocal species has one of the largest repertoires of any North American bird, complete with several thousand songs. The brown thrasher has a bright reddish-brown back and long tail. The underparts are white or buffy with thin dark streaks and the eyes are yellow. Brown thrashers inhabit thickets and dense vegetation, including riparian areas, wood edges, and hedgerows. These birds are partial or short-distance migrants, with birds wintering in the southern portion of their breeding range. Brown thrasher populations are declining throughout their range. Habitat loss, through maturation of shrublands and elimination of hedgerows, is likely the cause of the decline.

Figure 26. Brown thrasher

Photo by: Ken Thomas

The Canada warbler (*Wilsonia canadensis*; Figure 27) is a brightly colored wood warbler. Also referred to as the "necklaced warbler," this bird has a black streaked band across its chest. The throat and breast are yellow and the back and wings are slate-gray. Canada warblers breed in a variety of habitats, including coniferous and hardwood forests, riparian thickets, and forested wetlands. Flying insects make up the bulk of the diet. Populations of Canada warblers have been negatively affected on both their breeding and wintering grounds. Forest clearing, forest fragmentation, and reduction of the forest understory are all associated with Canada warbler population declines.

Figure 27. Canada warbler

Photo by: Jon Cross, www.ohio-nature.com

The Cape May warbler (*Dendroica tigrina*; Figure 28) is a small, active warbler. Breeding plumage is striking, with a bright yellow rump, throat, and breast streaked with black. The face is orange-brown with a black eyestripe, and the wings exhibit a narrow white wing bar. Cape May warblers breed across the northern United States and into Canada, where large expanses of coniferous woodland are present. They feed mainly on spruce budworms, but also consume other insects and nectar. Numbers of Cape May warblers rise and fall somewhat regularly, in response to availability of spruce budworms. However, loss of mature boreal forest through logging and loss of winter habitat may lead to long-term population declines.

Figure 28. Cape May warbler

Photo by: S. Maslowski, USFWS

Common loons (*Gavia immer*; Figure 29) 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 29. Common loon

Photo by: Carrol Henderson, MN DNR

Common nighthawks (*Chordeiles minor*; Figure 30) 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 30. Common nighthawk

Photo by: Carrol Henderson, MN DNR

Common terns (*Sterna hirundo*; Figure 31) 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. The common tern is listed as Threatened in Minnesota.

Figure 31. Common tern

Photo by: Carrol Henderson, MN DNR

The Connecticut warbler (*Oporornis agilis*; Figure 32) is a rarely seen, little studied member of the warbler family. Despite its name, this bird is uncommon in Connecticut, breeding instead in the Great Lakes region and central Canada. It tends to inhabit poorly drained areas, including tamarack-black spruce bogs. Connecticut warblers have an olive-gray back with light yellow underparts and a white eye ring. Males possess a gray hood, while females have a whitish throat. Although little information is available on Connecticut warbler populations, some reports suggest they are declining. Fragmentation of breeding habitat and loss of winter habitat may be associated with the declines.

Figure 32. Connecticut warbler

Photo by: Steve Reischel, www.sandbluff.org

The dunlin (*Calidris alpina*; Figure 33) passes through Minnesota during the summer en route to its breeding grounds in the Arctic and subarctic tundra. During migration it can be found on mudflats and sandy beaches. This mid-sized member of the sandpiper family has distinctive breeding plumage, including a black belly patch that extends behind its black legs. The back is reddish-brown and the head and breast are white with faint streaks. Dunlin are gregarious in winter and form large flocks of several hundred birds. Habitat loss is putting populations of this species at risk. In addition, dunlin serve as an indicator species for the health of the arctic ecosystem, so gathering knowledge about this species should be a high priority.

Figure 33. Dunlin at Leech Lake, 2010.

Eastern wood-pewees (*Contopus virens*; Figure 34) 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 34. Eastern wood-pewee

Photo by: J.A. Spendelow

The Forster's tern (*Sterna forsteri*; Figure 35) is a species of Special Concern in Minnesota. It is similar in appearance to the common tern, with a black cap, orange bill and legs, and a whitish tail. However, it has white (not gray) underparts and white primary feathers on its wings. During the summer, Forster's terns are often found inhabiting marshes, particularly those with abundant vegetation and large areas of open water. They are loosely colonial and nest on gravel islands or atop muskrat houses, often in close proximity to black terns. Forster's terns feed mainly on fish, diving to catch their prey from just below the water's surface. Populations of Forster's terns are declining primarily due to destruction of wetlands.

Figure 35. Forster's tern

Photo by: Carrol Henderson, MN DNR

Franklin's gulls (*Leucophaeus pipixcan*; Figure 36) are small gulls common in the prairie marshes of the Great Plains. Listed as a species of Special Concern in Minnesota, these gulls nest at only a few locations in the western part of the state. Optimal breeding habitat includes patches of open water interspersed with stands of sparse vegetation. Breeding Franklin's gulls possess a black cap, white eye crescents and a red bill. The juveniles have a gray back, black bill, and partial dark cap. These birds nest in large colonies that may contain thousands of pairs. Populations of Franklin's gulls are highly susceptible to habitat loss and human disturbance.

Figure 36. Franklin's gull

Photo by: Dave Herr

Golden-winged warblers (*Vermivora chrysoptera*; Figure 37) are small, active, insectivorous warblers. They possess a distinctive yellow crown and yellow patch on the wings. A black mask and throat contrast with the gray and white plumage on the back and breast. They often inhabit forest edges, such as those along marshes, bogs, and fields, and are also common in alder shrub swamps. Regional declines of the golden-winged warbler are considerable. Human-caused disturbance and hybridization with increasing numbers of blue-winged warblers are correlated with the declines.

Figure 37. Golden-winged warbler

Photo by: Carrol Henderson, MN DNR

The Le Conte's sparrow (*Ammodramus leconteii*; Figure 38) is a small, elusive sparrow of open, grassy areas. Wet meadows, sedge marshes, and prairies may all harbor populations of this bird. Males and females look similar, with a buffy orange face, throat and breast and white belly. The sides are streaked with black, and the nape is pinkish and streaked with chestnut. Because of their secretive habits, little is known about the population status of the Le Conte's sparrow. Drainage of wetlands may have caused population declines in some areas, but long-term geographic trends have been inconsistent. Maintenance of grassland areas will be beneficial to the Le Conte's sparrow.

Figure 38. Le Conte's sparrow

Photo by: David Arbour

The least bittern (*Ixobrychus exilis*; Figure 39) is the smallest member of the heron family found in North America. Although rarely seen, the least bittern is fairly common within suitable habitat. Least bitterns breed in densely vegetated marshes throughout much of the eastern United States. The crown, back and tail of the least bittern are greenish in color, while the throat, sides and underparts are streaked with brown and white. The small size and narrow body of the least bittern allow it to move easily through dense emergent vegetation. These birds often forage while clinging to reeds and branches with their long curved claws. Secretive marsh birds such as the least bittern are difficult to survey accurately, so population trends are unclear. Destruction of wetlands poses a major threat to this species.

Figure 39. Least bittern

Photo by: Thomas Bentley, www.thomasbentley.com

Least flycatchers (*Empidonax minimus*; Figure 40) 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 40. Least flycatcher

Photo by: J.A. Spendelow

Marsh wrens (*Cistothorus palustris*; Figure 41) are small, stocky wrens. Their color is brown with black and white streaks on the back and black barring on the tail. They have a dark brown or black cap and a white eye line. Marsh wrens are noisy birds, and sing almost continually during the breeding season. The male's song repertoire may include up to 200 different songs. Marsh wrens often hold their tails in an upright position, in "classic" wren posture. They inhabit a variety of marshes. Emergent vegetation, such as cattails or bulrush, is one of the most important habitat components. While populations of marsh wrens are increasing in some areas, others are threatened by loss and degradation of wetland habitat.

Figure 41. Marsh wren

Photo by: Dave Herr

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

Figure 42. Nelson's sparrow

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

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

Figure 43. Northern harrier

Photo courtesy of: Robert Bastarache

The northern pintail (*Anas acuta*; Figure 44) is an open-country nester, found in seasonal wetlands and grassy uplands during the summer. This mallard-sized bird has a distinctive long neck and long, pointed tail. The male has a brown head and gray body, with a white streak that stretches up the side of the neck. Females are much plainer in coloration, with mottled tan and brown feathers. Northern pintails dabble for food in shallow water, or forage for seeds in harvested grain fields. Although the northern pintail remains numerous world-wide, several surveys have recorded long-term declines in North America. Northern pintail nests are susceptible to predators and farming practices. Habitat conservation and restoration will help maintain healthy populations of this species.

Figure 44. Northern pintail

Photo by: Dave Herr

Northern rough-winged swallows (*Stelgidopteryx serripennis*; Figure 45) are small, fairly common songbirds. They are brown on the head and back with a pale brown throat and white belly. The outer wing feathers, or primaries, have "hooks" on the edge, giving them a rough feel. These swallows are insectivorous and feed in the air, often over water. They will nest either singly or colonially near rocky or exposed banks of clay or sand. Open habitat is preferred for breeding. Northern rough-winged swallows are fairly adaptable and are even increasing in parts of their range. Continued monitoring is important to help maintain this trend.

Figure 45. Northern rough-winged swallow

Photo by: Dave Herr

Ovenbirds (*Seiurus aurocapillus*; Figure 46) 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 46. Ovenbird

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

Red-necked grebes (*Podiceps grisegena*; Figure 47) are one of the larger grebe species. The red neck, which distinguishes the bird, is visible only during the breeding season; in the winter it turns to whitish or gray. The back is dark, and the head is characterized by white cheeks and a black cap. Red-necked grebes breed in a variety of water bodies, from marshes to small, shallow lakes to the bays of large lakes. Both the male and female help build the nest, a floating mat of plant material anchored to emergent vegetation. These birds are uncommon in Minnesota, and populations are imperiled by the loss and modification of wetland habitat.

Figure 47. Red-necked grebe

Rose-breasted grosbeaks (*Pheucticus ludovicianus*; Figure 48) are summer visitors to Minnesota birdfeeders. 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 48. Rose-breasted grosbeak

Photo by: J.A. Spendelow

Sedge wrens (*Cistothorus platensis*; Figure 49) are small, brown wrens with buffy underparts and white streaks on the back and crown. They have an indistinct white eye stripe, and often hold their short tails in a cocked, upright position. As their name implies, they prefer marshes and meadows with abundant dense sedges and grasses. The nest is often made of sedges, as well. Sedge wrens are unpredictable in their migration patterns, and may be abundant in an area one year and completely absent the next. Human development of wetlands is the primary reason for the recent notable declines in sedge wren populations.

Figure 49. Sedge wren

Photo by: Berlin Heck

The semipalmated sandpiper (*Calidris pusilla*; Figure 50) is a small member of a group of shorebirds known as "peeps." Breeding adults are mottled black and brown on top and white underneath. The legs and bill are black, and a white stripe is visible on the wings in flight. Semipalmated sandpipers are long-distance migrants, breeding in the tundra across North American and spending the winters in the southern U.S. and South America. Although these birds may migrate in large flocks consisting of several hundred thousand birds, they are generally monogamous and territorial on their breeding grounds. Semipalmated sandpipers have declined significantly over the past few decades. They rely heavily on critical migration stopover points, and habitat destruction at these sites is a major threat to the species.

Figure 50. Semipalmated sandpiper at Leech Lake, 2010.

The swamp sparrow's (*Melospiza georgiana*; Figure 51) slow trill is a familiar sound in swampy areas in the summer. Other wetlands, such as bogs and meadows, may also harbor populations of this species. Swamp sparrows eat mainly seeds and fruits, but may also be adventurous feeders, wading in the water and putting their heads underneath in order to capture aquatic insects. This rusty-colored bird has black streaks on the back and an unstreaked gray breast and neck. A reddish cap is easily visible during the breeding season. Swamp sparrows thrive in suitable habitat; however, destruction of wetlands has put this species at risk.

Figure 51. Swamp sparrow

Photo by: Jim Stasz

The trumpeter swan (*Cygnus buccinator*; Figure 52) is the largest of the North American waterfowl. It inhabits lakes, ponds, and large rivers, feeding on roots and stems of aquatic vegetation. Adult trumpeter swans are all white with a black bill and face. Juveniles are whitish-gray with a mottled bill. Historically, trumpeter swans nested across much of North America. However, excessive hunting in the 19th and early 20th centuries led to large population declines, and by 1880 trumpeter swans had disappeared from Minnesota. Captive breeding programs and habitat protection efforts have been successful, and the Minnesota population now numbers over 2000. However, habitat loss and lead poisoning still pose threats to swan populations. This bird is listed as Threatened in Minnesota.

Figure 52. Trumpeter swan

Photo by: Dave Herr

The veery (*Catharus fuscescens*; Figure 53) is one of the most easily identifiable thrushes. It has faint dark spots on a buffy breast and a reddish brown back and head. The legs are pink and the eyes are dark with an indistinct light eye ring. The veery was named after its most common call, a "vee-er" sound. Riparian areas with dense vegetation and wetlands within large forests are good places to find the veery. The veery is suffering declines throughout many parts of its range. Destruction of winter habitat and parasitism by brown-headed cowbirds are major reasons cited for the decline.

Figure 53. Veery

Photo by: Deanna Dawson

Virginia rails (*Rallus limicola*; Figure 54) 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 54. Virginia rail

Photo by: David Arbour

White-throated sparrows (*Zonotrichia albicollis*; Figure 55) are common in Minnesota during their spring and fall migrations. They are recognizable by the white patch on the throat and their characteristic "Old Sam Peabody Peabody Peabody" song. The head is striped with black and tan or white, and has a yellow spot above the eye. The chest is gray and the back is streaked with brown and black. They inhabit coniferous or mixed forests, and prefer areas with multiple openings and abundant low-growing vegetation. During winter and migration, they may also be found in woodlots, city parks, and backyards. Nests are often build on or near the ground. Although white-throated sparrows are widespread, they are declining over portions of their breeding range.

Figure 55. White-throated sparrow

Photo by: Dave Herr

The yellow rail (*Coturnicops noveboracensis*; Figure 56) is one of the smallest rails in North America. Like the Virginia rail, it is difficult to see, and often the only way to detect a yellow rail is to hear it. Their call is distinctive, and sounds like two stones being tapped together. Yellow rails are brownish in color with pale yellow stripes. The breast is buffy and the beak is short and yellow. The crown is dark and dark eye patches are present. Yellow rails breed in dense sedge meadows and shallow marshes in the northern US and Canada, and migrate south to spend their winters along the Gulf Coast. Yellow rail populations are difficult to monitor, but may be at risk due to degradation of wetlands. Yellow rails are listed as a species of Special Concern in Minnesota.

Figure 56. Yellow rail

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

The yellow-bellied sapsucker's (*Sphyrapicus varius*; Figure 57) 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. The tell-tale sign of a sapsucker's presence is the systematic pattern of holes bored into the trunk and limbs of trees. Yellow-bellied sapsuckers create a food source for many other species when they drill these 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 57. Yellow-bellied sapsucker

Photo by: J.A. Spendelow

In addition to the species in greatest conservation need identified during the 2010 surveys, two other bird SGCN have been documented at Leech Lake. They are the American black duck and Wilson's phalarope.

American black ducks (*Anas rubripes*; Figure 58) are large dabbling ducks. The body is dark brown, rather than black, with a lighter brown head and neck and red or orange legs. Male and female black ducks are similar in plumage. They breed in a variety of habitats, from beaver ponds to sedge meadows. Populations have declined across their range, including in Minnesota, over the past 50 years. The decline is attributed mainly to the presence of mallards (*Anas platyrhynchos*), which readily hybridize with American black ducks and may outcompete them for breeding spots.

Figure 58. American black duck

Source: U.S. Fish and Wildlife Service

The Wilson's phalarope (*Phalaropus tricolor*; Figure 59) is a small member of the sandpiper family. Unlike most bird species, breeding females are more brightly colored than the males. Females have a black stripe that goes through the eye and down the neck, and the neck and wings are reddish. The belly is white and the back is gray. Male Wilson's phalaropes are generally smaller and duller, although individuals vary considerably. Wilson's phalaropes breed in prairie wetlands in the northern United States and Canada. During migration, they inhabit shallow ponds, marshes, flooded fields, and mudflats. They forage mainly in shallow water or on shore, but may swim in tight circles to create small whirlpools that bring insects and other food to the surface. Wilson's phalarope populations are threatened by habitat loss in their breeding and migration staging areas.

Figure 59. Wilson's phalarope

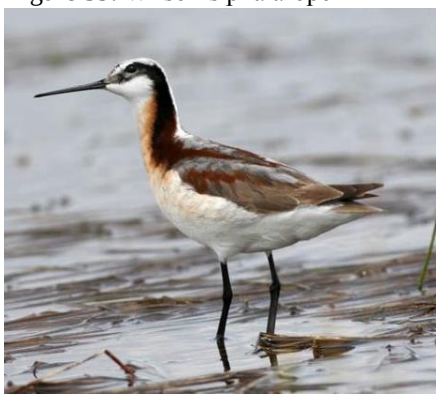


Photo by: Dave Herr

Methods

Bird surveys were conducted in May and June, 2010. Surveyors used several techniques to collect information on bird species. Modified point count surveys were conducted in various habitats along the Leech Lake shoreline. Surveyors listened for approximately five minutes per station and recorded all new 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 marsh 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 took place in the early evening. Both point count and call-playback surveys were conducted from a boat. 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. Time constraints prevented surveyors from conducting point counts at all 877 pre-designated survey stations; however, surveyors attempted to survey all major habitat types and develop a comprehensive bird species list.

Results

Surveyors documented 130 bird species on Leech Lake in 2010 (Table 1). Of these, 38 were species in greatest conservation need. Leech Lake species in greatest conservation need included aquatic-dependent species, such as the black tern, common loon, and red-necked grebe, wetland-dependent species, such as the marsh wren, swamp sparrow, and Virginia rail, and forest-dependent species, such as the ovenbird, veery, and Connecticut warbler. Two species (common tern and trumpeter swan) are identified as Threatened in the state of Minnesota, and five species (American white pelican, bald eagle, Forster's tern, Franklin's gull, and yellow rail) are of Special Concern in the state.

Table 1. Bird species identified during Leech Lake surveys, May – June 2010.
* denotes a species in greatest conservation need.

Description	Common Name	Scientific Name
Waterfowl	Canada Goose	*Branta canadensis*
	Trumpeter Swan*	*Cygnus buccinator*
	Wood Duck	*Aix sponsa*
	Gadwall	*Anas strepera*
	American Wigeon	*Anas americana*
	Mallard	*Anas platyrhynchos*
	Blue-winged Teal	*Anas discors*
	Northern Pintail*	*Anas acuta*
	Green-winged Teal	*Anas crecca*
	Canvasback	*Aythya valisineria*
	Redhead	*Aythya americana*
	Ring-necked Duck	*Aythya collaris*
	Bufflehead	*Bucephala albeola*
	Common Goldeneye	*Bucephala clangula*
	Hooded Merganser	*Lophodytes cucullatus*
	Common Merganser	*Mergus merganser*
	Red-breasted Merganser	*Mergus serrator*
Grouse/turkeys	Ring-necked Pheasant	*Phasianus colchicus*
	Ruffed Grouse	*Bonasa umbellus*
Loons	Common Loon*	*Gavia immer*
Grebes	Pied-billed Grebe	*Podilymbus podiceps*
	Red-necked Grebe*	*Podiceps grisegena*
Cormorants	Double-crested Cormorant	*Phalocrocorax auritus*
Pelicans	American White Pelican*	*Pelecanus erythrorhynchos*
Herons/bitterns	American Bittern*	*Botaurus lentiginosus*
	Least Bittern*	*Ixobrychus exilis*
	Great Blue Heron	*Ardea herodias*
	Green Heron	*Butorides virescens*
Vultures	Turkey Vulture	*Cathartes aura*
Hawks/eagles	Osprey	*Pandion haliaetus*
	Bald Eagle*	*Haliaeetus leucocephalus*
	Northern Harrier*	*Circus cyaneus*
	Cooper's Hawk	*Accipiter cooperii*
	Broad-winged Hawk	*Buteo platypterus*
Rails/coots	Yellow Rail*	*Coturnicops noveboracensis*
	Virginia Rail*	*Rallus limicola*
	Sora	*Porzana carolina*
	American Coot	*Fulica americana*
Cranes	Sandhill Crane	*Grus canadensis*

Table 1, continued.

Description	Common Name	Scientific Name
Plovers	Killdeer	*Charadrius vociferus*
Sandpipers/allies	Spotted Sandpiper	*Actitis macularius*
	Solitary Sandpiper	*Tringa solitaria*
	Lesser Yellowlegs	*Tringa flavipes*
	Semipalmated Sandpiper*	*Calidris pusilla*
	Least Sandpiper	*Calidris minutilla*
	Dunlin*	*Calidris alpina*
	Wilson's Snipe	*Gallinago delicata*
Gulls/terns	Bonaparte's Gull	*Chroicocephalus philadelphia*
	Franklin's Gull*	*Leucophaeus pipixcan*
	Ring-billed Gull	*Larus delawarensis*
	Herring Gull	*Larus argentatus*
	Caspian Tern	*Hydroprogne caspia*
	Black Tern*	*Chlidonias niger*
	Common Tern*	*Sterna hirundo*
	Forster's Tern*	*Sterna forsteri*
Cuckoos	Black-billed Cuckoo*	*Coccyzus erythropthalmus*
Goatsuckers	Common Nighthawk*	*Chordeiles minor*
Hummingbirds	Ruby-throated Hummingbird	*Archilochus colubris*
Kingfishers	Belted Kingfisher	*Megaceryle alcyon*
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*
	Yellow-bellied Sapsucker*	*Sphyrapicus varius*
	Downy Woodpecker	*Picoides pubescens*
	Hairy Woodpecker	
	Northern Flicker	*Colaptes auratus*
	Pileated Woodpecker	*Dryocopus pileatus*
Flycatchers	Eastern Wood-Pewee*	*Contopus virens*
	Alder Flycatcher	*Empidonax alnorum*
	Least Flycatcher*	*Empidonax minimus*
	Eastern Phoebe	*Sayornis phoebe*
	Great Crested Flycatcher	*Myiarchus crinitus*
	Eastern Kingbird	*Tyrannus tyrannus*
Vireos	Yellow-throated Vireo	*Vireo flavifrons*
	Warbling Vireo	*Vireo gilvus*
	Red-eyed Vireo	*Vireo olivaceus*
Jays/crows	Blue Jay	*Cyanocitta cristata*
	American Crow	*Corvus brachyrhynchos*
	Common Raven	*Corvus corax*

Table 1, continued.

Description	Common Name	Scientific Name
Swallows	Purple Martin	*Progne subis*
	Tree Swallow	*Tachycineta bicolor*
	Northern Rough-winged Swallow*	*Stelgidopteryx serripennis*
	Cliff Swallow	*Petrochelidon pyrrhonota*
	Barn Swallow	*Hirundo rustica*
Chickadees	Black-capped Chickadee	*Poecile atricapilla*
Nuthatches	Red-breasted Nuthatch	*Sitta canadensis*
	White-breasted Nuthatch	*Sitta carolinensis*
Creepers	Brown Creeper	*Certhia americana*
Wrens	Sedge Wren*	*Cistothorus platensis*
	Marsh Wren*	*Cistothorus palustris*
Kinglets	Ruby-crowned Kinglet	*Regulus calendula*
Thrushes	Eastern Bluebird	*Sialia sialis*
	Veery*	*Catharus fuscescens*
	Hermit Thrush	*Catharus guttatus*
	American Robin	*Turdus migratorius*
Mockingbirds	Gray Catbird	*Dumetella carolinensis*
	Brown Thrasher*	*Toxostoma rufum*
Waxwings	Bohemian Waxwing	*Bombycilla garrulus*
	Cedar Waxwing	*Bombycilla cedrorum*
Warblers	Golden-winged Warbler*	*Vermivora chrysoptera*
	Nashville Warbler	*Vermivora ruficapilla*
	Yellow Warbler	*Dendroica petechia*
	Chestnut-sided Warbler	*Dendroica pensylvanica*
	Cape May Warbler*	*Dendroica tigrina*
	Black-throated Green Warbler	*Dendroica virens*
	Pine Warbler	*Dendroica pinus*
	Black-and-white Warbler	*Mniotilta varia*
	American Redstart	*Setophaga ruticilla*
	Ovenbird*	*Seiurus aurocapilla*
	Northern Waterthrush	*Seiurus noveboracensis*
	Connecticut Warbler*	*Oporornis agilis*
	Common Yellowthroat	*Geothlypis trichas*
	Canada Warbler*	*Wilsonia canadensis*
Sparrows/allies	Chipping Sparrow	*Spizella passerina*
	Savannah Sparrow	*Passerculus sandwichensis*
	Le Conte's Sparrow*	*Ammodramus leconteii*
	Nelson's Sparrow*	*Ammodramus nelsoni*
	Song Sparrow	*Melospiza melodia*
	Swamp Sparrow*	*Melospiza georgiana*
	White-throated Sparrow*	*Zonotrichia albicollis*

Table 1, continued.

Description	Common Name	Scientific Name
Cardinals/allies	Scarlet Tanager	*Piranga olivacea*
	Northern Cardinal	*Cardinalis cardinalis*
	Rose-breasted Grosbeak*	*Pheucticus ludovicianus*
	Indigo Bunting	*Passerina cyanea*
Blackbirds	Bobolink*	*Dolichonyx oryzivorus*
	Red-winged Blackbird	*Agelaius phoeniceus*
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
	Common Grackle	*Quiscalus quiscula*
	Brown-headed Cowbird	*Molothrus ater*
	Baltimore Oriole	*Icterus galbula*
Finches	House Finch	*Carpodacus mexicanus*
	American Goldfinch	*Spinus tristis*

Loon Nesting Areas

Objectives

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

Introduction

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

Loon pair with chick

Photo by: Paul Bolstad

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

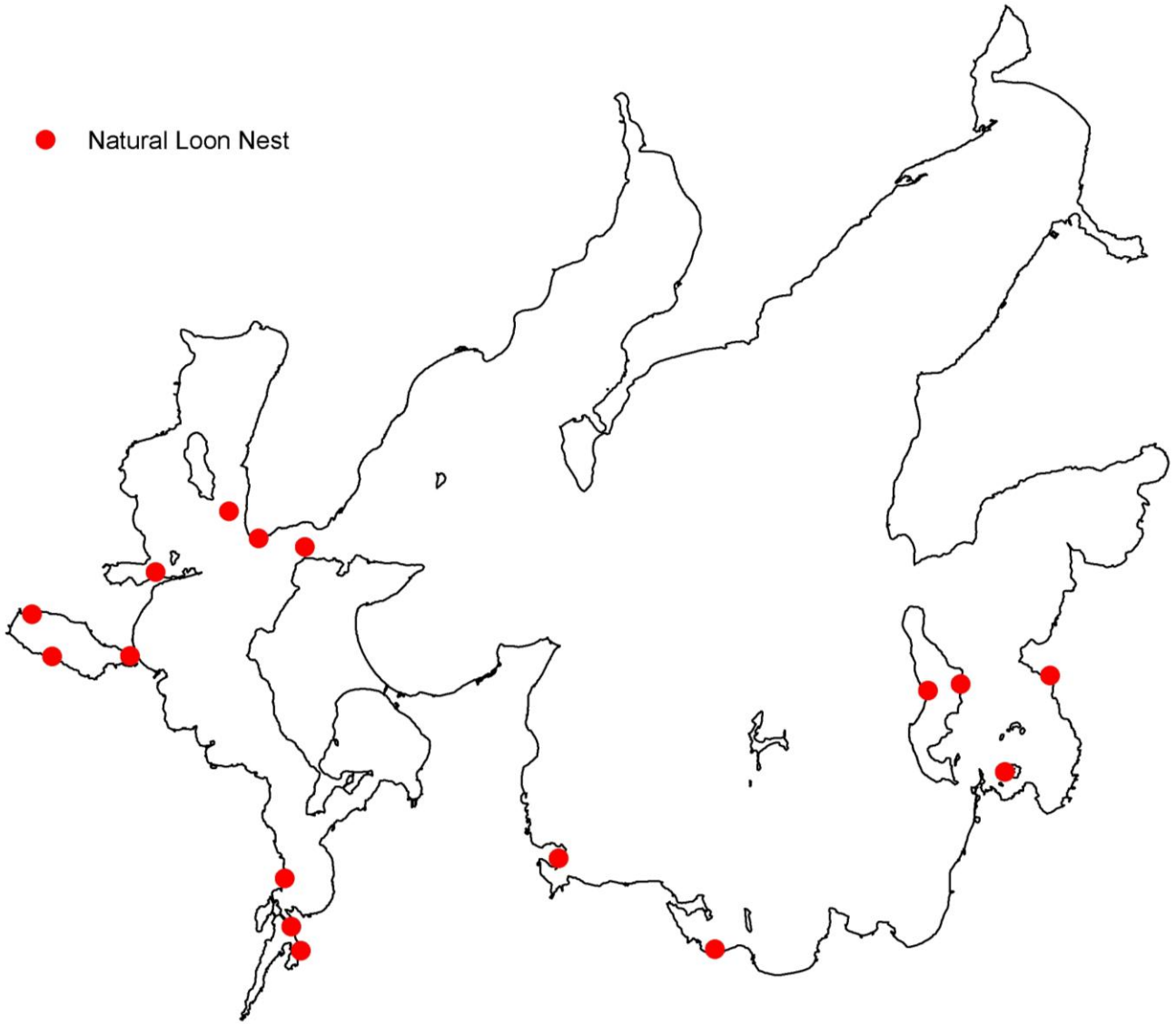
Methods

Bird surveyors mapped Leech Lake loon nests in May and June, 2010. Surveyors located nests by driving slowly along the shoreline and searching for incubating birds. Single adult birds foraging near shore were also frequently indicative of a nearby nest. On several occasions during the nesting season, loon pairs or adult loons with chicks were observed. If the nest or nesting area could not be located, these observations were not included in the analyses. Information from LoonWatcher reports was used to supplement 2010 observations. Loon nesting locations were mapped 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.

Results

Eighteen probable loon nesting areas have been identified on Leech Lake (Figure 60). Two of the locations were documented by volunteer LoonWatchers in the 1980s and 1990s; the other 16 locations were recorded by bird surveyors in 2010. All nests were natural, and no artificial nesting platforms were observed on the lake. Most of the loon nesting areas were located in the southern half of Leech Lake. The vast majority of the nesting areas were located in or near distinct bays. Nesting areas were documented in Boy Bay, Headquarters Bay, Shingobee Bay, Kabekona Bay, Welsh's Bay, Uram Bay, Portage Bay, Miller Bay, and the narrows at the entrance to Walker Bay. Two nests were found on the shores of Bear Island.

Figure 60. Location of natural loon nests recorded on Leech Lake between 1988 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 61. Mink frog

Photo by: Jeff LeClere, www.herpnet.net

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

Figure 62. Green frog

Photo by: Jeff LeClere, www.herpnet.net

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

Methods

The aquatic frog survey methodology followed the Minnesota Frog and Toad Calling Survey (MFTCS) protocol (see Minnesota's Sensitive Lakeshore Identification Manual for additional information on how this protocol was adjusted for water routes). Frog survey points were located around the entire lake, spaced 400 meters apart. Surveys were conducted between sunset and 1:00 AM. At each station surveyors listened for up to five minutes for all frog and toad calls. An estimate of abundance and a calling index were recorded for both green and mink frogs. For other species, only a calling index was recorded. If survey conditions such as rain or wind noticeably affected listening ability, the survey was terminated. Frog surveys were conducted at 797 stations on Leech Lake during the summers of 2007 – 2009. Several stations were inaccessible due to the presence of wild rice beds. In addition, researchers conducting bird surveys on Leech Lake during summer 2010 noted frog and toad presence at survey stations.

Results

Target species

Mink frogs were by far the most commonly documented frog species on Leech Lake. Surveyors recorded this species at 197 survey stations (Figure 63). These stations occurred along the entire lake shoreline, and all of the major bays had mink frogs present. Abundance estimates at these stations ranged from one frog (at 43 stations) to 100+ frogs (at six stations). The highest densities of mink frogs were along the northwestern shoreline of Portage Bay and near the Leech Lake River outlet at Federal Dam (Figure 64). Index values for mink frogs ranged from one (individual frogs could be counted; silence between calls) to three (full chorus of frogs; calls constant, continuous, and overlapping).

Green frogs were documented at 10 stations on Leech Lake (Figure 65). These stations were all located in the southern half of Leech Lake, and included stations near Agency Bay and on Bear Island. Abundance estimates ranged from one to four frogs; no green frog choruses were recorded.

Other species

In addition to mink and green frogs, surveyors recorded gray treefrogs (*Hyla versicolor*), American toads (*Bufo americanus*), northern leopard frogs (*Rana pipiens*), western chorus frogs (*Pseudacris triseriata*) and wood frogs (*Rana sylvatica*) along the shoreline of Leech Lake. Gray treefrogs were documented at 141 survey stations. Although they were distributed widely across the Leech Lake shoreline, they were particularly abundant along sections of shoreline near Agency Bay, Headquarters Bay, Portage Bay, Miller Bay (Whipholt Creek inlet), and the Leech Lake River outlet. Spring peepers, northern leopard frogs, and western chorus frogs were recorded at 41, 27, and 16 stations, respectively. Surveyors documented American toads at eight stations, and wood frogs were heard calling at four different locations.

Figure 63. Distribution of mink and green frogs documented during Leech Lake surveys, 2007 – 2009.

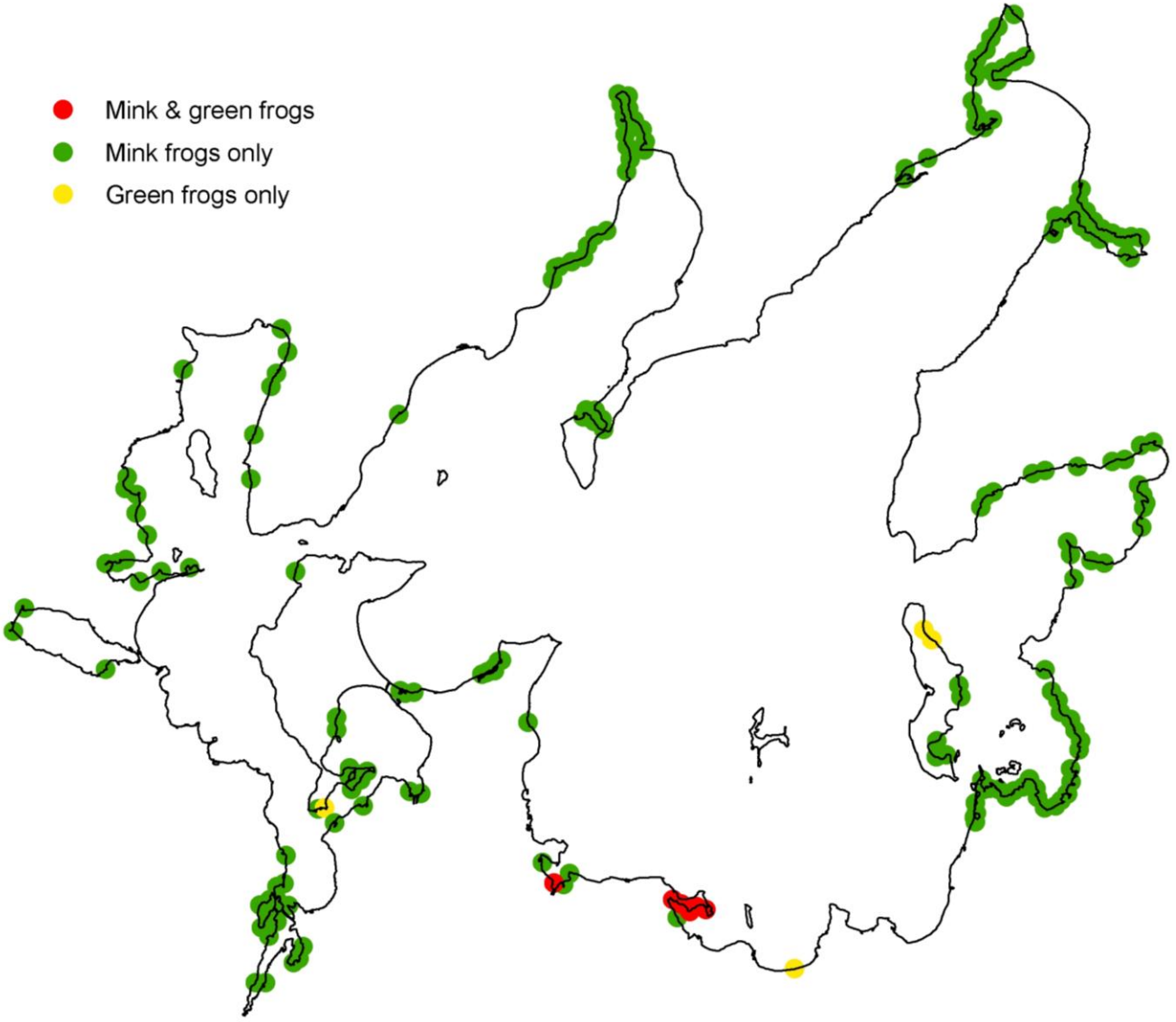


Figure 64. Abundance estimates of mink frogs on Leech Lake, 2007 – 2009.

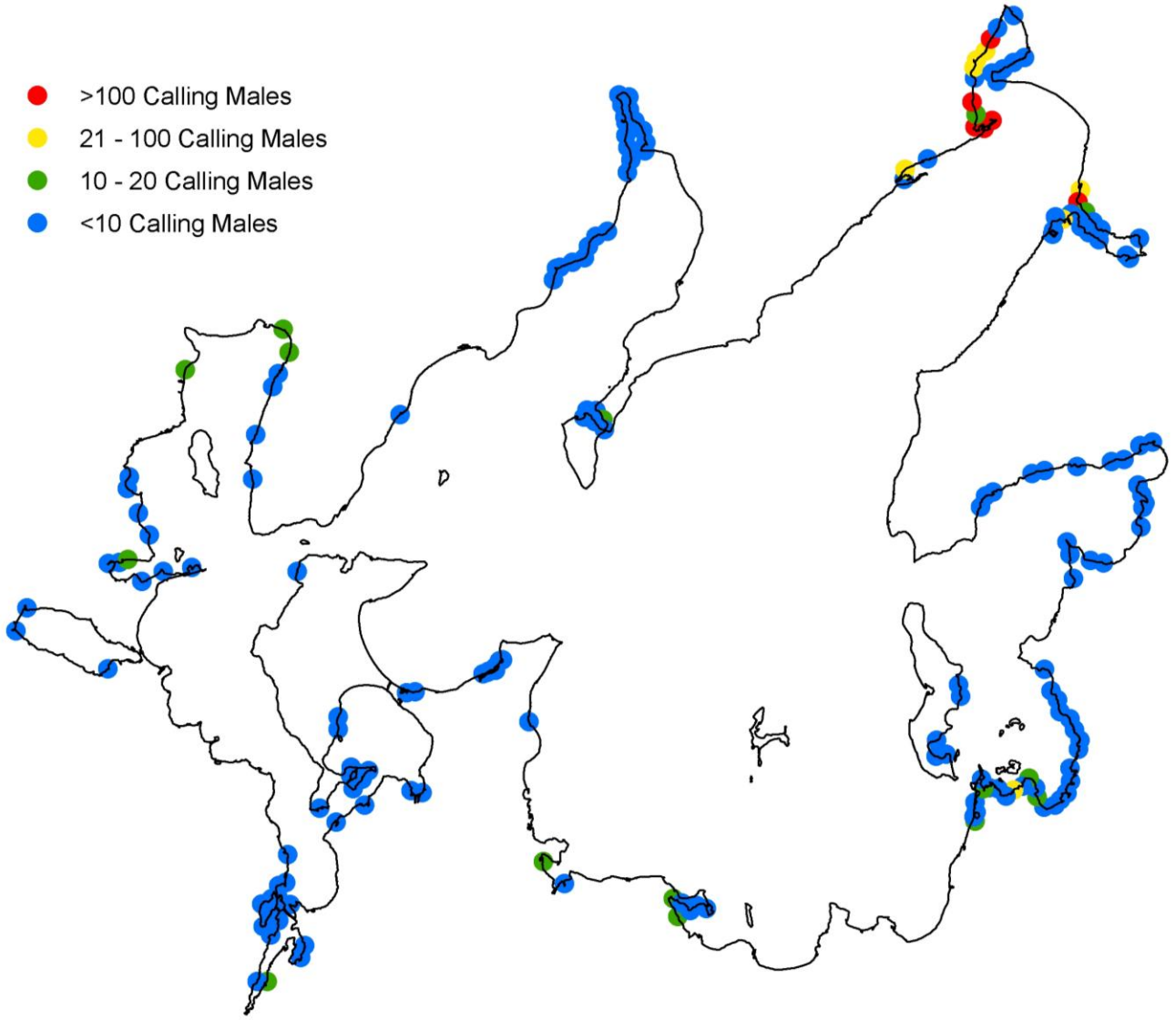
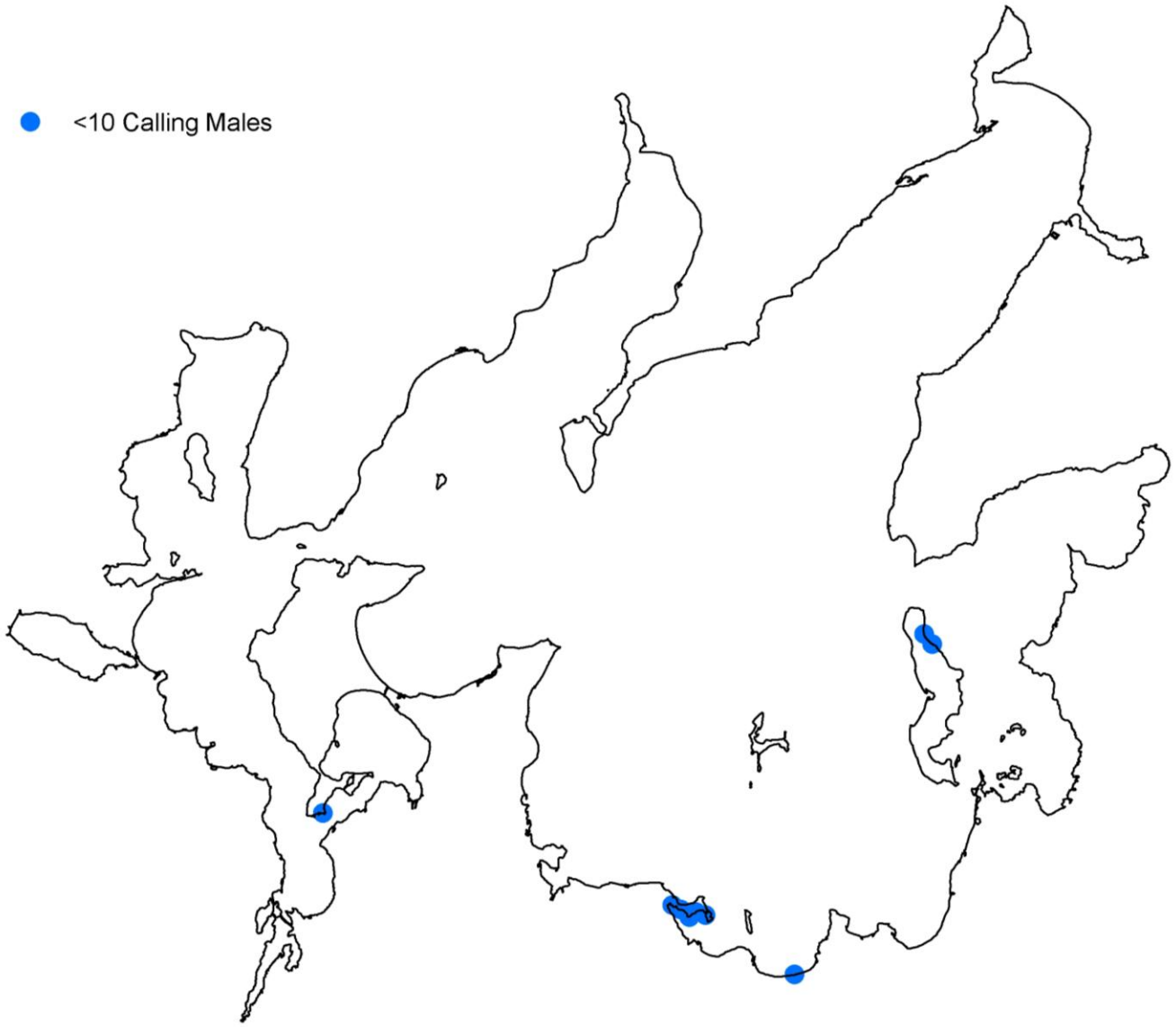


Figure 65. Abundance estimates of green frogs on Leech Lake, 2007 – 2009.



Nongame Fish

Introduction

Fish Species in Greatest Conservation Need

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

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

Figure 66. Pugnose shiner

Photo by: Konrad Schmidt

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

Figure 67. Least darter

Photo by: Konrad Schmidt

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

Figure 68. Longear sunfish

Photo by: Konrad Schmidt

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

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

Figure 69. Blackchin shiner

Photo by: Konrad Schmidt

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

Figure 70. Blacknose shiner

Photo by: Konrad Schmidt

Banded killifish (*Fundulus diaphanus*; Figure 71) are slender fish with slightly flattened heads. The mouth, which opens dorsally, is an adaptation for surface feeding. Dark vertical bars are present along the sides. Size ranges from about 50 – 100 mm. Calm, clear, shallow water with abundant aquatic vegetation and a sandy or gravely substrate is preferred by the killifish.

Figure 71. Banded killifish

Photo by: Konrad Schmidt

Methods

Leech Lake fish data were obtained from the Walker Area Fisheries Office and the Natural Heritage Information System. Data were collected during various surveys between 1950 – 2009. Survey techniques included seining, trawling, and electrofishing (Schultz et al. 2007, Schultz 2009).

Results

Forty-two fish species have been recorded in Leech Lake (Table 2). These species include two species in greatest conservation need, the pugnose shiner and least darter, and all three proxy species (blackchin shiner, blacknose shiner, banded killifish).

The presence of both species in greatest conservation need and proxy species indicates minimal disturbance along some sections of shoreline. However, because populations of these species are at risk throughout 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.

Table 2. Fish species identified during various Leech Lake surveys, 1950 - 2009.
* denotes species in greatest conservation need

Description	Common Name	Scientific Name
Bowfins	Bowfin	*Amia calva*
Minnows/carps	Spotfin shiner	*Cyprinella spiloptera*
	Common shiner	*Luxilus cornutus*
	Golden shiner	*Notemigonus crysoleucas*
	Pugnose shiner*	*Notropis anogenus*
	Emerald shiner	*Notropis atherinoides*
	Bigmouth shiner	*Notropis dorsalis*
	Blackchin shiner	*Notropis heterodon*
	Blacknose shiner	*Notropis heterolepis*
	Spottail shiner	*Notropis hudsonius*
	Sand shiner	*Notropis stramineus*
	Mimic shiner	*Notropis volucellus*
	Bluntnose minnow	*Pimephales notatus*
	Fathead minnow	*Pimephales promelas*
	Longnose dace	*Rhinichthys cataractae*
Suckers	White sucker	*Catostomus commersoni*
North American freshwater catfishes	Black bullhead	*Ameiurus melas*
	Yellow bullhead	*Ameiurus natalis*
	Brown bullhead	*Ameiurus nebulosus*
	Tadpole madtom	*Noturus gyrinus*
Pikes	Northern pike	*Esox lucius*
	Muskellunge	*Esox masquinongy*
Mudminnows	Central mudminnow	*Umbra limi*
Salmon/trout	Cisco/tullibee	*Coregonus artedi*
	Lake whitefish	*Coregonus clupeaformis*
Trout-perches	Trout-perch	*Percopsis omiscomaycus*
Hakes/burbots	Burbot	*Lota lota*

Table 2, continued.

Description	Common Name	Scientific Name
Killifishes	Banded killifish	*Fundulus diaphanus*
Sticklebacks	Brook stickleback	*Culaea inconstans*
Sculpins	Mottled sculpin	*Cottus bairdi*
Sunfishes	Rock bass	*Ambloplites rupestris*
	Pumpkinseed	*Lepomis gibbosus*
	Bluegill	*Lepomis macrochirus*
	Smallmouth bass	*Micropterus dolomieu*
	Largemouth bass	*Macropterus salmoides*
	Black crappie	*Pomoxis nigromaculatus*
Perches	Iowa darter	*Etheostoma exile*
	Least darter*	*Etheostoma microperca*
	Johnny darter	*Etheostoma nigrum*
	Yellow perch	*Perca flavescens*
	Logperch	*Percina caprodes*
	Walleye	*Sander vitreus*

Rare Features

Objective

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

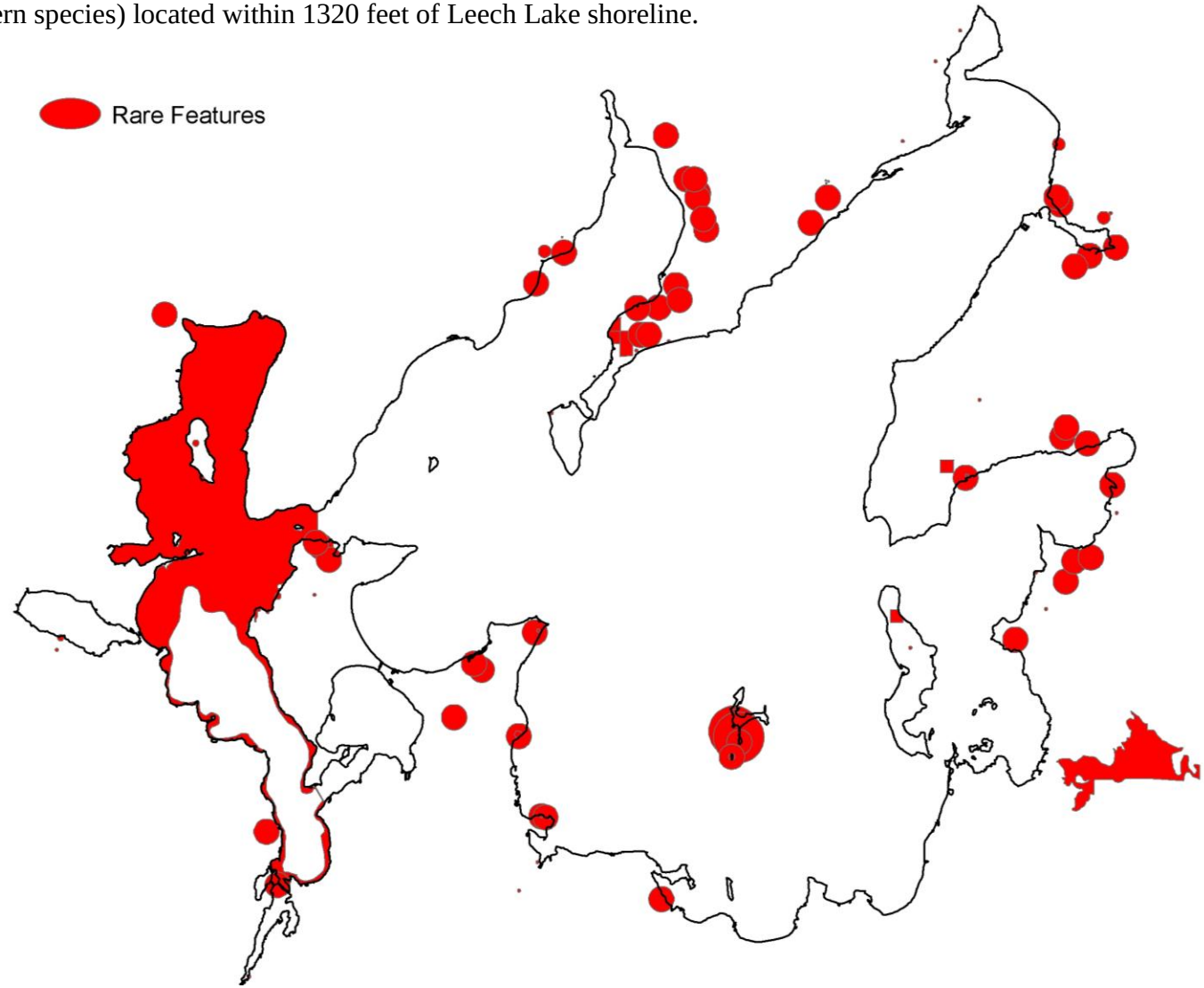
Researchers obtained locations of rare features from the Rare Features Database. Only "listed" plant and animal species (Federal or State endangered, threatened, or special concern) were considered in this project. Rare features within 1320 feet of the shoreline were mapped using GIS. Varying buffer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

Results

There were 84 rare features documented within the shoreland zone of Leech Lake (Figure 72). These features represent multiple bird and vascular plant locations, as well as locations of several rare fish and an invertebrate. The publication of exact descriptive information is prohibited in order to help protect these rare species.

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

Figure 72. Natural Heritage Database rare features (Federal or State-listed endangered, threatened, or special concern species) located within 1320 feet of Leech Lake shoreline.



 Rare features data have been provided by the Division of Ecological Resources, Minnesota Department of Natural Resources (MNDNR) and were current as of August 20, 2010. 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.

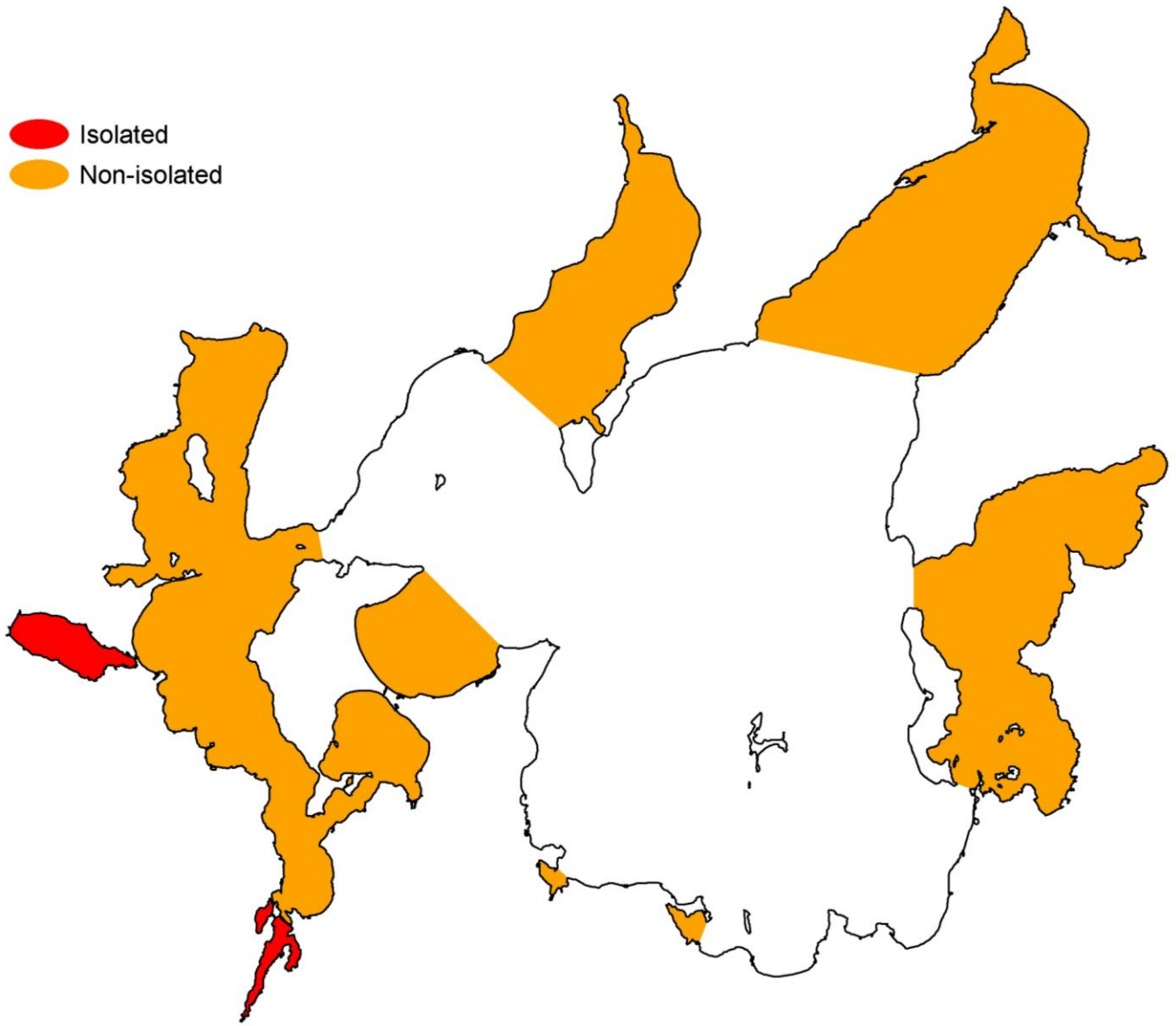
Methods

Bays were delineated using lake maps and aerial photos. Obvious bays (e.g., significant indentations of shoreline or bodies of water set off from main body) 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. On Leech Lake, only bays greater than 50 acres in size were considered during bay delineation. Non-isolated bays were open to the main water body by a wide mouth (>200 m). Isolated bays had a narrower connection (<200m) to the main water body, or were offshoots of non-isolated bays.

Results

There were three isolated bays identified in Leech Lake (Figure 73). Kabekona Bay, Shingobee Bay and Pumphouse Bay are offshoots of Walker Bay, and have a narrow connection (less than 50 meters in width) to this bay. Seven additional areas were classified as non-isolated bays. These included Sucker Bay, Portage Bay, Boy/Headquarters Bay, Uram Bay, Traders Bay, Miller Bay, and the Agency/Walker/Steamboat/Welshes Bay area.

Figure 73. Location of isolated and non-isolated bays in Leech 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 nine variables. These scores were based on each variable's presence or abundance in relation to the analysis window (Table 3). 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 74). 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 75). Due to the large size of Leech Lake, clusters were identified using a search radius of 9,000 feet. 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. Stretches of sensitive shoreline less than 250 meters in length and non-permanent land forms (e.g., floating bogs) were not included in the sensitive lakeshore designation. Sensitive lakeshore areas will be forwarded to the local government for potential designation as resource protection areas (Figure 76).

Table 3. Criteria for assigning scores to analysis windows for each variable

Variable	Score	Criteria
Wetlands	3	> 25% of analysis window contains wetlands
	2	12.5 – 25% contains wetlands
	1	< 12.5% contains wetlands
	0	No wetlands present
Hydric Soils	3	> 25% of analysis window contains hydric soils
	2	12.5 – 25% hydric soils
	1	< 12.5% hydric soils
	0	No hydric soils present
Near-shore Plant Occurrence	3	Frequency of occurrence is > 75% (> 75% of points within analysis window contained vegetation)
	2	Frequency of occurrence is 25 – 75%
	1	Frequency of occurrence < 25%
	0	No vegetation present
Aquatic Plant Richness	3	Total number of plant taxa per analysis window > 10
	2	Total number of plant taxa 5 – 10
	1	Total number of plant taxa 1 – 4
	0	No vegetation present
Presence of Emergent and Floating-leaf Plant Beds	3	Emergent and/or floating-leaf plant stands occupy > 25% of the aquatic portion of the analysis window
	2	Stands occupy 5 – 25%
	1	Stands present but occupy less than 5%
	0	No emergent or floating-leaf plant beds present
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
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 74. Total score layer created by summing scores of all nine variables. Highest total scores represent most sensitive areas of shoreline.

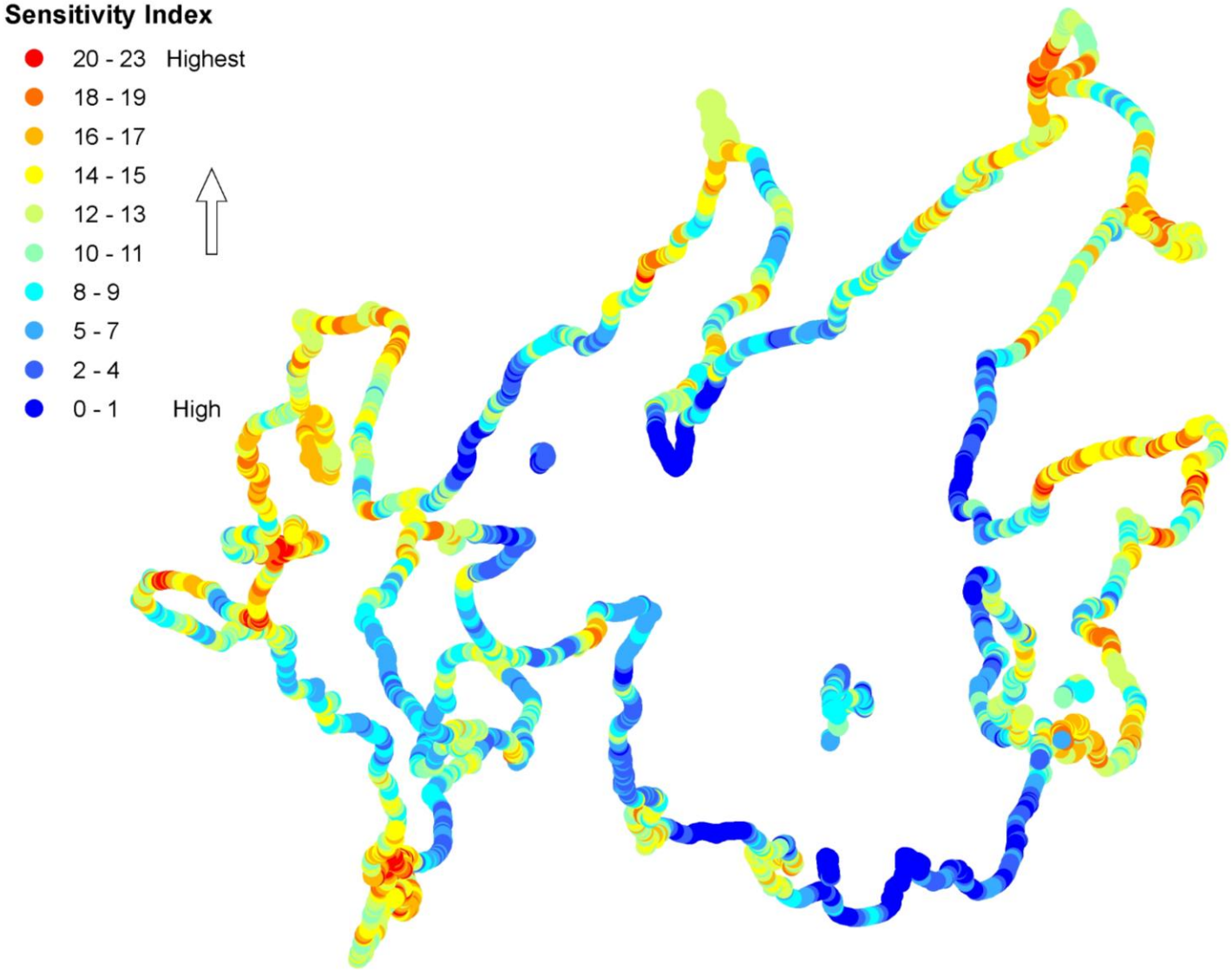


Figure 75. GIS-identified clusters of points with similar total scores. Red areas are those with highest scores (i.e., areas of highly sensitive shoreline).

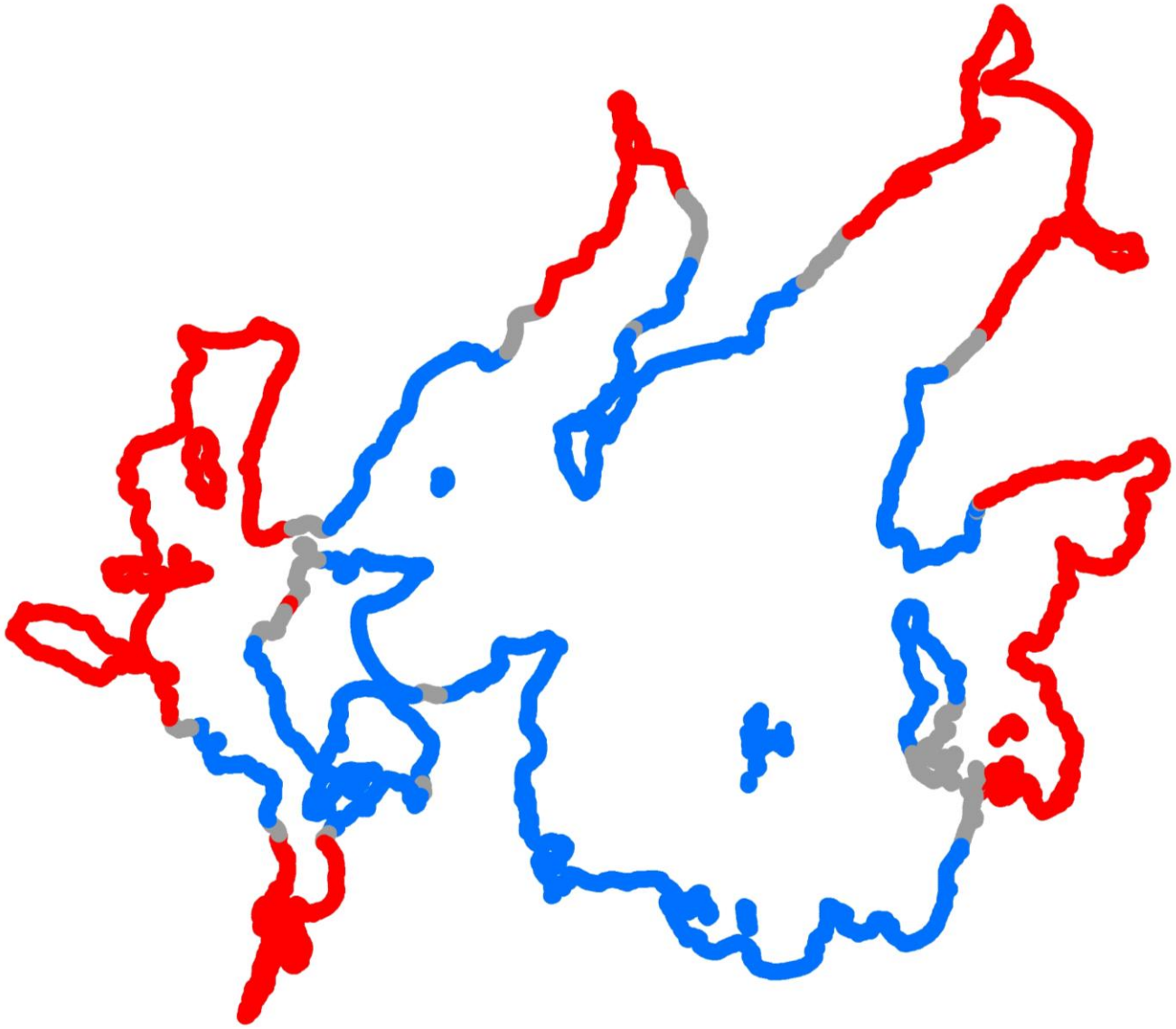
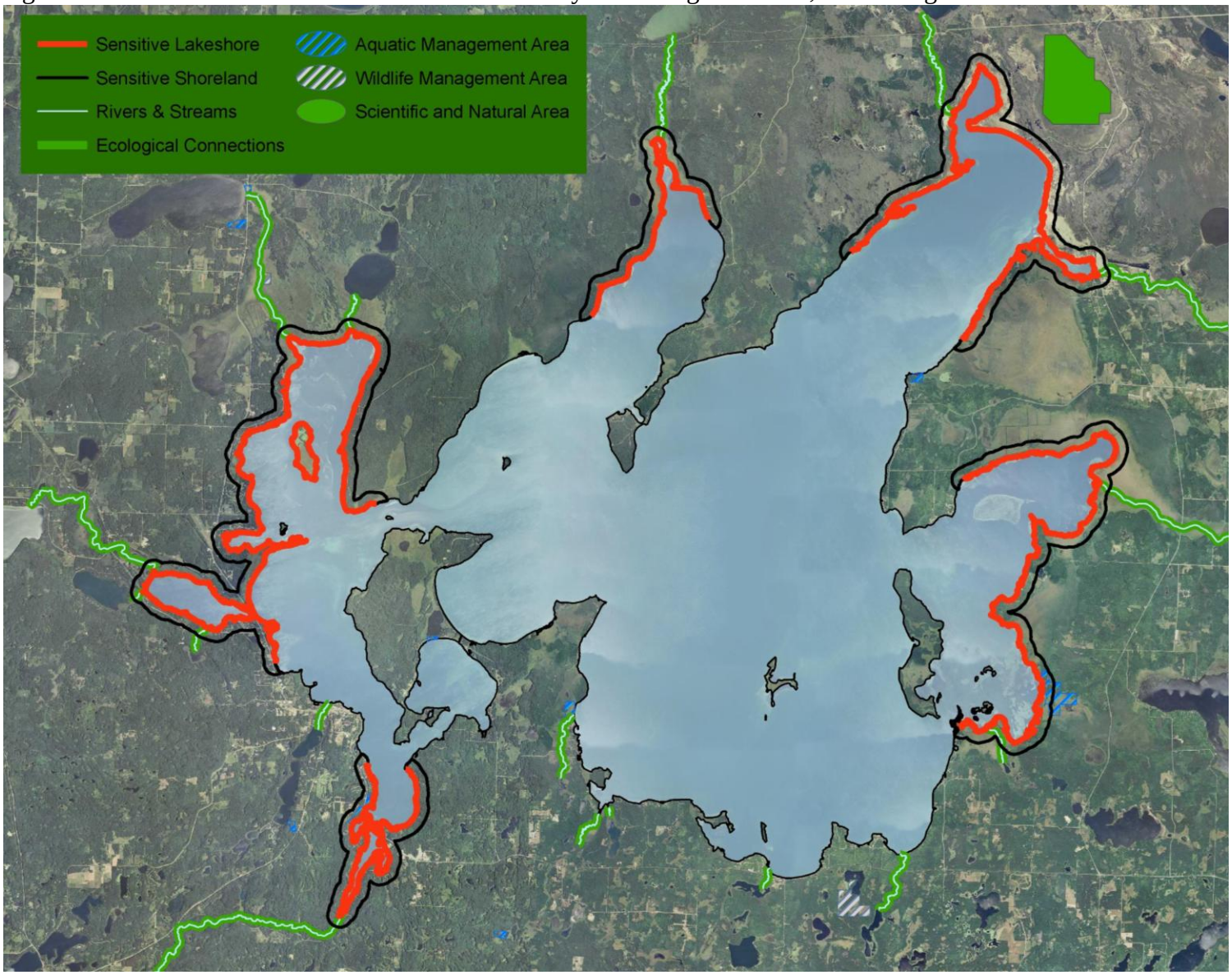


Figure 76. Leech Lake sensitive lakeshore identified by the ecological model, and ecological connections.



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. Multiple Leech Lake inlets and the Leech Lake outlet were identified as important ecological connections. Portage Lake Creek (Portage Lake), Sucker Creek (Lower Sucker Lake), Steamboat River (Steamboat Lake), Kabekona River (Kabekona Lake), Shingobee River (Shingobee Lake), Bishop Creek (Cedar Lake) and Boy River (Boy Lake) are major inlets, and all contribute flow and provide connectivity to Leech Lake. Nine minor inlets, including Crooked Creek (Crooked Lake), Benedict River (Benedict Lake), Cedar Creek (Cedar Lake), May Lake Creek (May Lake), Nolan Creek, Rat Lake Creek (Rat Lake), Current Lake Creek (Current Lake), and several other creeks (Deep Lake, Jack Lake) also provide important habitat connectivity to Leech Lake. The Leech Lake River flows out of Leech Lake at Federal Dam. It connects to several lakes in the east, including Drumbeater Lake and Mud Lake and Goose Lake in the Mud Goose Wildlife Management Area. Depending on the existing shoreland classification of these rivers, the County may use the ecological connection recommendation to consider reclassifying to a more protective river class.

Other Areas of Ecological Significance

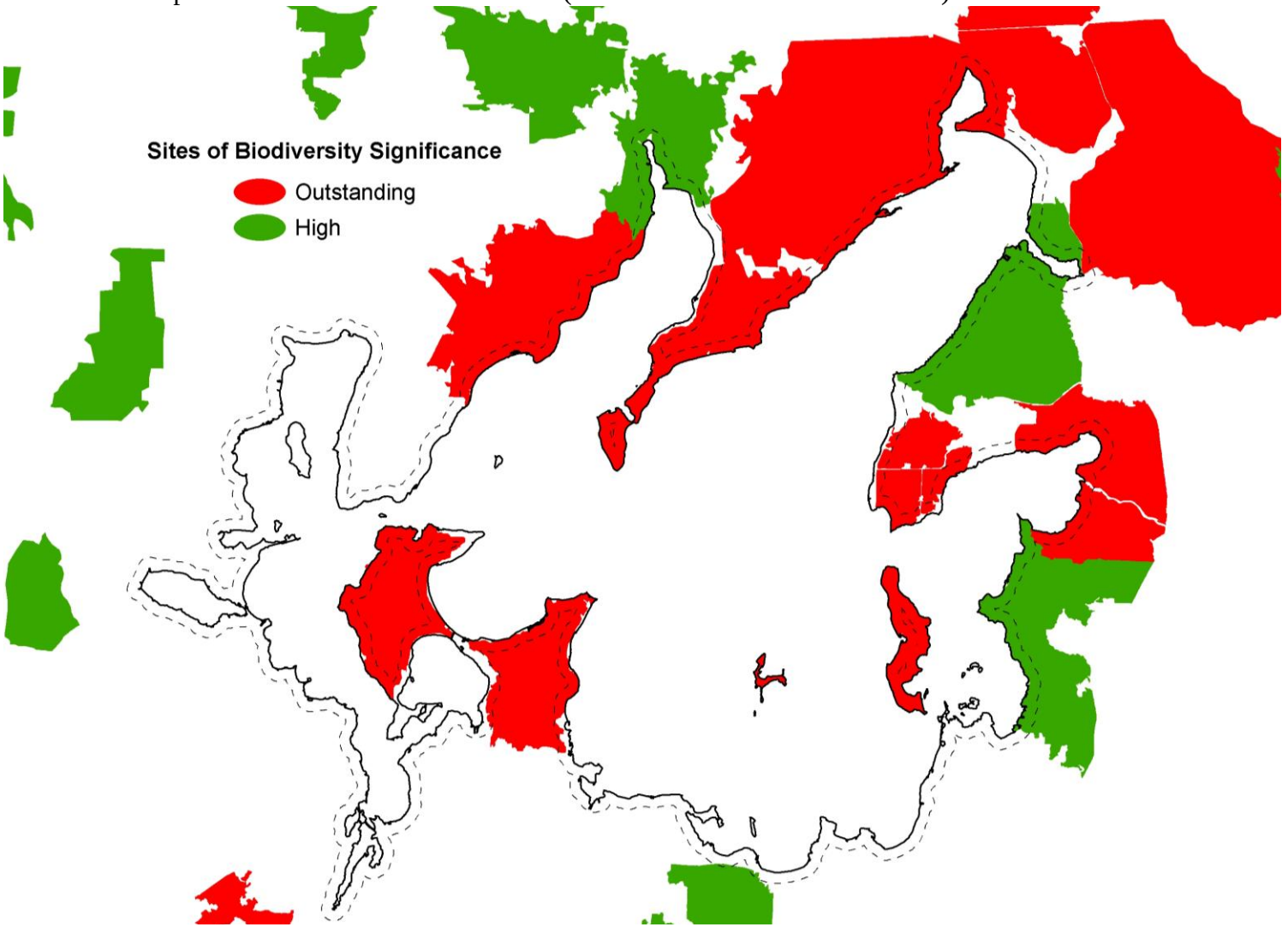
There are other areas of ecological significance near Leech Lake that contain important communities, but these sites are not necessarily associated with priority shoreland areas. The Minnesota County Biological Survey (MCBS) assigns rankings of biodiversity significance to survey sites across the state. These ranks are based on the presence of rare species and native plant communities within the site as well as the landscape context of the site. Sites of outstanding biodiversity significance contain the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, most ecologically intact landscapes (MCBS 2009). Sites of high biodiversity significance contain good quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes. There are nearly 10,000 acres of outstanding biodiversity significance sites and over 3,000 acres of high biodiversity significance sites within the shoreland zone of Leech Lake (Figure 77). Important native plant communities at these sites include relatively undisturbed tracts of mesic hardwood forests, white cedar, black ash, and tamarack swamps, and sedge meadows. They include sites that have been previously designated for habitat protection, such as Hole-in-Bog Peatland Scientific and Natural Area, Drumbeater Lake State Waterfowl Refuge, Mud Goose Wildlife Management Area, and Buetow and Five Mile Point Aquatic Management Areas. Identification of additional ecologically significant areas adjacent to these sites helps guide conservation and management efforts on these lands.

Sensitive Lakeshore

Five primary lakeshore areas of Leech Lake were identified as potential resource protection districts. These areas contained critical habitat, such as emergent and floating-leaf vegetation, as well as a high diversity of plant and animal species. The ecological model displays these areas both as sensitive shoreline and as high priority shoreland. 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 outcompete native species. The larger a natural area is, the more likely it is to support populations of native plants and animals. Large natural areas that support a diversity of species and habitats help comprise a healthy ecosystem. The inlets and outlet of Leech Lake are also an important part of the lake ecosystem. They provide connectivity between Leech Lake and nearby habitat. They allow movement of animals from various populations, increasing diversity. Habitat connectivity also allows animals with different vegetation requirements during different life stages to access these habitats. Protection of both the shoreline itself and the habitat surrounding the shoreline will be the most effective way to preserve the plant and animal communities in and around Leech Lake, and the value of the lake itself.

Figure 77. Minnesota County Biological Survey (MCBS) sites of outstanding and high biodiversity significance. Dashed lines depict the Leech Lake shoreland area (area within 1320 feet of shoreline).



 Sites of outstanding and high biodiversity significance depicted on the map are preliminary in status (as of November, 2010) and are subject to change.

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