Final Report
Sensitive Lakeshore Survey
Steamboat Lake (11-0504-00)
Cass County, Minnesota

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STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ECOLOGICAL RESOURCES

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

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

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Executive Summary

Aquatic plant surveys documented 33 native aquatic plant taxa in Steamboat Lake. These included nine emergent, three floating-leaf and 21 submerged and free-floating taxa. Twenty-four shoreline emergent plants were also documented. Submerged plants occurred to a depth of 19 feet but were most common in the shore to ten feet depth zone, where 95% of the sample sites contained vegetation. Common submerged plants included muskgrass, bladderwort, and several pondweed species. Ninety acres of emergent bulrush and twenty-one acres of wild rice were mapped in Steamboat Lake. In addition, one unique submerged aquatic plant was documented during the surveys.

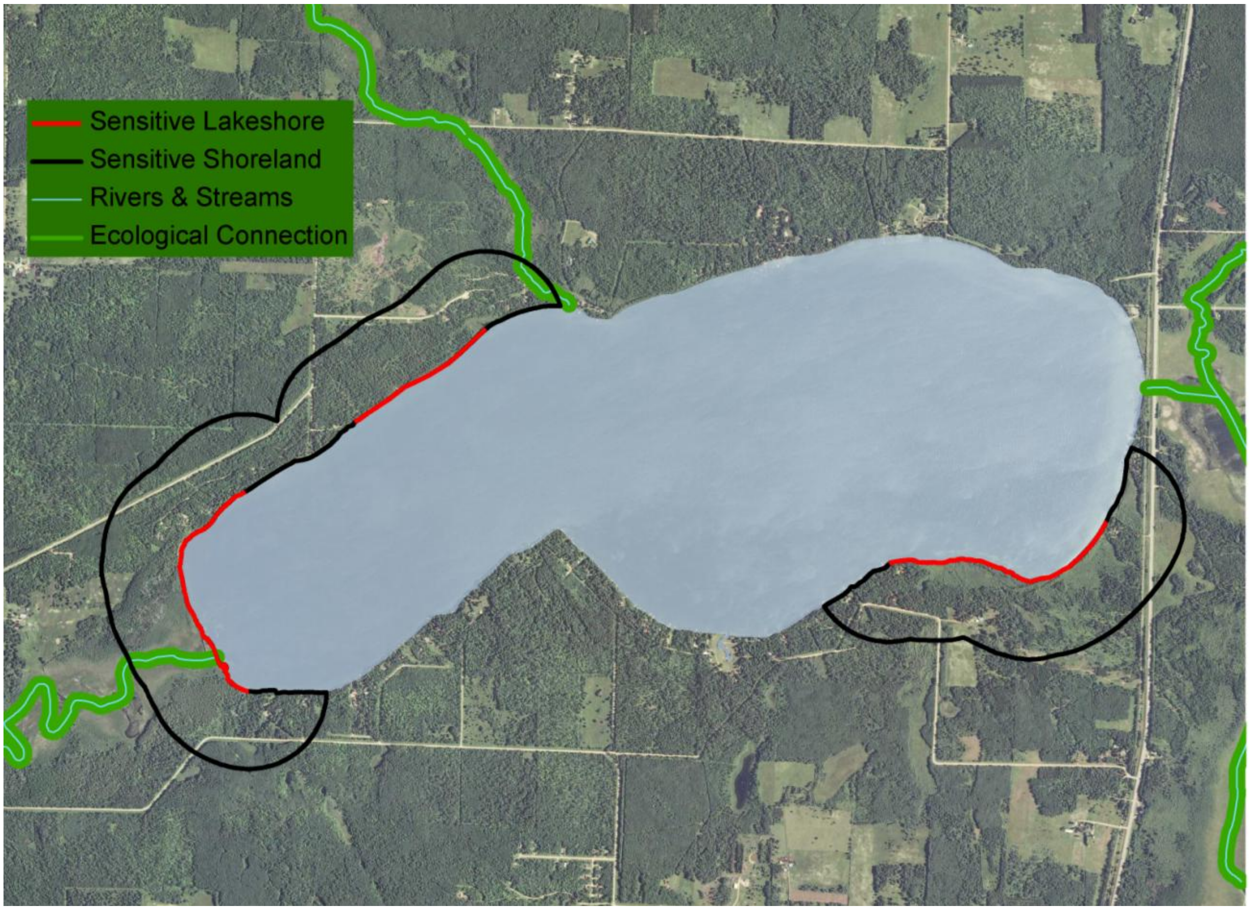
Sixty-four bird species were documented during the Steamboat Lake bird surveys. The most commonly detected species on Steamboat Lake was the red-eyed vireo, which was found at 85% of the survey stations. The veery was the most commonly detected species of greatest conservation need. It was found at one-third of the survey stations, and was widespread along the shoreline of Steamboat Lake.

Surveyors identified ten fish species not previously documented in Steamboat Lake, bringing the total observed historical fish community to 35 species. The newly recorded species in Steamboat Lake were blackchin shiner, blacknose shiner, central mudminnow, common shiner, golden shiner, mimic shiner, mottled sculpin, pugnose shiner, spotfin shiner, and spottail shiner. Thirty fish species were documented during the 2008 nongame fish surveys. Bluegills and yellow perch were recorded at the most survey stations and in the greatest numbers. One species of greatest conservation need, the pugnose shiner, was also detected during the surveys. No mink or green frogs were observed.

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

The ecological model identified three primary sensitive lakeshore areas to be considered for potential resource protection districting by Cass County. The two inlets and outlet of Steamboat Lake were identified as ecological connections. The County may use this objective, science-based information in making decisions about districting and reclassification of lakeshore areas.

The most probable highly sensitive lakeshore areas and the recommended resource protection districts are:



Introduction

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

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

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

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

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

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

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

Lake Description

Steamboat Lake (DOW 11-0504-00) is located on the border of Cass and Hubbard Counties, north-central Minnesota (Figure 1). The lake occurs in the northwestern corner of the Leech Lake River Watershed. It receives flow from inlets on the west and north sides of the lake (Figure 2). The Steamboat River flows east through Steamboat Lake and eventually empties into Steamboat Bay of Leech Lake.

Figure 1. Location of Steamboat Lake in Cass and Hubbard Counties, Minnesota.

The eastern portion of Steamboat Lake lies in Cass County, within the boundaries of the Leech Lake Nation Indian Reservation and the Chippewa National Forest. Much of the shoreline is privately owned, and is developed with residential homes and a private youth camp.

Steamboat Lake has a surface area of 1,755 acres and slightly over eight miles of shoreline. The single, elongated basin has an east-west orientation. Steamboat Lake has a maximum depth of 93 feet and about 30% of the basin is less than 15 feet in depth (Figure 3).

Steamboat Lake is described by the Minnesota DNR as a Class 22 lake. Lakes in this class are generally large, deep, clear, and irregularly shaped (MN DNR 2006b). Yellow perch are abundant in Steamboat Lake; the lake is also managed for walleye. Steamboat Lake is a mesotrophic lake, with moderate levels of nutrient enrichment (MPCA 2008). Average Secchi depth transparency (which measures light penetration into the water column) between 2004 and 2007 was approximately 12 feet (MPCA 2008), indicating relatively high water clarity.

Figure 2. Features of Steamboat Lake.

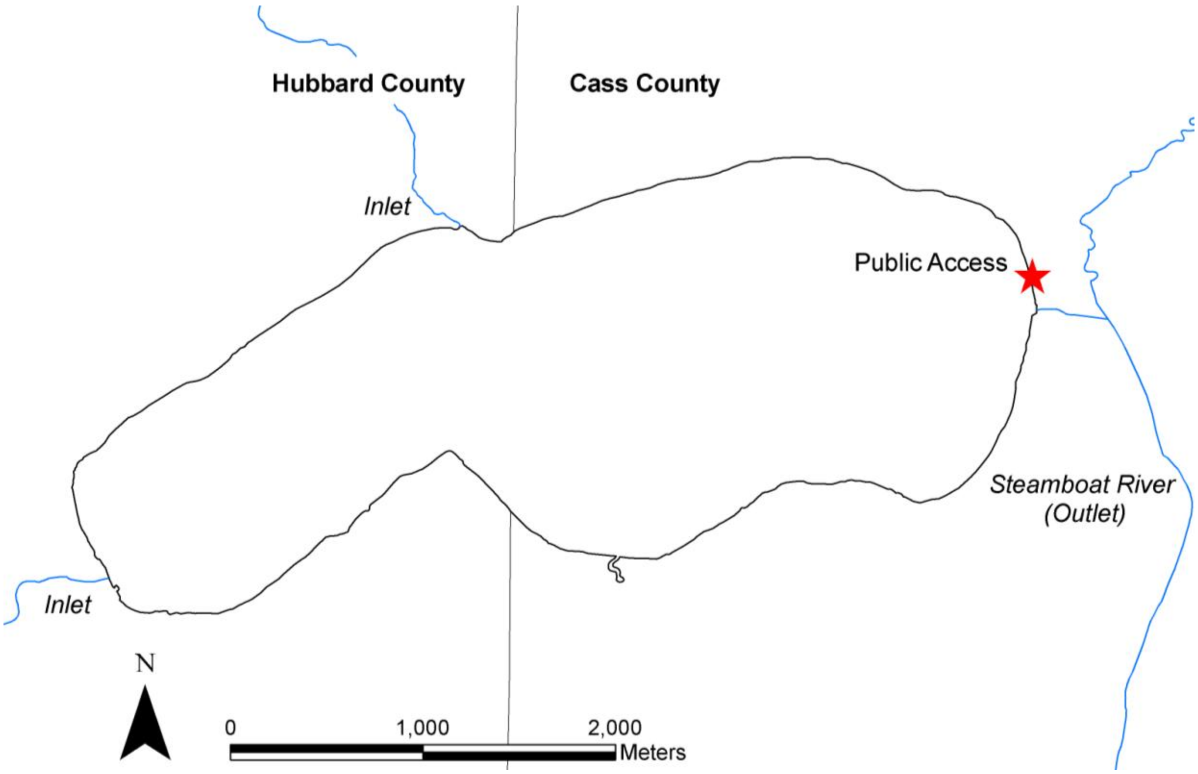
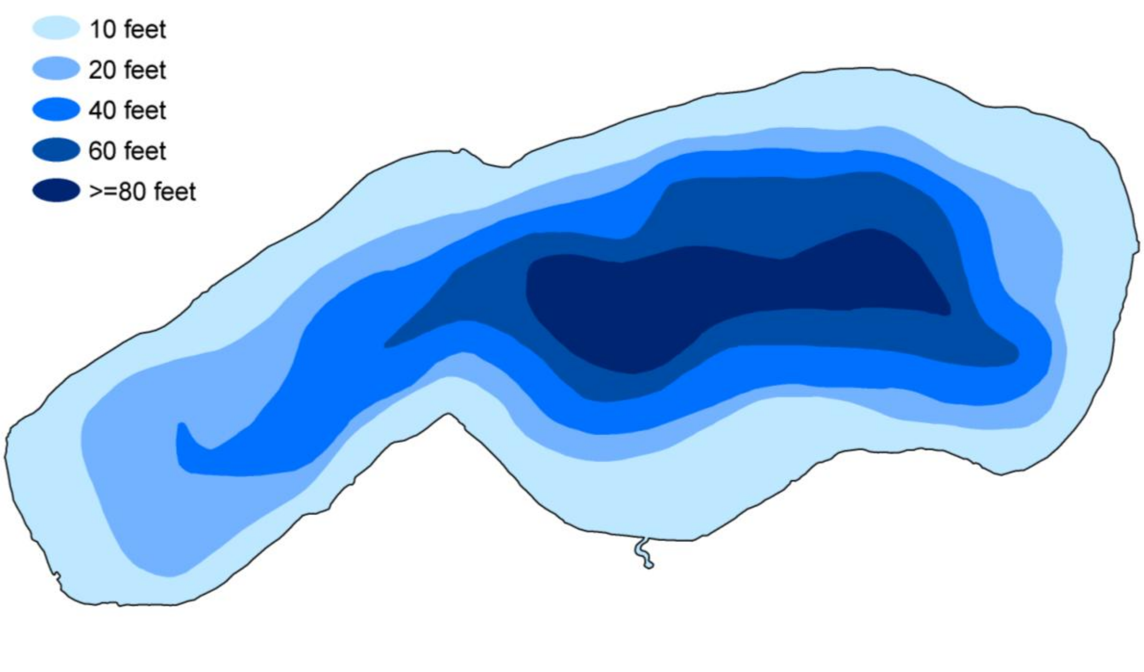


Figure 3. Depth contours of Steamboat Lake.



I. Field Surveys and Data Collection

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

Pugnose shiner photo courtesy of Konrad Schmidt

Wetlands

Objective

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

Introduction

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

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

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

Methods

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

Results

Approximately 360 acres, or 25% of the Steamboat Lake shoreland (area within 1320 feet of the shoreline), are described as wetlands by NWI. The largest areas are associated with the inlets and outlets and are located along the eastern, western and northwestern shorelines (Figure 4). Some of these larger wetland complexes are greater than 70 acres in size, while many of the smaller, scattered patches range in size from one to ten acres. State Highway 371 bisects the wetland complex along the eastern shore.

The dominant wetland types include emergent (Cowardin et al. 1979) or marsh (MN DNR 2003) systems, palustrine scrub-shrub (Cowardin et al. 1979) or wetland shrubland (MN DNR 2003) systems, and forested wetlands (Cowardin et al. 1979, MN DNR 2003). The emergent wetlands are characterized by herbaceous, emergent wetland vegetation, whereas the palustrine scrub-shrub systems are dominated by deciduous or evergreen shrubs. The forested wetlands included both deciduous and evergreen trees. The water regime varies among the wetland types, and includes seasonally flooded, semipermanently flooded, and temporarily flooded soils.

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

Hydric Soils

Objectives

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

Introduction

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

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

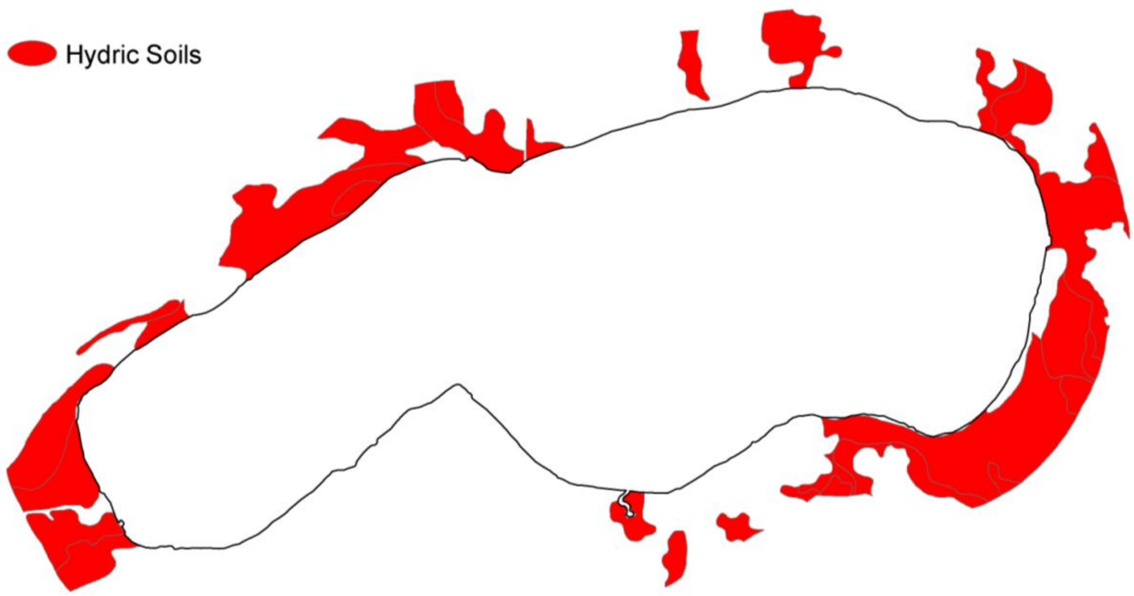
Methods

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

Results

Hydric soils are present in varying amounts along much of the shoreline of Steamboat Lake (Figure 5). Approximately 480 total acres of hydric soils are located within the shoreland (area within 1320 feet of the shoreline). Soil types include muck, mucky peat, and loamy sand. The organic matter content of these soils ranges from low to very high, and most of the soils are very poorly drained.

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



Plant Surveys

Objectives

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

Summary

Aquatic plants occurred around the entire perimeter of Steamboat Lake. A total of 33 native aquatic plant taxa were recorded in Steamboat Lake. These included nine emergent, three floating-leaf and 21 submerged and free-floating taxa. Twenty-four shoreline emergent plants were also documented.

Within the shore to five feet depth zone, 34% of the sample sites contained at least one emergent or floating-leaf plant. Floating-leaf plants included white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), and floating-leaf pondweed (*Potamogeton natans*). About one acre of waterlily beds or mixed beds of waterlilies and emergents were mapped and the largest beds were located along the southeast shore. Ninety acres of hard-stem bulrush (*Schoenoplectus acutus*) were mapped and bulrush was the most abundant emergent plant taxa in Steamboat Lake. Twenty-one acres of wild rice (*Zizania palustris*) were mapped; this species was located primarily at the west end of the lake where there is inflow from Steamboat River. Wild rice beds were often mixed with floating-leaf and other emergent plants.

Submerged plants occurred to a depth of 19 feet but were most common in the shore to ten feet depth zone, where 95% of the sample sites contained vegetation. Common submerged plants included muskgrass (*Chara* sp.), greater bladderwort (*Utricularia vulgaris*), flat-stem pondweed (*Potamogeton zosteriformis*), coontail (*Ceratophyllum demersum*) and northern watermilfoil (*Myriophyllum sibiricum*).

One unique submerged aquatic plant, mare's tail *(Hippuris vulgaris*), was documented during the surveys.

Introduction

The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity, water chemistry, water depth, substrate and wave activity. Deep or wind-swept areas may lack in aquatic plant growth, whereas sheltered shallow areas may support an abundant and diverse native aquatic plant community that, in turn, provides critical fish and wildlife habitat and other lake benefits.

The annual abundance, distribution and composition of aquatic plant communities may change due to environmental factors, predation, the specific phenology of each plant species, introductions of non-native plant or animal species, and human activities in and around the lake.

Non-native aquatic plant species have not been documented in Steamboat Lake. However, if they invade the lake, they may directly or indirectly impact the native plant community. Non-native plant species, such as Eurasian watermilfoil (*Myriophyllum spicatum*) or curly-leaf pondweed (*Potamogeton crispus*), may form dense surface mats that shade out native plants. The impact of these invasive species varies among lakes but the presence of a healthy native plant community may help mitigate the harmful effects of these exotics.

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

Floating-leaf and emergent plants

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

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

Hard-stem bulrush (*Schoenoplectus acutus*) is an emergent, perennial plant that occurs in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). Bulrush stems are round in cross section and lack showy leaves (Figure 6). Clusters of small flowers form near the tips of long, narrow stalks. This emergent may occur from shore to water depths of about six feet and its stems may extend several feet above the water surface. Bulrush stands are particularly susceptible to destruction by excess herbivory and direct removal by humans.

Figure 6. Bulrush bed in Steamboat Lake

Wild rice (*Zizania palustris*; Figure 7) is an emergent annual plant that reproduces each year from seed set in the previous fall. Wild rice is most commonly found in lakes of central and northern Minnesota. Cass County is one of five Minnesota counties with the highest concentration of lakes supporting natural wild rice stands (MN DNR 2008b). Wild rice generally requires habitat with some water flow, such as lakes with inlets and outlets. This plant most often is found in water depths of 0.5 to three feet in soft substrates (MN DNR 2008b). Wild rice is one of the most important waterfowl foods in North America and is used by more than 17 species of wildlife listed by the Minnesota Department of Natural Resources as "species of greatest conservation need" (MN DNR 2008b). Other ecological benefits associated with wild rice stands include habitat for fish and aquatic invertebrates, shoreline protection and stabilization, and nutrient uptake. This plant also has special cultural and spiritual significance to the Ojibwe people and wild rice harvest provides important economic benefits to local economies (MN DNR 2008b).

Figure 7. Wild rice bed in Steamboat Lake

Figure 8. Mixed bed of wild rice and yellow waterlilies in Steamboat Lake

Floating-leaf plants are anchored to the lake bottom by rhizomes and their main leaves float on the water surface. These plants include white waterlily (*Nymphaea odorata*) and yellow waterlily (*Nuphar variegata*). These plants often co-occur in mixed beds with submerged and/or emergent plants (Figure 8).

Submerged plants

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

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

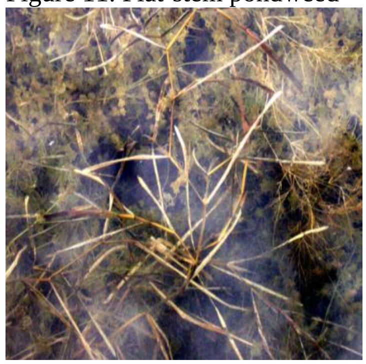
Figure 9. Bed of muskgrass

Greater bladderwort (*Utricularia vulgaris*; Figure 10) is an entirely submerged plant except during bloom when its small, showy yellow flowers extend above the water surface. This plant is weakly rooted to the substrate and may drift freely through the water column. It reproduces by fragments and winter buds that can float to new areas of the lake. Greater bladderwort is an insectivorous plant and uses its small "bladders" to trap invertebrates. Greater bladderwort prefers soft substrates like muck and silt (Nichols 1999b). Greater bladderwort is one of the most common species throughout Minnesota (Ownbey and Morley 1991).

Figure 10. Flowers of greater bladderwort

Flat-stem pondweed (*Potamogeton zosteriformis*; Figure 11) is a perennial plant that is anchored to the lake bottom by underground rhizomes. It is named for its flattened, grass-like leaves. Depending on water clarity and depth, these plants may reach the water surface and produce flowers that extend above the water. These pondweeds are anchored to the lake bottom by rhizomes and overwinter by winter buds.

Figure 11. Flat-stem pondweed



Coontail (*Ceratophyllum demersum*; Figure 12) is the most common submerged flowering plant in Minnesota lakes. It grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. Coontail is a perennial and can overwinter as a green plant under the ice before beginning new growth early in spring. Because it is only loosely rooted to the lake bottom it may drift between depth zones (Borman et al. 2001). Coontail provides important cover for young fish, including bluegills, perch, largemouth bass and northern pike. It also supports aquatic insects beneficial to both fish and waterfowl.

Figure 12. Coontail

Northern watermilfoil (*Myriophyllum sibiricum*; Figure 13) is a rooted, perennial submerged plant with finely dissected leaves. It may reach the water surface, particularly in depths less than ten feet and its flower stalk extends above the water surface. It spreads primarily by stem fragments and overwinters by hardy rootstalks and winter buds. Northern watermilfoil is not tolerant of turbidity and grows best in clear water lakes. This native plant provides fish shelter and insect habitat and the extensive root systems help stabilize near-shore substrates.

Figure 13. Northern watermilfoil

Pondweeds (*Potamogeton* spp. and *Stuckenia* spp.) are one of the largest groups of submerged plants in Minnesota lakes. These plants are rooted perennials and their rhizomes may form mats on the lake bottom that help consolidate soil (Arber 1920). Pondweeds have opposite, entire leaves and form "cigar-shaped" flowers that emerge above the water surface. Many pondweed species overwinter as hardy rhizomes while other species produce tubers, specialized winter buds, or remain "evergreen" under the ice. Seeds and tubers of pondweeds are an important source of waterfowl food (Fassett 1957). The foliage of pondweeds is food for a variety of marsh birds, shore birds and wildlife and provides shelter, shade and spawning sites for a range of fish species (Borman et al. 2001). Pondweeds inhabit a wide range of aquatic sites and species vary in their water chemistry and substrate preferences and tolerance to turbidity. There are over 35 species of pondweeds in Minnesota and they vary in leaf shapes and sizes.

Broad-leaf pondweeds include white-stem pondweed (*Potamogeton praelongus*; Figure 14), large-leaf pondweed (*P. amplifolius*), Illinois pondweed (*P. illinoensis*), and variable pondweed (*P. gramineus*). These plants are often called "cabbage" plants by anglers. Some broad-leaf pondweeds may form floating leaves in sheltered sites while other species have only submerged leaves. Species like white-stem and large-leaf pondweed are common in many clear water Minnesota lakes but are often among the first species to decline in degraded water. White-stem pondweed is not tolerant of turbidity (Nichols 1999b) and may be negatively impacted by increased lake development.

Figure 14. White-stem pondweed

Unique aquatic plants

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

- Plant species that are not listed as rare but are uncommon in the state or locally. These may include species that are proposed for rare listing.
- Plants species with high coefficient of conservatism values (C values). These values range from 0 to 10 and represent the "estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition" (Nichols 1999a, Bourdaghs et al. 2006). Plant species with assigned C values of 9 and 10 were included as unique species.

Mare's tail (*Hippuris vulgaris*) is a submerged plant with whorls of leaves that resemble a horse's tail (Figure 15). This plant occurs primarily in northern Minnesota lakes but is relatively uncommon. It is often associated with cold-water streams or springs (Voss 1985) and its presence in a waterbody may be indicative of relatively good water quality. This submerged plant may form emergent leaves and stems in shallow water.

Figure 15. Mare's tail

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

Methods

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

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

Grid point-intercept survey
A grid point-intercept survey was conducted in Steamboat Lake on August 13, 14, 18, 19, and 27, 2008 (Perleberg and Loso 2008). A GIS computer program was used to establish aquatic plant survey points throughout the littoral (i.e., vegetated) zone of the lake to a depth of 20 feet. Points were spaced 65 meters apart and 632 sites were sampled within the shore to 20 feet depth zone. An additional 22 sites were surveyed in the 21 to 25 feet depth zone but since no vegetation was found, these deeper water sites were not used in analyses. Surveyors navigated to each site using a handheld GPS unit. At each sample site, water depth and all vegetation within a one-meter squared sample area were sampled using a double-headed garden rake. All aquatic plant species present within the sample plot were recorded and frequency of occurrence was

calculated for each species. Any additional species found outside the sample plots were recorded as present in the lake. Voucher specimens were collected for most species and were submitted to The Herbarium of the University of Minnesota Bell Museum of Natural History, St. Paul, MN.

Near-shore vegetation surveys

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

Searches for unique and rare species

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

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

A targeted search for rare aquatic vascular plants in Steamboat Lake was conducted by the Minnesota County Biological Survey on July 9, 2008 (Myhre 2008). This search focused on sites that were most likely to contain rare plant species. Botanists used professional experience to select rare species search sites and included factors such as shoreline development, substrate type, water depth, and native plant community type in their site selection. To gain access to shallow vegetated areas, searches were conducted by slowly kayaking, canoeing and/or wading through the site.

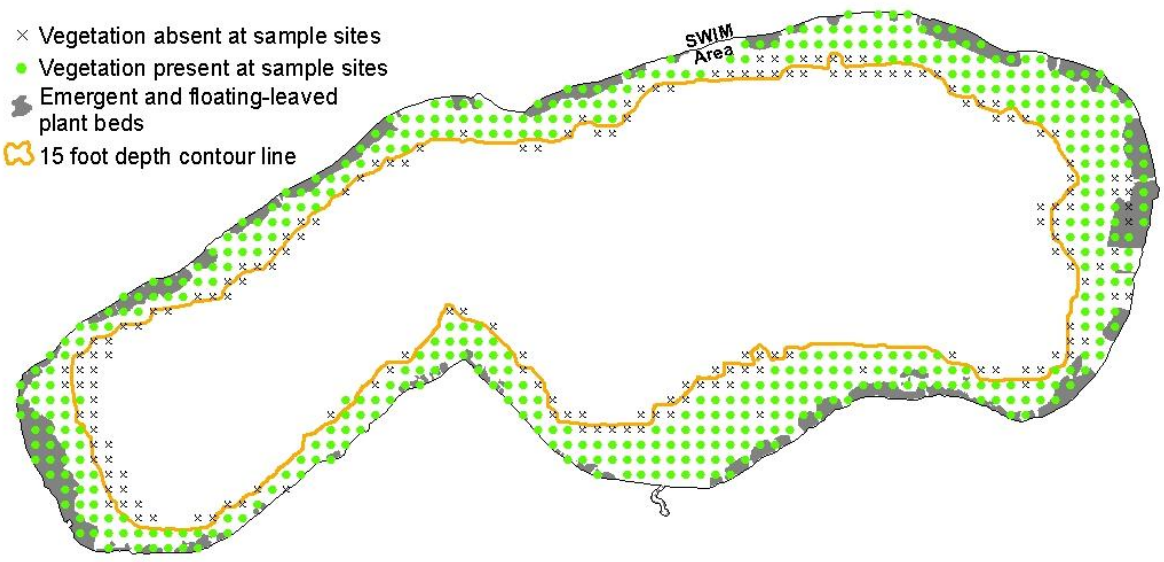
A brief habitat description and a list of all plant taxa found in the search area were recorded. When necessary, plant specimens were sent to the authority in the field for identification verification and annotation. Voucher specimens were collected to document county records and several other species,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

Results

Distribution of plants by water depth

Emergent and floating-leaf plants occurred in water depths of seven feet and less. Submerged plants were found to a water depth of 19 feet (Figure 16). This vegetated zone includes about one-third of the lake and within this area, 76% of the survey sites contained vegetation. Plant occurrence was greatest in depths from shore to ten feet, where 95% of the sites were vegetated. In water depths of 11 to 20 feet, only 45% of the sites contained plants.

Figure 16. Aquatic plant distribution in Steamboat Lake, 2008.



Aquatic plant species observed

A total of 33 native plant taxa were observed in Steamboat Lake. These included nine emergent, three floating-leaf, and 21 submerged and free-floating taxa (Table 1). An additional 24 plant taxa were found along the shoreline of Steamboat Lake (Appendix 1).

Emergent and floating-leaf plants

Surveyors delineated approximately 116 acres of emergent plants and the most common taxa were wild rice and bulrush. About 90 acres of bulrush were mapped in the lake and some beds extended nearly 1,000 meters along shore and more than 100 meters lakeward (Figure 17). Surveyors also mapped about 21 acres of mixed wild rice. Wild rice beds occurred mainly in silt substrates and were concentrated in the west end of the lake where the the Steamboat River enters. Wild rice was also abundant in Steamboat Bay Lake and Steamboat River.

Other emergent plants occurred at scattered locations around the lake and included broad-leaved arrowhead (*Sagittaria latifolia*), giant burreed (*Sparganium eurycarpum*), and narrow-leaved cattail (*Typha angustifolia*). Many of these emergent plants occupied the transitional zone between the lake and adjacent wetlands. Numerous additional native emergents occurred in these adjacent wetlands but this survey did not include an exhaustive wetland species inventory.

About one acre of floating-leaf plant beds were mapped and the largest beds occurred along the southeast shore (Figure 17). The most common species were white waterlily, yellow waterlily, and floating-leaf pondweed (*Potamogeton natans*). Because surveyors avoided motoring into floating-leaf plant beds, the frequency values obtained for these taxa (Table 1) were lower than the actual lakewide occurrence. Frequency values for floating-leaf taxa represent the occurrence of these taxa only within the sites that were surveyed. Waterlily beds often contained scattered bulrush and wild rice plants as well as submerged plants and were usually associated with muck sediments.

Table 1. Floating-leaf and emergent aquatic plants recorded in Steamboat Lake, 2008.

Description	Common Name	Scientific Name	Frequency[a]
FLOATING-LEAF	Yellow waterlily	*Nuphar variegata*	4
	Floating-leaf pondweed	*Potamogeton natans*	2
	White waterlily	*Nymphaea odorata*	<1
EMERGENT	Hard-stem bulrush	*Schoenoplectus acutus*	11
	Wild rice	*Zizania palustris*	2
	Broad-leaved arrowhead	*Sagittaria latifolia*	<1
	Giant burreed	*Sparganium eurycarpum*	<1
	Narrow-leaved cattail	*Typha angustifolia*	<1
	Giant cane	*Phragmites australis*	Present[b]
	Horsetail	*Equisetum* sp.	Present
	Broad-leaved cattail	*Typha latifolia*	MCBS[c]
	Small's spikerush	*Eleocharis palustris*	MCBS

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations (N = 632). They represent the percent of the sample stations that contained a plant taxon.

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

[c]MCBS = located only during Minnesota County Biological Survey, 9 July 2008.

Nomenclature follows MNTaxa 2009.

Figure 17. Distribution of emergent and floating-leaf plant beds in Steamboat Lake, 2008.

Submerged plants
Muskgrass was found in 54% of all sample sites (Table 2). It was the most abundant plant in depths from shore to 15 feet (Figure 18A). Muskgrass occurred throughout Steamboat Lake. Greater bladderwort was found in 24% of the sample sites in Steamboat Lake. It occurred throughout the vegetated zone (Figure 18B) and was most common from shore to ten feet in depth.

Eight different pondweed species (*Potamogeton* spp. and *Stuckenia* spp.) were documented in Steamboat Lake. Flat-stem pondweed was the most abundant and was found in 23% of all sample sites. It was most common in depths of six to ten feet, and was scattered throughout Steamboat Lake (Figure 18C). White-stem pondweed was the second-most commonly occurring pondweed species. It was present in five percent of all sample sites and was most abundant in depths of ten feet and less (Figure 18F).

Coontail was found in 19% of all sample sites. It was abundant on the west half of Steamboat Lake, but it also occurred at scattered locations throughout the east half of the lake. Coontail was most common within the six to ten feet depth zone where it occurred in 39% of the sites (Figure 18D).

Northern watermilfoil was present from shore to a depth of 13 feet. It was found in 14% of all sample sites (Figure 18E) and was most abundant from six to ten feet in depth where it occurred in 30% of the sites.

Figure 18. Distribution of common aquatic plants in Steamboat Lake, 2008.

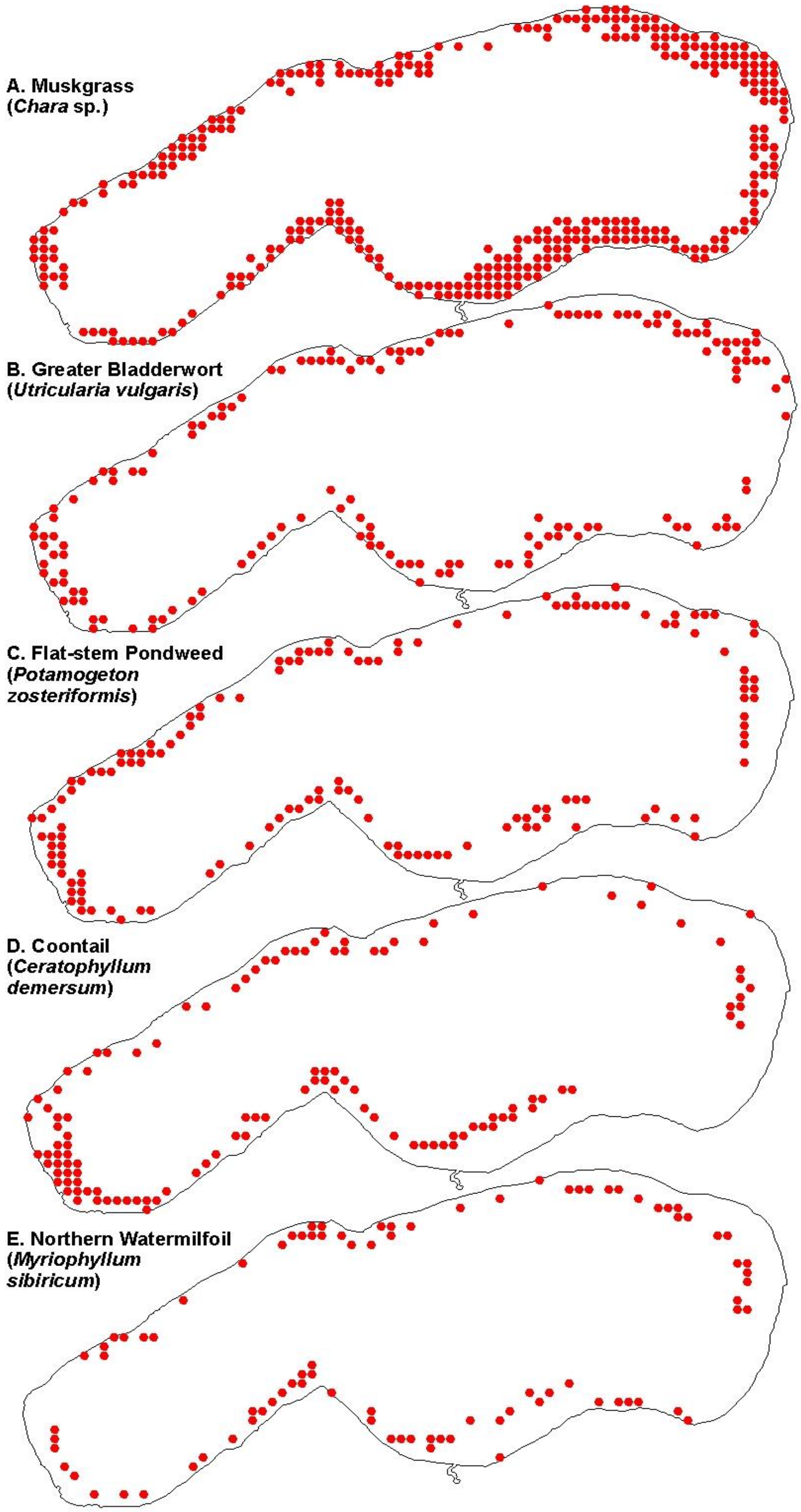


Table 2. Submerged and free-floating aquatic plants recorded in Steamboat Lake, 2008.

Description			Common Name	Scientific Name	Frequency[a]
SUBMERGED and/or FREE-FLOATING	Algae and mosses		Muskgrass	*Chara* sp.	54
			Watermoss	Not identified to species	<1
	Rooted plants	Grass-leaf plants	Flat-stem pondweed	*Potamogeton zosteriformis*	23
			Wild celery	*Vallisneria americana*	<1
		Dissected-leaf plants	Coontail	*Ceratophyllum demersum*	18
			Northern watermilfoil	*Myriophyllum sibiricum*	14
			White water buttercup	*Ranunculus aquatilis*	<1
			Mare's tail	*Hippuris vulgaris*	<1
		Bushy-leaf plants	Bushy pondweed	*Najas flexilis*[b]	6
			Canada waterweed	*Elodea canadensis*	5
			Fries' pondweed	*Potamogeton friesii*	3
			Narrow-leaf pondweed	*Potamogeton* sp.[c]	<1
		Broad-leaf plants	White-stem pondweed	*Potamogeton praelongus*	5
			Illinois pondweed	*Potamogeton illinoensis*	2
			Clasping-leaf pondweed	*Potamogeton richardsonii*	1
			Large-leaf pondweed	*Potamogeton amplifolius*	<1
		Fine-leaf plants	Sago pondweed	*Stuckenia pectinata*	<1
	Free-drifting		Greater bladderwort	*Utricularia vulgaris*	24
			Star duckweed	*Lemna trisulca*	3
			Lesser duckweed	*Lemna minor*	<1
			Greater duckweed	*Spirodela polyrhiza*	Present[d]

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations (N = 632). They represent the percent of the sample stations that contained a plant taxon.

[b]May have included some specimens of *Najas guadalupensis.*

[c]Some specimens of "narrow-leaved pondweeds" were positively identified as *Potamogeton friesii* (Fries' pondweed). However, it is not known whether other "look-a-like" narrow-leaf pondweed species occurred in the lake. Therefore, a separate group of unidentified narrow-leaf pondweeds (*Potamogeton* sp.) are reported here but not counted in species tally.

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

Unique plants

In addition to the commonly occurring plants in Steamboat Lake, one unique plant species, mare's tail, was located along the northeast shore (Figure 19).

Species richness

The number of plant taxa found in each one square meter sample site ranged from zero to nine (Figure 20). Sites with the highest number of species occurred on the west shore, in shallow water and within mixed beds of emergent, floating-leaf and submerged plants. In water depths greater than 10 feet, most sites contained either no plants or only one species.

Figure 19. Distribution of unique aquatic plants in Steamboat Lake, 2008.

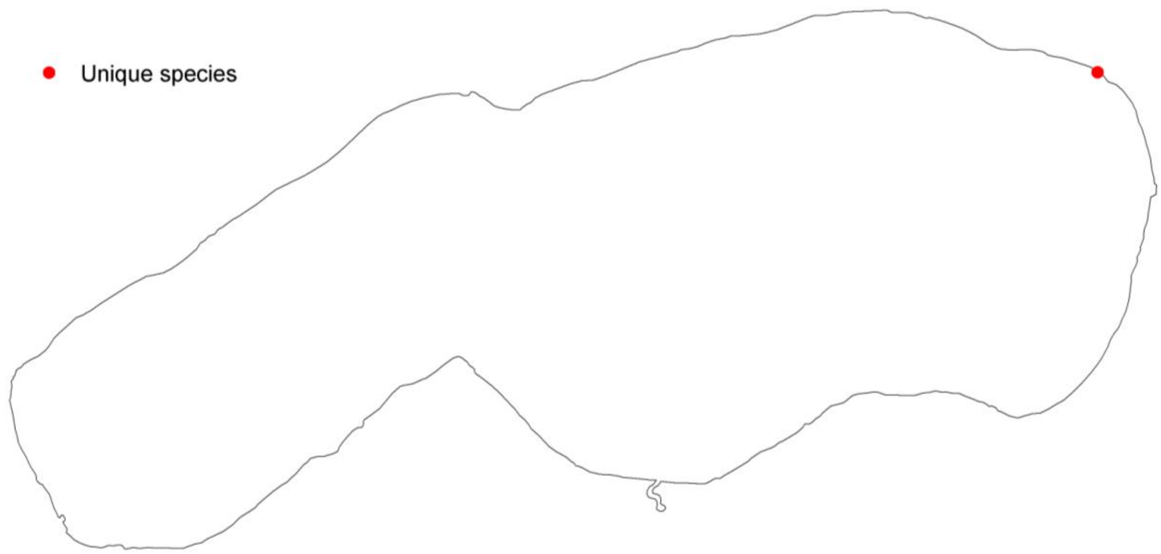
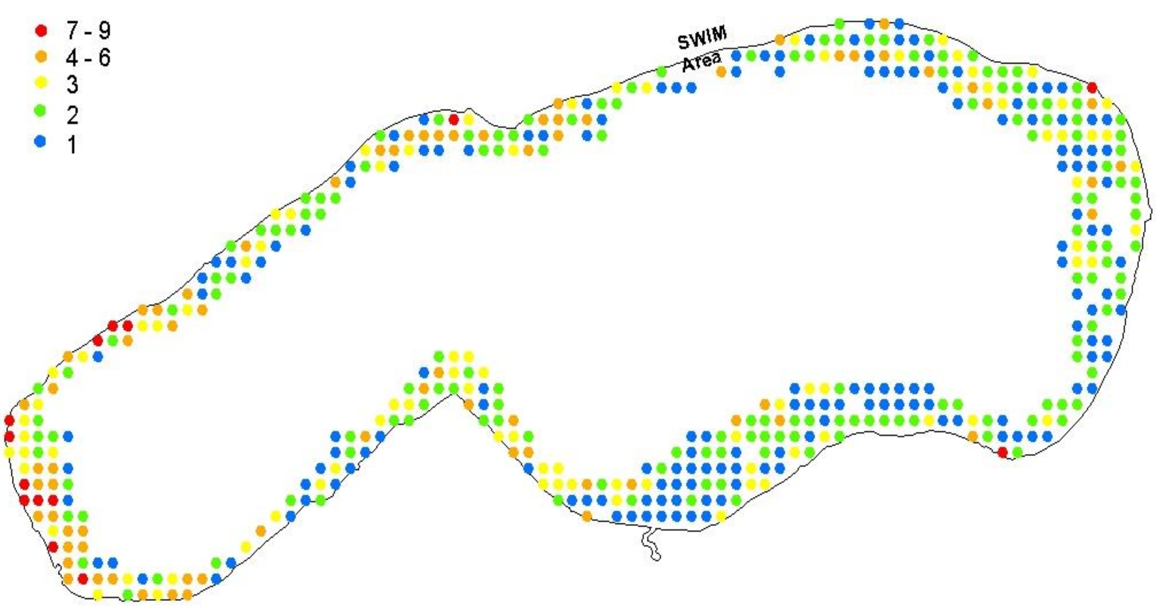


Figure 20. Aquatic plant richness (number of plant taxa per sampling station) in Steamboat Lake, 2008.



Near-shore Substrates

Objective

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

Introduction

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

Methods

Near-shore substrate in Steamboat Lake was evaluated at a total of 363 sampling stations set up in the grid point-intercept aquatic plant surveys and near-shore fish surveys. Plant sample stations were 65 meters apart and occurred in a grid from shore to a depth of 25 feet; substrate was recorded at sample sites where water depth was seven feet or less. To increase sample coverage at near-shore sites not covered by the grid sampling, substrate was also evaluated at near-shore fish sample stations. Fish sample stations were located every 400 meters around the perimeter of the lakeshore and substrate was evaluated at 33 of these stations.

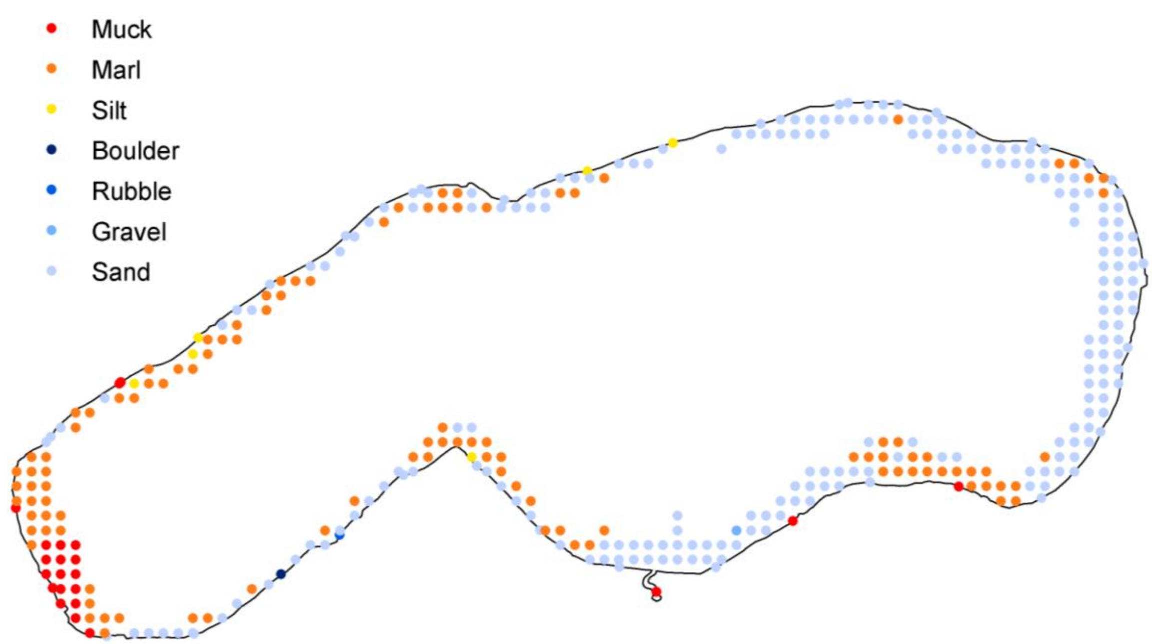
Surveyors evaluated substrate by tapping a pole into the lake bottom; soft substrate could usually be brought to the surface on the pole or sampling rake for evaluation. If this was not feasible, substrate was evaluated by visual observation. Standard lake substrate classes were based on the DNR Fisheries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

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

Results

Sand was the dominant near-shore substrate at Steamboat Lake. It was recorded at over 60% of the sample sites, predominantly on the eastern half of the lake (Figure 21). The western portion of Steamboat Lake was comprised mainly of soft substrates, such as muck and marl. These soft substrates were also scattered along both the northern and southern shorelines. Large-diameter hard substrates, including boulders and rubble, were present in only one or two locations.

Figure 21. Distribution of Steamboat Lake near-shore substrates, 2008.



Bird Surveys

Objectives

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

Introduction

Bird Species of Greatest Conservation Need
There are 97 bird species of greatest conservation need (SGCN) in Minnesota. Species of greatest conservation need are documented in Minnesota's State Wildlife Action Plan, Tomorrow's Habitat for the Wild and Rare (2006). Fifteen of these species were identified at Steamboat Lake.

Figure 22. American white pelican

Photo by: Carrol Henderson

<u>American white pelicans</u> (*Pelecanus erythrorhynchos*; Figure 22) are one of the largest birds in North America. These white waterbirds have a wingspan of nearly 10 feet, and weigh up to 30 pounds. They have black wingtips and an orange bill with a pouch. Unlike some pelicans, American white pelicans do not dive for their food, but feed while swimming. They nest in colonies on remote freshwater lakes, and depend on wetlands for many stages of their life cycle. Habitat loss is the largest known cause of nesting failure, although predation and boating disturbance can also be factors.

Figure 23. Bald eagle

Photo by: Carrol Henderson

<u>Bald eagles</u> (*Haliaeetus leucocephalus*; Figure 23) are an increasingly common sight in Minnesota. Once listed as an endangered species, bald eagle numbers have rebounded due to effective environmental protection laws and conservation efforts. Adult bald eagles are easily identified by the white head and tail, although these colors don't appear until birds are 4 or 5 years old. Prior to that, eagles are generally dark brown with white feathers scattered along the wings, head, tail and back. With a wingspan of up to 7 feet, bald eagles are one of the largest birds in North America. They are found in forested areas near large, open bodies of water. Although bald eagle numbers are increasing, these birds still face threats from environmental contaminants and destruction of habitat. Bald eagles are listed as a species of Special Concern in the state of Minnesota.

Common loons (*Gavia immer*; Figure 24) 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 24. Common loon

Photo by: Carrol Henderson

Common terns (*Sterna hirundo*; Figure 25) are the most widespread terns in North America. In the breeding season common terns have a solid black cap with gray back and underparts. The gray wings have dark edges. The rump is white, and the legs and bill are orange-red in color. Common terns nest in colonies, often on islands or peninsulas of larger lakes with sandy substrates. Populations of common terns declined in the late 1800s, when their feathers were used to adorn clothing, and again in the 1970s, likely due to poisoning by pesticides. Habitat loss, nest predation, and disturbance by humans may also negatively affect common terns.

Figure 25. Common tern

Photo by: Carrol Henderson

Eastern wood-pewees (*Contopus virens*; Figure 26) are medium-sized, nondescript birds common in Eastern forests. They utilize multiple habitat types, including deciduous forests, mixed woods, and suburban areas. This bird gets its name from its call, a slurred "pee-ah-wee." Eastern wood-pewees are grayish-olive above, with a paler throat and belly and whitish wingbars. They forage throughout the canopy, often flying out from their perch to catch insects before returning to the same perch. Populations of eastern wood-pewees are declining throughout much of their range. One possible cause of the decline is the increase in white-tailed deer. Deer browse and decrease the lower-canopy foraging area available to the pewee.

Figure 26. Eastern wood-pewee

Photo by: J.A. Spendelow

Golden-winged warblers (*Vermivora chrysoptera*; Figure 27) 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 27. Golden-winged warbler

Photo by: Carrol Henderson

The horned grebe (*Podiceps auritus*; Figure 28) is a small member of the grebe family. This bird gets its name from yellow patches of feathers behind the eyes ("horns") that appear during the breeding season. At this time, the neck and belly are reddish, and the head is black. Non-breeding plumage is mainly grayish-black and white. Horned grebes breed on freshwater lakes and wetlands of small to medium size, and migrate to coastal areas during the winter. They feed on fish, insects, and crustaceans, and often eat their own feathers to help with the filter and digestion of fish bones. Although horned grebe numbers appear stable, the breeding range is contracting toward the northwest. Oil spills and pesticide contamination also pose threats to horned grebe populations.

Figure 28. Horned grebe

Photo by: Dave Herr

Ovenbirds (*Seiurus aurocapillus*; Figure 29) 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 29. Ovenbird

Photo source: U.S. Fish and Wildlife Service

Rose-breasted grosbeaks (*Pheucticus ludovicianus*; Figure 30) are summer visitors to Minnesota bird feeders. The males are easily identified by a red triangle on a white breast, with a black head and back and a large bill. Females are more difficult to identify, and resemble a large sparrow with brown and white streaks. Rose-breasted grosbeaks are found in open woodlands near water, edges of marshes, meadows and woodlands, and suburban parks and gardens. The winter range spans from southern Mexico to South America and the Caribbean. Significant regional declines in rose-breasted grosbeak populations have been noted.

Figure 30. Rose-breasted grosbeak

Photo by: J.A. Spendelow

Sedge wrens (*Cistothorus platensis*; Figure 31) 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 31. Sedge wren

Photo by: Berlin Heck

The swamp sparrow's (*Melospiza georgiana*; Figure 32) 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 32. Swamp sparrow

Photo by: Jim Stasz

Figure 33. Veery

Photo by: Deanna Dawson

The veery (*Catharus fuscescens*; Figure 33) 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 34. White-throated sparrow

Photo by: Dave Herr

White-throated sparrows (*Zonotrichia albicollis*; Figure 34) are common in Minnesota during their spring and fall migrations. They are recognizable by the white patch on the throat and their characteristic "Old Sam Peabody Peabody Peabody" song. The head is striped with black and tan or white, and has a yellow spot above the eye. The chest is gray and the back is streaked with brown and black. White-throated sparrows inhabit coniferous or mixed forests, and prefer areas with multiple openings and abundant low-growing vegetation. 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.

The loud, bubbly song of the winter wren (*Troglodytes troglodytes*; Figure 35) belies its small size. At four inches in length, the winter wren is the smallest of the North American wrens. Winter wrens are dark brown in color and have fine barring on the wings, tail, and underparts. They often hold their short tail in an upright position. Winter wrens are sometimes described as "mouse-like" because of their small stature and tendency to stay near the ground, foraging around like a rodent. The winter wren inhabits a variety of habitats, including conifer forests and riparian areas. They nest in cavities, and may build several nests each breeding season. Loss of forested habitat may pose a threat to the winter wren.

Figure 35. Winter wren

Photo source: U.S. Fish and Wildlife Service

The yellow-bellied sapsucker's (*Sphyrapicus varius*; Figure 36) name describes it well. This medium-sized woodpecker exhibits a yellow underside, and feeds primarily on sap it harvests from trees. The forehead and crown are red, and the throat is also red in the male. The back and sides are striped with black and white. Deciduous forests and riparian areas along streams characterize the breeding habitat of this species. Yellow-bellied sapsuckers create a food source for many other species when they drill holes for sap, and are therefore considered an important part of the ecosystem. Populations currently appear stable, and care should be taken to ensure they remain that way.

Figure 36. Yellow-bellied sapsucker

Photo by: J.A. Spendelow

Methods

Surveyors used several techniques to collect information on bird species. Point counts were conducted at 34 stations, located 400 meters apart along the lakeshore. Surveyors listened for five minutes per station and recorded all species detected (heard or seen) within that time. Point count surveys were conducted in the early morning hours, when species were most likely to be singing. Call-playback surveys were conducted at survey stations that had appropriate habitat. At each station, surveyors played a tape that included the calls of six marsh birds (least bittern (*Ixobrychus exilis*), yellow rail (*Coturnicops noveboracensis*), sora (*Porzana carolina*), Virginia rail (*Rallus limicola*), American bittern (*Botaurus lentiginosus*), and pied-billed grebe (*Podilymbus podiceps*)) and listened for a response. Call-playback surveys generally took place in the early evening. Both survey techniques were dependent on good listening conditions, and surveys were stopped if inclement conditions prevented the ability to hear bird vocalizations. Casual observations of birds seen or heard on the lake or on the lakeshore were also recorded.

Results

Sixty-four bird species were documented during the Steamboat Lake bird surveys. The majority of these, including 13 of the 15 species of greatest conservation need, were identified during the point count or call-playback surveys (Table 3). Several species were also documented during casual observation of the lake (Appendix 2). The most commonly detected bird species on Steamboat Lake was the red-eyed vireo, which was found at 85% of the survey stations. The song sparrow, which was second in abundance, was detected at over 70% of the stations. Blue jays and American crows were each found at 15 or more survey stations.

The veery was the most commonly detected species of greatest conservation need. It was found at 10 of 34 survey stations, along much of the shoreline of Steamboat Lake (Figure 37). The ovenbird, another forest-dwelling species of greatest conservation need, was detected at nearly 20% of the survey stations. Its distribution was also widespread along the Steamboat Lake shoreline. Of the four eastern wood-pewees detected during the bird surveys, one was heard south of the public access, but the other three occurred along the northern lake shoreline. The remaining forest-dwelling species of greatest conservation need (white-throated sparrow, rose-breasted grosbeak, winter wren, yellow-bellied sapsucker) were each identified at three or fewer locations.

The bald eagle was the second most commonly detected species of greatest conservation need. It was found at seven survey stations along the southern and eastern shorelines (Figure 38).

Four different aquatic habitat-dwelling species of conservation need were documented on Steamboat Lake. Two of them, the horned grebe and common tern, were detected while casually observing the lake; their sightings were not associated with a specific survey station. The American white pelican, documented during an evening call-playback survey, was found at one survey station along the western lake edge (Figure 39). Common loons were found at six different survey stations. Sightings were widespread along the lakeshore.

The wetland-dwelling species of greatest conservation need occurred where large wetland complexes were present. The golden-winged warbler and sedge wren were both detected in the wetland along the western shoreline; the swamp sparrow was identified at three survey stations in various corners of the lake (Figure 40).

Figure 37. Distribution of forest habitat-dependent bird species of greatest conservation need in Steamboat Lake, May – June 2009.

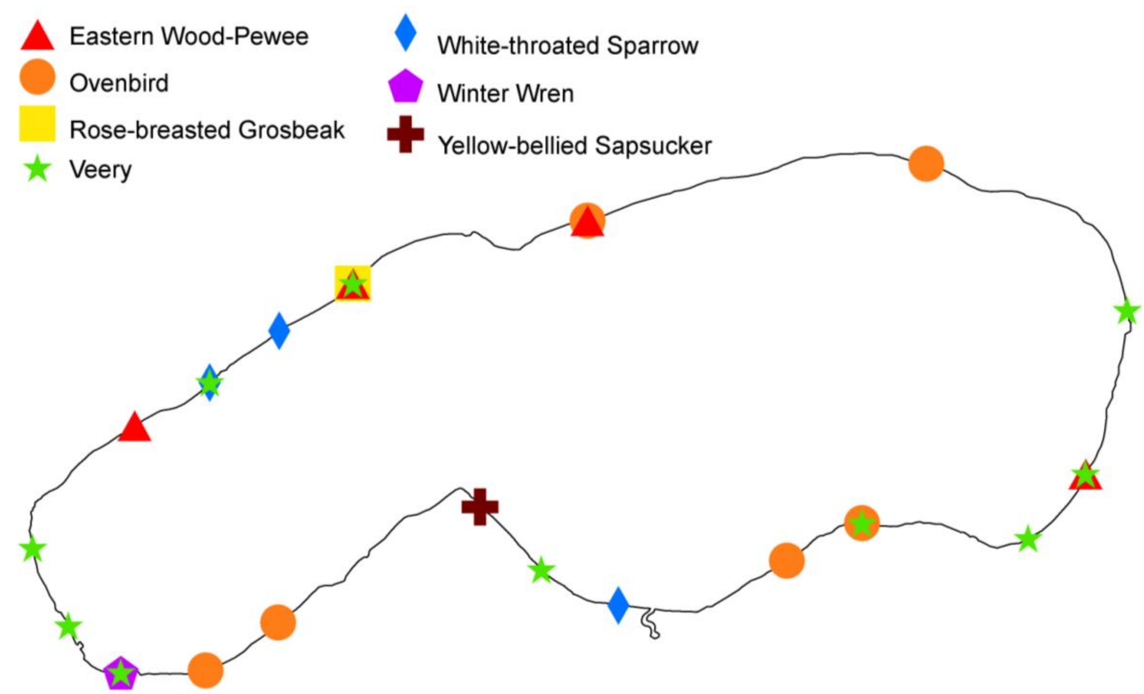


Figure 38. Distribution of bird species of greatest conservation need that occupy a variety of habitats in Steamboat Lake, May – June 2009.

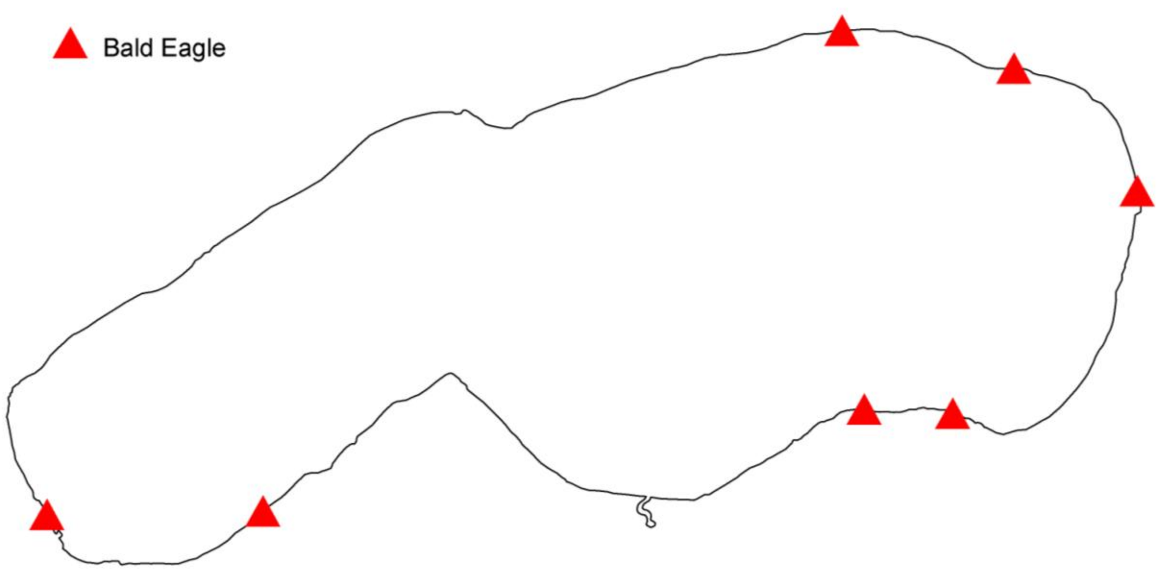


Figure 39. Distribution of aquatic habitat-dependent bird species of greatest conservation need in Steamboat Lake, May – June 2009.

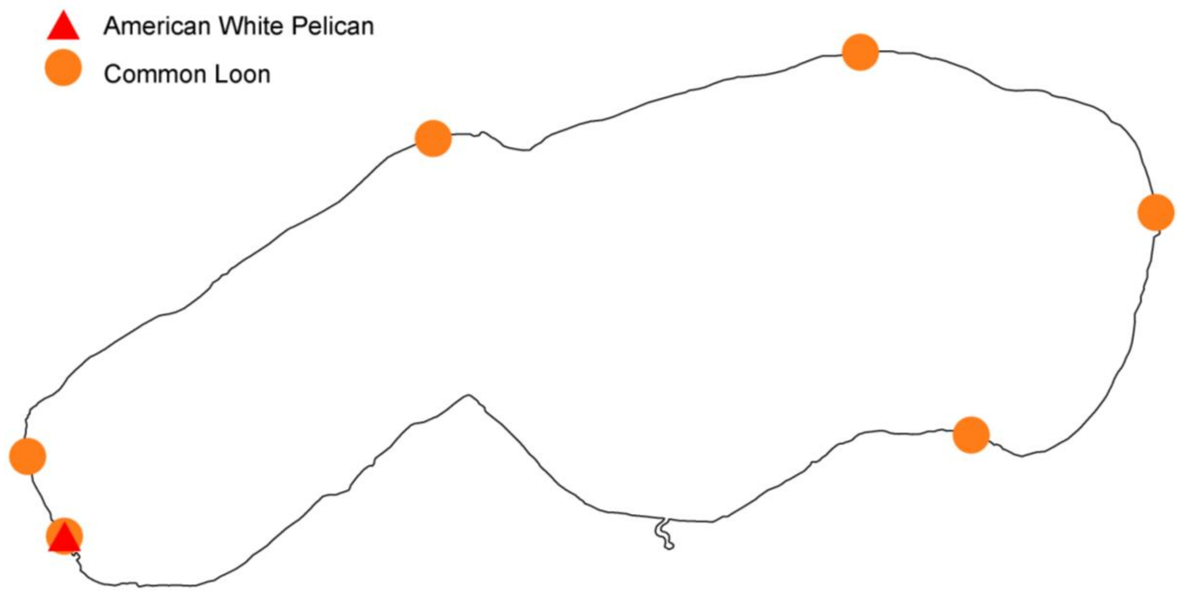


Figure 40. Distribution of wetland habitat-dependent bird species of greatest conservation need in Steamboat Lake, May – June 2009.

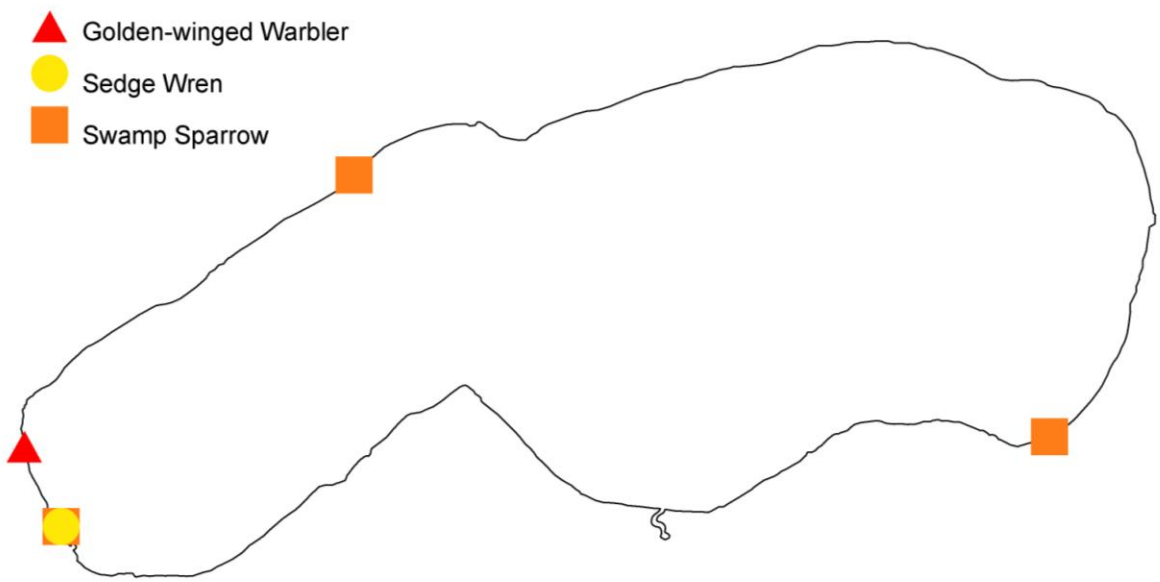


Table 3. Species list and frequency of occurrence of bird species identified during point count and call-playback surveys, May – June 2009. * denotes a species of greatest conservation need.

Description	Common Name	Scientific Name	%[a]
Waterfowl	Canada Goose	*Branta canadensis*	6
	Wood Duck	*Aix sponsa*	3
	Mallard	*Anas platyrhynchos*	38
	Common Goldeneye	*Bucephala clangula*	9
Loons	Common Loon*	*Gavia immer*	18
Pelicans	American White Pelican*	*Pelecanus erythrorhynchos*	3
Herons/bitterns	Great Blue Heron	*Ardea herodias*	15
	Green Heron	*Butorides virescens*	3
Hawks/eagles	Osprey	*Pandion haliaetus*	3
	Bald Eagle*	*Haliaeetus leucocephalus*	21
Falcons	Merlin	*Falco columbarius*	3
Gulls/terns	Ring-billed Gull	*Larus delawarensis*	3
Pigeons/doves	Mourning Dove	*Zenaida macroura*	3
Kingfishers	Belted Kingfisher	*Megaceryle alcyon*	3
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*	6
	Yellow-bellied Sapsucker*	*Sphyrapicus varius*	3
	Northern Flicker	*Colaptes auratus*	6
	Pileated Woodpecker	*Dryocopus pileatus*	3
Flycatchers	Eastern Wood-Pewee*	*Contopus virens*	12
	Alder Flycatcher	*Empidonax alnorum*	15
	Eastern Phoebe	*Sayornis phoebe*	18
	Great Crested Flycatcher	*Myiarchus crinitus*	6
Vireos	Warbling Vireo	*Vireo gilvus*	6
	Red-eyed Vireo	*Vireo olivaceus*	85
Jays/crows	Blue Jay	*Cyanocitta cristata*	44
	American Crow	*Corvus brachyrhynchos*	56
Swallows	Tree Swallow	*Tachycineta bicolor*	15
	Barn Swallow	*Hirundo rustica*	6
Chickadees	Black-capped Chickadee	*Poecile atricapilla*	9
Nuthatches	White-breasted Nuthatch	*Sitta carolinensis*	12
Wrens	House Wren	*Troglodytes aedon*	3
	Winter Wren*	*Troglodytes troglodytes*	3
	Sedge Wren*	*Cistothorus platensis*	3

Table 3, continued.

Description	Common Name	Scientific Name	% [a]
Thrushes	Eastern Bluebird	*Sialia sialis*	3
	Veery*	*Catharus fuscescens*	29
	American Robin	*Turdus migratorius*	41
Mockingbirds	Gray Catbird	*Dumetella carolinensis*	12
Starlings	European Starling	*Sturnus vulgaris*	3
Waxwings	Cedar Waxwing	*Bombycilla cedrorum*	12
Warblers	Golden-winged Warbler*	*Vermivora chrysoptera*	3
	Yellow Warbler	*Dendroica petechia*	29
	Chestnut-sided Warbler	*Dendroica pensylvanica*	6
	Pine Warbler	*Dendroica pinus*	3
	Black-and-white Warbler	*Mniotilta varia*	21
	American Redstart	*Setophata ruticilla*	3
	Ovenbird*	*Seiurus aurocapillus*	18
	Northern Waterthrush	*Seiurus noveboracensis*	3
	Common Yellowthroat	*Geothlypis trichas*	38
Sparrows/allies	Chipping Sparrow	*Spizella passerina*	18
	Song Sparrow	*Melospiza melodia*	71
	Swamp Sparrow*	*Melospiza georgiana*	9
	White-throated Sparrow*	*Zonotrichia albicollis*	9
Cardinals/allies	Northern Cardinal	*Cardinalis cardinalis*	3
	Rose-breasted Grosbeak*	*Pheucticus ludovicianus*	3
Blackbirds	Red-winged Blackbird	*Agelaius phoeniceus*	38
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	3
	Common Grackle	*Quiscalus quiscula*	18
	Baltimore Oriole	*Icterus galbula*	9
Finches	American Goldfinch	*Spinus tristis*	6

[a] % – Percent of surveyed sample sites in which a bird species occurred (N = 34)

Bird Species Richness

Objective

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

Introduction

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

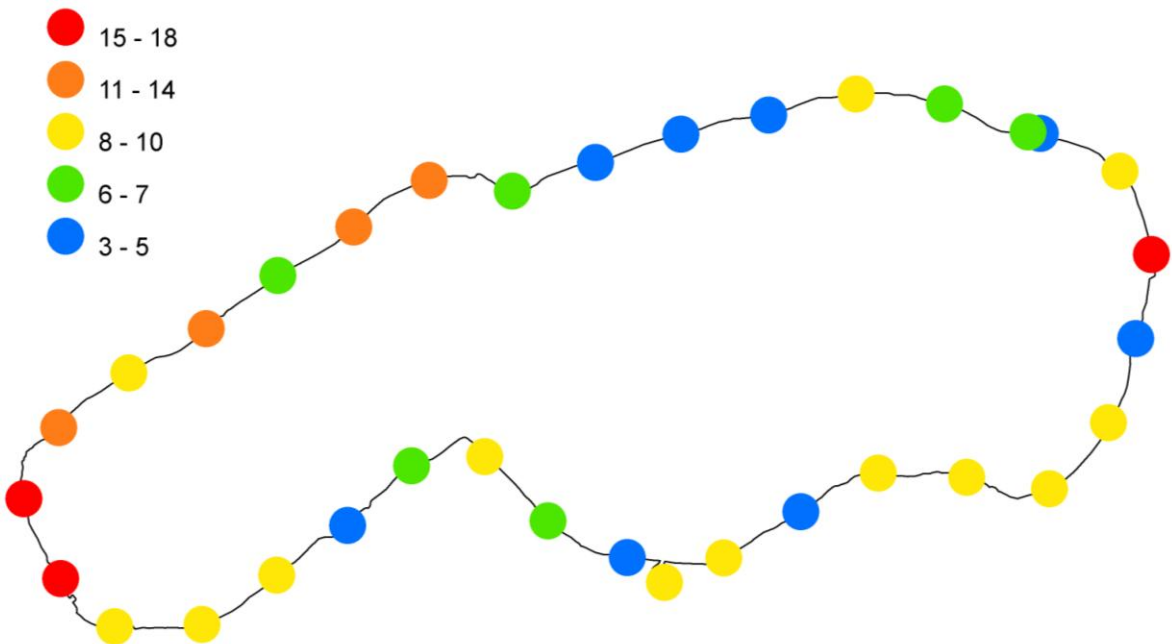
Methods

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

Results

Bird species diversity at Steamboat Lake ranged from three to 18 species at a single survey station (Figure 41). Nearly one-quarter of the sites had between 10 and 16 bird species. The survey stations with the greatest bird diversity were somewhat scattered along the shoreline, but most occurred within the western half of Steamboat Lake. The number of species of greatest conservation need at a single survey station ranged from zero to six. One survey station contained six species of greatest conservation need, while 11 stations had zero.

Figure 41. Bird species richness (number of species per sample site) in Steamboat Lake, May – June 2009.



Loon Nesting Areas

Objectives

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

Introduction

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

Loon pair with chick

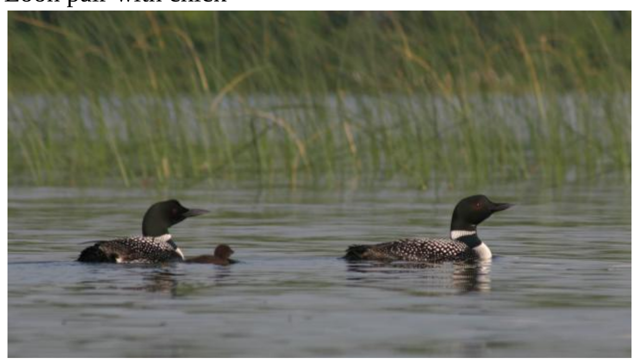


Photo by: Paul Bolstad

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

Methods

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

Results

Loon nesting areas have not been documented on Steamboat Lake.

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 41. Mink frog

Photo by: Jeff LeClere, www.herpnet.net

Mink frogs (Figure 41) 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 42. Green frog

Photo by: Jeff LeClere, www.herpnet.net

Green frogs (Figure 42) are medium-sized, greenish or brownish frogs with small dark spots. The belly is often brighter in color than the back. A large tympanum (eardrum) helps identify the green frog. They can be found in a variety of habitats surrounding lakes, streams, marshes, and swamps, but are strongly associated with the shallow water of lakeshores. Although green frog populations are generally stable, regional declines and local extinctions have been noted.

Methods

The aquatic frog survey methodology followed the Minnesota Frog and Toad Calling Survey (MFTCS) protocol (see Minnesota's Sensitive Lakeshore Identification Manual for additional information on how this protocol was adjusted for water routes). Frog survey points were located around the entire lake, spaced 400 meters apart. Surveys were conducted between sunset and 1:00 AM. At each station surveyors listened for up to five minutes for all frog and toad calls. An estimate of abundance and a calling index were recorded for both green and mink frogs. For other species, only calling index was recorded. If survey conditions such as rain or wind noticeably affected listening ability, the survey was terminated.

Results

No mink or green frogs were heard by surveyors on Steamboat Lake in 2008. Given concern about conducting the aquatic frog survey late in the breeding season on Steamboat Lake (the 2008 survey was conducted in mid-July), the aquatic frog survey was repeated at the end of June 2009. Again, no mink or green frogs were heard by surveyors.

Gray treefrogs (*Hyla versicolor*) were documented at Steamboat Lake. Frog surveyors heard gray treefrogs calling at three survey stations in 2008 and nine stations in 2009. All index values for this species equaled one (individual frog calls were distinct, with no overlap). Other frog or toad species that may be found near Steamboat Lake, such as wood frog (*Rana sylvatica*), spring peepers (*Pseudacris crucifer*), leopard frog (*Rana pipiens*), chorus frog (*Pseudacris triseriata*), and American toad (*Bufo americanus*), usually breed earlier in the year and are not strongly associated with larger lakes.

Nongame Fish Surveys

Objectives

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

Introduction

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

Pugnose shiners (*Notropis anogenus*; Figure 43) 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 43. Pugnose shiner

Photo by: Konrad Schmidt

Least darters (*Etheostoma microperca*; Figure 44) 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 44. Least darter

Photo by: Konrad Schmidt

Longear sunfish (*Lepomis megalotis*; Figure 45) are a deep-bodied fish reaching a length of 71 – 94 mm. These colorful fish have a belly that is orange-red, and the sides are speckled with turquoise. Adults have an elongated opercular "ear flap" that is trimmed in white. Like the other species of greatest conservation need, the longear sunfish prefers clear, shallow, vegetated areas and is intolerant of turbidity.

Figure 45. Longear sunfish

Photo by: Konrad Schmidt

Proxy species

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

Blackchin shiners (*Notropis heterodon*; Figure 46) are small (50 – 75 mm) fish with a bronze-colored back and silver sides and belly. A dark lateral band extends through the chin. Like the species of greatest conservation need, the blackchin shiner inhabits clear water with abundant submerged aquatic vegetation; it also prefers a clean sand or gravel substrate. This species cannot tolerate turbidity or loss of aquatic vegetation.

Figure 46. Blackchin shiner

Photo by: Konrad Schmidt

Blacknose shiners (*Notropis heterolepis*; Figure 47) 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 47. Blacknose shiner

Photo by: Konrad Schmidt

Banded killifish (*Fundulus diaphanus*; Figure 48) 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 48. Banded killifish

Photo by: Konrad Schmidt

Methods

Fish surveys were conducted using Minnesota's Sensitive Lakeshore Survey Protocol. Fish survey stations were located 400 meters apart, and were the same stations used for surveying birds and aquatic frogs. At each station, fish were sampled using three different methods: trapnetting, shoreline seining, and electrofishing. At several locations, excessive vegetation, depth, or soft substrate prevented surveyors from using seines or trapnets. However, electrofishing samples were still collected, from a boat if necessary. All species captured using the different sampling methods were identified and counted. Target fish species included near-shore species of greatest conservation concern (pugnose shiner, least darter, and longear sunfish) and proxy species (blackchin shiner, blacknose shiner, and banded killifish). These species are associated with large, near-shore stands of aquatic grasses and macrophytes. They are intolerant to disturbance, and have been extirpated from lakes where extensive watershed and lakeshore development has occurred.

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

Results

Thirty fish species were documented during the 2008 nongame fish surveys on Steamboat Lake (Table 4). Bluegills and yellow perch were recorded at the most survey stations and in the greatest numbers. Surveyors detected each species at 31 of 33 survey stations, and counted nearly 600 individuals of each. Rock bass, pumpkinseed, bowfin, yellow bullhead, and banded killifish were all found at over 50% of the survey stations.

Surveyors identified ten fish species not previously documented in Steamboat Lake, bringing the total observed historical fish community to 35 species. The newly recorded species in Steamboat Lake were blackchin shiner, blacknose shiner, central mudminnow, common shiner, golden shiner, mimic shiner, mottled sculpin, pugnose shiner, spotfin shiner, and spottail shiner.

One species of greatest conservation need was detected during the Steamboat Lake fish surveys. Pugnose shiners were documented at five survey stations, in both the northeast and southwest corners of the lake (Figure 49). Surveyors found a total of nine individuals at these five sites. In addition to the one species of greatest conservation need, surveyors also detected all three proxy species (Figure 50). Banded killifish were found in by far the greatest numbers; surveyors counted over 300 individuals at 18 survey stations. Thirteen blackchin shiners were recorded at five survey stations, and five blacknose shiners were recorded at two survey stations.

The presence of pugnose shiners and the three proxy species at Steamboat Lake 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 4. Abundance and frequency of detection of fish species identified during Steamboat Lake fish surveys, July 2008. * denotes species of greatest conservation need

Description	Common Name	Scientific Name	# [a]	% [b]
Bowfins	Bowfin	*Amia calva*	49	58
Minnows	Spotfin shiner	*Cyprinella spiloptera*	29	12
	Common shiner	*Luxilus cornutus*	7	9
	Golden shiner	*Notemigonus crysoleucas*	1	3
	Pugnose shiner*	*Notropis anogenus*	9	15
	Emerald shiner	*Notropis atherinoides*	1	3
	Blackchin shiner	*Notropis heterodon*	13	15
	Blacknose shiner	*Notropis heterolepis*	5	6
	Spottail shiner	*Notropis hudsonius*	1	3
	Mimic shiner	*Notropis volucellus*	493	36
	Bluntnose minnow	*Pimephales notatus*	168	45
	Fathead minnow	*Pimephales promelas*	1	3
Suckers	White sucker	*Catostomus commersonii*	73	30
North American freshwater catfishes	Black bullhead	*Ameiurus melas*	17	36
	Yellow bullhead	*Ameiurus natalis*	33	58
	Brown bullhead	*Ameiurus nebulosus*	14	33
	Tadpole madtom	*Noturus gyrinus*	23	30
Pikes	Northern pike	*Esox lucius*	12	24
Mudminnows	Central mudminnow	*Umbra limi*	2	6
Killifishes	Banded killifish	*Fundulus diaphanus*	328	55
Sculpins	Mottled sculpin	*Cottus bairdi*	1	3
Sunfishes	Rock bass	*Ambloplites rupestris*	128	88
	Pumpkinseed	*Lepomis gibbosus*	96	70
	Bluegill	*Lepomis macrochirus*	588	94
	Largemouth bass	*Micropterus salmoides*	5	9
Perches	Iowa darter	*Etheostoma exile*	9	21
	Johnny darter	*Etheostoma nigrum*	46	42
	Yellow perch	*Perca flavescens*	587	94
	Logperch	*Percina caprodes*	24	21
	Walleye	*Sander vitreus*	7	21

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

[b] % – Percent of surveyed sample sites in which a species occurred (N = 33)

Figure 49. Distribution of fish species of greatest conservation need documented in Steamboat Lake, July 2008.

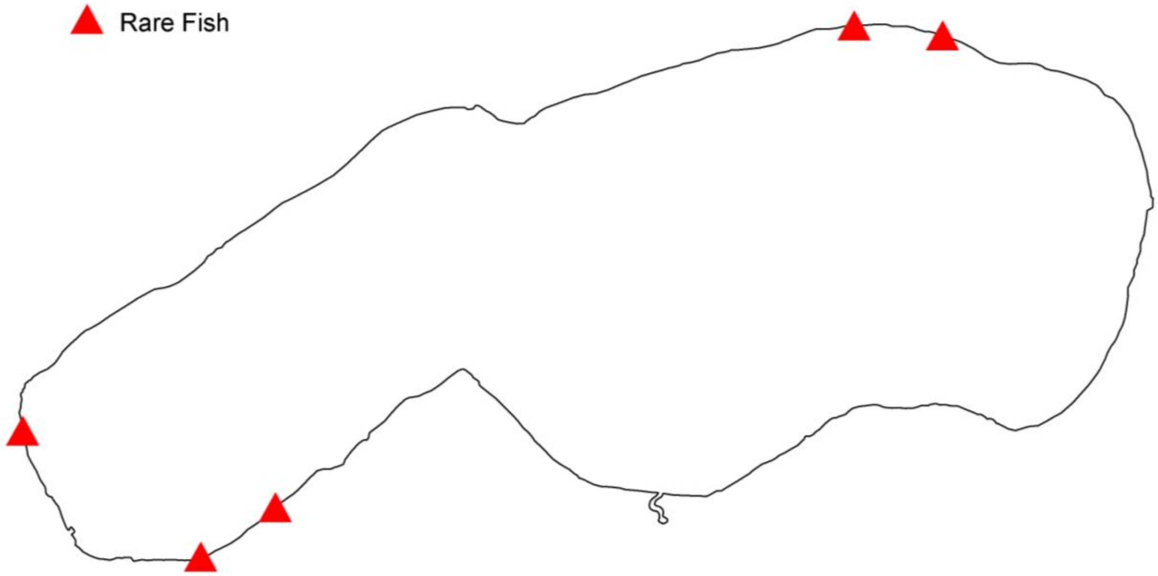
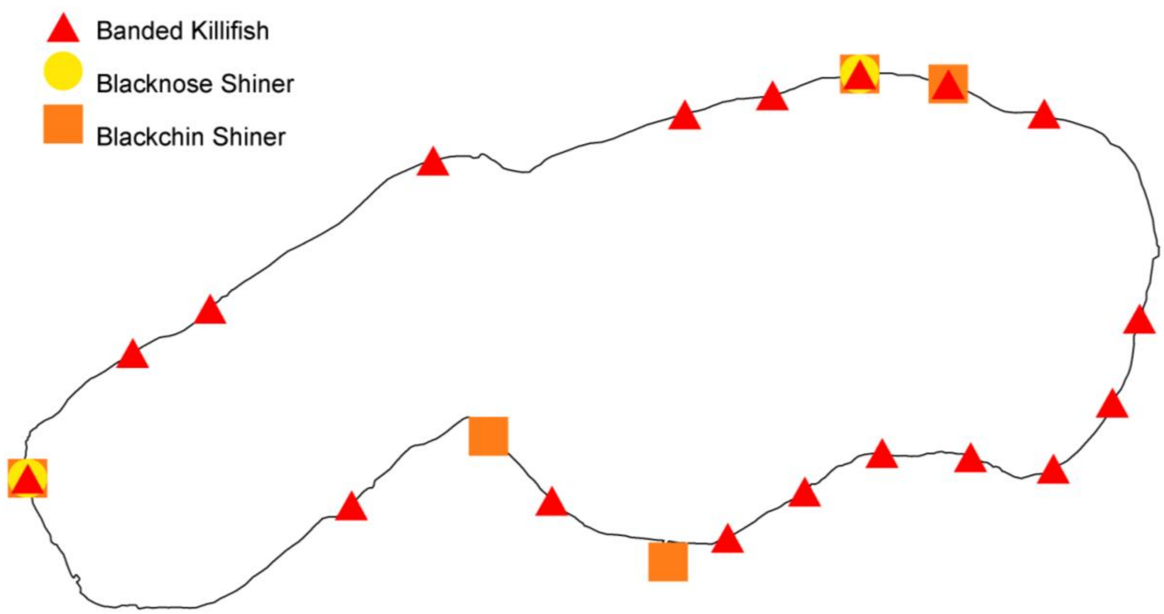


Figure 50. Distribution of fish proxy species documented in Steamboat Lake, July 2008.



Aquatic Vertebrate Richness

Objective

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

Introduction

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

Methods

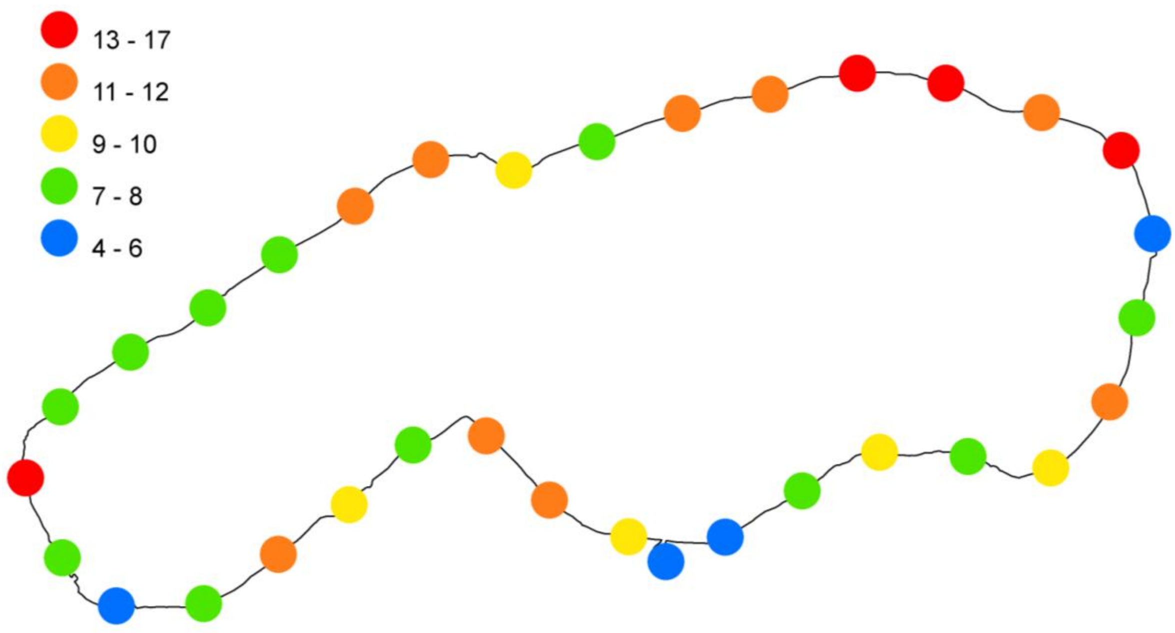
Aquatic vertebrate species were documented during the nongame fish sampling surveys. All aquatic vertebrates, including fish, frogs, and turtles, captured during trapnetting, seining, and electrofishing surveys were identified to the species level. Young-of-year animals that could not be identified to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

Results

The maximum number of aquatic vertebrate species documented at a Steamboat Lake survey station was 17 (Figure 51). This station was located in the northeastern corner of the lake. One additional site contained 15 species, and nearly half of the survey stations (N = 15) contained between 10 and 14 species. Surveyors recorded no fewer than four species at a survey station.

Fish were by far the most commonly documented aquatic vertebrates. Surveyors also recorded painted turtles (at five stations) and a snapping turtle (at one station). Hybrid sunfish were identified at Steamboat Lake, but were not included in the analyses.

Figure 51. Aquatic vertebrate species richness (number of species per survey station) documented during Steamboat Lake fish surveys, July 2008.



Other Rare Features

Objective

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

Introduction

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

Methods

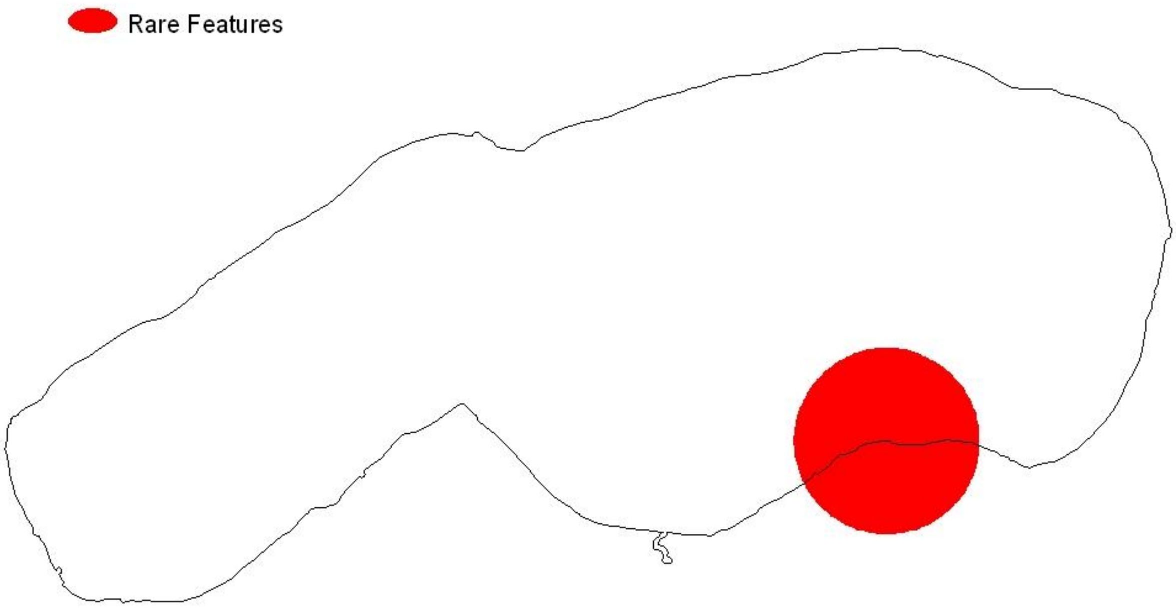
Researchers obtained locations of rare features from the Rare Features Database. Only "listed" plant and animal species (Federal or State endangered, threatened, or special concern) were considered in this project; non-listed unique plant species were included in the "Unique Plant Species" section of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

Results

One rare feature was documented near the shoreline of Steamboat Lake (Figure 52). The feature was a location of a bird species of Special Concern. The publication of exact descriptive and locational information is prohibited in order to help protect rare species.

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

Figure 52. Natural Heritage Database rare features (Federal or State-listed endangered, threatened, or special concern species) located within 1320 feet of Steamboat 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 March 11, 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, bodies of water set off from main body or enclosed by land) were mapped based on inspection of lake maps. Additional bays were identified using aerial photos. Underwater shoals or reefs that offset a body of water from the main body were visible only in these photographs. Non-isolated bays were open to the main water body by a wide mouth. Isolated bays had a narrower connection to the main water body, or were offshoots of non-isolated bays.

Results

No bays were identified on Steamboat Lake.

II. Ecological Model Development

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

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

Scores for each of the layers were summed (Figure 53). 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 54). The clusters with high values (i.e., areas of highly sensitive shoreline) were buffered by ¼ mile. These buffered areas were defined as most likely highly sensitive lakeshore areas. These areas will be forwarded to the local government for potential designation as resource protection areas (Figure 55).

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

Variable	Score	Criteria
Wetlands	3	> 25% of analysis window is in wetlands
	2	12.5 – 25% is in wetlands
	1	< 12.5% is in wetlands
	0	No wetlands present
Hydric Soils	3	> 25% of analysis window is hydric soils
	2	12.5 – 25% hydric soils
	1	< 12.5% hydric soils
	0	No hydric soils present
Near-shore Plant Occurrence	3	Frequency of occurrence is > 75% (> 75% of points within analysis window contained vegetation)
	2	Frequency of occurrence is 25 – 75%
	1	Frequency of occurrence < 25%
	0	No vegetation present

Table 5, continued.

Variable	Score	Criteria
Aquatic Plant Richness	3	Total number of plant taxa per analysis window > 10
	2	Total number of plant taxa 5 – 10
	1	Total number of plant taxa 1 – 4
	0	No vegetation present
Presence of Emergent and Floating-leaf Plant Beds	3	Emergent and/or floating-leaf plant stands occupy > 25% of the aquatic portion of the analysis window
	2	Stands occupy 5 – 25%
	1	Stands present but occupy less than 5%
	0	No emergent or floating-leaf plant beds present
Unique or Rare Plant Species	3	Presence of 2 or more unique or rare plant species within analysis window
	2	Presence of 1 unique plant species
	0	No unique plant species present
Near-shore Substrate	3	Frequency of occurrence is > 50% soft substrate (i.e., > 50% of points within analysis window consisted of soft substrate)
	2	Frequency of occurrence is 25 – 50% soft substrate
	1	Frequency of occurrence < 25% soft substrate
	0	No soft substrate present
Birds	3	Presence of 3 or more SGCN within analysis window
	2	Presence of 2 SGCN
	1	Presence of 1 SGCN
	0	No SGCN present
Bird Richness	3	Total number of bird species within analysis window > 25
	2	Total number of bird species 11 – 25
	1	Total number of bird species 1 – 10
	0	No bird species observed
Loon Nesting Areas	3	Presence of natural loon nest within analysis window
	2	Presence of loon nest on artificial platform
	0	No loon nesting observed
Frogs	3	Presence of both mink and green frogs within analysis window
	2	Presence of mink or green frogs
	0	Neither mink nor green frogs present

Table 5, continued.

Variable	Score	Criteria
Fish	3	Presence of one or more SGCN within analysis window
	2	Presence of one or more proxy species
	0	Neither SGCN nor proxies present
Aquatic Vertebrate Richness	3	Total number of aquatic vertebrate species within analysis window > 10
	2	Total number of aquatic vertebrate species 5 – 10
	1	Total number of aquatic vertebrate species 1 – 4
	0	No aquatic vertebrate species observed
Rare Features	3	Presence of multiple Natural Heritage features within analysis window
	2	Presence of a Natural Heritage feature
	0	No Natural Heritage feature present
Bays	3	Protected or isolated bay within analysis window
	2	Non-protected or non-isolated bay
	0	Not a distinctive bay

Figure 53. Total score layer created by summing scores of all 15 variables. Highest total scores represent most sensitive areas of shoreline.

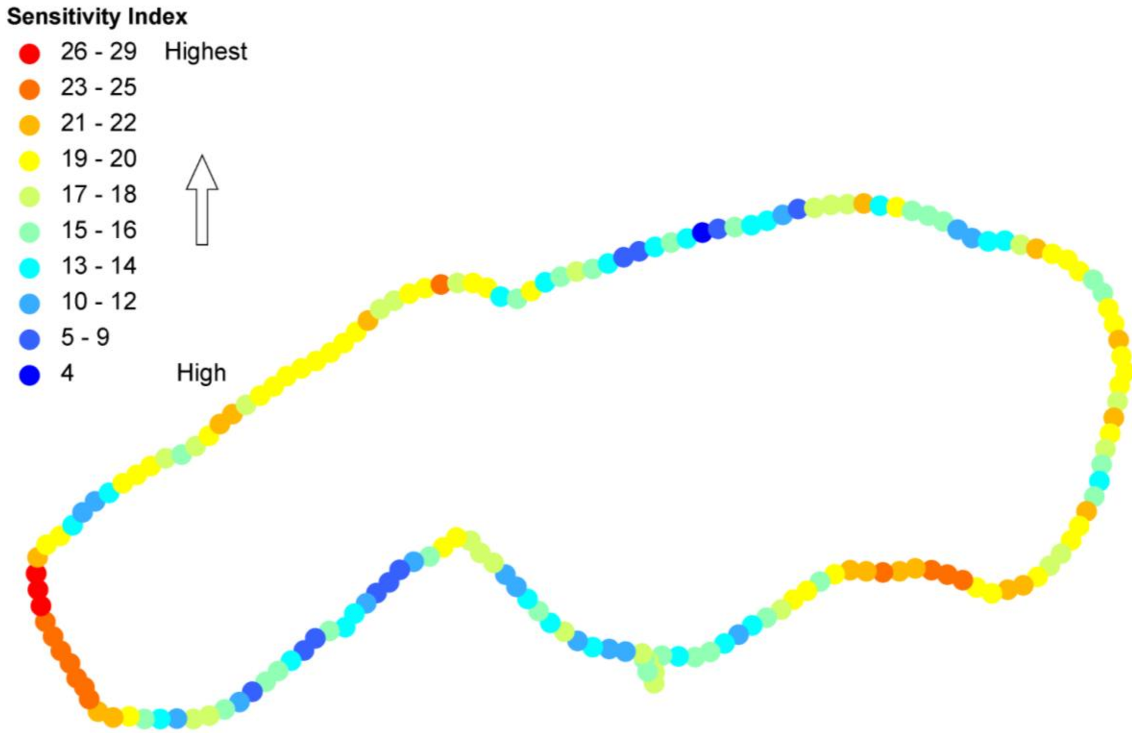


Figure 54. GIS-identified clusters of points with similar total scores. Red areas are those with high scores (i.e., areas of highly sensitive shoreland).

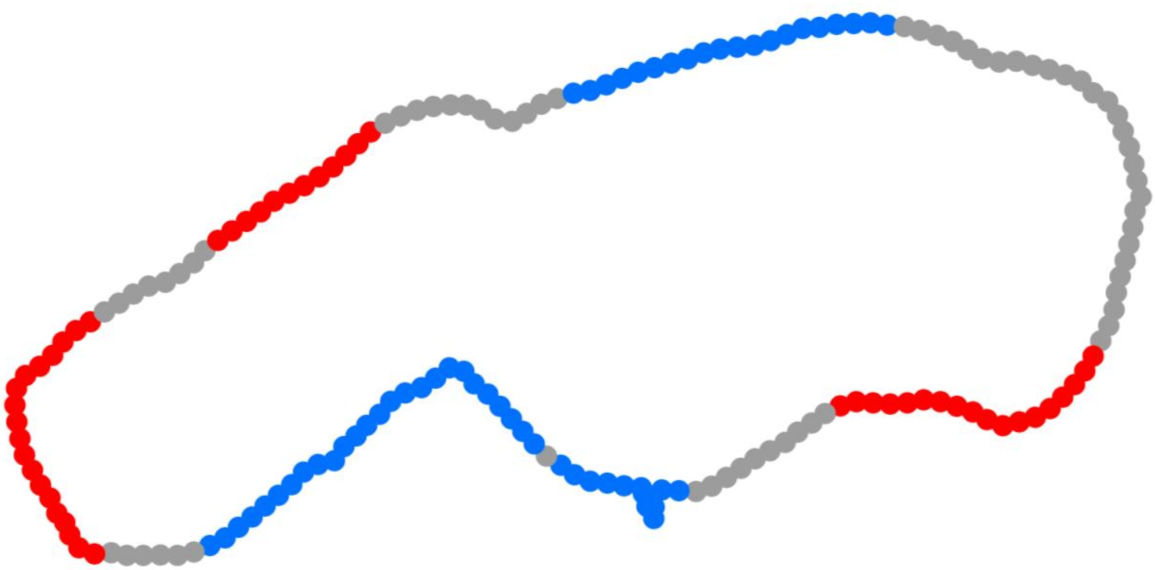
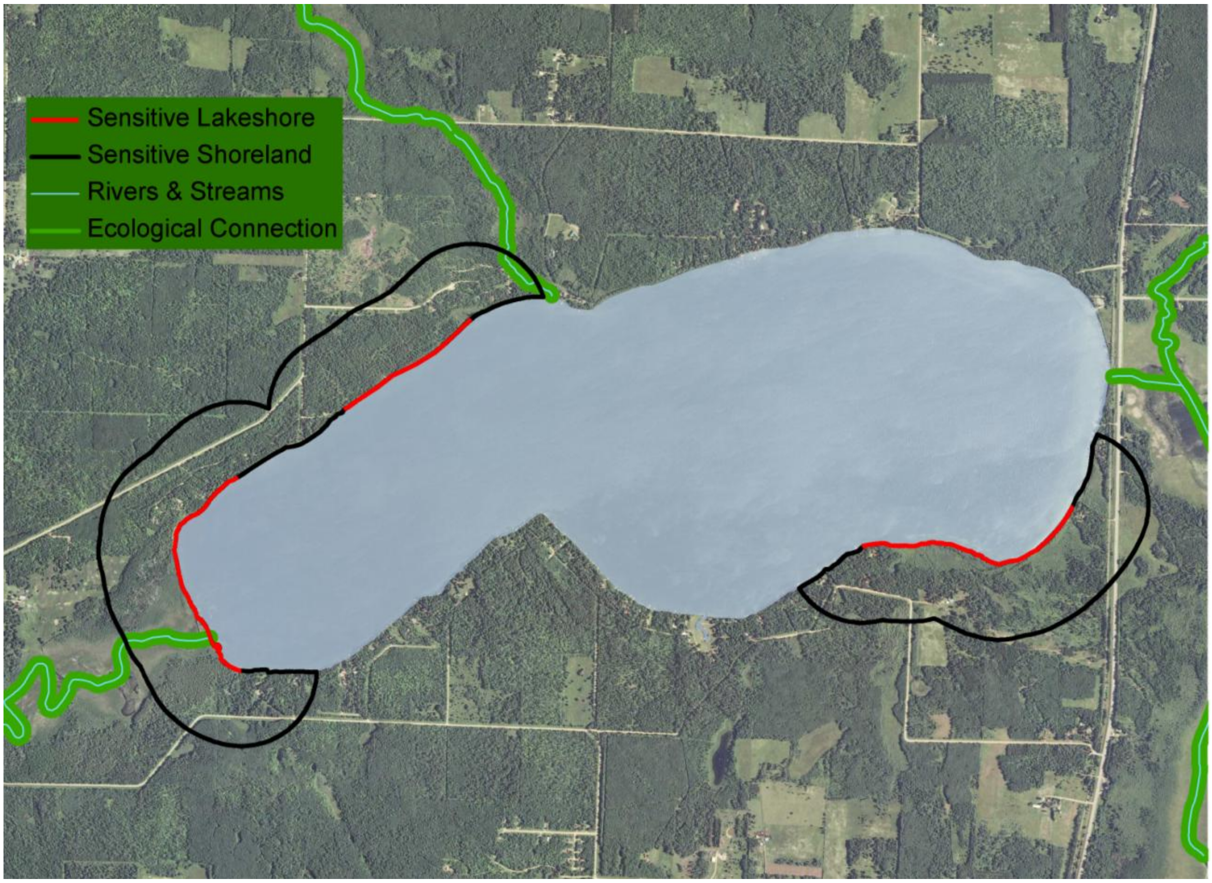


Figure 55. The sensitive lakeshore areas identified by the ecological model.



Habitat Connectivity

In addition to the sensitive shorelands identified through the GIS model, surveyors considered adjacent river shorelines that provide habitat connectivity to and from the lake shorelands. Aquatic habitat connectivity allows for the movement of aquatic organisms within a watershed, and the benefits are numerous. Organisms can move between existing habitats, colonize new areas, or recolonize former habitat in the wake of local extinctions. Connectivity allows organisms to move between multiple waterbodies and access various food sources. It allows animals with different vegetation requirements during different life stages to access those habitats. It allows movement of animals from various populations, increasing diversity. The inlets and outlet of Steamboat Lake were identified as important ecological connections. The west and north inlets are the primary wetland corridors into the lake. The outlet of Steamboat Lake connects to the Boy River and then to Leech Lake. Movement of fish and other species through these corridors is likely. Depending on the existing shoreland classification of these rivers and streams, the County may use the ecological connection recommendation to consider reclassifying to a more protective river class.

Other Areas of Ecological Significance

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

Emergent and floating-leaf plant beds that occur outside of the sensitive shoreland districts are areas of ecological significance. Extensive emergent aquatic plant stands occur in the lake and have already been fragmented by boat channels. Further destruction of bulrush plants would be particularly detrimental because attempts to restore these types of plants have had limited success.

Native submerged plant beds are also considered sites of ecological significance, regardless of whether or not they are associated with priority shorelines. Not only do these beds provide critical habitat for fish and wildlife, but they may also help mitigate the potentially harmful impacts if invasive plants occur in the lake.

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

Sensitive Lakeshore

Several stretches along the Steamboat Lake shore were identified as sensitive lakeshore. These areas provided critical habitat, such as wetlands. These areas also supported a great diversity of plant and wildlife species, including species of greatest conservation need. The ecological model displays these areas both as sensitive shoreline and as high priority shorelands. Although the shoreline itself is important, development and land alteration nearby may have significant negative effects on many species. Fragmented habitats often contain high numbers of invasive, non-native plants and animals that may 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 outlets of Steamboat Lake are also an important part of the lake ecosystem. They provide habitat connectivity between Steamboat Lake and nearby habitat. They allow movement of animals from various populations, increasing diversity. Habitat connectivity also allows animals with different vegetation requirements during different life stages to access those habitats. Protection of both the shoreline itself and the habitat surrounding the shoreline will be the most effective way to preserve the plant and animal communities in and around Steamboat Lake, and the value of the lake itself.

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

Description	Common Name	Scientific Name	Survey type
SHORELINE EMERGENT	Jewelweed	*Impatiens capensis*	1
	Water horehound	*Lycopus uniflorus*	1
	Reed canary grass	*Phalaris arundinaceae* (I)	1, 2
SHORELINE SHRUBS	Balsam fir	*Abies balsamea*	1
	Paper birch	*Betula papyrifera*	1
	Red-osier dogwood	*Cornus sericea*	1
	Ash	*Fraxinus* sp.	1
	Black spruce	*Picea mariana*	1
	Willow	*Salix* sp.	2
	White cedar	*Thuja occidentalis*	1
	Elm	*Ulmus* sp.	1
UPLAND FORBS	Canada anemone	*Anemone canadensis*	1
	Wild sarsaparilla	*Aralia nudicaulis*	1
	Large-leaf aster	*Eurybia macrophylla*	1
	Pennsylvania sedge	*Carex pensylvanica*	1
	Upland sedge	*Carex* sp.	1
	Horsetail	*Equisetum* sp.	1
	Wild pea	*Lathyrus venosus*	1
	Canada mayflower	*Maianthemum canadense*	1
	Bluegrass	*Poa* sp.	1
	Hair-capped moss	*Polytrichum* sp.	1
	Dandelion (I)	*Taraxacum* sp. (I)	1
	Early meadow rue	*Thallictricum dioicum*	1
	Stinging nettle	*Urtica dioica*	1

1. Perleberg, D. and Loso, S. August 27, 2008 (nearshore vegetation plots)
2. Myhre, K. July 9, 2008 (Minnesota County Biological Survey)

Nomenclature follows MNTaxa 2009.

I = introduced in Minnesota

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

Common Name	Scientific Name
Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Common Goldeneye	*Bucephala clangula*
Common Loon	*Gavia immer*
Horned Grebe	*Podiceps auritus*
American White Pelican	*Pelecanus erythrorhynchos*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Merlin	*Falco columbarius*
Sandhill Crane	*Grus canadensis*
Ring-billed Gull	*Larus delawarensis*
Caspian Tern	*Hydroprogne caspia*
Common Tern	*Sterna hirundo*
Mourning Dove	*Zenaida macroura*
Belted Kingfisher	*Megaceryle alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Wood-Pewee	*Contopus virens*
Alder Flycatcher	*Empidonax alnorum*
Eastern Phoebe	*Sayornis phoebe*
Great Crested Flycatcher	*Myiarchus crinitus*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*
Tree Swallow	*Tachycineta bicolor*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapilla*
White-breasted Nuthatch	*Sitta carolinensis*
House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes troglodytes*
Sedge Wren	*Cistothorus platensis*
Eastern Bluebird	*Sialia sialis*
Veery	*Catharus fuscescens*
American Robin	*Turdus migratorius*
Gray Catbird	*Dumetella carolinensis*
European Starling	*Sturnus vulgaris*
Cedar Waxwing	*Bombycilla cedrorum*
Golden-winged Warbler	*Vermivora chrysoptera*

Appendix 2, continued.

Common Name	**Scientific Name**
Yellow Warbler	*Dendroica petechia*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Pine Warbler	*Dendroica pinus*
Black-and-white Warbler	*Mniotilta varia*
American Redstart	*Setophata ruticilla*
Ovenbird	*Seiurus aurocapillus*
Northern Waterthrush	*Seiurus noveboracensis*
Common Yellowthroat	*Geothlypis trichas*
Chipping Sparrow	*Spizella passerina*
Song Sparrow	*Melospiza melodia*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
Northern Cardinal	*Cardinalis cardinalis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Red-winged Blackbird	*Agelaius phoeniceus*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Baltimore Oriole	*Icterus galbula*
American Goldfinch	*Spinus tristis*