Final Report
Sensitive Lakeshore Survey
Washburn Lake (11-0059-00)
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 Lakeshores Project

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

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Executive Summary

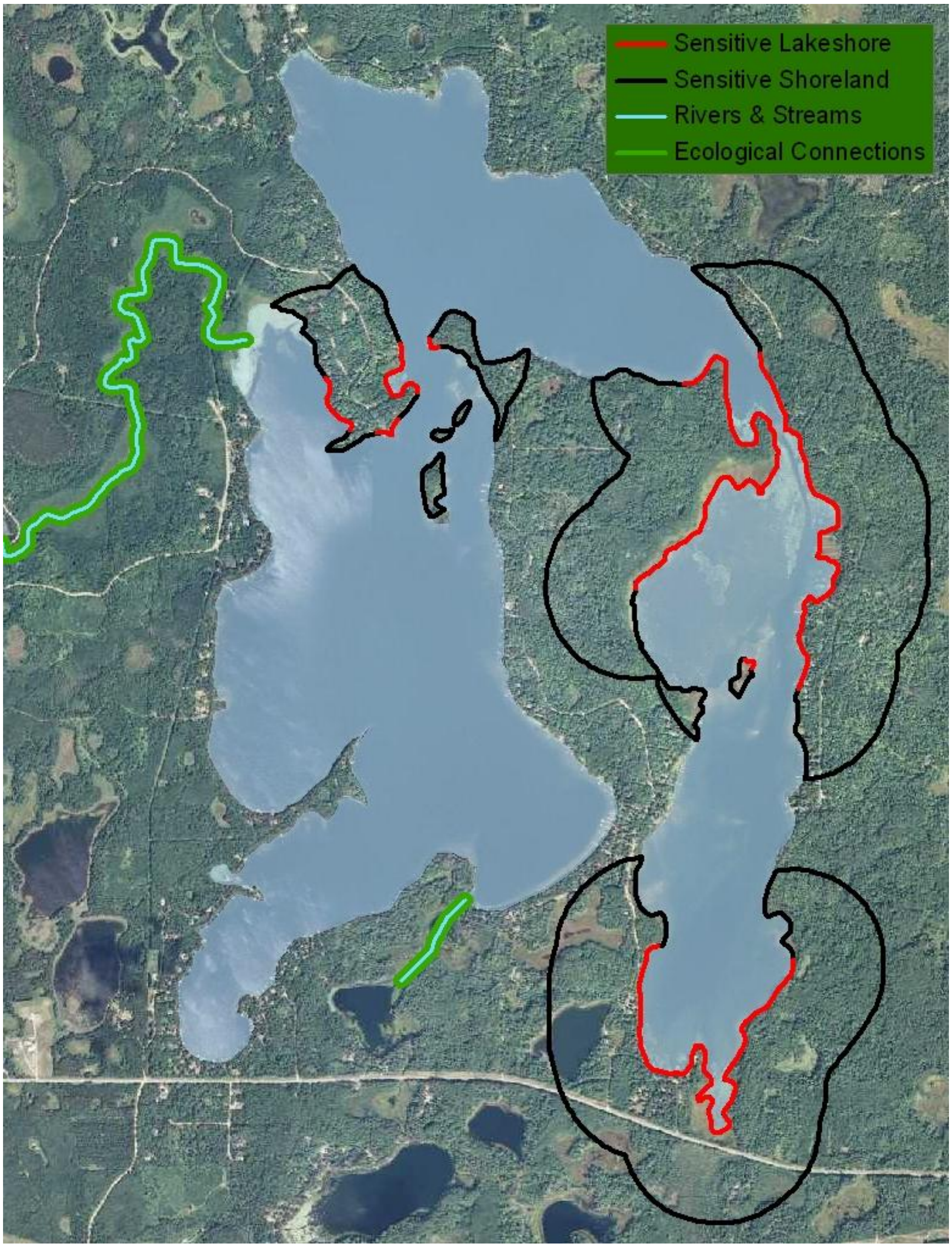
Aquatic plants occurred around the entire perimeter of Washburn Lake. Plant surveyors recorded a total of 58 native aquatic plant taxa, including 31 submerged, three free-floating, five floating-leaf, and 19 emergent taxa. In addition, they recorded more than 45 shoreline plant taxa. Eight unique and two rare (Special Concern) aquatic plant species were documented in the lake. Submerged plants were most common in the shore to 15 feet depth zone. Common submerged plants included muskgrass, bushy pondweed, wild celery, coontail, watermilfoils, and broad and narrow-leaf pondweeds. Emergent and floating-leaf plants covered more than 180 acres and included bulrush, wild rice and waterlilies. The non-native Eurasian watermilfoil (*Myriophyllum spicatum*) was documented for the first time in the lake in 2009 but was present in less than one percent of the sample sites.

Bird surveyors documented 80 bird species at Washburn Lake, including 16 species of greatest conservation need. The ovenbird, found at nearly 40% of the survey stations, was the most commonly recorded species of greatest conservation need. The veery was recorded at 25% of the stations surveyed. Overall, song sparrows were the most commonly detected bird species at Washburn Lake, followed by red-eyed vireos, yellow warblers, American robins, and common yellowthroats.

Although no near-shore fish species of greatest conservation need were detected during the Washburn Lake nongame fish surveys, surveyors did record one offshore-dwelling species of greatest conservation need, the greater redhorse. Blackchin shiners, blacknose shiners and banded killifish were documented within the lake. These fish species are proxy species for the species of greatest conservation need. Bluegills, found at 97% of the survey stations, were the most commonly documented species. Overall, surveyors identified 30 fish species, including eight species previously unrecorded in Washburn Lake. These species were blackchin shiner, blacknose shiner, central mudminnow, golden shiner, greater redhorse, Iowa darter, mottled sculpin, and tadpole madtom. The addition of these species brings the total observed fish community in Washburn Lake to 34 species. Both mink frogs and green frogs were documented during the Washburn Lake frog surveys.

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 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 Washburn Lake sensitive lakeshore areas.

Lake Description

Washburn Lake is located about three miles northwest of the town of Outing, in Cass County, Minnesota (Figure 1).

Washburn Lake is located near the top of the Pine River Major Watershed. The land use in the watershed is mostly forest and wetlands with many lakes. Daggett Brook flows south from Island and George Lakes into the west bay of Washburn Lake and then outlets Washburn Lake at the south end (Figure 2). Flow continues south through Daggett Brook and eventually enters the Mississippi River at the south end of the watershed.

Washburn Lake has a surface area of 1554 acres and is composed of three distinct but connected basins (Figure 2). The west basin is the largest in area (807 acres) with a maximum depth of 111 feet; the north basin is 456 acres in area with a maximum depth of 81 feet; and the eastern basin is the smallest (389 acres) and shallowest with a maximum depth of only 23 feet (Figure 3; Lindon and Heiskary 2005). Small islands are located in the west and east basins.

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

The shoreline of Washburn Lake is mostly developed with residential homes. Shorelines that remain undeveloped are mostly wetlands and/or lands within public ownership. A public access is located at the south end of the east basin within the Land O'Lakes State Forest.

Washburn Lake is described as a mesotrophic lake, or a lake with moderate levels of nutrient enrichment (MPCA 2009). The average Secchi depth (which measures water transparency) between 1990 and 2008 was about 12 feet, indicating moderate water clarity (MPCA 2009).

Figure 2. Features of Washburn Lake.

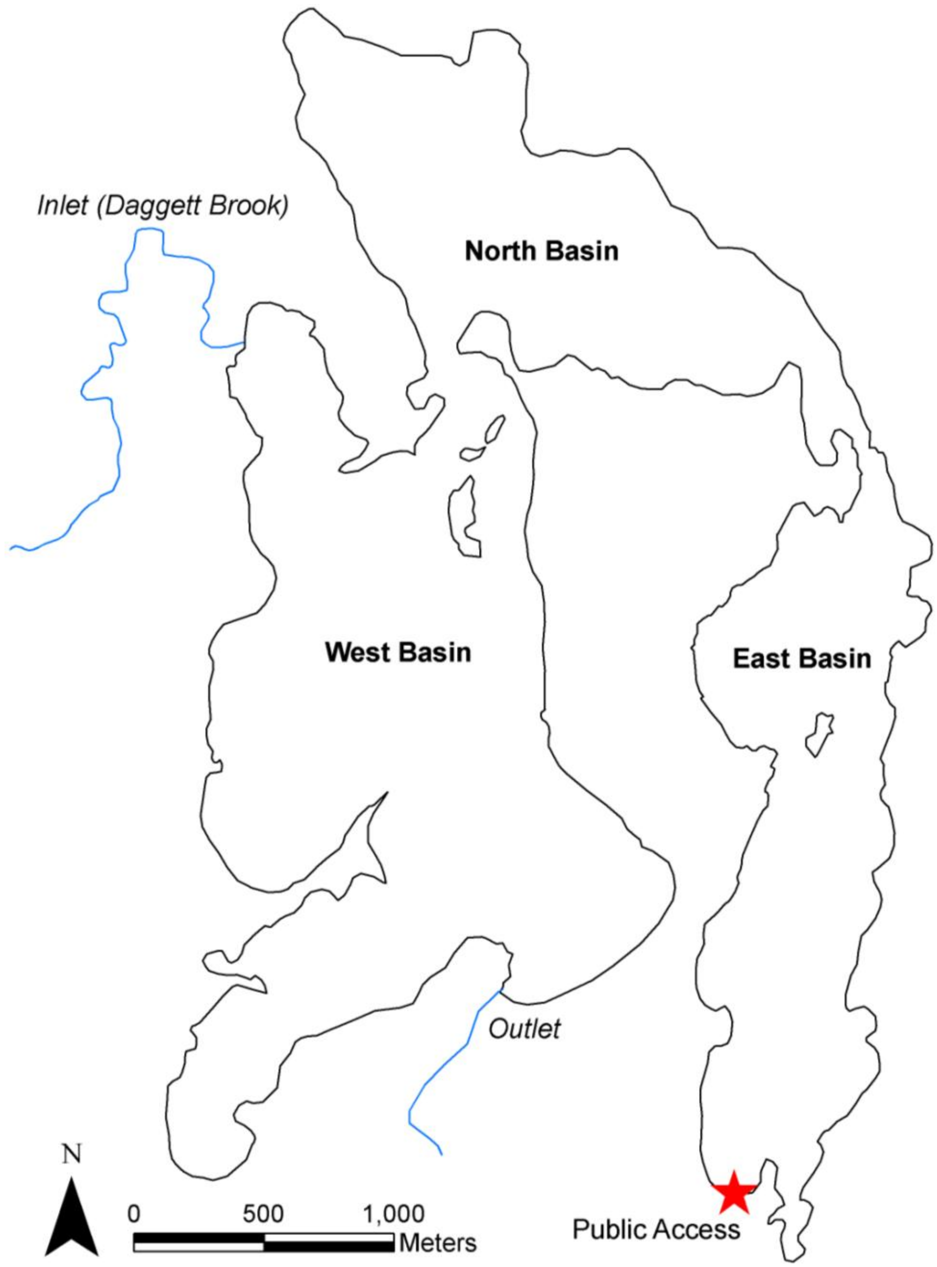
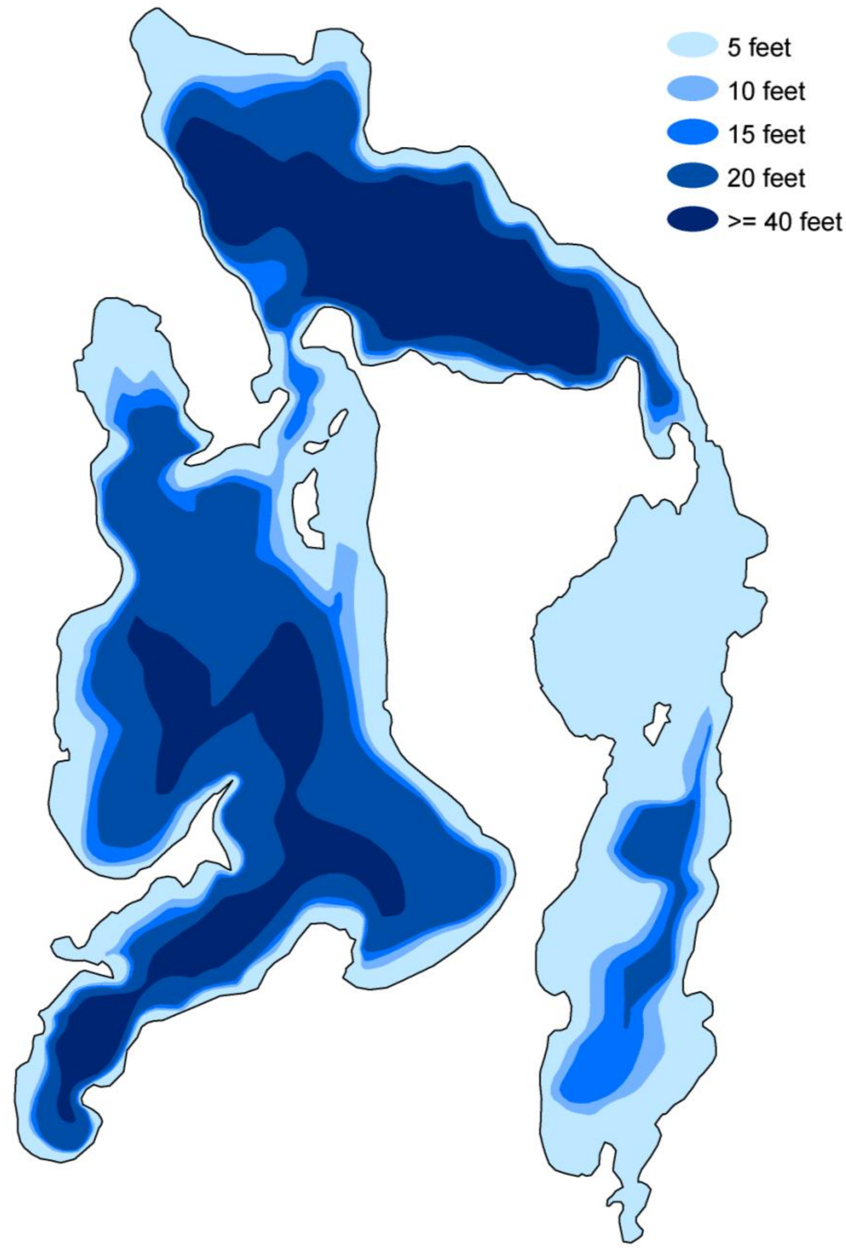


Figure 3. Depth contours of Washburn Lake.



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 Washburn 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 Geographic Information System (GIS) computer program. Only wetlands occurring within the extended state-defined shoreland area (i.e., within 1320 feet of the shoreline) were considered in this project. Wetlands classified as lacustrine or occurring lakeward of the Washburn Lake ordinary high water mark were excluded from this analysis.

Results

Approximately 350 acres, or slightly over 15%, of the Washburn Lake shoreland area (the area within 1320 feet of the shoreline) are described as wetlands by NWI. Wetlands occurred along much of the shoreline, but the largest complexes were at the northern end of the lake and along the southern edge of the east basin (Figure 4). The dominant wetland types included emergent wetland, characterized by herbaceous, emergent wetland vegetation; scrub-shrub systems, dominated by deciduous or evergreen shrubs; and forested wetlands with deciduous or evergreen trees (Cowardin et al. 1979). The water regime varied among wetlands, and included saturated, seasonally flooded, and semi-permanently flooded soils.

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

Hydric Soils

Objective

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

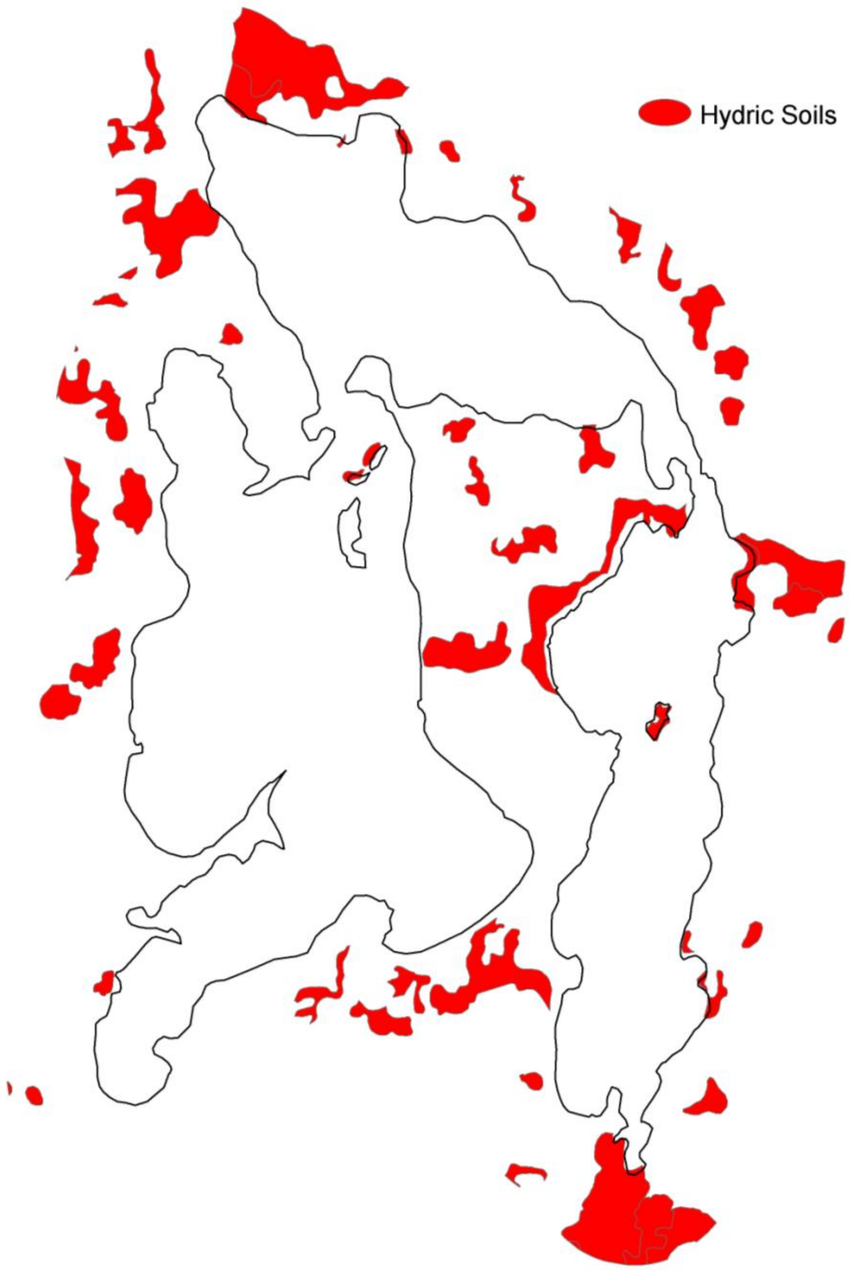
Methods

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

Like the wetlands, hydric soils occurred in the largest quantities at the northern edge of the lake and at the southern tip of the east basin (Figure 5). Approximately 320 acres of hydric soils encompassed just under 15% of the Washburn Lake shoreland district. Soil types included loamy sand, muck, and peat, and ranged from poorly drained to very poorly drained. Most of these soils also had a very high organic matter content.

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



Plant Surveys

Objectives

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

Summary

Fifty-eight native aquatic plant taxa were found in the lake, including 31 submerged, three free-floating, five floating-leaved and 19 emergent taxa. An additional 47 shoreline emergent plants were recorded.

Aquatic plants occurred around the entire perimeter of Washburn Lake and one plant was found to a depth of 24 feet. Plant occurrence was greatest in depths from shore to 15 feet, where 86% of the sites were vegetated in 2006 and 84% contained plants in 2009. Common submerged plants included muskgrass (*Chara* sp.), bushy pondweed (*Najas flexilis* and *N. guadalupensis*), flat-stem pondweed (*Potamogeton zosteriformis*), muskgrass (*Chara* sp.), wild celery (*Vallisneria americana*), coontail (*Ceratophyllum demersum*), northern watermilfoil (*Myriophyllum sibiricum*), Canada waterweed (*Elodea canadensis*) and broad and narrow-leaf pondweeds (*Potamogeton* spp.). The non-native Eurasian watermilfoil (*Myriophyllum spicatum*) was documented for the first time in the lake in 2009 but was present in less than one percent of the sample sites.

In the shore to five feet depth zone, 22% of the sample sites contained at least one emergent or floating-leaf plant. Floating-leaf plants, including white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), watershield (*Brasenia schreberi*), and floating-leaf pondweed (*Potamogeton natans*), occupied about 15 acres. About 68 acres of wild rice (*Zizania palustris*) and about 90 acres of bulrush (*Schoenoplectus* spp.) were mapped.

Eight unique aquatic plants were documented during the surveys. Submerged unique species were flat-leaved bladderwort (*Utricularia intermedia*), leaf-less watermilfoil (*Myriophyllum tenellum*), creeping spearwort (*Ranunculus flammula*), and water bulrush (*Schoenoplectus subterminalis*). Floating-leaf and emergent unique species were narrow-leaved burreed (*Sparganium angustifolium*), three-way sedge (*Dulichium arundinaceum*), wiregrass-woolly sedge (*Carex lasiocarpa*), and water arum (*Calla palustris*).

Two rare (Special Concern) emergent aquatic plants were recorded in Washburn Lake: few-flowered spikerush (*Eleocharis quinquiflora*) and twig-rush (*Cladium mariscoides*).

Introduction

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

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

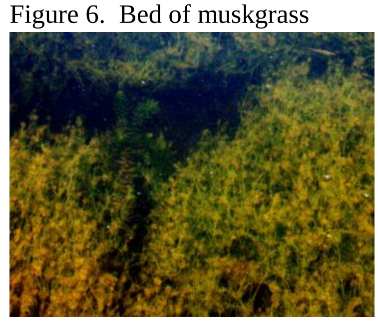
Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. Motorboat activity in vegetated areas can be particularly harmful for species such as bulrush, wild rice and waterlilies. Shoreline and watershed development can also indirectly influence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

Submerged plants

Submerged plants have leaves that grow below the water surface but some species also have the ability to form floating and/or emergent leaves, particularly in shallow, sheltered sites. Submerged plants may be firmly attached to the lake bottom by roots or rhizomes, or they may drift freely with the water current. This group includes non-flowering plants such as large algae, mosses, and fern-like plants, and flowering plants that may produce flowers above or below the water surface. Submerged plants may form low-growing mats or may grow several feet in the water column with leaf shapes that include broad ovals, long and grass-like, or finely dissected.

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

Figure 6. Bed of muskgrass



Bushy pondweed (*Najas flexilis*; Figure 7) is unusual because it is one of the few annual submerged species in Minnesota and must re-establish every year from seed. Bushy pondweed grows entirely below the water surface. It prefers hard substrates and is not tolerant of turbidity (Nichols 1999b). The seeds and foliage of this plant are an important duck food and beds of this plant provide good fish cover. Southern bushy pondweed (*Najas guadalupensis*) is closely related species to bushy pondweed and it can be difficult to distinguish the two species. Southern naiad is a perennial plant that grows low in the water column. The seeds and foliage of this plant are an important duck food and beds of this plant provide good fish cover.

Figure 7. Bushy pondweed

Canada waterweed (*Elodea canadensis*) is a rooted, perennial submerged species that is widespread throughout Minnesota (Ownbey and Morley 1991) and is adapted to a variety of conditions. It is tolerant of low light and prefers soft substrates (Nichols 1999b). This species can overwinter as an evergreen plant and spreads primarily by fragments. The branching stems of this plant (Figure 8) can form thick underwater plant beds that are valuable habitat for a variety of fish and invertebrates.

Figure 8. Canada waterweed

Photo by: Vic Ramey, U. of Florida

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 20 species of pondweeds in Minnesota and they vary in leaf shapes and sizes. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water.

Pondweeds can be grouped by their leaf shape. Ribbon-leaf pondweeds are plants with long, narrow, grass-like leaves. This group includes flat-stem pondweed (*Potamogeton zosteriformis),* Robbin's pondweed (*P. robbinsii;* Figure 9) and ribbon-leaf pondweed (*P. epihydrus*). Broad-leaf pondweeds are often referred to as "cabbage" by anglers and include Illinois pondweed (*P. illinoensis;* Figure 10), large-leaf pondweed (*P. amplifolius*), white-stem pondweed (*P. praelongus*) and clasping-leaf pondweed (*P. richardsonii*). Some broad-leaf pondweeds may also form floating leaves. Narrow-leaf pondweeds have very narrow, almost needle-width leaves. Sago pondweed (*Stuckenia pectinata;* Figure 11) is a narrow-leaf pondweed.

Figure 9. A ribbon-leaf (Robbin's) pondweed

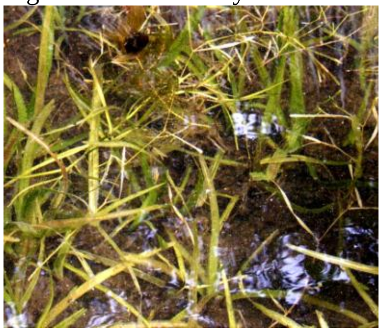
Figure 10. A broad-leaf (Illinois) pondweed

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

Figure 11. A narrow-leaf (Sago) pondweed

Wild celery (*Vallisneria americana*; Figure 12) is a rooted, perennial submerged plant that resembles ribbon-leaved pondweeds. Unlike the pondweeds that have branches of leaves, wild celery leaves all arise from the base of the plant. Beds of wild celery provide food and shelter for fish and all parts of the plant are consumed by waterfowl, shorebirds and muskrats (Borman et al. 1997). Wild celery is a particularly important food source for canvasback ducks (Varro 2003).

Figure 12. Wild celery



Some submerged aquatic plants have adapted to the underwater environment by forming finely divided leaves that provide less resistance to water currents. These leaves form an intricate network that provides habitat habitat for small invertebrates. Coontail and watermilfoils are examples of plants with finely divided leaves.

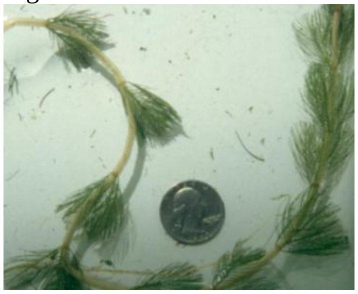
Figure 13. Coontail

Coontail (*Ceratophyllum demersum*; Figure 13) is the most common submerged flowering plant in Minnesota lakes. It grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. Coontail is a perennial and can over-winter as a green plant under the ice and then begins 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 14. Northern watermilfoil

Northern watermilfoil (*Myriophyllum sibiricum*; Figure 14) and whorled watermilfoil (*M. verticillatum*) are native, rooted, perennial submerged plants with finely divided, "feather-shaped" leaves. These plants may reach the water surface, particularly in depths less than ten feet and their flower stalks extend above the water surface. They spread primarily by stem fragments and overwinter by hardy rootstalks and winter buds. Native watermilfoils are not tolerant of turbidity and grow best in clear water lakes. These native plant provide fish shelter and insect habitat and the extensive root systems help stabilize near-shore substrates.

Figure 15. Eurasian watermilfoil



Eurasian watermilfoil (*Myriophyllum spicatum;* Figure 15) is not native to Minnesota and was first documented in the state in 1987 in Lake Minnetonka. Since then, it has spread to more than 200 waterbodies, including several northern Minnesota lakes. This plant is very similar in appearance and growth form to the native watermilfoils. In some lakes it may grow abundantly and may limit recreational activities and negatively impact native habitat. In 2009, it was first found in Washburn Lake.

Floating-leaf and emergent plants

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

Figure 16. White waterlily

Figure 17. Yellow waterlily

White and yellow waterlilies can be found in lakes in both northern and southern Minnesota. White waterlily (*Nymphaea odorata*; Figure 16) has showy white flowers and round leaves with radiating veins. Yellow waterlily (*Nuphar variegata*; Figure 17) has smaller yellow flowers and oblong leaves with parallel veins. These species often co-occur in mixed beds but yellow waterlily is generally restricted to depths less than seven feet and white waterlily may occur to depths of ten feet (Nichols 1999b).

Figure 18. Watershield

Watershield (*Brasenia schreberi*) is most often found in soft-water lakes (Borman et al. 2001) in northern Minnesota. It has relatively small, floating oval leaves and small reddish flowers (Figure 18). The leaves are green on top, while the underside of the leaves and stems are reddish-purple. The leaves and stems of watershield have a slippery, gelatinous coating.

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

Bulrushes (*Schoenoplectus* spp.) are emergent, narrow-leaved, perennial plants that occur in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). Bulrush stems are round in cross section and lack showy leaves (Figure 19). 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 19. Bulrush

Wild rice (*Zizania palustris*; Figure 20) is an emergent, grass-leaved, 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).

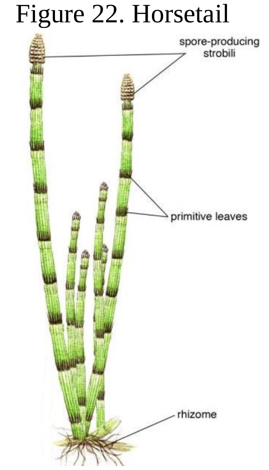
Figure 20. Wild rice

Arrowhead (*Sagittaria* spp.; Figure 21) are broad-leaf, perennial plants that may form emergent, floating and/or submerged leaves. These plants may be found submerged in several feet of water or growing emergent along shore and in wetlands. These plants form showy white flowers. Arrowhead seeds and tubers are valuable food for waterfowl and marsh birds and leaves and tubers may be eaten by muskrats (Newmaster et al. 1997).

Figure 21. Arrowhead

Horsetail (*Equisetum fluviatile*; Figure 22) is an emergent aquatic plant that resembles bulrush with slender stalks that extend out of the water. It is a primitive plant that does not form flowers but reproduces by spores. The stems are hollow, jointed, rough-textured and high in silica. These plants are also called "scouring rushes" because they were historically used for scouring, sanding and filing. Waterfowl feed on the rhizomes and stems of horsetail plants.

Figure 22. Horsetail



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.

Bladderworts (*Utricularia* spp.) are a group of submerged plants with finely divided leaves. They produce roots but do not firmly anchor to the lake bottom. Greater bladderwort (*U. vulgaris)* is found in lakes and ponds throughout Minnesota but several other species are much less common. Unique bladderwort species include flat-leaved bladderwort (*U. intermedia*). Bladderworts have specialized air bladders that regulate their position in the water column. They also act as "underwater Venus fly-traps" by catching and digesting small insects in the bladders. Bladderworts produce small but showy flowers (Figure 23) that emerge above the water surface. They prefer soft substrates (Nichols 1999b) but also float freely in the water column and may be found in protected areas such as waterlily beds. They are found in protected, shallow lake areas and have been documented at scattered locations throughout northern Minnesota (Ownbey and Morley 1991).

Figure 23. Bladderwort in flower

Leaf-less watermilfoil (*Myriophyllum tenellum*; Figure 24) is a low-growing submerged plant found in low alkalinity, low conductivity waters (Nichols 1999b). This plant prefers hard substrates like sand and gravel (Nichols 1999b). Leaf-less watermilfoil stems arise singly along buried rhizomes. Its leaves are very small scales or bumps on the stems. Flowers form if the tips rise above the water. Leaf-less watermilfoil provides habitat for panfish and shelter for small invertebrates. The network of rhizomes it produces is a good sediment stabilizer (Borman et al. 2001).

Figure 24. Leaf-less watermilfoil

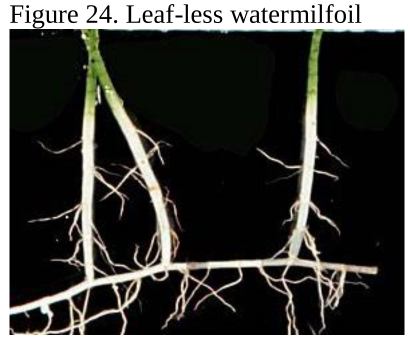


Photo by: Theodore Cochrane, U. of WI-Madison, Wisconsin State Herbarium

<u>Creeping spearwort</u> (*Ranunculus flammula;* Figure 25) occurs mainly on lakes in the northern half of Minnesota (Flora of North America 1993+). This plant is a member of the buttercup family and if stranded on mudflats, it may form characteristic yellow buttercup flowers. The submerged linear leaves emerge in small clusters from arched runners or stolons. This plant grows on hard substrates like sand and gravel (Borman et al. 2001). In Cass County lakes it often grows as a submerged plant but may grow as a short emergent on mudflats.

Figure 25. Creeping spearwort

Photo: Emmet J. Judziewicz, U W – Stevens Point & Madison, WI State Herbarium

<u>Water bulrush</u> (*Schoenoplectus subterminalis*) is a submerged, perennial plant with fine leaves that may form mats and float near the water surface (Figure 26). In mid to late summer its leaf tips and flower stalk may emerge above the water surface. This species once had a patchy distribution throughout North America but may now be extirpated from Illinois (Flora of North America 2007) and its conservation status is listed as critically impaired in several other states (NatureServe 2008). It is infrequently found in Wisconsin (Nichols 1999b) and Minnesota (Ownbey and Morley 1991) lakes.

Figure 26. Water bulrush

Photo by: D.W. Taylor. © 1996.

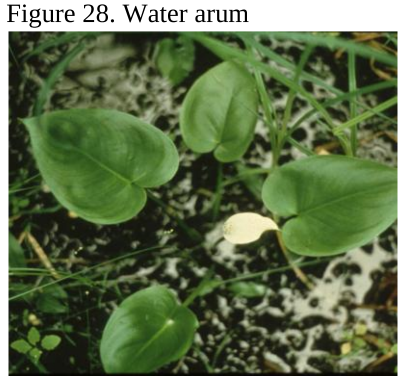
There are several species of burreed (*Sparganium* spp.) in Minnesota and the genus includes emergent and floating-leaf plants. <u>Narrow-leaved burreed</u> (*Sparganium angustifolium*) occurs in scattered lakes of northeastern Minnesota. In Wisconsin it has been documented along shores of low conductivity and low alkalinity lakes. This floating-leaf plant grows in water up to five feet deep (Nichols 1999b). The grass-like leaves are narrow and rounded on the tip (Borman et al. 2001). This plant produces flowers (Figure 27) in early summer and fruits in middle to late summer.

Figure 27. Narrow-leaved burreed

Photo: Emmet J. Judziewicz, U W – Stevens Point & Madison, WI State Herbarium

<u>Water arum</u> (*Calla palustris*; Figure 28) is an emergent, perennial wetland plant that may grow along marshy lakeshores as well as in wooded swamps, marshes and bogs (Nichols 1999b). The plant is recognizable by its heart-shaped leaves and the showy, white petal-like spathe. This is a species of northern latitudes and Minnesota is the southwestern limit (Flora of North America 2007). Within Minnesota, water arum primarily occurs in the northeast half of the state (Ownbey and Morley 1991).

Figure 28. Water arum



<u>Three-way sedge</u> (*Dulichium arundinaceum*; Figure 29) is an emergent, perennial plant that grows along soft bottom

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

Figure 29. Three-way sedge

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

Wiregrass-woolly sedge (*Carex lasiocarpa*; Figure 30) is an emergent, perennial plant that grows in small tufts with long scaly stolons. It is purplish-red at the base and is usually smooth. The leaves have no midvein and are usually roughened near the tip. The staminate scales are light reddish-brown, erect and can be sessile or subsessile. The pistillate scales are lanceolate and are purplish-brown with a green center. Wiregrass sedge can be found around sloughs and lake shorelines (Mohlenbrock 2005). It is found in northern and central Minnesota at scattered locations (Ownbey and Morley 1991).

Figure 30. Wiregrass-woolly sedge

Rare aquatic plants

Few-flowered spikerush (*Eleocharis quinqueflora*; Figure 31) is an emergent perennial plant that grows along lakeshores and river banks. This plant has slightly triangular flowering stems. The flowers are not showy and grow in a solitary spike. Spikerushes are very important food for waterfowl and muskrats (Newmaster et al. 1997). Few-flowered spikerush is found in scattered locations throughout northern Minnesota (Ownbey and Morley 1991).

Figure 31. Few-flowered spikerush

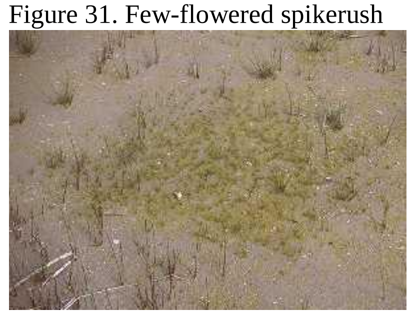


Photo: Emmet J. Judziewicz, Univ. of WI – Stevens Point and Madison, WI State Herbarium

Twig-rush (*Cladium mariscoides*; Figure 32) is an emergent spiky perennial plant that has smooth flowering stems. The flowers are branched and in long clusters of three to ten brown scaly spikelets. The fruits are oval achenes with lengthwise stripes. This plant grows in fens and on marshy lakeshores (Newmaster et al. 1997). Twig-rush is found in scattered locations in northern Minnesota (Ownbey and Morley 1991).

Figure 32. Twig-rush

Species richness

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

Between 2006 and 2009, the aquatic plant communities of Washburn Lake were described and measured using several techniques as found in Minnesota's Sensitive Lakeshore Identification Manual. Plant nomenclature follows MNTaxa 2009.

Grid point-intercept survey

A grid point-intercept survey was conducted in Washburn Lake on July 26, 27, 31 and August 1-3, 2006 (Perleberg 2006) and was repeated on July 20, 21, 27, 30 and August 3, 2009. 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 703 sites were sampled within the shore to 20 feet depth interval. An additional 26 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. Frequency was calculated using only the survey sites that were surveyed in both 2006 and 2009. Surveyors navigated to each site using a handheld Global Positioning (GPS) unit. At each sample site, water depth was measured and all vegetation within a one-meter squared area was sampled using a double-headed garden rake. All aquatic plant species present within the sample plot were recorded and frequency of occurrence was calculated for each species. Any additional species found outside the sample plots were recorded as present in the lake. Voucher specimens were collected for most species and were submitted to The Herbarium of the University of Minnesota Bell Museum of Natural History, St. Paul, MN.

Emergent and floating-leaf bed delineation

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

Near-shore vegetation survey

Near-shore vegetation surveys were conducted at four 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 Washburn 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 Washburn Lake.

Surveyors searched for unique and rare plant species in 2006 and 2009 during the lakewide point-intercept surveys and in 2007 during the near-shore plot surveys. A targeted search for rare aquatic vascular plants was conducted by the Minnesota County Biological Survey Program on July 23, 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 was recorded.

If unique or rare plant species were located, surveyors recorded the site location, the plant species found, associated plant species, approximate water depth and substrate type. When necessary, plant specimens were sent to the authority in the field for identification verification and annotation. Voucher specimens were made to document new locations of rare species, county records and some other species and were submitted to The Herbarium of the University of Minnesota Bell Museum of Natural History, St. Paul, MN. Data for rare plant species were entered into the Rare Features Database of the MN DNR Natural Heritage Information System.

Results

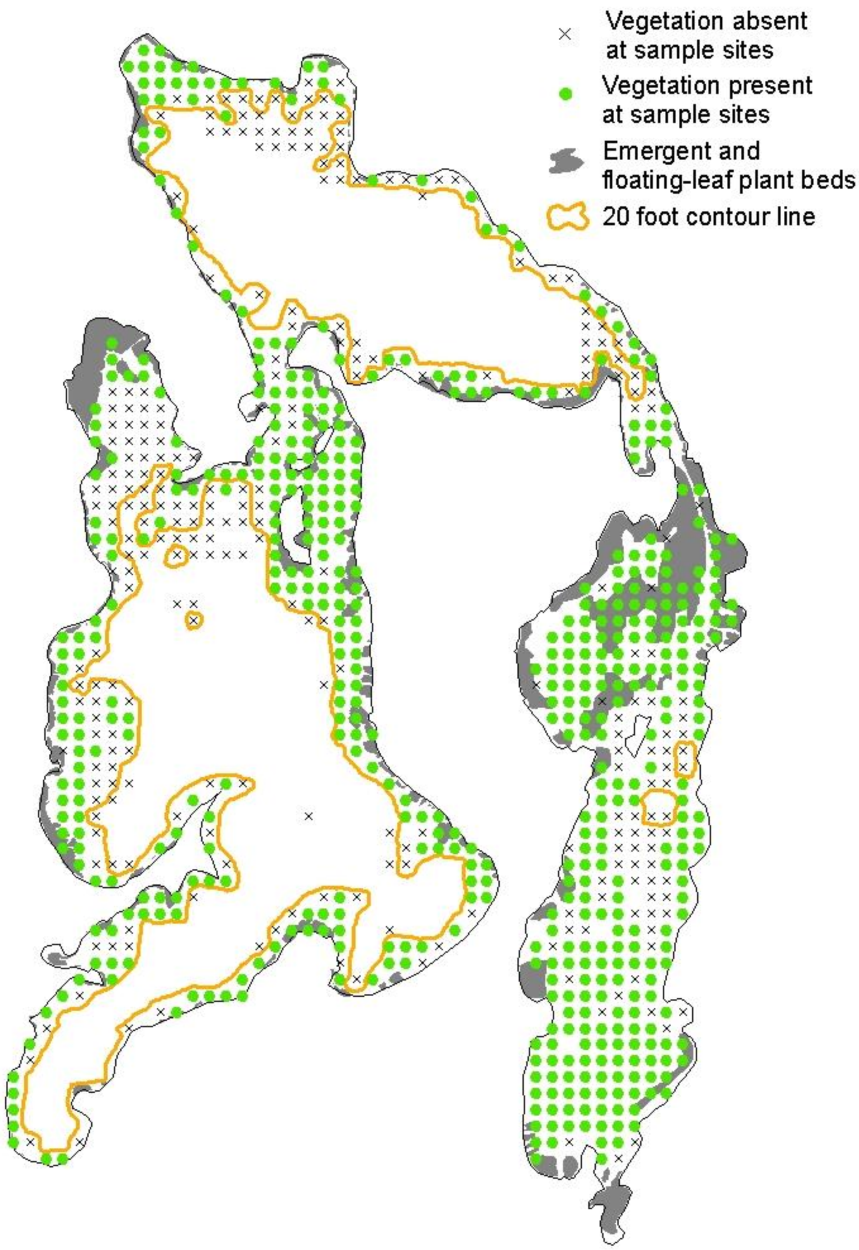
Distribution of plants by water depth

The percent of sites with vegetation was greatest in the depth zone from shore to 15 feet. Within this zone, plants occurred in 86% of the sample sites in 2006 and in 84% of the sites in 2009. In 2006, one submerged plant was found in 24 feet of water (Figure 33), but beyond 15 feet, plant growth was sparse. In water depths of 16 to 20 feet, the percent of sites containing vegetation was three percent in 2006 and six percent in 2009.

Distribution of plants in main basin versus bays

Aquatic plants occurred around the entire lake perimeter and were most extensive in the eastern basin where vegetation extended across most of the basin. Most bays contained beds of emergent and floating-leaved plants.

Figure 33. Aquatic plant distribution in Washburn Lake, 2006.



Aquatic plant species observed

A total of 58 native aquatic plant taxa were recorded in Washburn Lake. These included 31 submerged (Table 1), three free-floating, five floating-leaf and 19 emergent taxa (Table 2). Several species that can be difficult to distinguish in the field were grouped together for analysis. One non-native submerged species, Eurasian watermilfoil (*Myriophyllum spicatum*), was documented during the 2009 survey. An additional 47 shoreline emergent plants were recorded (Appendix 1).

Table 1. Submerged and free-floating aquatic plants recorded in Washburn Lake, 2006 – 2009.

Description			Common name	Scientific name	Frequency[a] 2006	Frequency[a] 2009
Non-flowering	Large algae		Muskgrass	*Chara* sp.	20	18
			Stonewort	*Nitella* sp.	2	2
	Fern relative		Quillwort	*Isoetes* sp.	1	<1
	Moss		Watermoss	Not identified to genus	<1	0
Flowering plants	Small, entire-leaved plants		Bushy pondweed	*Najas flexilis*[b]	29	19
			Southern naiad	*Najas guadalupensis*[b]		
			Canada waterweed	*Elodea canadensis*	11	14
	Pondweeds	Ribbon-leaved	Flat-stem pondweed	*Potamogeton zosteriformis*	25	20
			Robbin's pondweed	*Potamogeton robbinsii*	11	12
			Ribbon-leaf pondweed	*Potamogeton epihydrus*	X[c]	0
		Fine-leaved	Fries' pondweed	*Potamogeton friesii*[b]	10	9
			Leafy pondweed	*Potamogeton foliosus*[b]		
			Straight-leaved pondweed	*Potamogeton strictifolius*[b]		
			Sago pondweed	*Stuckenia pectinata*	1	<1
		Broad-leaved	Illinois pondweed	*Potamogeton illinoensis*	9	7
			Variable pondweed	*Potamogeton gramineus*	8	5
			Clasping-leaf pondweed	*Potamogeton richardsonii*	6	3
			White-stem pondweed	*Potamogeton praelongus*	6	9
			Large-leaf pondweed	*Potamogeton amplifolius*	5	3
	Other ribbon-leaved plants		Wild celery	*Vallisneria americana*	18	13
			Water stargrass	*Zosterella dubia*	2	1
	Divided-leaved plants		Coontail	*Ceratophyllum demersum*	14	15
			Northern watermilfoil	*Myriophyllum sibiricum*[b]	12	21
			Whorled watermilfoil	*Myriophyllum verticillatum*[b]		
			Eurasian watermilfoil	*Myriophyllum spicatum*	0	<1
			Water marigold	*Bidens beckii*	7	8
			White water buttercup	*Ranunculus aquatilis*	<1	1
			Greater bladderwort	*Utricularia vulgaris*	<1	1
			Flat-leaved bladderwort	*Utricularia intermedia*	X[c]	<1
	Needle-leaved plants		Creeping spearwort	*Ranunculus flammula*	<1	1
			Leafless watermilfoil	*Myriophyllum tenellum*	<1	1
			Water bulrush	*Schoenoplectus subterminalis*	X[c]	X[d]
Free-floating			Star duckweed	*Lemna trisulca*	<1	<1
			Lesser duckweed	*Lemna minor*	<1	<1
			Greater duckweed	*Spirodela polyhriza*	0	<1

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations. They represent the percent of the sample stations within the shore to 20 feet depth zone (N = 703) that contained a plant taxon.

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

X[c] = located only during Minnesota County Biological Survey, 23 July 2008 (not found during the 2006 survey)

X[d] = located during the 2009 point-intercept survey but only found outside of sample points.

Table 2. Floating-leaf and emergent aquatic plants recorded in Washburn Lake, 2006 – 2009.

Description		Common Name	Scientific Name	Frequency[a] 2006	Frequency[a] 2009
Floating-leaf		White waterlily	*Nymphaea odorata*	3	3
		Watershield	*Brasenia schreberi*	2	4
		Yellow waterlily	*Nuphar variegata*	1	2
		Floating-leaf pondweed	*Potamogeton natans*	1	1
		Floating-leaved burreed	*Sparganium angustifolium*	X[d]	<1
Emergent	Narrow-leaved	Hard-stem bulrush	*Schoenoplectus acutus*[b]	8	9
		Soft-stem bulrush	*Schoenoplectus tabernaemontani*[b]		
		Three-square bulrush	*Schoenoplectus pungens*	<1	1
		River bulrush	*Bolboschoenus fluviatilis*	X[c]	0
		Needlegrass	*Eleocharis acicularis*	3	1
		Spikerush	*Eleocharis palustris*	1	3
		Swamp horsetail	*Equisetum fluviatile*	<1	<1
		Twig-rush	*Cladium mariscoides*	X[d]	0
		Brown-fruited rush	*Juncus pelocarpus*	X[d]	0
	Grass-leaved	Wild rice	*Zizania palustris*	5	5
		Three-way sedge	*Dulichium arundinaceum*	X[c]	<1
		Giant cane	*Phragmites australis*	X[c]	0
		Narrow-leaved burreed	*Sparganium angustifolium*	X[d]	0
		Narrow-leaved cattail	*Typha angustifolia*	X[c]	0
		Giant burreed	*Sparganium eurycarpum*	0	<1
		Cattail	*Typha* sp.	0	<1
		Narrow-leaved sedge	*Carex* sp.	0	<1
	Broad-leaved	Broad-leaved arrowhead	*Sagittaria latifolia*	6	6
		Water arum	*Calla palustris*	X[c]	0

[a]Frequency values are provided for taxa that were observed within point-intercept survey sample stations. They represent the percent of the sample stations within the shore to 20 feet depth zone (N = 703) that contained a plant taxon.

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

X[c]= located during 2006 survey but not found within sample sites

X[d]= located only during Minnesota County Biological Survey, 23 July 2008 (not found during the 2006 survey)

Submerged plants

The plant community included leafy plants that are anchored to the lake bottom by roots as well as large algae that may resemble leafy plants but are weakly anchored to the lake bottom.

Low-growing plants were common in Washburn Lake and included bushy pondweeds and muskgrass. Bushy pondweeds (*Najas flexilis* and *N. guadalupensis*) were present in 29% of all sample sites and muskgrass occurred in 20% of the sites (Table 1). These plants were widespread around the shoreline and often occurred together (Figure 34A, C). They occurred most frequently in water depths of ten feet and less. Flat-stem pondweed was the most abundant pondweed found in Washburn Lake. It was found in 25% of all sample sites. Flat-stem pondweed was the dominant plant in the six to ten feet depth zone and was one of only a few species to occur in depths greater than 15 feet. This plant was common in all three basins of Washburn Lake (Figure 34B). Wild celery, found at 18% of the sites, occurred most frequently in the east and west lake basins. It was found at scattered locations in the north basin (Figure 34D).

Coontail was recorded in 14% of the Washburn Lake survey sites, primarily in the north and west basins (Figure 35A). Northern watermilfoil, broad-leaf pondweeds and Canada waterweed are other important aquatic plant species found in Washburn Lake (Figure 35B-D).

Figure 34. Distribution of common aquatic plants in Washburn Lake, 2006.

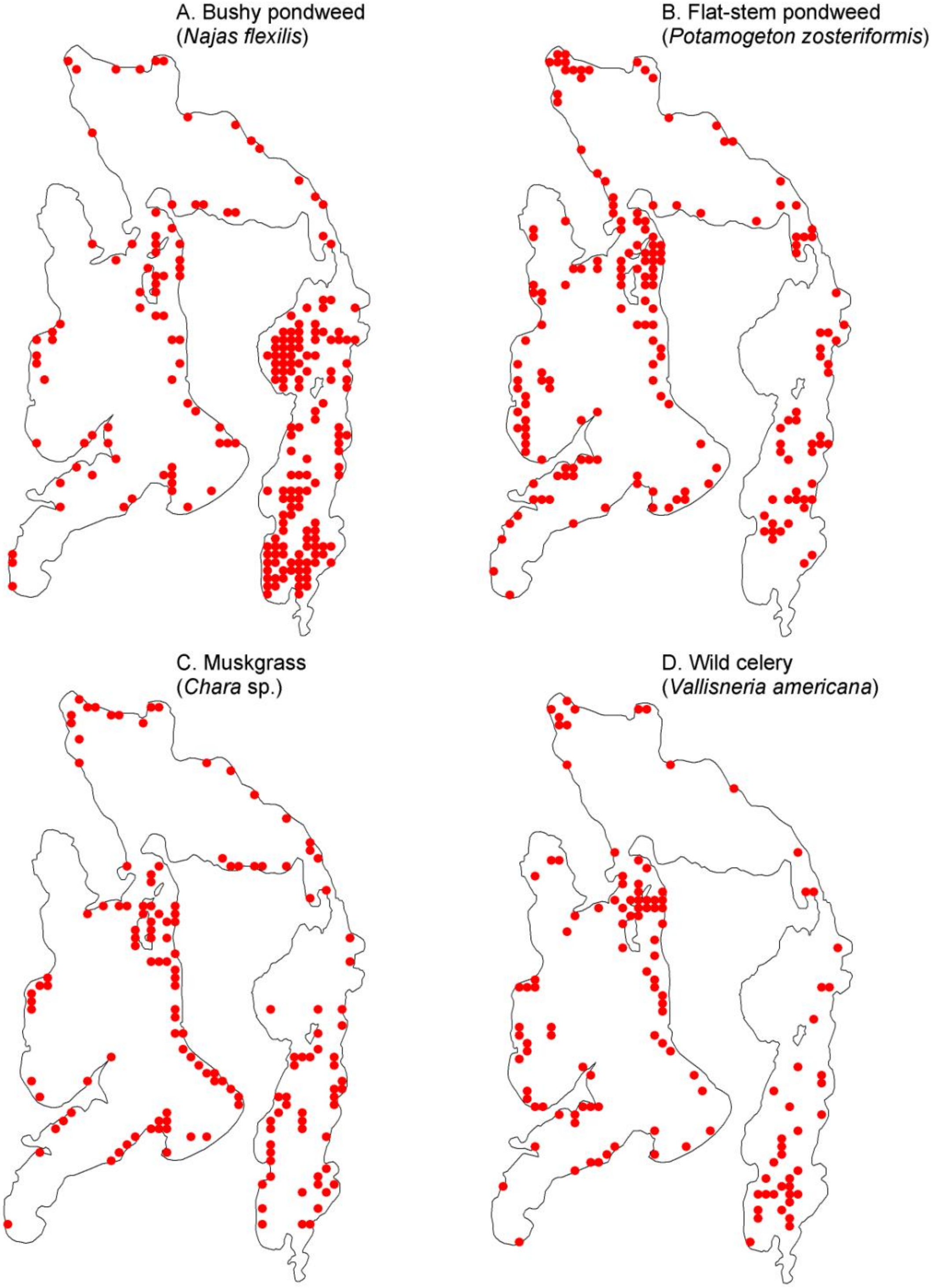
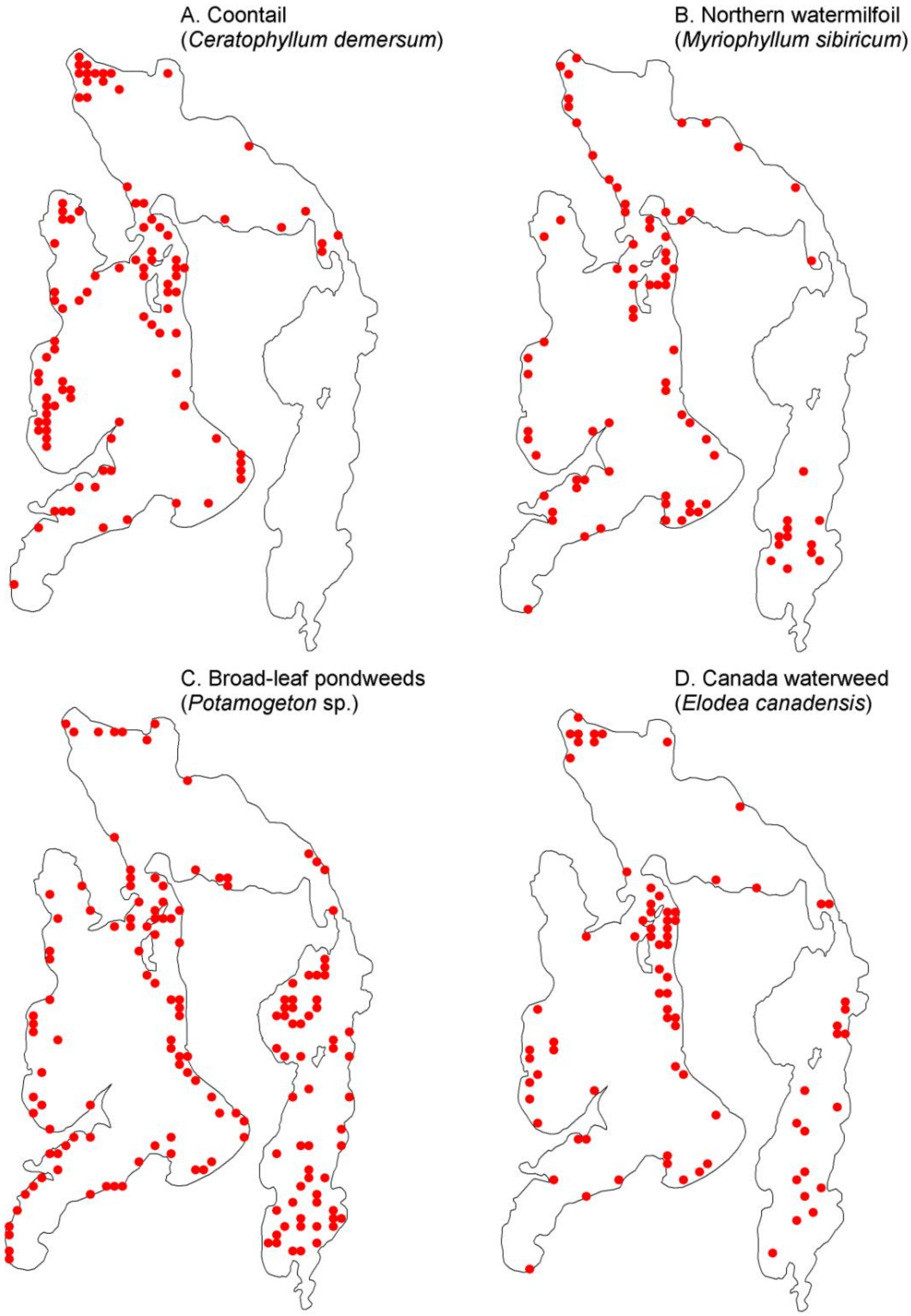


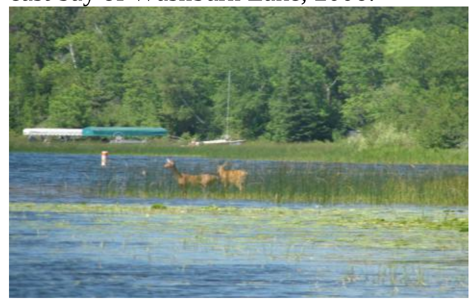
Figure 35. Distribution of common aquatic plants in Washburn Lake, 2006.



Floating-leaf and emergent plants

Floating-leaf and emergent plants occurred in water depths of eight feet and less. About 15 acres of floating-leaf plant beds were mapped and the largest beds occurred along the protected, shallow shores of the south shorelines of the east bay (Figure 36).

Figure 37. Waterlilies and bulrush in the east bay of Washburn Lake, 2006.



The most common floating-leaf plant species were white waterlily, yellow waterlily, watershield, and floating-leaf pondweed. Because surveyors avoided motoring into floating-leaf plant beds, the frequency values obtained for these taxa (Table 2) were lower than the actual lakewide occurrence. Frequency values for floating-leaf taxa represent the occurrence of these taxa only within the sites that were surveyed. Waterlily beds often contained scattered bulrush plants as well as submerged plants (Figure 37) and were usually associated with muck sediments.

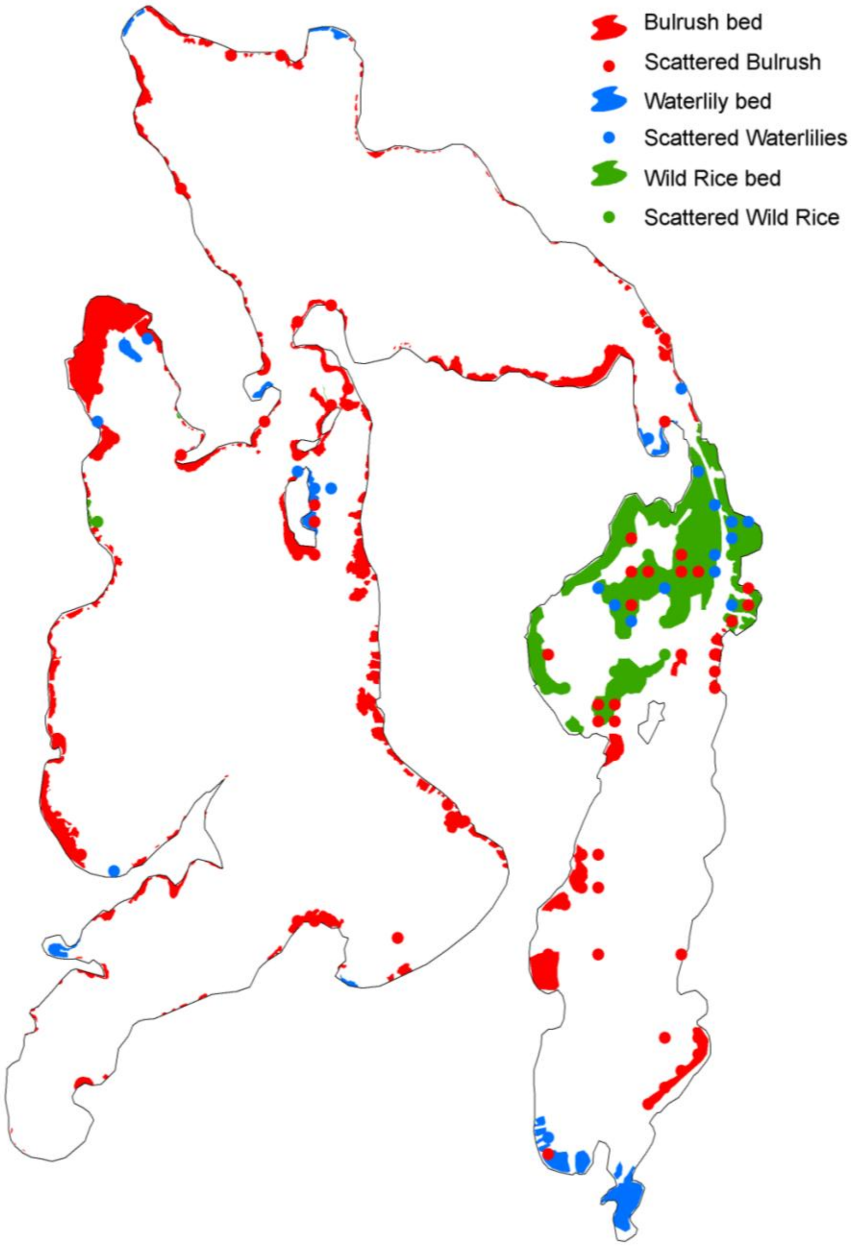
Figure 38. Wild rice in Washburn Lake, 2006.

Surveyors delineated approximately 171 acres of emergent plants and the most common taxa were wild rice (Figure 38) and bulrush. About 68 acres of mixed wild rice were mapped in silt substrates along the channel from the east basin to the north basin. About 90 acres of bulrush and mixed bulrush were mapped.

Figure 39. Horsetail bed in Washburn Lake, 2006.

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

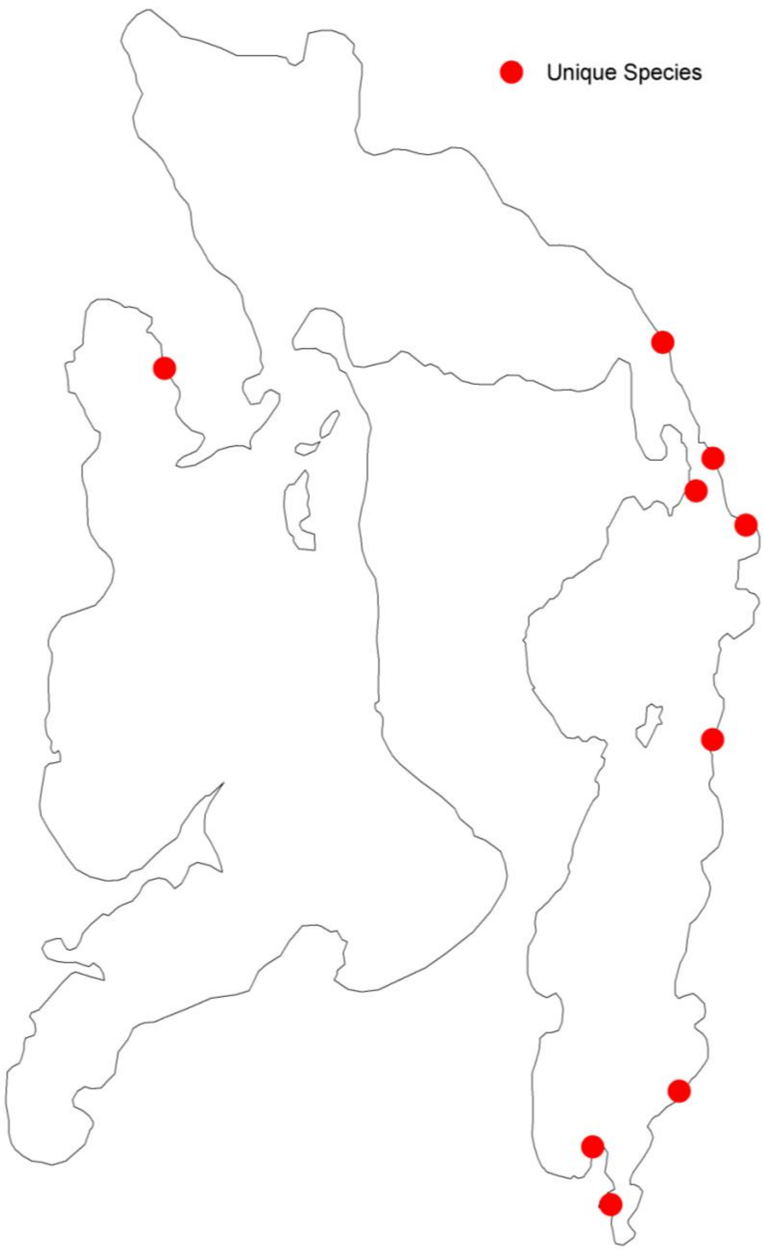
Figure 36. Distribution of floating-leaf and emergent plant beds in Wasburn Lake.



Unique plants

In addition to the commonly occurring plants in Washburn Lake, eight unique plant species were found at nine locations during the survey (Figure 40). Unique submerged aquatic plants found in Washburn Lake included flat-leaved bladderwort, leaf-less watermilfoil, creeping spearwort, and water bulrush. Unique floating-leaf and emergent plants were narrow-leaved burreed, three-way sedge, wiregrass-woolly sedge, and water arum.

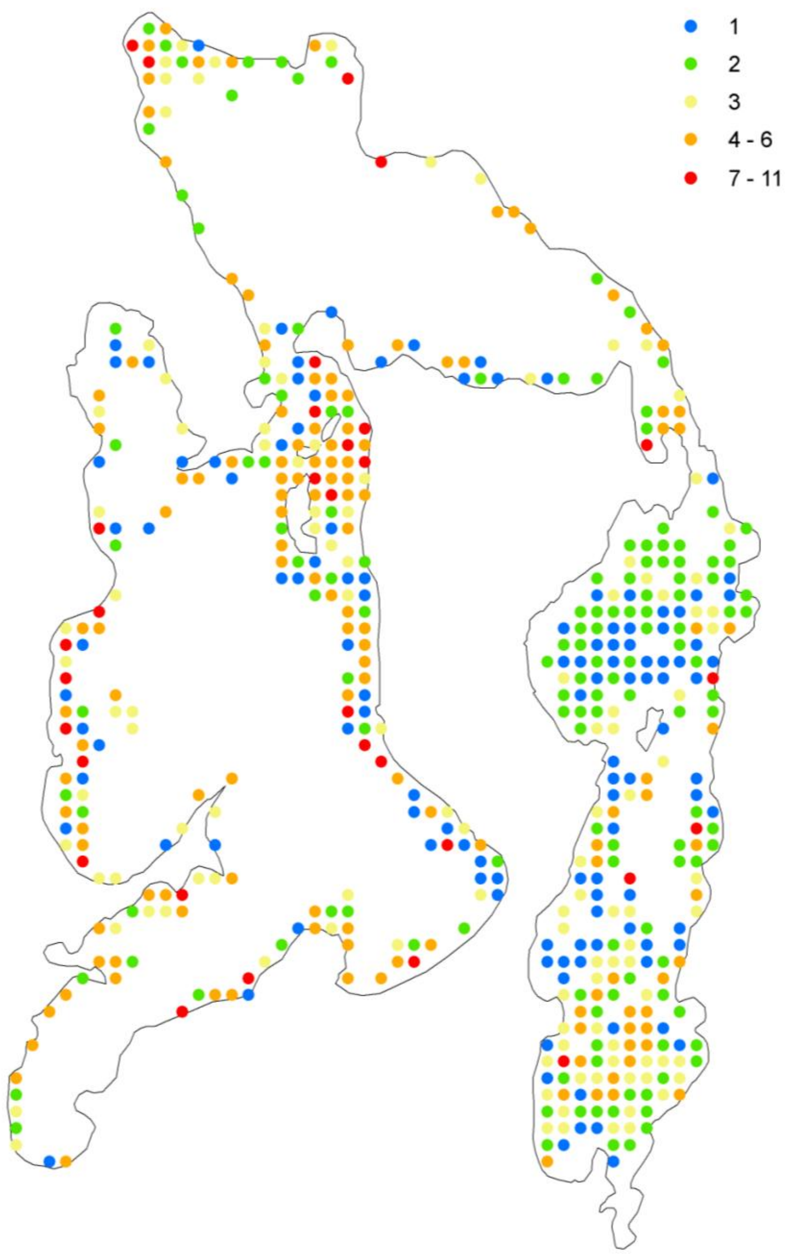
Figure 40. Unique aquatic plants in Washburn Lake, 2006-2009.



Rare plant species
Two rare emergent aquatic plants were found along the Washburn Lake shoreline. Few-flowered spikerush and twig-rush occurred in sandy substrates along a windswept shoreline. These plants occurred with a diversity of other native aquatic plants.

Species richness
The number of plant taxa found in each one square meter sample site ranged from zero to 11 (Figure 41). Sites near shore, in water less than 10 feet in depth, contained the greatest number of plant taxa. In depths greater than 15 feet, most sites contained one or no plant taxa.

Figure 41. Aquatic plant richness (number of taxa per sampling station), 2006.



Near-shore Substrates

Objective

1. Describe and map the near-shore substrates of Washburn 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 Washburn Lake was evaluated at a total of 403 sampling stations set up in the grid point-intercept aquatic plant surveys and near-shore fish surveys. Plant sample stations were 65 meters apart and occurred in a grid from shore to a depth of 20 feet; substrate was evaluated at sample sites in seven feet of water or less. To increase sample coverage at near-shore sites not covered by the grid sampling, substrate was also evaluated at near-shore fish sample stations. Fish sample stations were located every 400 meters around the perimeter of the lakeshore and substrate was evaluated at 38 of these stations.

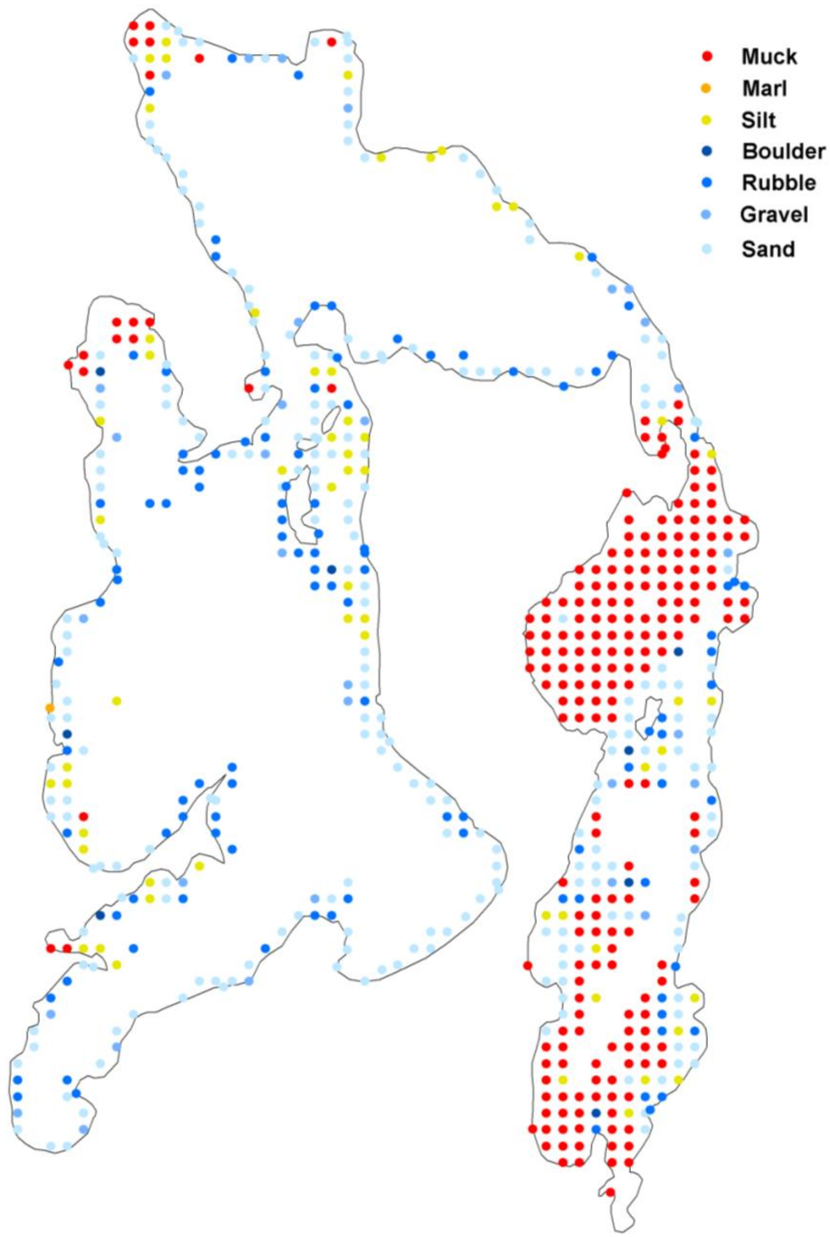
Surveyors evaluated substrate by tapping a pole into the lake bottom; soft substrate could usually be brought to the surface on the pole or sampling rake for evaluation. If this was not feasible, substrate was evaluated by visual observation. Standard lake substrate classes were based on the DNR Fisheries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

<table>
<tr><th>Substrate Group</th><th>Type</th><th>Description</th></tr>
<tr><td rowspan="4">Hard Bottom</td><td>Boulder</td><td>Diameter over 10 inches</td></tr>
<tr><td>Rubble</td><td>Diameter 3 to 10 inches</td></tr>
<tr><td>Gravel</td><td>Diameter 1/8 to 3 inches</td></tr>
<tr><td>Sand</td><td>Diameter less than 1/8 inch</td></tr>
<tr><td rowspan="3">Soft Bottom</td><td>Silt</td><td>Fine material with little grittiness</td></tr>
<tr><td>Marl</td><td>Calcareous material</td></tr>
<tr><td>Muck</td><td>Decomposed organic material</td></tr>
</table>

Results

Substrate types varied between the three basins of Washburn Lake (Figure 42). The east basin was primarily muck, with scattered silt, sand, gravel, rubble and boulders in the central portion. The north and west basins contained a variety of substrate types, including several small areas of marl along the west shore of the west basin. Hard bottom substrates, particularly sand and gravel, occurred mainly along straight shorelines, whereas the protected bays were characterized by muck. Overall, the dominant near-shore substrate type was muck, which occurred at over 40% of the sampling sites.

Figure 42. Distribution of Washburn Lake near-shore substrates, 2006 – 2009.



Bird Surveys

Objectives

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

Introduction

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

Figure 43. Bald eagle

Photo by: Carrol Henderson

Bald eagles (*Haliaeetus leucocephalus*; Figure 43) are an increasingly common sight in Minnesota. Once listed as an endangered species, bald eagle numbers have rebounded due to effective environmental protection laws and conservation efforts. Adult bald eagles are easily identified by the white head and tail, although these colors don't appear until birds are 4 or 5 years old. Prior to that, eagles are generally dark brown with white feathers scattered along the wings, head, tail and back. With a wingspan of up to 7 feet, bald eagles are one of the largest birds in North America. They are found in forested areas near large, open bodies of water. Although bald eagle numbers are increasing, these birds still face threats from environmental contaminants and destruction of habitat. Bald eagles are listed as a species of Special Concern in the state of Minnesota.

Figure 44. Black-billed cuckoo

Photo source: U.S. Fish and Wildlife Service

Black-billed cuckoos (*Coccyzus erythropthalmus*; Figure 44) are one of two cuckoo species regularly found in Minnesota. These slender, long-tailed birds summer and breed in Minnesota and the east-central United States before heading south to spend the winter in South America. Black-billed cuckoos have a brown back and white underside, and may be distinguished by a curved black bill and red ring around the eye. They inhabit deciduous forests and thickets, and are often found near water. The black-billed cuckoo is listed as a species of Regional Concern on the Partners in Flight watchlist.

The Cape May warbler (*Dendroica tigrina*; Figure 45) is a small, active warbler. Breeding plumage is striking, with a bright yellow rump, throat, and breast streaked with black. The face is orange-brown with a black eyestripe, and the wings exhibit a narrow white wing bar. Cape May warblers breed across the northern United States and into Canada, where large expanses of coniferous woodland are present. They feed mainly on spruce budworms, but also consume other insects and nectar. Numbers of Cape May warblers rise and fall somewhat regularly, in response to availability of spruce budworms. However, loss of mature boreal forest through logging and loss of winter habitat may lead to long-term population declines.

Figure 45. Cape May warbler

Photo by: S. Maslowski, USFWS

Common loons (*Gavia immer*; Figure 46) 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 46. Common loon

Photo by: Carrol Henderson

Common nighthawks (*Chordeiles minor*; Figure 47) are most often seen in the air, exhibiting an erratic flight pattern as they forage for insects. They are cryptically colored with brown, gray, and white mottling. A white bar is visible across the wing when the bird is in flight. The breeding ritual includes a dramatic display during which the male dives straight toward the ground before quickly turning upward; air rushing through the wings makes a deep booming sound. Originally found in open rural areas, the nighthawk has adapted to urban settings and often nests on gravel rooftops. Despite their adaptability, nighthawks have declined in some areas. Predation and a decreased insect food base due to the use of pesticides may be factors in this decline.

Figure 47. Common nighthawk

Photo by: Carrol Henderson

Eastern wood-pewees (*Contopus virens*; Figure 48) are medium-sized, nondescript birds common in Eastern forests. They utilize multiple habitat types, including deciduous forests, mixed woods, and suburban areas. This bird gets its name from its call, a slurred "pee-ah-wee." Eastern wood-pewees are grayish-olive above, with a paler throat and belly and whitish wingbars. They forage throughout the canopy, often flying out from their perch to catch insects before returning to the same perch. Populations of eastern wood-pewees are declining throughout much of their range. One possible cause of the decline is the increase in white-tailed deer. Deer browse and decrease the lower-canopy foraging area available to the eastern wood-pewee.

Figure 48. Eastern wood-pewee

Photo by: J.A. Spendelow

Golden-winged warblers (*Vermivora chrysoptera*; Figure 49) 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 49. Golden-winged warbler

Photo by: Carrol Henderson

Least flycatchers (*Empidonax minimus*; Figure 50) are the smallest flycatchers found in Minnesota. Like many other flycatchers, they are olive to gray in color with two white wingbars and whitish underparts. They have a small bill and a prominent white eye ring. The best way to distinguish least flycatchers from other flycatchers is the call, a harsh "che-bek." These birds are often found along water edges in mature, open woods. Least flycatchers are common throughout most of their range where habitat is suitable. However, they are sensitive to human disturbance and require large areas of forest to survive.

Figure 50. Least flycatcher

Photo by: J.A. Spendelow

Ovenbirds (*Seiurus aurocapillus*; Figure 51) 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 51. Ovenbird

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

Rose-breasted grosbeaks (*Pheucticus ludovicianus*; Figure 52) are summer visitors to Minnesota bird feeders. The males are easily identified by a red triangle on a white breast, with a black head and back and a large bill. Females are more difficult to identify, and resemble a large sparrow with brown and white streaks. Rose-breasted grosbeaks are found in open woodlands near water, edges of marshes, meadows and woodlands, and suburban parks and gardens. The winter range spans from southern Mexico to South America and the Caribbean. Significant regional declines in rose-breasted grosbeak populations have been noted. Protection of large, unfragmented areas of hardwood forest would be beneficial to the rose-breasted grosbeak.

Figure 52. Rose-breasted grosbeak

Photo by: J.A. Spendelow

Sedge wrens (*Cistothorus platensis*; Figure 53) 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 53. Sedge wren

Photo by: Berlin Heck

The <u>swamp sparrow's</u> (*Melospiza georgiana*; Figure 54) 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 54. Swamp sparrow

Photo by: Jim Stasz

The <u>veery</u> (*Catharus fuscescens*; Figure 55) 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 55. Veery

Photo by: Deanna Dawson

<u>White-throated sparrows</u> (*Zonotrichia albicollis*; Figure 56) are common in Minnesota during their spring and fall migrations. They are recognizable by the white patch on the throat and their characteristic "Old Sam Peabody Peabody Peabody" song. The head is striped with black and tan or white, and has a yellow spot above the eye. The chest is gray and the back is streaked with brown and black. They inhabit coniferous or mixed forests, and prefer areas with multiple openings and abundant low-growing vegetation. During winter and migration, they may also be found in woodlots, city parks, and backyards.Nests are often build on or near the ground. Although white-throated sparrows are widespread, they are declining over portions of their breeding range.

Figure 56. White-throated sparrow

Photo by: Dave Herr

The wood thrush (*Hylocichla mustelina*; Figure 57) has become a symbol of declining neotropical migrant birds, its population having decreased significantly in recent decades over much of its range. They can be distinguished from other North American thrushes by a rusty head and large blackish spots contrasting with white (not buffy) underparts and dull white eye-ring. The flutelike song of the wood thrush, its hallmark, is a familiar sound in eastern deciduous woodlands in summer, especially at dawn and dusk. Primary habitat features include a shrub-subcanopy layer, shade, moist soil, and leaf litter, which enhance feeding and nesting. Destruction and fragmentation of forests in both breeding and wintering areas are factors in the species' declining abundance.

Figure 57. Wood thrush

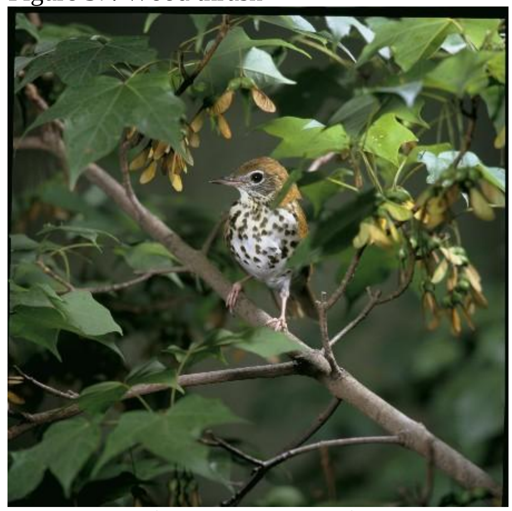


Photo courtesy of: U.S. Fish and Wildlife Service

The yellow-bellied sapsucker's (*Sphyrapicus varius*; Figure 58) 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 58. Yellow-bellied sapsucker

Photo by: J.A. Spendelow

Methods

Surveyors used several techniques to collect information on bird species. Point counts were conducted at 79 stations, located 400 meters apart along the lakeshore. Surveyors listened for five minutes per station and recorded all species detected (heard or seen) within that time. Point count surveys were conducted in the early morning hours, when species were most likely to be singing. Call-playback surveys were conducted at survey stations that had appropriate habitat. At each station, surveyors played a tape that included the calls of six marsh birds (least bittern (*Ixobrychus exilis*), yellow rail (*Coturnicops noveboracensis*), sora (*Porzana carolina*), Virginia rail (*Rallus limicola*), American bittern (*Botaurus lentiginosus*), and pied-billed grebe (*Podilymbus podiceps*)) and listened for a response. Call-playback surveys generally took place in the early evening. Both survey techniques were dependent on good listening conditions, and surveys were stopped if inclement conditions prevented the ability to hear bird vocalizations. Casual observations of birds seen or heard on the lake or on the lakeshore were also recorded.

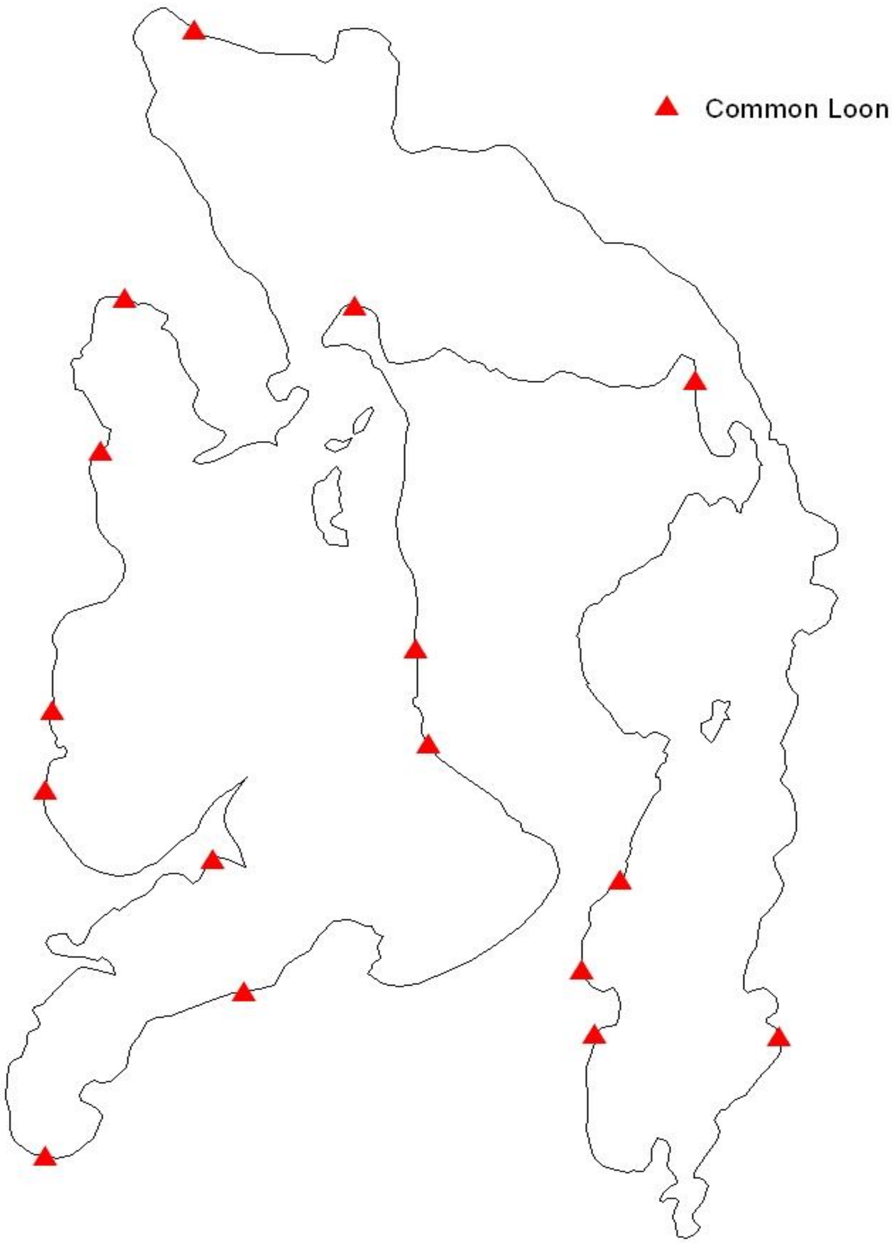
Results

Surveyors identified 16 species of greatest conservation need at Washburn Lake. The ovenbird was found at the greatest number of locations, with surveyors identifying this species at nearly 40% of the survey stations, followed by the veery which was documented at 25% of the stations surveyed. Common loons, least flycatchers, swamp sparrows, and yellow-bellied sapsuckers were all documented at five or more survey stations. The black-billed cuckoo, Cape May warbler, sedge wren, and wood thrush were detected rarely; each of these species was found at only one survey station. The remaining species of greatest conservation need identified during the surveys were the bald eagle, common nighthawk, eastern wood-pewee, golden-winged warbler, rose-breasted grosbeak, and white-throated sparrow.

Surveyors recorded 73 bird species during the point count and call-playback surveys at Washburn Lake (Table 3). Seven additional species were recorded through casual observation, for a total of 80 species (Appendix 2). Song sparrows were the most frequently detected species overall, documented at 84% of the stations surveyed. Red-eyed vireos were the second most frequently recorded species, found at 66% of the survey stations. Yellow warblers, American robins, and common yellowthroats rounded out the top five most frequently detected species.

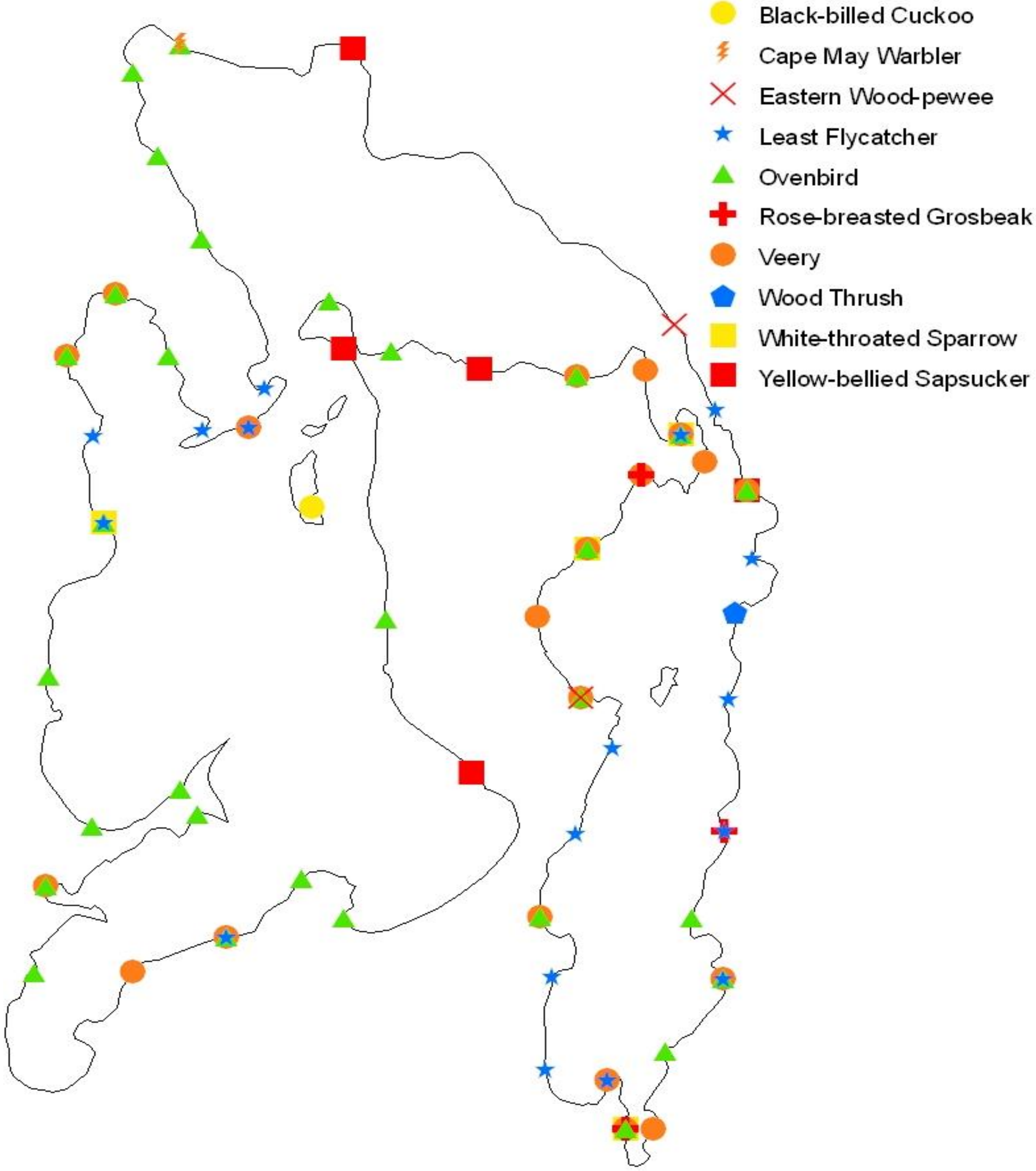
The common loon, an aquatic habitat-dependant species of greatest conservation need, was documented at multiple locations along the shoreline of all three basins (Figure 59). Although many of the sightings were within small bays, loons were also detected along exposed shorelines of the lake.

Figure 59. Distribution of aquatic habitat-dependent bird species of greatest conservation need at Washburn Lake, May – June 2008 & 2009.



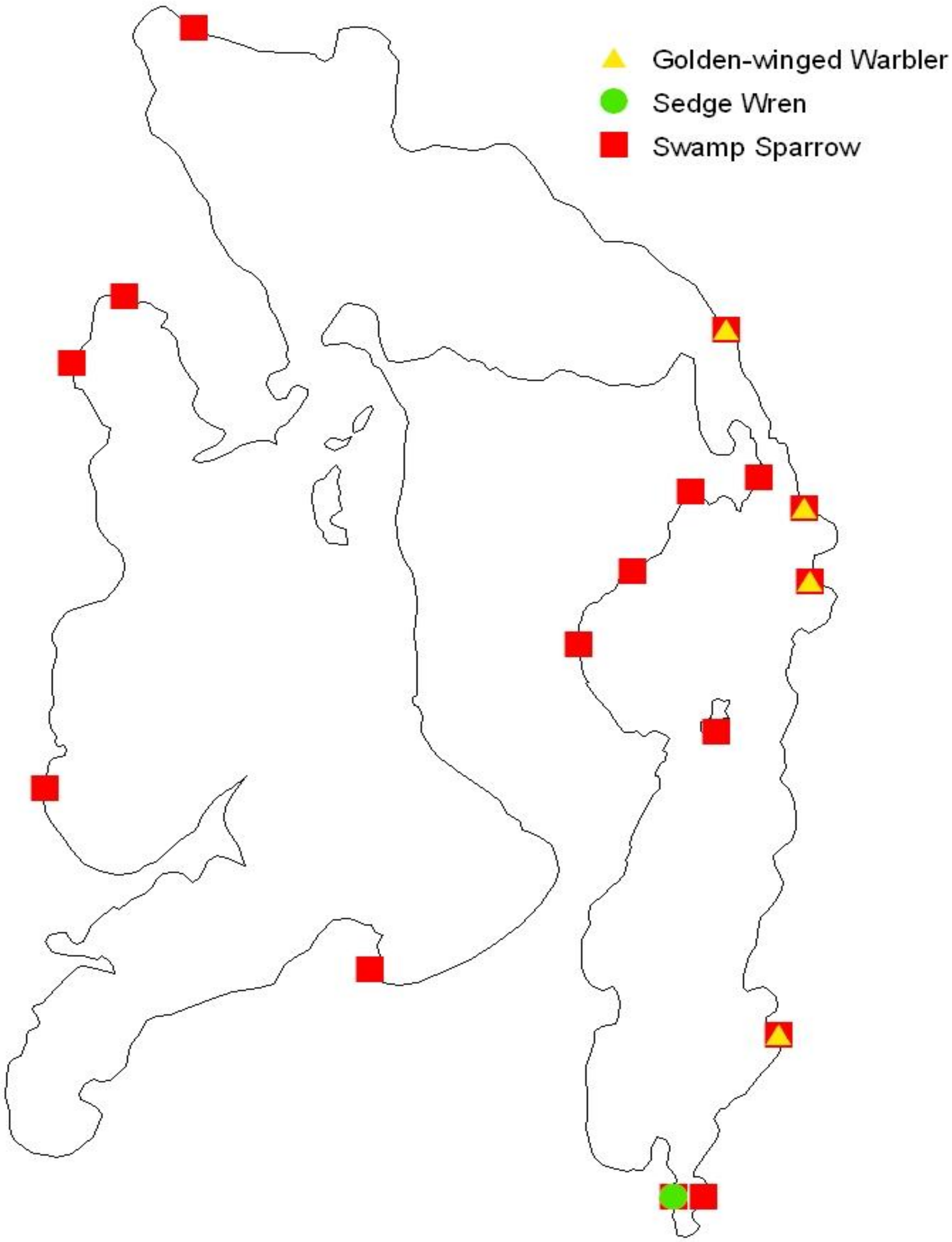
The majority of the bird species of greatest conservation need documented at Washburn Lake were forest-dwelling species (Figure 60). The four most common forest-dwelling species of greatest conservation need (ovenbird, veery, least flycatcher, yellow-bellied sapsucker) were found along the shorelines of all three basins. The veery appeared to be associated with bays while the ovenbird and yellow-bellied sapsucker exhibited a scattered distribution. Rose-breasted grosbeak detections were limited to the east basin of Washburn Lake. The only Cape May warbler detected was along the western shoreline of the west basin and a single wood thrush was found along on the east shore of the east basin.

Figure 60. Distribution of forest habitat-dependent bird species of greatest conservation need at Washburn Lake, May – June 2008 & 2009.



Those species that depend mainly on wetland habitats (golden-winged warbler, sedge wren, and swamps sparrow) were found mainly in bays (Figure 61). The only sedge wren detected was found in the south bay of the east basin.

Figure 61. Distribution of wetland habitat-dependent bird species of greatest conservation need at Washurn Lake, May – June 2008 & 2009.



Species that occupy a variety of habitats were found in all three basins (Figure 62). Common nighthawks were observed feeding within a bay located at the north end of the east basin and bald eagles were found at various locations within all three basins.

Figure 62. Distribution of bird species of greatest conservation need that occupy a variety of habitats at Washburn Lake, May – June 2008 & 2009.

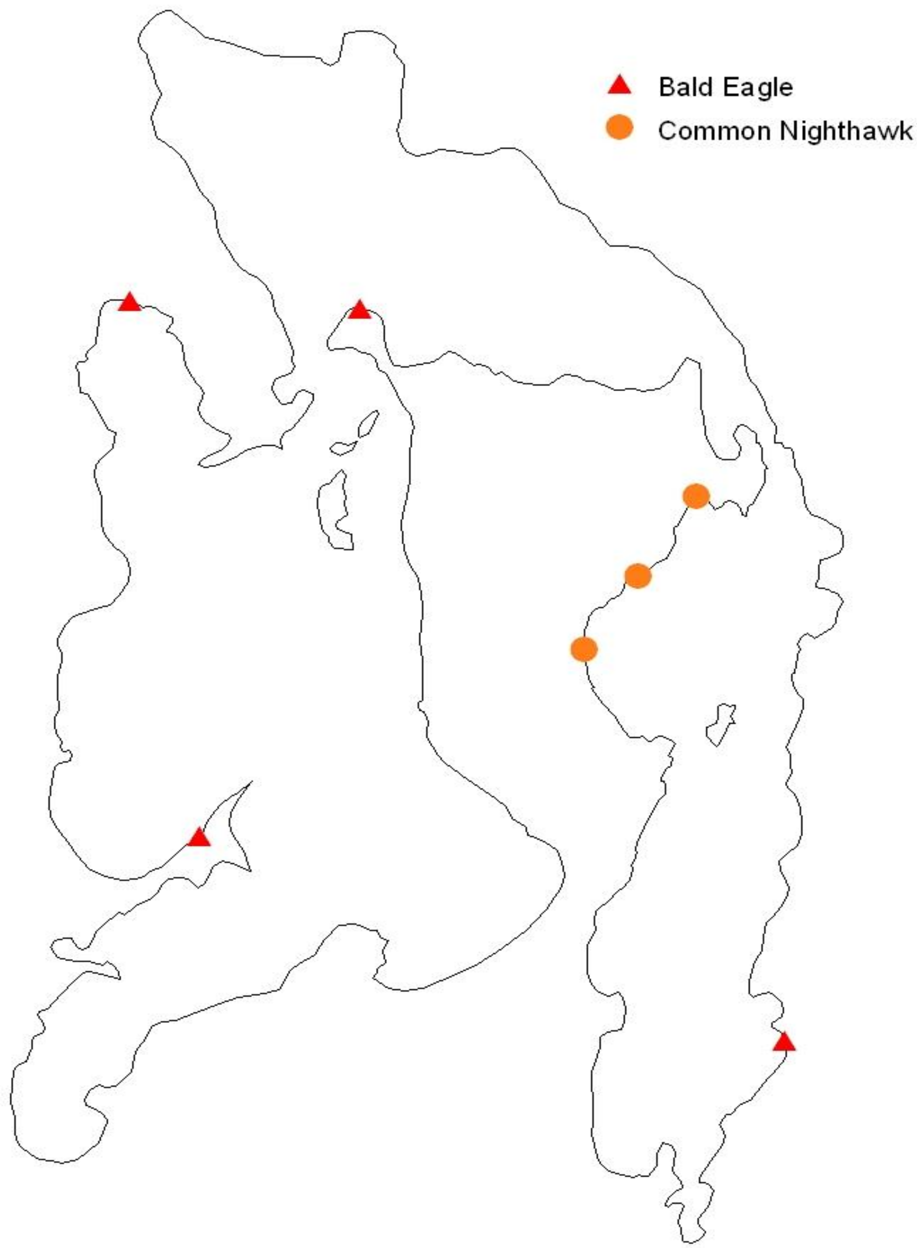


Table 3. Species list and frequency of occurrence of bird species identified during Washburn Lake surveys, May – June 2008 & 2009. * denotes a species of greatest conservation need.

Description	Common Name	Scientific Name	% [a]
Waterfowl	Canada Goose	*Branta canadensis*	1
	Wood Duck	*Aix sponsa*	8
	Mallard	*Anas platyrhynchos*	13
	Common Goldeneye	*Bucephala clangula*	1
	Hooded Merganser	*Lophodytes cucullatus*	3
Loons	Common Loon*	*Gavia immer*	20
Herons/bitterns	Great Blue Heron	*Ardea herodias*	4
	Green Heron	*Butorides virescens*	10
Vultures	Turkey Vulture	*Cathartes aura*	1
Hawks/eagles	Osprey	*Pandion haliaetus*	1
	Bald Eagle*	*Haliaeetus leucocephalus*	5
Falcons	Merlin	*Falco columbarius*	1
Rails/coots	Sora	*Porzana carolina*	4
Plovers	Killdeer	*Charadrius vociferus*	1
Gulls/terns	Ring-billed Gull	*Larus delawarensis*	4
Cuckoos	Black-billed Cuckoo*	*Coccyzus erythropthalmus*	1
Goatsuckers	Common Nighthawk*	*Chordeiles minor*	4
Hummingbirds	Ruby-throated Hummingbird	*Archilochus colubris*	6
Kingfishers	Belted Kingfisher	*Megaceryle alcyon*	16
Woodpeckers	Red-bellied Woodpecker	*Melanerpes carolinus*	6
	Yellow-bellied Sapsucker*	*Sphyrapicus varius*	6
	Downy Woodpecker	*Picoides pubescens*	8
	Hairy Woodpecker	*Picoides villosus*	10
	Northern Flicker	*Colaptes auratus*	9
	Pileated Woodpecker	*Dryocopus pileatus*	4
Flycatchers	Eastern Wood-Pewee*	*Contopus virens*	3
	Alder Flycatcher	*Empidonax alnorum*	14
	Least Flycatcher*	*Empidonax minimus*	22
	Eastern Phoebe	*Sayornis phoebe*	32
	Great Crested Flycatcher	*Myiarchus crinitus*	1
	Eastern Kingbird	*Tyrannus tyrannus*	13
Vireos	Yellow-throated Vireo	*Vireo flavifrons*	3
	Warbling Vireo	*Vireo gilvus*	8
	Red-eyed Vireo	*Vireo olivaceus*	66
Jays/crows	Blue Jay	*Cyanocitta cristata*	24
	American Crow	*Corvus brachyrhynchos*	18
	Common Raven	*Corvus corax*	1

Table 3, continued.

Description	**Common Name**	**Scientific Name**	**%** [a]
Swallows	Purple Martin	*Progne subis*	8
	Tree Swallow	*Tachycineta bicolor*	29
	Barn Swallow	*Hirundo rustica*	19
Chickadees	Black-capped Chickadee	*Poecile atricapilla*	19
Nuthatches	Red-breasted Nuthatch	*Sitta canadensis*	5
	White-breasted Nuthatch	*Sitta carolinensis*	20
Wrens	House Wren	*Troglodytes aedon*	4
	Sedge Wren*	*Cistothorus platensis*	1
Thrushes	Veery*	*Catharus fuscescens*	25
	Hermit Thrush	*Catharus guttatus*	1
	Wood Thrush*	*Hylocichla mustelina*	1
	American Robin	*Turdus migratorius*	51
Mockingbirds	Gray Catbird	*Dumetella carolinensis*	19
Waxwings	Cedar Waxwing	*Bombycilla cedrorum*	15
Warblers	Golden-winged Warbler*	*Vermivora chrysoptera*	5
	Yellow Warbler	*Dendroica petechia*	61
	Chestnut-sided Warbler	*Dendroica pensylvanica*	22
	Cape May Warbler*	*Dendroica tigrina*	1
	Pine Warbler	*Dendroica pinus*	4
	Black-and-white Warbler	*Mniotilta varia*	19
	American Redstart	*Setophaga ruticilla*	24
	Ovenbird*	*Seiurus aurocapilla*	38
	Northern Waterthrush	*Seiurus noveboracensis*	3
	Common Yellowthroat	*Geothlypis trichas*	38
Tanagers	Scarlet Tanager	*Piranga olivacea*	5
Sparrows/allies	Chipping Sparrow	*Spizella passerina*	29
	Song Sparrow	*Melospiza melodia*	85
	Swamp Sparrow*	*Melospiza georgiana*	20
	White-throated Sparrow*	*Zonotrichia albicollis*	5
Cardinals/allies	Rose-breasted Grosbeak*	*Pheucticus ludovicianus*	4
Blackbirds	Red-winged Blackbird	*Agelaius phoeniceus*	52
	Common Grackle	*Quiscalus quiscula*	11
	Brown-headed Cowbird	*Molothrus ater*	4
	Baltimore Oriole	*Icterus galbula*	20
Finches	Pine Siskin	*Spinus pinus*	4
	American Goldfinch	*Spinus tristis*	32

[a] % – Percent of surveyed sample sites in which a bird species occurred (N=79)

Bird Species Richness

Objective

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

Introduction

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

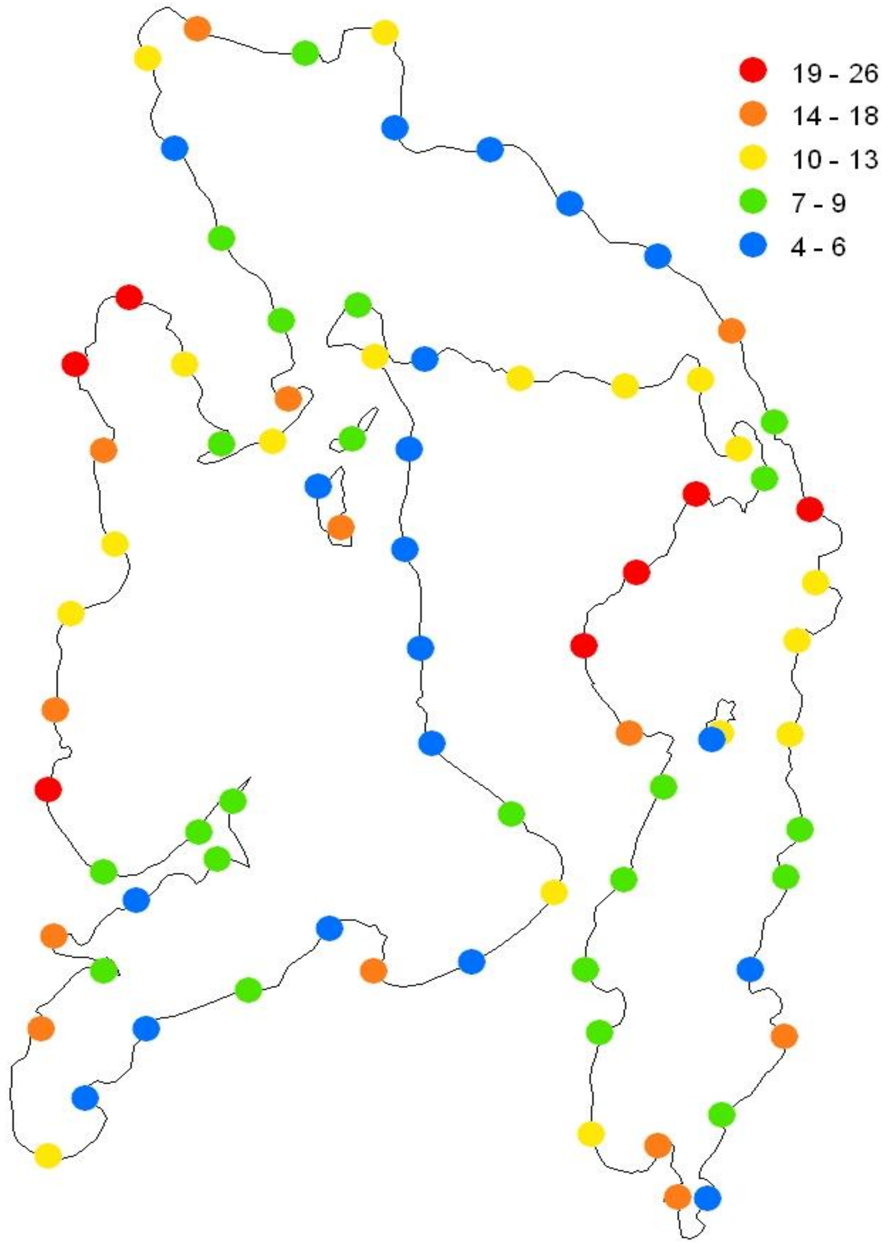
Methods

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

Results

Bird richness (the number of bird species at a single survey point) ranged from four to 26 species at each site surveyed (Figure 63). Nineteen or more species were recorded at seven survey stations, located primarily in the northern bays of the east and west basins of Washburn Lake. Thirty-one additional survey stations supported 10 or more species. The maximum number of species of greatest conservation need recorded at a single survey station was seven. This site was located near the south end of the east basin. An additional four survey locations documented five or more species of greatest conservation need, all located in the east basin with the exception of one site located at the north end of the west basin.

Figure 63. Bird species richness (number of species per sample site) at Washburn Lake, May – June 2008 & 2009.



Loon Nesting Areas

Objectives

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

Introduction

Washburn Lake loon chick, 2009.

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

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

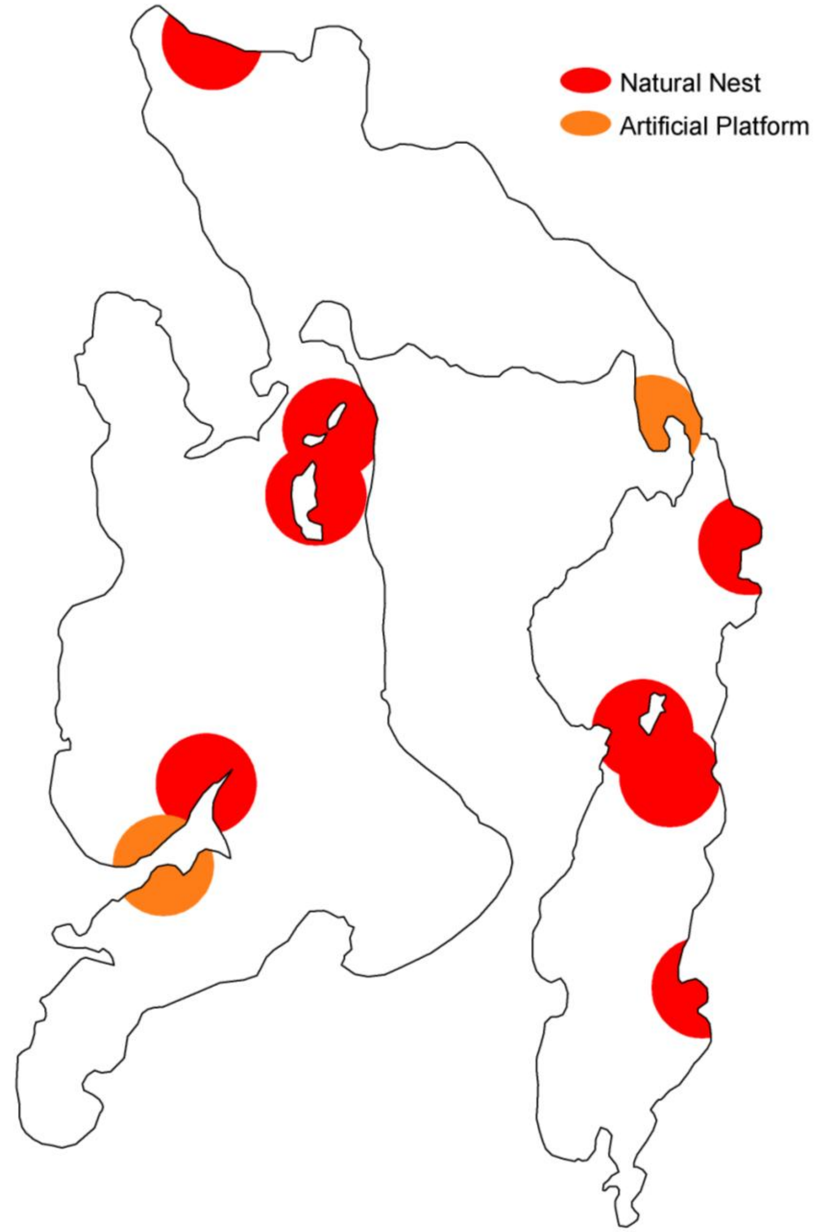
Methods

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

Results

Since 1980, ten loon nesting areas have been identified on Washburn Lake (Figure 64). Loon nests have been located in all three lake basins, as well as in the channel connecting the north basin and the east basin. Many of the nesting areas have been located on islands or within small protected areas of shoreline. In 2009, multiple artificial platforms were utilized by loons.

Figure 64. Location of natural loon nests and manmade loon platforms recorded on Washburn Lake between 1980 and 2009.



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 65. Mink frog

Photo by: Jeff LeClere, www.herpnet.net

<u>Mink frogs</u> (Figure 65) 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 66. Green frog

Photo by: Jeff LeClere, www.herpnet.net

<u>Green frogs</u> (Figure 66) are medium-sized, greenish or brownish frogs with small dark spots. The belly is often brighter in color than the back. A large tympanum (eardrum) helps identify the green frog. They can be found in a variety of habitats surrounding lakes, streams, marshes, and swamps, but are strongly associated with the shallow water of lakeshores. Although green frog populations are generally stable, regional declines and local extinctions have been noted.

Methods

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

Results

Target species
Both mink frogs and green frogs were documented during the Washburn Lake frog surveys. Green frogs were heard at 26 different survey stations, in all three lake basins (Figure 67). Mink frogs were heard less frequently; surveyors recorded this species at four survey stations. Two of the four mink frog locations were within the channel that connects the north basin to the east basin. Mink frogs were also recorded along the eastern shoreline of the east basin, and at the northern edge of the west basin.

At survey stations where green frogs were present, abundance estimates ranged from one frog to more than 100 frogs (Figure 68). At many of these stations, frog calls were continuous and overlapping, or a full chorus was audible. No more than ten mink frogs were heard at a single Washburn Lake survey station (Figure 69).

Other species
Several additional anuran species were recorded during the Washburn Lake frog surveys. Gray treefrogs (*Hyla versicolor*) were heard at 19 survey stations scattered along the shoreline. Index values for gray treefrogs ranged from one (individual frog calls could be distinguished; no overlap) to three (full chorus of calls). Surveyors also heard American toads (*Bufo americanus*) at two survey stations on the eastern shoreline of the east basin. Other frog species that may be found near Washburn Lake, such as wood frog (*Rana sylvatica*), spring peeper (*Pseudacris crucifer*) and chorus frog (*Pseudacris triseriata*), breed earlier in the year and are not strongly associated with larger lakes.

Figure 67. Distribution of green and mink frogs heard during Washburn Lake frog surveys, July 2007.

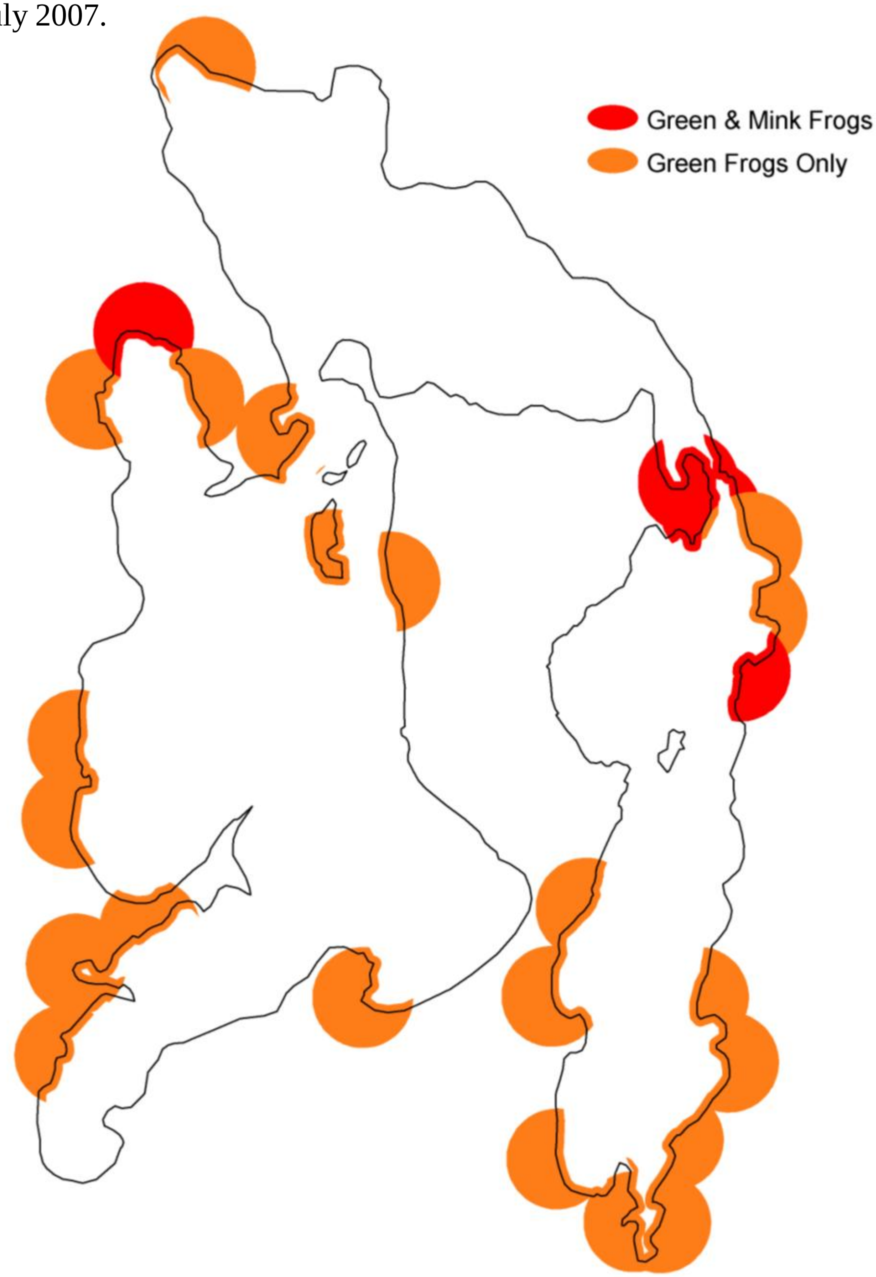


Figure 68. Abundance of green frogs heard during Washburn Lake frog surveys, July 2007.

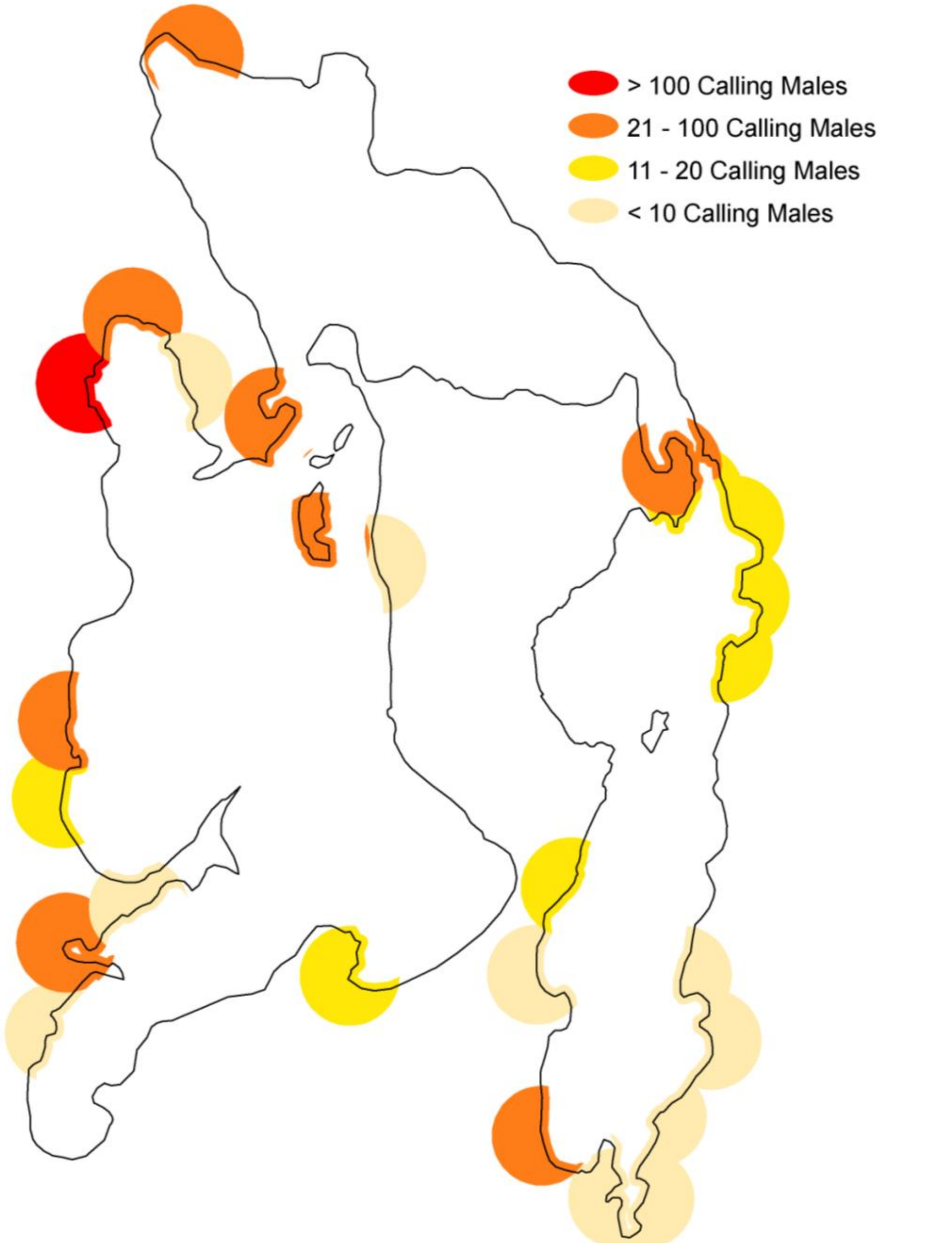
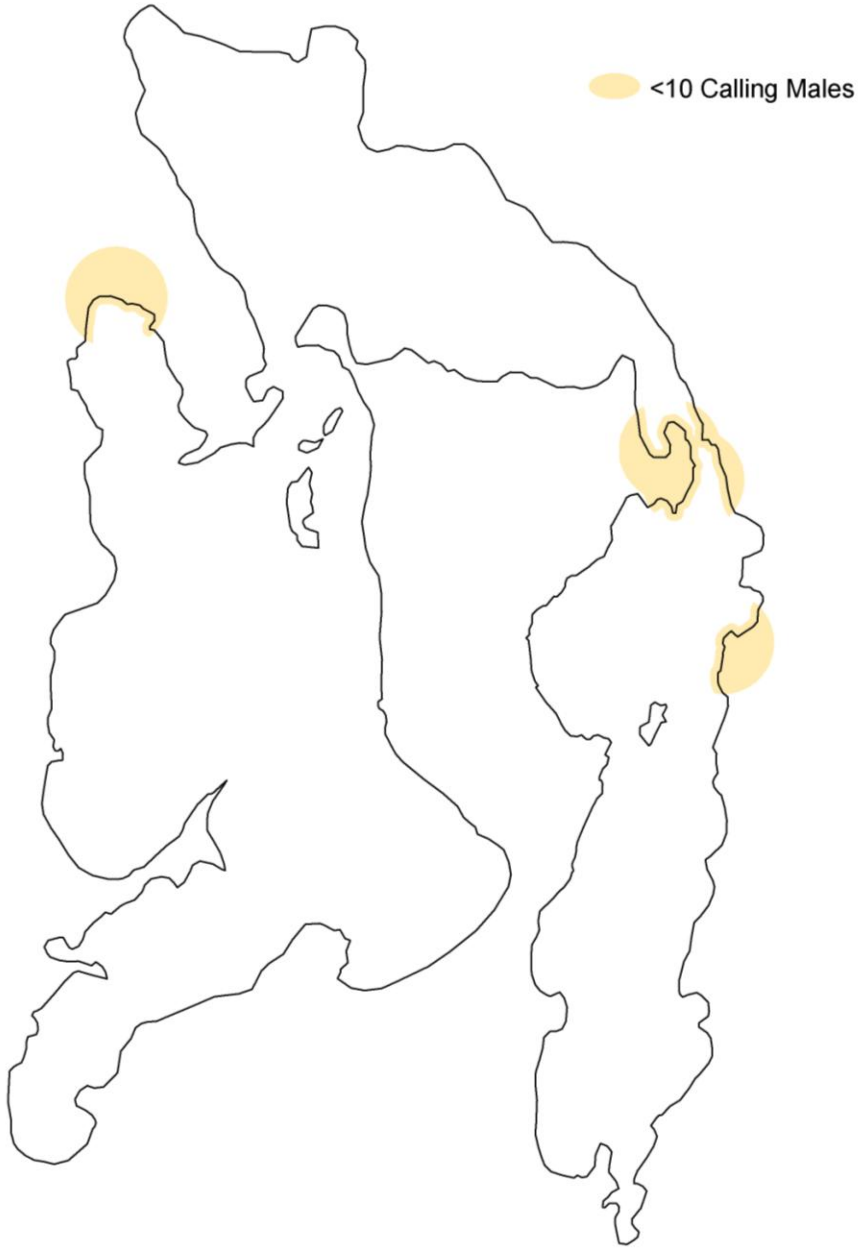


Figure 69. Abundance of mink frogs heard during Washburn Lake frog surveys, July 2007.



Nongame Fish Surveys

Objectives

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

Introduction

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

Pugnose shiners (*Notropis anogenus*; Figure 70) 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 70. Pugnose shiner

Photo by: Konrad Schmidt

Least darters (*Etheostoma microperca*; Figure 71) 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 71. Least darter

Photo by: Konrad Schmidt

Longear sunfish (*Lepomis megalotis*; Figure 72) 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 72. 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 73) 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 73. Blackchin shiner

Photo by: Konrad Schmidt

Blacknose shiners (*Notropis heterolepis*; Figure 74) 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 74. Blacknose shiner

Photo by: Konrad Schmidt

Banded killifish (*Fundulus diaphanus*; Figure 75) 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 75. 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. Due to time contraints in 2007, surveyors were only able to survey every other station (i.e., surveyed stations were 800 meters apart). At each station, fish were sampled using three different methods: trapnetting, shoreline seining, and electrofishing. At several locations, excessive vegetation, depth, or soft substrate prevented surveyors from using seines or trapnets. However, electrofishing samples were still collected, from a boat if necessary. All species captured using the different sampling methods were identified and counted. Target fish species included near-shore species of greatest conservation concern (pugnose shiner, least darter, and longear sunfish) and proxy species (blackchin shiner, blacknose shiner, and banded killifish). These species are associated with large, near-shore stands of aquatic grasses and macrophytes. They are intolerant to disturbance, and have been extirpated from lakes where extensive watershed and lakeshore development has occurred.

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

Results

There were no near-shore fish species of greatest conservation need detected during the 2007 nongame fish surveys on Washburn Lake. One offshore-dwelling species of greatest conservation need, the greater redhorse (*Moxostoma valenciennesi*; Figure 76), was identified at a survey station in the north basin. Greater redhorse, like the target species of greatest conservation need, are sensitive to chemical pollutants and turbidity, and inhabit clear water rivers and lakes.

Figure 76. Greater redhorse

All three proxy fish species were documented in Washburn Lake (Figure 77). Blacknose shiners were identified most frequently and in the greatest numbers. Approximately 60 individuals were found at 12 of 38 survey stations around the entire shoreline. Blackchin shiners were recorded at five survey stations. Their distribution was limited to the west and east lake basins. Banded killifish were identified at two survey stations in the north basin, and surveyors recorded fewer than ten individuals. Substrate type at sites where proxy species were present was primarily sand. Aquatic vegetation biovolume was similar between sites that contained proxy species and sites that did not.

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

Overall, surveyors identified 30 fish species at Washburn Lake (Table 4). Bluegills, found at 97% of the survey stations, were the most commonly documented species. Black and yellow bullheads and rock bass were each recorded at over 70% of the sites. Several species, the emerald shiner and greater redhorse, were detected at only one station each.

Eight fish species previously unrecorded in Washburn Lake were documented during the 2007 surveys. These species were blackchin shiner, blacknose shiner, central mudminnow, golden shiner, greater redhorse, Iowa darter, mottled sculpin, and tadpole madtom. The addition of these species brings the total observed fish community in Washburn Lake to 34 species.

Figure 77. Distribution of fish proxy species documented during Washburn Lake fish surveys, May – June 2007.

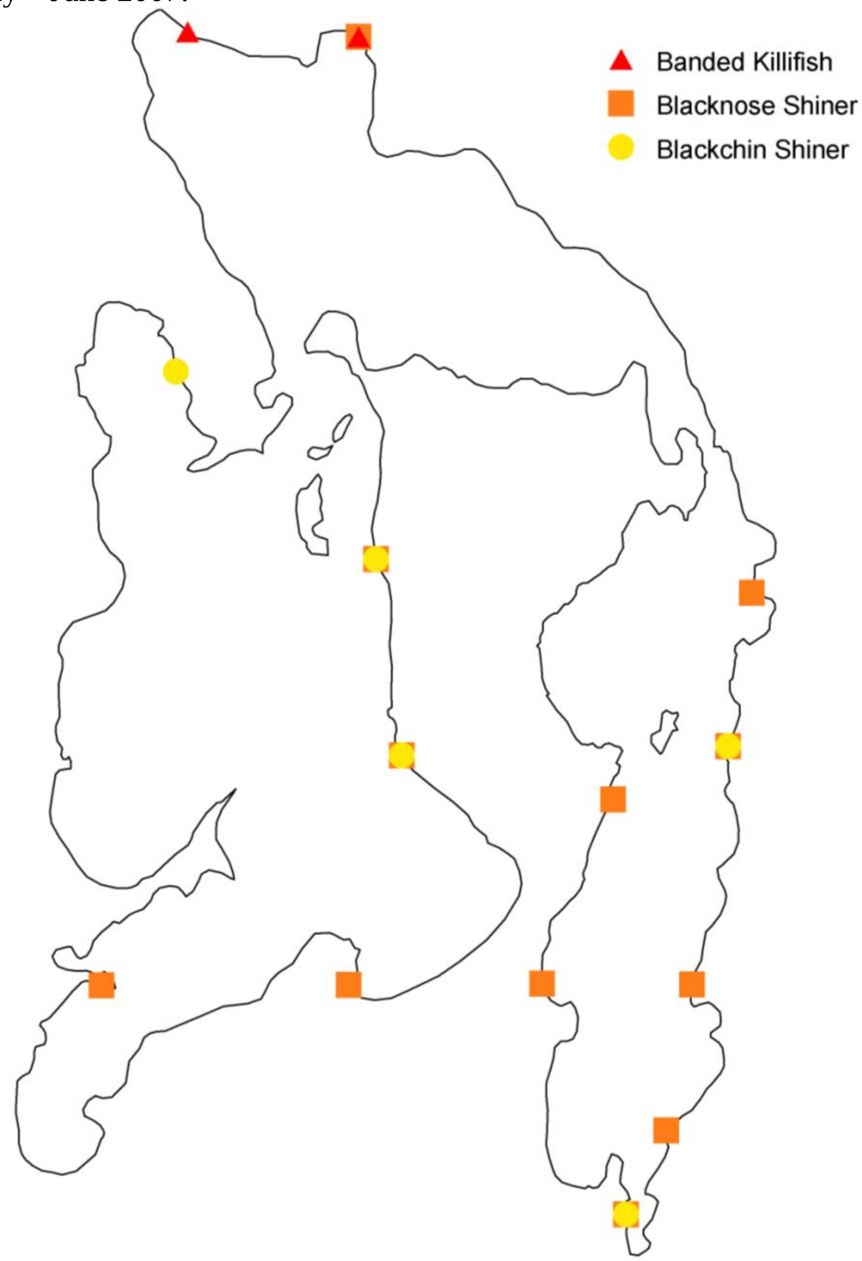


Table 4. Abundance and frequency of fish species identified during Washburn Lake fish surveys, May – June 2007. * denotes species of greatest conservation need

Description	**Common Name**	**Scientific Name**	**#** [a]	**%** [b]
Bowfins	Bowfin	*Amia calva*	18	34
Minnows/carps	Common shiner	*Luxilus cornutus*	3	3
	Golden shiner	*Notemigonus crysoleucas*	17	18
	Emerald shiner	*Notropis atherinoides*	3	5
	Blackchin shiner	*Notropis heterodon*	5	13
	Blacknose shiner	*Notropis heterolepis*	60	32
	Spottail shiner	*Notropis hudsonius*	173	11
	Mimic shiner	*Notropis volucellus*	21	18
	Bluntnose minnow	*Pimephales notatus*	688	68
Suckers	White sucker	*Catostomus commersoni*	2	5
	Greater redhorse*	*Moxostoma valenciennesi*	1	3
North American freshwater catfishes	Black bullhead	*Ameiurus melas*	113	71
	Yellow bullhead	*Ameiurus natalis*	181	74
	Brown bullhead	*Ameiurus nebulosus*	82	39
	Tadpole madtom	*Noturus gyrinus*	5	11
Pikes	Northern pike	*Esox lucius*	15	37
Mudminnows	Central mudminnow	*Umbra limi*	15	13
Killifishes	Banded killifish	*Fundulus diaphanus*	9	5
Sculpins	Mottled sculpin	*Cottus bairdi*	4	5
Sunfishes	Rock bass	*Ambloplites rupestris*	188	71
	Green sunfish	*Lepomis cyanellus*	10	11
	Pumpkinseed	*Lepomis gibbosus*	93	63
	Bluegill	*Lepomis macrochirus*	1100	97
	Largemouth bass	*Macropterus salmoides*	24	32
	Black crappie	*Pomoxis nigromaculatus*	28	32
Perches	Iowa darter	*Etheostoma exile*	7	8
	Johnny darter	*Etheostoma nigrum*	14	26
	Yellow perch	*Perca flavescens*	143	66
	Logperch	*Percina caprodes*	6	8
	Walleye	*Sander vitreus*	6	13

[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=38).

Aquatic Vertebrate Richness

Objective

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

Introduction

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

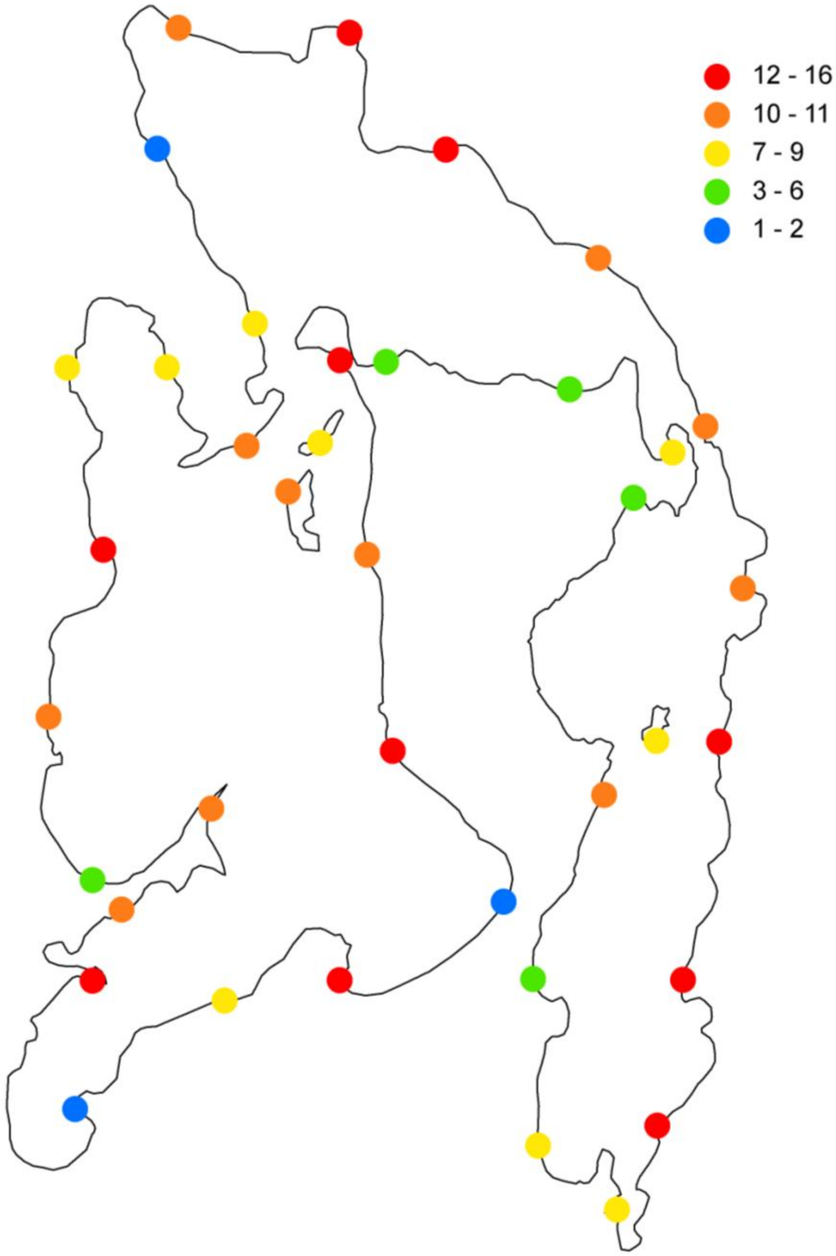
Methods

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

Results

The number of species per Washburn Lake sample site ranged from one to 16 (Figure 78). Over half (N = 21 sites) of the surveyed sites had 10 or more species, and only four of the 38 sites had fewer than five species. The sites of highest diversity were scattered along the lakeshore, and occurred within the west, north, and east basins. The majority of the documented species were fish, although green frogs and painted turtles were also identified. Hybrid sunfish were also detected in Washburn Lake, but were not used in analyses.

Figure 78. Aquatic vertebrate species richness (number of species per sample site) in Washburn Lake, May – June 2007.



Other Rare Features

Objective

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

Introduction

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

Methods

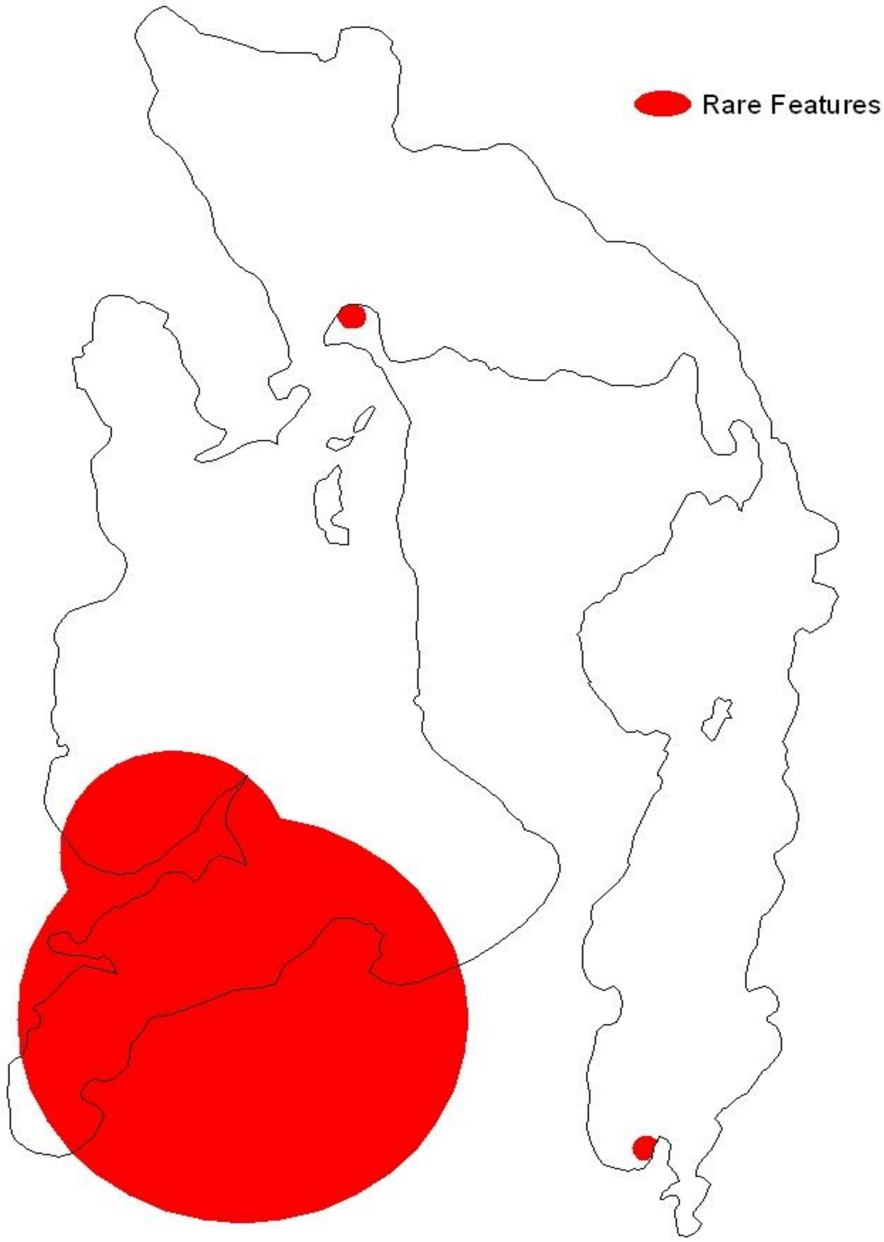
Researchers obtained locations of rare features from the Rare Features Database. Only "listed" plant and animal species (Federal or State endangered, threatened, or special concern) were considered in this project; non-listed unique plant species were included in the "Unique Plant Species" section of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

Results

Five rare feature locations have been identified at Washburn Lake (Figure 79). The rare features include a bird species of special concern and two plant species of special concern. The publication of exact descriptive and locational information is prohibited in order to help protect these rare species.

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

Figure 79. Natural Heritage Database rare features (Federal or State-listed endangered, threatened, or special concern species) located within 1320 feet of Washburn 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 November 24, 2009. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Bay Delineation

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.

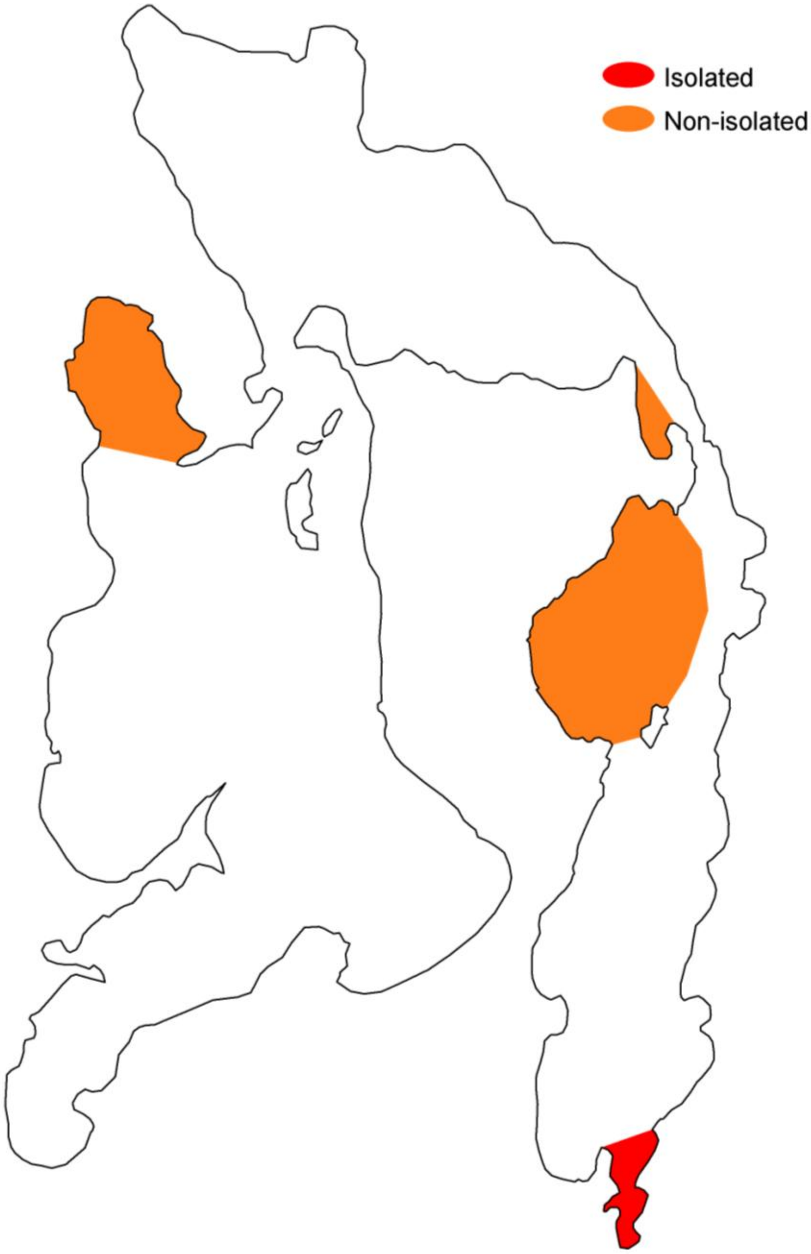
Methods

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

One isolated bay and three non-isolated bays were identified in Washburn Lake (Figure 80). The isolated bay and one non-isolated bay are located within the east basin, while a second non-isolated bay occurs at the northern edge of the west basin. The third non-isolated bay is located within the channel that connects the north and east lake basins.

Figure 80. Location of isolated and non-isolated bays in Washburn 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 81). 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 82). 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 83).

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

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

Table 5, continued.

Variable	Score	Criteria
Bird Richness	3	Total number of bird species within analysis window > 25
	2	Total number of bird species 11 – 25
	1	Total number of bird species 1 – 10
	0	No bird species observed
Loon Nesting Areas	3	Presence of natural loon nest within analysis window
	2	Presence of artificial loon nest (nesting platform)
	0	No loon nesting observed
Frogs	3	Presence of both mink frogs and green frogs within analysis window
	2	Presence of mink frogs or green frogs
	0	Neither mink frogs nor green frogs present
Fish	3	Presence of one or more species of greatest conservation need (SGCN) within analysis window
	2	Presence of one or more proxy species
	0	Neither SGCN nor proxies observed
Aquatic Vertebrate Richness	3	Total number of aquatic vertebrate species within analysis window > 10
	2	Total number of aquatic vertebrate species 5 – 10
	1	Total number of aquatic vertebrate species 1 – 4
	0	No aquatic vertebrate species observed
Rare Features	3	Presence of multiple Natural Heritage features within analysis window
	2	Presence of one Natural Heritage feature
	0	No Natural Heritage feature present
Bays	3	Isolated bay within analysis window
	2	Non-isolated bay
	0	Not a distinctive bay

Figure 81. Total score layer created by summing scores of all 15 variables. Highest total scores represent most sensitive areas of shoreline.

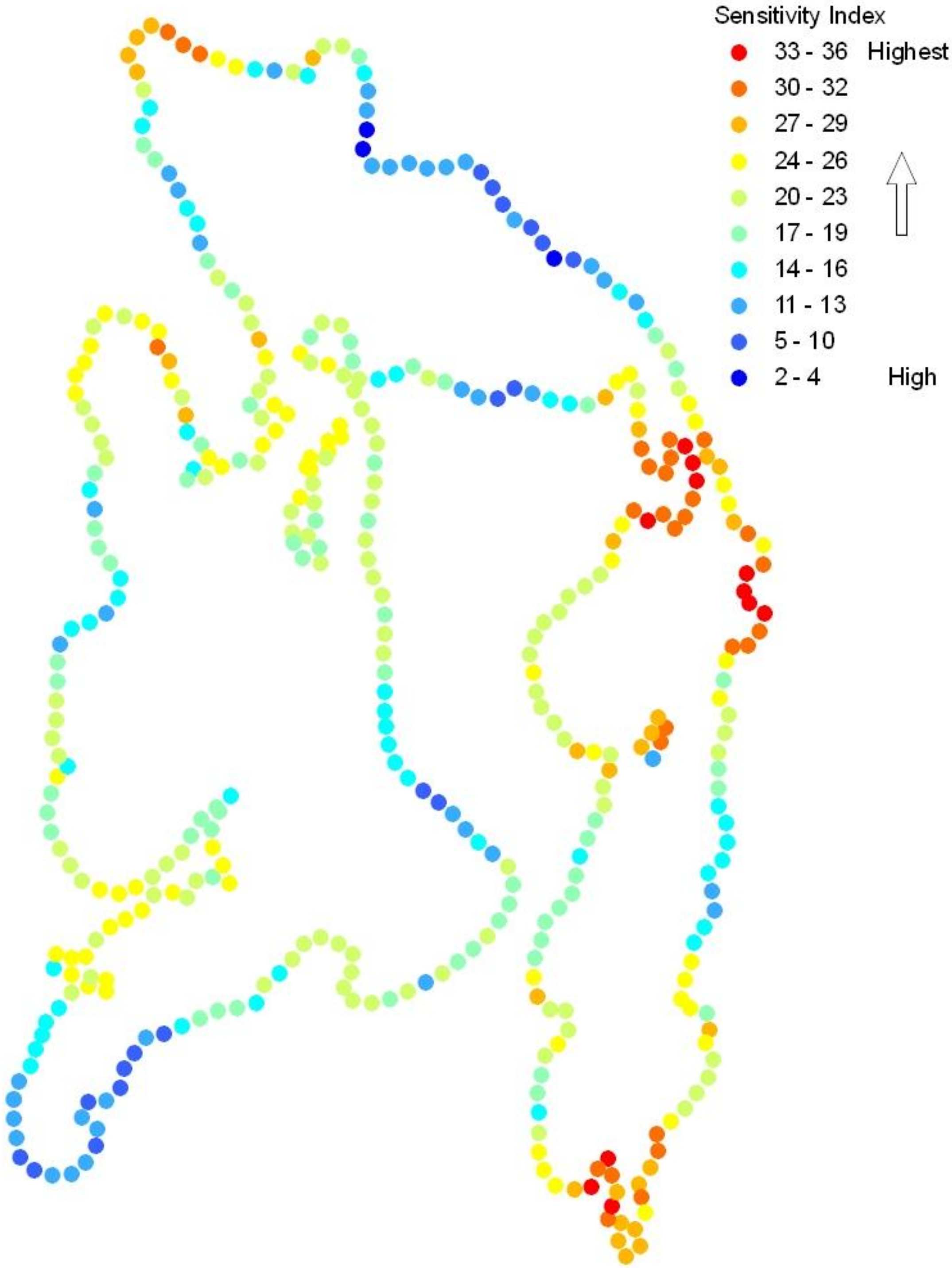


Figure 82. GIS-identified clusters of points with similar total scores. Red areas are those with high scores (i.e., areas of highly sensitive shoreland).

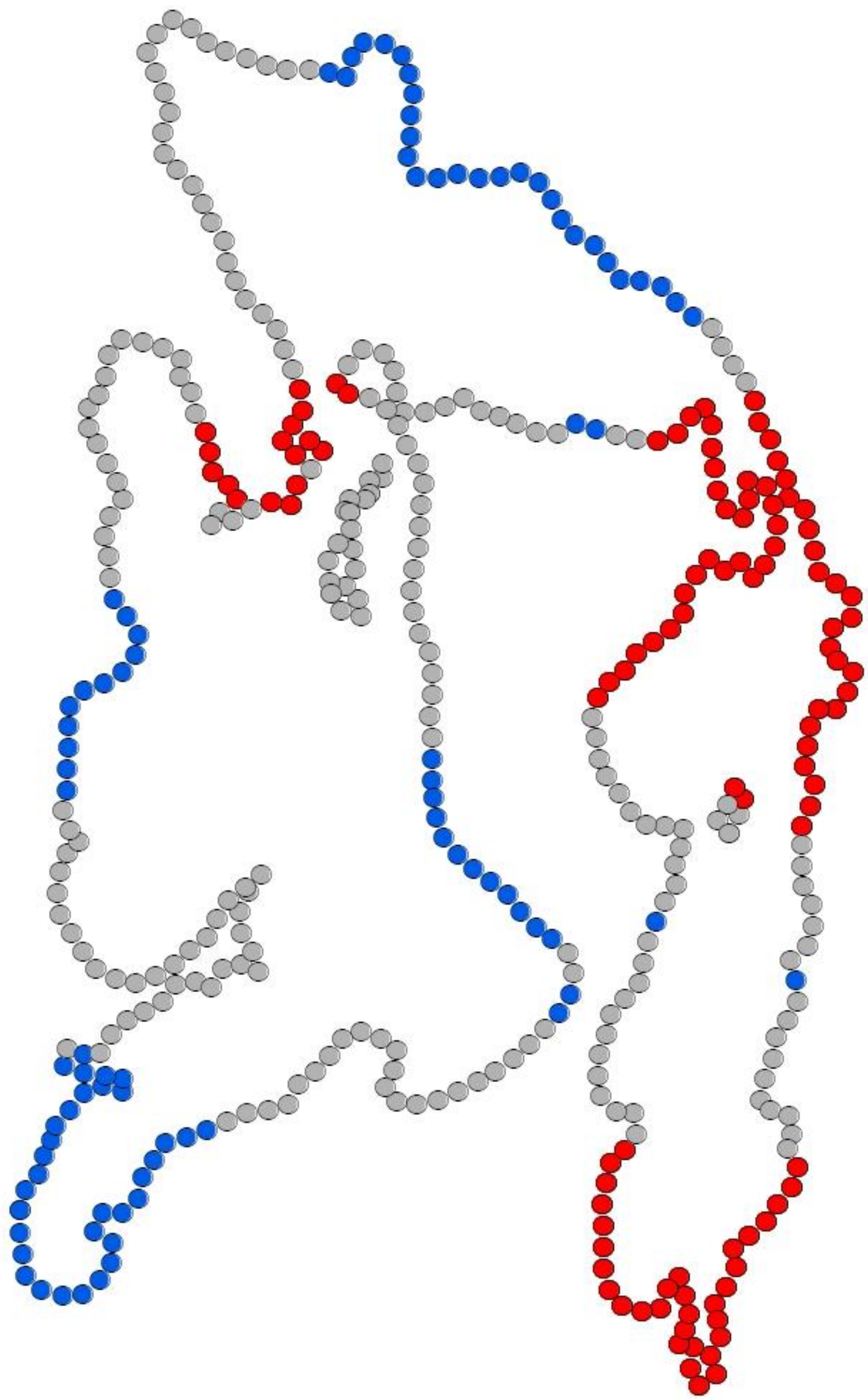
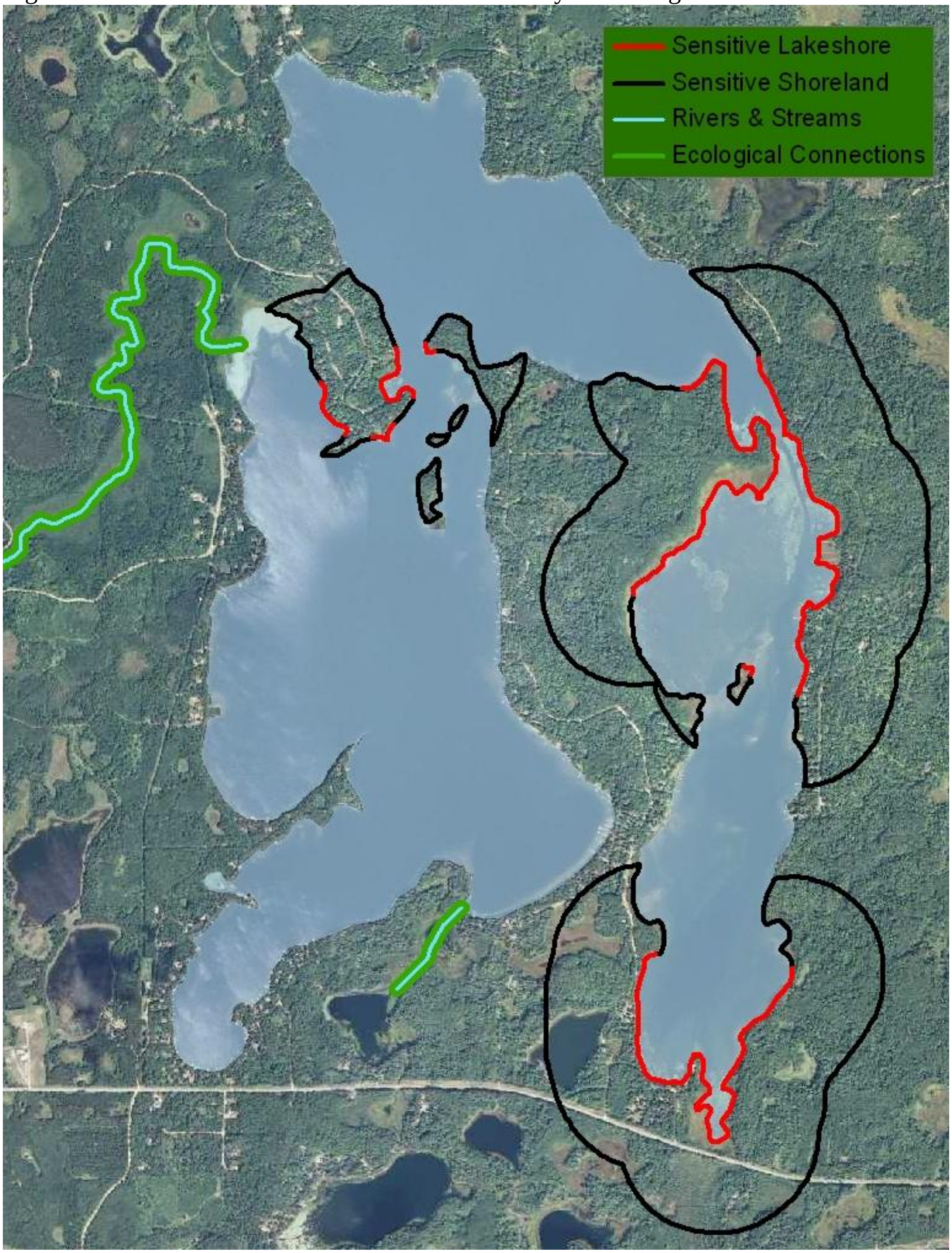


Figure 83. The sensitive lakeshore areas identified by the ecological model.



Habitat Connectivity
In addition to the sensitive shorelands identified through the GIS model, surveyors considered adjacent river shorelines that provide habitat connectivity to and from the lake shorelands. Aquatic habitat connectivity allows for the movement of organisms within a watershed. Organisms can move between existing habitats, colonize new areas, or recolonize former habitat in the wake of local extinctions. Daggett Brook flows through Washburn Lake as the primary inlet and outlet, and was identified as an important ecological connection. Depending on the existing shoreland classification of this river, the County may use the ecological connection recommendation to consider reclassifying to a more protective river class.

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

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

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

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

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

Sensitive Lakeshore
The bays and shallow areas of Washburn Lake contained a great diversity of plant and animal species, including species of greatest conservation need. Critical habitat, such as emergent and floating-leaf vegetation, was also present in high quantities. The ecological model displays these areas both as sensitive shoreline and as high priority shorelands. Although the shoreline itself is important, development and land alteration nearby may have significant negative effects on many species. Fragmented habitats often contain high numbers of invasive, non-native plants

and animals that may out-compete native species. The larger a natural area is, the more likely it is to support populations of native plants and animals. Large natural areas that support a diversity of species and habitats help comprise a healthy ecosystem. The inlets and outlet of Washburn Lake are also an important part of the lake ecosystem. They provide habitat connectivity between Washburn 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 Washburn Lake, and the value of the lake itself.

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Appendix 1. Shoreline emergent aquatic plants recorded in Washburn Lake, 2007 and 2008.

Description	Common Name	Scientific Name	Survey[a]
Grasses and Sedges	Canada bluejoint	*Calamagrostis canadensis*	1
	Wiregrass sedge	*Carex lasiocarpa* var. *americana*	2
	Wide-leaved sedge	*Carex* sp.	1
	Nut grass	*Cyperus* sp.	1
	Cotton-grass sedge	*Eriophorum* sp.	1
	Canada rush	*Juncus canadensis*	2
Wetland Forbs	Swamp milkweed	*Asclepias incarnata*	1, 2
	Beggarticks	*Bidens* sp.	1
	Marsh bellflower	*Campanula aparinoides*	1
	Bulb-bearing water hemlock	*Cicuta bulbifera*	1
	Spotted water hemlock	*Cicuta maculata*	1
	Common boneset	*Eupatorium perfoliatum*	2
	Spotted Joe-pye weed	*Eutrochium maculatum*	1, 2
	Bedstraw	*Galium* sp.	1
	Jewelweed	*Impatiens* sp.	1
	Iris	*Iris* sp.	1
	Northern bugleweed	*Lycopus uniflora*	1,2
	Tufted loosestrife	*Lysimachia thyrsiflora*	1
	Marsh mint	*Mentha arvensis*	1
	Monkey flower	*Mimulus* sp.	1
	Purple loosestrife	*Lythrum salicaria**	1
	Swamp candles	*Lysimachia thrysiflora*	2
	Monkey flower	*Mimulus ringens*	2
	Marsh forget-me-not	*Myosotis scorpoides**	1
	Purple-fringed orchid	*Platanthera psycodes*	1
	Tear thumb	*Polygonum* sp.	1
	Swamp fivefinger	*Potentilla palustris*	2
	Water dock	*Rumex* sp.	1
	Marsh skullcap	*Scutellaria galericulata*	1, 2
	Chickweed	*Stellaria calycantha*	1
	Northern marsh fern	*Thelypteris palustris*	1, 2
	Marsh St. Johns wort	*Triadenum fraseri*	1, 2
	Stinging nettle	*Utrica dioica*	1
	Blue vervain	*Verbena* sp.	1
Upland Grasses	Reed canary grass	*Phalaris arundinacea**	1,2
	Kentucky blue grass	*Poa* sp.*	1
	Meadow sweet	*Spiraea alba*	2

[a]Survey: 1 = August 1, 2007 (Perleberg and Loso, nearshore vegetation plots), 2 = July 23, 2008 (K. Myhre, MN DNR Minnesota County Biological Survey).

*Indicates plant is not native to Minnesota

Nomenclature follows MNTaxa 2009.

Appendix 1, continued. Shoreline emergent aquatic plants recorded in Washburn Lake, 2007 and 2008.

Description	Common Name	Scientific Name	Survey
Upland Forbs	Hog peanut	*Amphicarpa bracteata*	1
	Aster	*Aster* sp.	1
	Thistle	*Cirsium* sp.	1
	Wild strawberry	*Fragaria virginiana*	1
	Goldenrod	*Solidago* sp.	1
Shoreline Saplings, Shrubs and Vines	Speckled alder	*Alnus incana*	2
	Red maple	*Acer rubrum*	1
	Dogwood	*Cornus* sp.	1
	Virginia creeper	*Parthenocissus* sp.	1
	Green ash	*Fraxinus pennsylvanica*	1
	Meadow sweet	*Spiraea alba*	2

[a]Survey: 1 = August 1, 2007 (Perleberg and Loso, nearshore vegetation plots), 2 = July 23, 2008 (K. Myhre, MN DNR Minnesota County Biological Survey).

*Indicates plant is not native to Minnesota

Nomenclature follows MNTaxa 2009.

Appendix 2. Bird species list. Includes all species within Washburn Lake and shoreland recorded during surveys and casual observation, May – June 2008 & 2009.

Common Name	**Scientific Name**
Canada Goose	*Branta canadensis*
Trumpeter Swan	*Cygnus buccinator*
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Common Goldeneye	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Common Loon	*Gavia immer*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Red-shouldered Hawk	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*
Merlin	*Falco columbarius*
Sora	*Porzana carolina*
Killdeer	*Charadrius vociferus*
Ring-billed Gull	*Larus delawarensis*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Barred Owl	*Strix varia*
Common Nighthawk	*Chordeiles minor*
Ruby-throated Hummingbird	*Archilochus colubris*
Belted Kingfisher	*Megaceryle alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Wood-Pewee	*Contopus virens*
Alder Flycatcher	*Empidonax alnorum*
Least Flycatcher	*Empidonax minimus*
Eastern Phoebe	*Sayornis phoebe*
Great Crested Flycatcher	*Myiarchus crinitus*
Eastern Kingbird	*Tyrannus tyrannus*
Yellow-throated Vireo	*Vireo flavifrons*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Purple Martin	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Barn Swallow	*Hirundo rustica*

Appendix 2, continued.

Common Name	Scientific Name
Black-capped Chickadee	*Poecile atricapilla*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
House Wren	*Troglodytes aedon*
Sedge Wren	*Cistothorus platensis*
Veery	*Catharus fuscescens*
Hermit Thrush	*Catharus guttatus*
Wood Thrush	*Hylocichla mustelina*
American Robin	*Turdus migratorius*
Black-capped Chickadee	*Poecile atricapilla*
Red-breasted Nuthatch	*Sitta canadensis*
Gray Catbird	*Dumetella carolinensis*
Cedar Waxwing	*Bombycilla cedrorum*
Golden-winged Warbler	*Vermivora chrysoptera*
Yellow Warbler	*Dendroica petechia*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Cape May Warbler	*Dendroica tigrina*
Pine Warbler	*Dendroica pinus*
Black-and-white Warbler	*Mniotilta varia*
American Redstart	*Setophaga ruticilla*
Ovenbird	*Seiurus aurocapilla*
Northern Waterthrush	*Seiurus noveboracensis*
Common Yellowthroat	*Geothlypis trichas*
Scarlet Tanager	*Piranga olivacea*
Chipping Sparrow	*Spizella passerina*
Song Sparrow	*Melospiza melodia*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Baltimore Oriole	*Icterus galbula*
Purple Finch	*Carpodacus purpureus*
Pine Siskin	*Spinus pinus*
American Goldfinch	*Spinus tristis*