

MINNESOTA'S WILDLIFE ACTION PLAN 2025-2035

CONSERVING HABITATS AND BIODIVERSITY

LAKES



mn DEPARTMENT OF
NATURAL RESOURCES

NONGAME WILDLIFE PROGRAM

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Lakes

Habitat Description

Lakes are iconic and ecologically important in Minnesota, numbering over 11,800 at least 10 acres in size. Glacial activity formed most of Minnesota lakes (Schwartz & Thiel, 1954) with the physical characteristics of each individual lake differing based on factors including the local geology and hydrology at each site. Lakes vary from shallow to 280 feet deep for Lake Saganaga – Minnesota’s deepest inland natural lake. Lake Superior is 1,290 feet deep. Minnesota has several other very large lakes: Lake of the Woods (950,400 ac, shared with Canada), Upper and Lower Red Lake (288,800 ac), Mille Lacs (132,516 ac), and Leech Lake (111,527 ac) ([Lakes, Rivers, and Wetlands Facts](#)). There are many ways to classify lakes but for simplicity, here we categorize lakes based on depth.

Deep Lakes

Here, we use ‘deep lakes’ to refer to water bodies greater than 15 feet (5 meters) deep. Deep lakes vary in productivity, ranging from low productivity northeastern Minnesota lakes with clear water, cold temperatures and minimal aquatic vegetation to high productivity southern Minnesota lakes with high nutrient concentrations, low water clarity and lesser amounts of rooted aquatic vegetation or dominated by filamentous or planktonic algae. A combination of factors related to climate, geology, hydrology, land use and land cover results in the general trend of lakes increasing in water clarity and decreasing in productivity and alkalinity from southwestern

to northeastern Minnesota. Communities of fish and other aquatic organisms also vary along this distribution of lake types in Minnesota (Schupp, 1992).

The close association between aquatic plant communities and fish communities is well recognized. Aquatic plants provide food and oxygen, shelter and spawning areas and improved water quality for fish. Plants also provide excellent food and habitat for zooplankton, insects, waterfowl and other wildlife. Aquatic vegetation also anchors sediments, maintaining water clarity. Radomski and others (2019) provides a short synthesis of the scientific studies and management of aquatic plants to highlight lake vegetation management actions that may benefit fisheries.

Deep, thermally stratified lakes with abundant dissolved oxygen throughout the water column are especially threatened in Minnesota. These lakes are commonly referred to as Coldwater Lakes. They support cold-adapted fish species, including lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), cisco (*C. artedii*) and burbot (*Lota lota*). In Minnesota, there are about 1000 lakes that support these coldwater fish communities. In northeast Minnesota, these lakes also support a variety of isoetids plant species, which are submerged aquatic plants that are slow-growing, evergreen, and forming basal rosettes, such as quillworts (*Isocetes* spp.), which are unique to these low nutrient coldwater lakes. Eutrophication (excessive nutrients) and climate change is reducing the number of lakes that support these two communities.



Photo: Teal Lake, Grand Portage Indian Reservation, Beau Liddell

Shallow Lakes

There are an estimated 4000 shallow lakes in Minnesota, permanent or semi-permanent water bodies less than 15 feet (5 meters) deep at the deepest and over 50 acres (20 hectares) in size (see DNR's [Shallow Lakes Program](#)). These lakes are typically dominated by wetland habitat (see also Non-forested Wetlands sub-chapter). While shallow lakes can support fish populations, often low levels of dissolved oxygen in winter limit their numbers.

Shallow lakes may have abundant aquatic plant growth due to sunlight reaching much of the lake bottom in these basins. Stands of emergent and floating-leaved aquatic plants such as cattails (*Typha* spp.), bulrush (*Schoenoplectus* spp.), bur-reeds (*Sparganium* spp.) and water lily (Nymphaeaceae), as well as submerged plants such as stoneworts (Characeae), coontail (*Ceratophyllum* spp.) and pondweeds (*Potamogeton* spp.), may be present throughout the entire basin. These plants provide excellent food and habitat for zooplankton, insects, fish, waterfowl and other wildlife. Aquatic vegetation also anchors sediments, maintaining water clarity.

Shallow lakes are dynamic ecosystems that often express considerable ecological variability. Nutrients in shallow lakes, unlike in deeper lakes, are regularly mixing. Shallow lakes do not thermally stratify for long periods

of time so there is a constant exchange of nutrients between the sediments and water column. Wave action also can often reach the bottom of the lake, suspending sediments in the water. Droughts lower water levels in shallow lakes resulting in exposed sediments. This exposure stimulates beneficial aquatic plant growth. Low water levels can produce conditions for fish winterkills that can decrease or eliminate fish populations. Such low water cycles have been affected by higher levels of precipitation and watershed alterations including draining of wetlands into larger water bodies. Persistent and high water levels restrict plant growth and reduce water quality, allowing significant algal growth. Milder winters also favor fish such as bullheads (*Ameiurus* spp.) and common carp (*Cyprinus carpio*), which in shallow lakes can reduce water quality and diminish the abundance of rooted aquatic plants.

Some shallow lakes can support wild rice (*Zizania palustris*, also known as *manoomin*), designated as a SGCN plant in this Plan due to cultural significance to many of the Tribal Nations in Minnesota. *Manoomin* is harvested traditionally each fall. Minnesota supports more acres of wild rice than any other state in the country. Wild rice has been historically documented in 45 of Minnesota's 87 counties and is thought to have been even more broadly distributed prior to European settlement (see [Wild Rice Management](#)).



Photo: Encountering dense wild rice on a shallow lake survey in Beltrami County, Amy Westmark

Habitat Map

To depict Lake and Lakeshore habitat (see Figure 3.17), we compiled spatial data from several sources: Shallow Lakes Identified by DNR Wildlife, Lake Basin Morphology, the National Wetland Inventory, and the DNR Native Plant Community Layer (for more information, see Habitat Map Methods in Chapter 3: Habitats). We note included sub-types below; underlined items have links to online descriptions.

Associated Native Plant Community Classes by Ecological Systems

Lakeshore (LK)

[LK_i32 Inland Lake Sand/Gravel/Cobble Shore \(PDF\)](#)

[LK_i43 Inland Lake Rocky Shore \(PDF\)](#)

[LK_i54 Inland Lake Clay/Mud Shore \(PDF\)](#)

[LK_u32 Lake Superior Sand/Gravel/Cobble Shore \(PDF\)](#)

[LK_u43 Lake Superior Rocky Shore \(PDF\)](#)

National Wetlands Inventory

From the [National Wetland Inventory for Minnesota](#) (NWI) Layer we included only the Non-Vegetated Aquatic Community type from the Simplified Plant Community Classification attribute field.

Lake Basin Morphology

We included all lakes identified by the [Lake Basin Morphology](#) layer.

Shallow Lakes Identified by DNR Wildlife

We included all Lakes identified in the [Shallow Lakes Identified by DNR Wildlife](#) layer.

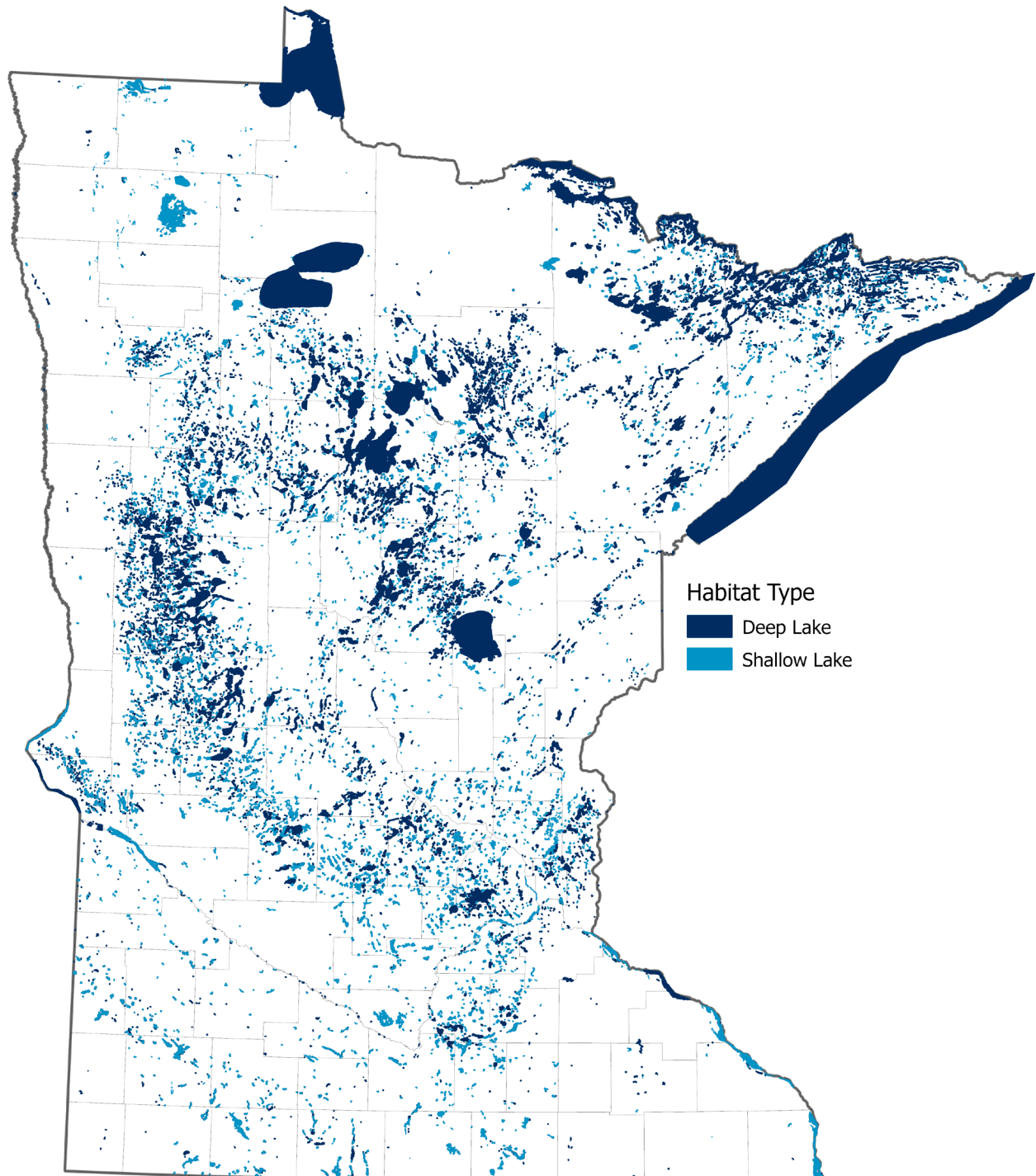


Figure 3.17. A map depicting Lake habitat in Minnesota including Non-Vegetated Aquatic Communities from the National Wetland Inventory for Minnesota as well as all lakes from the Shallow Lakes Identified by DNR Wildlife and the Lake Basin Morphology layers. Lakeshore habitat is not depicted in the map but is included in the data.

Conservation Overview

Minnesota's lakes receive considerable recreation and development, and are faced with threats from invasive species, shoreline alteration, altered hydrology, eutrophication and other pollution and climate change. Minnesota lakes face serious changes due to human alteration of land, water and air. Shorelines are altered by lakeshore property owners. Minnesota has currently lost 40 to 50% of its natural shorelines, and the rate of loss is estimated to be 1 to 2% per decade (Minnesota Natural Shoreline Partnership, 2023). As a lake's watershed becomes more developed, nutrient levels increase and water quality decreases due to pollution runoff, poor stormwater management, and shoreline phosphorus pollution from subsurface sewage treatment systems (septic systems). Nutrients reaching lakes from this pollution result in eutrophication, where lakes receive surplus nutrients which can result in excessive plant and algal growth. Agricultural lands shed large amounts of sediment and pollution and can contribute to lake water quality impairments. These lands are also drained with ditches and tiling, and thousands of acres of Minnesota's shallow lakes have been affected.

Recreation can be problematic in lake ecosystems. Boating in or near shallow water suspends lake sediments, destroys aquatic plants and erodes shoreline, especially when shoreline vegetation is removed and replaced with lawn down to the lake. Boat strikes can kill wildlife; species like turtles and loon chicks are particularly vulnerable. Fish stocking has altered the native aquatic faunal communities, and homogenized fish assemblages in Minnesota lakes (Radomski & Goeman, 1996). Aquatic vegetation can be affected by docks and shallow water disturbance (Radomski et al., 2010). Aquatic vegetation loss for north central Minnesota lakes was estimated at 15% (Radomski, 2006). Lead, a toxic element, is extensively used in fishing tackle. In popular angling lakes, tackle loss results in many metric tons of lead across lake bottoms annually (Radomski et al., 2006). Waterbirds ingest this

lead, which is often lethal. Additionally, other tackle and discarded fishing line can entrap wildlife.

Several invasive aquatic species are present in many Minnesota lakes, moved among lakes by gear and watercraft. The invasive aquatic plants [Eurasian watermilfoil \(*Myriophyllum spicatum*\)](#) and [curly-leaf pondweed \(*Potamogeton crispus*\)](#) have been present in Minnesota lakes for decades. Eurasian watermilfoil can grow to the water surface and compete with native plants. Several invasive aquatic animals also occur in many Minnesota lakes, including [common carp](#) and [zebra mussels \(*Dreissena polymorpha*\)](#). Common carp is widely distributed in central and southern Minnesota; this fish severely affects shallow lakes as their feeding habits uproot aquatic plants and suspends fine sediments into the water. Zebra mussels filter the water, which reduces food for larval fish and other animals and increases water clarity. Zebra mussels can change the food web and reduce the carrying capacity for popular fish such as walleye (*Sander vitreus*) ([Infested Waters List](#)).

Air pollution also degrades Minnesota lakes, including a range of chemicals such as mercury primarily from coal burning, pesticides via drift from farm and residential lands, microplastics and nanoplastics via wind and waves moving broken down plastic waste fragments, and greenhouse gases via combustion of coal and gas. Mercury bioaccumulates and biomagnifies through lake food webs, which affects wildlife and human health as a potent neurotoxicant ([Mercury, Minnesota Pollution Control Agency](#)). Fish from lakes in the northeast generally have the higher mercury concentrations (Radomski et al., 2024). Of particular concern, due to the magnitude of change, is climate change from burning fossil fuels. In Minnesota, lakes now have warmer water and shorter ice cover seasons. Fish communities are changing; those changes and other widespread environmental changes are anticipated to accelerate under future emissions scenarios ([Climate trends affecting lakes and rivers](#)).

Species in Greatest Conservation Need

Lakes provide habitat for 87 animal and 36 plant SGCN as primary or secondary habitat (see Table 3.16). Primary habitats are those that species rely on and use most consistently; loss or degradation of these habitats would have the most significant negative effect on their populations. Secondary habitats are used by the species less frequently.

Animals with more general habitat requirements are associated with multiple

habitat types, while specialists are associated with one or few. Habitat associations for most insects were not differentiated into primary and secondary habitats and are shown in the total column. Plant species were only associated with their single most primary habitat. Detailed tables associating each SGCN with the 15 habitats identified in the 2025-2035 SWAP can be found in [Appendix D](#) (animals) and [Appendix E](#) (plants). Examples of selected SGCN are described below; state-listed species are linked to their account in the [Rare Species Guide](#).

Table 3.16. Numbers of Species in Greatest Conservation Need associated with lakes as either primary or secondary habitat.

Species Groups	Primary Habitat	Secondary Habitat	Total
Amphibians	2	1	3
Birds	18	6	24
Fish	8	3	11
Mammals	0	9	9
Reptiles	1	0	1
Bees	-	-	4
Beetles	-	-	2
Caddisflies	12	3	15
Dragonflies and Damselflies	-	-	13
Mayflies	-	-	2
Mussels	1	0	1
Snails (aquatic)	1	0	1
Spiders	-	-	1
Plants	36	-	36
Total	79	22	123

Amphibians

The [mudpuppy \(*Necturus maculosus*\)](#) is Minnesota's only fully aquatic salamander and is restricted to medium or large rivers and lakes (primarily in deep lakes but secondarily with shallow lakes). Lakes may be used more often in western Minnesota than farther east. Submerged rocks or logs provide cover and important breeding habitat. Eastern newt (*Notophthalmus viridescens*) occupies shallow lakes and will be threatened by a pathogenic fungus if or when it arrives to North America. [Blanchard's cricket frog \(*Acris blanchardi*\)](#) may utilize lakes, particularly when they are fed, or are near, rivers and streams. Large, deep lakes, even with predatory fish, may be used but generally only if they are associated with a river or stream.

Birds

Of 24 SGCN bird species using lakes, 8 are primarily limited to shallow lakes such as the American bittern (*Botaurus lentiginosus*), [common gallinule \(*Gallinula galeata*\)](#) and [Wilson's phalarope \(*Phalaropus tricolor*\)](#). Together, the 22 bird SGCN utilizing lake habitats represent 28% of all bird SGCN.

Both shallow and deep lakes are well recognized for their importance to waterfowl and other waterbirds. Many of these species will use open water during migration, as well as for foraging and loafing during the breeding season. However, most SGCN waterbirds require emergent vegetation, or in some cases islands or other shoreline habitat, for nesting.

Waterfowl species, such as the American black duck (*Anas rubripes*), canvasback (*Aythya valisineria*) and northern pintail (*Anas acuta*) nest in emergent marsh or grassland vegetation adjacent to lake shores or open water in marshes. Buffleheads (*Bucephala albeola*), restricted to far northwestern Minnesota during the breeding season, are cavity-nesters. American bitterns, least bitterns (*Ixobrychus exilis*) and common gallinules require relatively dense emergent vegetation, so only nest on portions of shallow lakes with suitable marsh vegetation. Four SGCN grebe species (Horned

(*Podiceps auritus*), red-necked (*Podiceps grisegena*), eared (*Podiceps nigricollis*) and western (*Aechmophorus occidentalis*)), plus [Franklin's gulls \(*Leucophaeus pipixcan*\)](#), black terns (*Chlidonias niger*) and [Forster's terns \(*Sterna forsteri*\)](#), build floating nests anchored to emergent vegetation, or on platforms or piles of vegetation. Franklin's gulls are commonly observed when migrating and during the breeding season, but only nest in very large colonies on one or two large, marshy lakes in northwestern Minnesota.

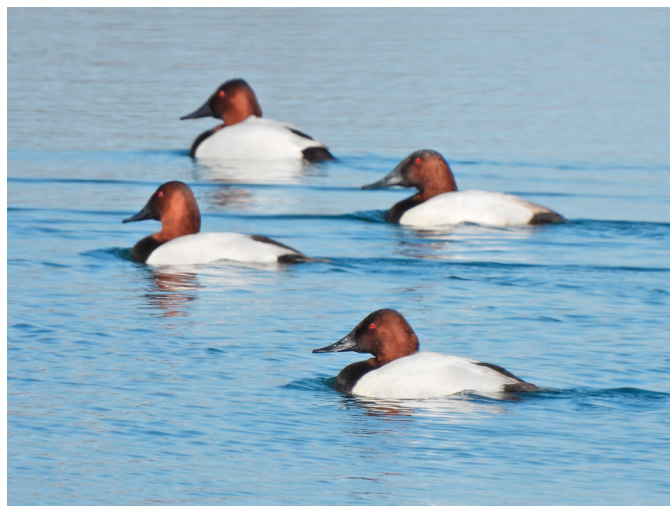


Photo: Canvasback ducks, Julia Geschke

[American white pelicans \(*Pelecanus erythrorhynchos*\)](#) nest on higher portions of shore habitats, typically on treeless islands, but feed or loaf on a wide variety of lakes and marshes. Black-crowned night herons (*Nycticorax nycticorax*) are a colonial-nesting species that forages along shorelines and in marshes. In Minnesota, they usually nest either in trees on islands, or (less commonly) on floating platforms of marsh vegetation.

During migration, many shorebird species use lake shoreline communities as resting and feeding sites. Two SGCN shorebirds do not nest in Minnesota but solely occur in the state as migrants. The red knot (*Calidris canutus*) is a relatively rare migrant, most often found on sand beaches of Lake Superior (particularly those on Minnesota Point). They can also be found, very rarely, on beaches or other types of shorelines away from Lake Superior. Buff-breasted sandpipers (*Tryngites subruficollis*) are

a migrant most often found in open uplands with very short or sparse vegetation. When they are in areas associated with lake shores they do not occur at the water-shoreline interface (wave zone), but may use higher, drier portions of shore habitats.

The Wilson's phalarope is a shorebird species that nests in Minnesota, often associated with sedge or grass dominated wetlands such as rich fen and wet prairie. Suitable nesting habitat includes relatively wide, floating sedge mats associated with the shorelines of lakes and rivers. Breeding sites include the shores of large, deep lakes (e.g., Lake-of-the-Woods and Leech Lake). Phalaropes are more aquatic than most shorebirds, frequently feeding while swimming in open water, usually in relatively shallow water close to shore.

[Piping plovers \(*Charadrius melodus*\)](#) now nest sporadically in only one location in Minnesota, along sand beaches on the south shores of Lake of the Woods, although they once nested along the dunes of Lake Superior. Critical habitat for this species has been designated by the U.S. Fish and Wildlife Service on Pine and Curry islands and also in the Duluth Harbor area. [Common terns \(*Sterna hirundo*\)](#) nest in a handful of colonies on islands with rocky or sandy shorelines in large lakes such as Leech Lake, Mille Lacs Lake, Lake of the Woods and Lake Superior (Duluth Harbor).

Fish

Lake-dwelling fish SGCN include several species. Pugnose shiner (*Miniellus anogenus*), [Northern sunfish \(*Lepomis peltastes*\)](#) and [least darter \(*Etheostoma microperca*\)](#) are associated with or depend on aquatic vegetation. These fish species are adversely affected by alterations to natural shorelines and increased nutrient loads. Lake sturgeon, a fish of large rivers and lakes, is affected by loss of connectivity due to dams (see River subchapter). Deepwater sculpin (*Myoxocephalus thompsonii*) inhabit deep lakes with cold waters, which are threatened by eutrophication and climate change. See also the Fish sub-chapter of Chapter 2.



Photo: Pugnose shiner, Matthew Kvam

Mammals

Perhaps the mammal SGCN most closely identified with lake habitats is the [moose \(*Alces alces*\)](#). Moose depend on lakes for drinking water. During the spring and summer, they are also attracted to lakes and their shoreline habitats for an abundance of favorite foods including sedges, horsetails, and aquatic plants such as pondweeds and water lilies. SGCN bat species not only utilize lakes for drinking but are also attracted to lakes and their riparian shorelines during the summer months for the aquatic insects that emerge from the water's surface.

Reptiles

[Blanding's turtle \(*Emydoidea blandingii*\)](#) use a variety of aquatic habitat, including wetlands and lakes. Deep lakes are usually avoided when shallow, well-vegetated wetlands are nearby. Populations in the southern portion of their range are threatened by warming water temperature due to climate change.

Insects

Lakes provide primary habitat for 12 species of caddisflies (Trichoptera) as well as secondary habitat for an additional 3 species, as well as habitat (unspecified as to primary or secondary) for 13 species of dragonflies and damselflies (Odonata). Please see the Aquatic Invertebrates sub-chapter for more information.

Mussels

Minnesota is home to the only known lake endemic freshwater mussel species, the lake floater (*Pyganodon lacustris*), which requires silt or soft mud bottoms, and low to non-existent flow. This species historically occupied lakes as far south as the Iowa/Minnesota border but now is only known from central to northern Minnesota.

Plants

The 36 vascular plant SGCN found associated with lake habitat represent 8% of all the SGCN plants.

Moyle (1945) suggested three aquatic floral regions of the state based on water chemistry data, which included soft-water, hard-water, and alkaline (Table 3.17).

A relatively small group of plants have evolved to live in the Minnesota's aquatic environments with special adaptations to survive unique

habitat conditions across the state. In soft-water lakes of the northeast, [American awlwort \(*Subularia aquatica ssp. americana*\)](#), [algae-like pondweed \(*Potamogeton confervoides*\)](#) and [lavender bladderwort \(*Utricularia resupinata*\)](#) occur in the shallow sandy sites of low nutrient, clear water lakes. Human-caused nutrient increases in these lakes can result in lower clarity and a shift to more leafy aquatic plants at the detriment of the small, low-nutrient adapted, rare species. In central Minnesota, [purple-flowered bladderwort \(*Utricularia purpurea*\)](#) and [spotted pondweed \(*Potamogeton pulcher*\)](#) appear restricted to very few lakes but may grow locally abundantly within sites. Direct removal of vegetation for recreational use as well as declines in water clarity threaten these species. Widgeon grass (*Ruppia maritima*) and [spiny naiad \(*Najas marina*\)](#) are “salt-loving” submerged plants that are adapted to the naturally higher alkalinity of western Minnesota lakes. Drainage and upland development have degraded many of these habitats.

Table 3.17. Limnologists (lake specialists) and biologists have classified midwestern lakes into biologically meaningful categories, often using a combination of hydrology and water chemistry (Sather 1991).

Aquatic Flora	Region	Alkalinity	Sulphate	pH
Soft-water	northeast	<40 ppm	<5 ppm	6.8-7.5
Hard-water	central	90-250 ppm	<50 ppm	8.0-8.8
Alkaline	western	>150 ppm	>125 ppm	8.4-9.2

Case Study: Minnesota Common Loon Restoration Project

In 2010, the Deepwater Horizon oil spill negatively affected the wildlife and ecosystems in the Gulf of America, and an environmental damage settlement of over \$20 billion was approved. Minnesota's state bird, the common loon, winters on coastal waters. Radio telemetry work and chemical analysis of eggs indicated that loons overwintering in the areas affected by the spill breed in Minnesota. The Open Ocean Trustee Implementation Group provided funds to Minnesota DNR to restore loons lost from the spill in a project spanning 2021-2025.

A partnership between the DNR, United States Geological Survey USGA, U.S. Fish and Wildlife Service and Minnesota Pollution Control Agency (MPCA) was established to accomplish the following goals: 1) acquire and protect lakeshore nesting and foraging habitat, 2) enhance habitat and increase lake stewardship and 3) reduce lead exposure through advocacy of non-toxic tackle.

Progress on goals:

1. As of July 2025, over 6.5 miles of lakeshore habitat across four parcels has been purchased and protected perpetually as DNR Aquatic Management Areas or Wildlife Management Areas. Two more acquisitions are planned for later in 2025. Extensive surveys confirm nesting and foraging use of the protected habitats by loons.
2. Artificial Nesting Platforms (ANPs) are floating platforms covered in natural vegetation that loons use to nest. They reduce nest failure from predation and water fluctuation. Volunteers were recruited to build and deploy 44 artificial loon nesting platforms to enhance nesting success of loons on lakes with low reproductive output, and the DNR and USGS has engaged in a research study to assess the efficacy of these nesting platforms as conservation tools. Teams of researchers monitored loons on these lakes throughout the reproductive season and provided detailed data on habitat use, nest success/failure, and productivity from nesting platforms. Platform use increased each consecutive year of deployment (1% in 2023, 18% in 2024, and 34% in 2025). Efforts are currently underway to continue the nest platforms project beyond 2025. Additionally, substantial outreach efforts have increased public engagement and interest in loon conservation and shoreline preservation and restoration (see Public Engagement Chapter)
3. The MPCA led a non-toxic fishing advocacy effort that has included 213 public engagement events and has provided 33,700 free non-toxic tackle sample packs between 2022-2024 ([Getting lead out of fishing tackle](#))

This loon conservation work will continue. By leveraging partnerships with local sports teams (Minnesota United Football Club; The Loons) the DNR has created a new permanent position, the Loon Program Coordinator, to continue and develop loon conservation, research, and outreach efforts across the state and to coordinate citizen science loon monitoring efforts. For more information on the Loon Restoration Project, see [Minnesota Loon Restoration Project](#) and the annual reports: [2021](#), [2022](#), [2023](#), [2024](#).



Photo: Loon on artificial nesting platform, Luke Fara, USGS

Primary Stressors in this Habitat

Throughout Minnesota, habitats have been lost and degraded due to pressures associated with human settlement, subsistence, livelihoods, and recreation. Indeed, habitat loss or alteration remains the primary threat to most, if not all, SGCN. In this section, we identify key “stressors” that may continue to contribute to habitat degradation and loss. The list is adapted from a globally recognized threats lexicon developed by the International Union for the Conservation of Nature (Salafsky et al., 2024). For additional details, see the “Stressors” section in Chapter 1: Species in Greatest Conservation Need.

It is important to note that some of the factors listed as “stressors” can also be used to advance conservation goals. Broad terms such as “fire management” reflect the dual nature of these factors as they may function as stressors in some contexts while serving as valuable conservation tools in others. For example, an intense wildfire following prolonged fire suppression may cause significant stress for the habitat and species affected, while prescribed fire, when planned appropriately, can enhance ecosystem health and resilience.

Information about a subset of primary stressors specifically affecting this habitat is included below, followed by a set of conservation actions addressing those stressors. See also: [Stressors to Biological Communities in Minnesota’s Lakes](#).



Development

Minnesota has currently lost 40 to 50% of its natural shorelines, and the rate of loss is estimated to be 1 to 2% per decade (Minnesota Natural Shoreline Partnership, 2023). Shorelines are often altered by lakeshore property owners. As a lake’s watershed becomes more developed, nutrient levels increase and water quality decreases due to pollution runoff, poor stormwater management, and shoreline phosphorus pollution from subsurface sewage treatment

systems (septic systems), and a lack of natural shoreline vegetation between lawns and the lake.

Both permitted and illegal removal of aquatic vegetation (via mechanical or herbicide) can be threats to lake habitats, as aquatic vegetation is important for many species including fish and loons. Common Loons (*Gavia immer*) nest near the water edge on lakes and use mud and aquatic vegetation to create the nest. Minnesota is losing natural shorelines due to shoreline development and property management practices that include clearing of natural vegetation and mowing of grasses; these are threats to loon nesting success and lake water quality ([Minnesota’s Vanishing Natural Shorelines: A Loss that Contributes to Degraded Lake Quality](#)).

Artificial shoreline stabilization structures are built to protect human infrastructure and prevent erosion. Riprap, bulkheads, jetties and other shoreline protection strategies are designed to alter the behavior and movement of sand and sediments. These strategies can effectively retain or increase sediment in select locations while eroding shoreline down shore. Artificial structures can eliminate access to beaches for some shore nesting species and beach erosion can degrade or eliminate nesting and foraging habitat for shore nesting SGCN (Prosser et al., 2018).



Crop Production

Some areas of crop production depend greatly on groundwater appropriation to sustain improved and reliable crop yields. These areas may also influence water levels of lakes that provide critical habitat to a variety of species. Direct surface water appropriation may also be used for crop production which more immediately affects water levels and flows of the surface water. Reduction in flows and water levels during critical times of the season, such as August, may affect certain species sensitive to warmer water temperatures and reduced habitat.

Drainage from agricultural fields within the watershed of a lake, either by surface flow, or by drain tiles, can affect downslope hydrology and water quality through the transmission of sediments and chemicals. Agricultural lands contribute as a leading cause of lake water quality impairments and contribute substantially to lake eutrophication. Over half of Minnesota's wetlands and shallow lakes have been ditched and drained. Wetland losses have been the greatest in the Prairie Parkland ecoregion where well over 90% of the wetlands have been drained or filled. 40% to 50% of remaining wetlands have altered hydrology from storm water inputs, roads, or drain tiles (Genet et al., 2019). The water conveyed through drainage systems often has increased levels of sediments, nutrients and chemicals that further impair the receiving water bodies. Excess phosphorus and silt remain in lakes and wetlands and result in degraded water quality and wildlife habitat. Tile drainage bypasses natural riparian areas that would normally serve to filter some of the nutrients and sediments so many of the wetlands remaining are in poor condition. Blann et al. (2009) is a thorough review of effects of agricultural drainage on aquatic ecosystems.



Livestock Management

Large livestock facilities can create runoff that may affect receiving waters and the habitats that many species depend upon. They can also affect groundwater resources and surface waters depending on the source of water being used.



Mining and Quarrying

Mining or quarrying operations may affect hydrology or produce sediments that can affect waters with sediments and chemicals.



Roads, Trails, and Railroads

Roads and railways can disrupt connectivity to lake habitats. In general, increased impervious surfaces adjacent to lakes and in watershed lead to increased

sedimentation, turbidity, and chemical levels. De-icing salts dispersed on roadways increase the salinization of the lakes ([Chloride, Minnesota Pollution Control Agency](#)).



Utility Corridors

Powerlines present a risk to waterfowl when situated between feeding and roosting areas. This is especially true for lines near lakes, rivers and wetlands. Less agile birds, such as trumpeter swans are particularly susceptible to collision with overhead lines located near waterbodies (APLIC, 2012).



Timber Harvest

Timber harvest is a forest management tool that can affect wildlife habitat by changing forest and woodland structural and compositional diversity. Forest management decisions, including inaction, typically have positive effects for some species and negative effects for others. Runoff from timber harvest sites may introduce sediments into waterways including lakes, particularly if buffer areas are not scaled appropriately.



Fishing

A leading cause of mortality in the common loon and other waterbirds is ingestion of lead fishing tackle. In popular angling lakes, tackle loss results in many metric tons of lead across lake bottoms annually (Radomski et al., 2006). This can occur when loons eat fish that have ingested lead tackle, eating bait with lead tackle attached, or from eating tackle directly off the lake bottom. Loons may also get entangled in loose fishing line or injured from ingested hooks. Lead is particularly toxic when ingested as the grinding mechanisms and acidic environment of the gizzard cause the lead to be transported into the blood and organs. A small lead fishing split shot weight can kill a loon in a matter of weeks ([Get the lead out, Minnesota DNR](#), [Lead Poisoning in Loons, U.S. Fish & Wildlife Service](#)).



Recreation

Large powerful boats, and particularly the use of wake boats (designed to throw a big wake for watersports) can disrupt vegetation and nesting waterbirds including loons and leads to erosion. Boat strikes commonly kill wildlife like loon chicks and turtles during the summer.

Human disturbance on beaches and islands serving as nesting and foraging areas for birds such as piping plovers and common terns disrupts nesting behavior and can limit reproductive success (DeRose-Wilson et al., 2018; Stantial et al., 2021). Beach access at times is a threat and temporary beach closures are needed.

Boats, docks, and fishing bait that are moved among lakes and not properly decontaminated contribute to the spread of invasive species (see below).



Dams and Water Management

Drainage of wetlands and fields in watersheds of lakes can affect seasonal hydrology of the remaining water bodies by delivering water at a faster rate through drainage networks. Dissolved nutrients and sediments can also be elevated in this runoff, leading to excess nutrients in the receiving water bodies. Natural connections between water bodies have been influenced by dams, bridges and culverts and impede species movement and alters habitat. See also Rivers sub-chapter.



Photo: Pickerelweed on Moose Lake, Rachel Kranz

Loons nest near the water's edge, and waterbodies that undergo large fluctuations in water levels may flood nests and reduce reproductive success of loons and other shore nesting species. (Windels et al. 2013). Water level fluctuations affect nesting and foraging habitat conditions for shore nesting bird species. High water levels erode or eliminate nesting sites (Maxson & Haws, 2000). Water level fluctuations also affect the nesting habitat of overwater nesters such as western grebes and red-necked grebes, black and Forster's terns. Water level management that results in rapid water level changes during the nesting season can destroy nests (Bracey et al., 2024).



Invasive Species (Problematic Non-native Species)

Several invasive aquatic species are present in Minnesota lakes. [Eurasian watermilfoil](#) and [curly-leaf pondweed](#) have been present in Minnesota lakes for a century and decades, respectively. Eurasian watermilfoil can grow to the water surface and compete with native plants. Curly-leaf pondweed is well adapted to nutrient-rich or nutrient polluted lakes. A newer invasive species, [starry stonewort](#) (*Nitellopsis obtusa*), is associated with native species declines and drastic changes in the structural complexity of plant communities.

Invasive aquatic animals present in many Minnesota lakes include [common carp](#), spiny water flea, rusty crayfish and zebra mussels. Common carp is widely distributed in central and southern Minnesota, disrupting shallow lakes as their feeding habits uproot aquatic plants and suspends fine sediments into the water. Zebra mussels filter the water, which reduces food for larval fish and other animals and increases water clarity. So, zebra mussels can change the food web and reduce the carrying capacity for popular fish such as walleye.

Shipping in the Great Lakes does not pose a direct threat to Lake Superior's fish, but the ships themselves are a vector for the

introduction of invasive species when they release their ballast water. As of April 2010, 89 non-native aquatic species had already been introduced into Lake Superior. Among the long list of non-native species are the following fish: ruffe (*Gymnocephalus cernuus*), round goby (*Apollonia melanostomus*), sea lamprey (*Petromyzon marinus*), alewife (*Alosa pseudoharengus*) and rainbow smelt (*Osmerus ordax*). Changes to ballast water regulations have reduced the rate of invasive species introduction by an estimated 85% since 2006 (Ricciardi & MacIsaac, 2022). Many biologists consider aquatic invasive species the biggest threat to the Great Lakes (Lake Superior Binational Program, 2014; see also Non-native Invasive Species and [Infested Waters List, Minnesota DNR](#)).



Water-borne Pollution

Eutrophication occurs when a lake becomes enriched in nutrients which leads to excessive plant and algal growth and is a major threat to Minnesota lakes. Nonpoint source pollution comes from many diffuse sources and includes phosphorus, nitrogen, sediment, bacteria and other contaminants, in part. Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. As runoff flows, it picks up and carries away natural and human-made pollutants, depositing them into lakes, rivers, wetlands, and groundwater and estuaries ([EPA NPS Webpage](#)). These nonpoint source pollutants represent the largest combined contribution (an estimated 86%) to the state's water pollution ([MPCA Water Quality Initiatives](#)). Water quality measured by nutrients and contaminants has been shown to decline with higher agricultural or urban development in the watershed. Some key effects include excess algal growth, reduced plant diversity, and reduced diversity in fish and invertebrate communities ([DNR Water quality non-point sources](#)).

Polyfluoroalkyl Substances (PFAS) and Polychlorinated biphenyls (PCBs) are

human made chemicals that are both banned in Minnesota, but persistent in the environment. PFAS may get into lakes from industrial discharge, leaching from landfills into groundwater, and from firefighting foam products. The specific effects of these pollutants on wildlife are poorly known, but their presence is documented in many fish and is reported on the [DNR Lakefinder website](#) for specific lakes.

Sulfates are naturally occurring chemicals that can be found in discharges from wastewater treatment plants and industrial facilities such as mines. Sulfates may be detrimental to wild rice; to protect this valuable resource, in Minnesota there is a long-standing water quality standard of 10 mg/L sulfate for waters used for production of wild rice ([Protecting wild rice waters](#), Minnesota Pollution Control Agency).



Air-borne Pollution

Air pollution includes a large range of chemicals, from mercury via primarily from coal burning, pesticides via drift from farm and residential lands ([Introduction to Pesticide Drift, U.S. EPA](#)), microplastics and nanoplastics via wind and waves moving broken down plastic waste fragments, to greenhouse gases via combustion of coal and gas. Mercury bioaccumulates and biomagnifies through lake food webs, which affects the wildlife and human health as it is a potent neurotoxicant. Fish from lakes in the northeast generally have the higher mercury concentrations (Radomski et al., 2024).



Changes in Temperature related to Climate

Minnesota has experienced a clear warming trend over the past century. Between 1895 and 2020, average statewide temperatures increased by 3.0 degrees Fahrenheit (°F; [Climate Trends](#)). This warming has become more pronounced in recent decades and during the winter months. Since 1985, average winter temperatures in Minnesota have risen by 5.4° F, with average winter low temperatures increasing even

more significantly by 6.8° F ([Climate Change in Minnesota](#)). These changes have led to a shortened season of snow cover and a reduction in lake ice duration by 10-14 days over the past 50 years (Minnesota Pollution Control Agency and Minnesota Department of Commerce 2025). Furthermore, these shifts in thermal regimes are ecologically significant. Many species are adapted to narrow temperature ranges, and such rapid changes can result in increased thermal stress, the spread of invasive species, and heightened disease and pathogen risks (Ratcliffe et al., 2025).

This warming trend is expected to continue. By mid-century (2040-2059), Minnesota's average annual temperature is projected to rise by an additional 3.8 - 4.5 °F, depending on future greenhouse gas emissions scenarios (Liess et al., 2022; [Climate Change in Minnesota](#)). Climate change does not act in isolation, interacting with invasive species dynamics, land-use change and shifts in water quality and quantity, compounding ecological effects (He et al., 2019; Finch et al., 2021). For additional context and resources, refer to the Climate Adaptation section in Chapter 6: Implementation.

Minnesota's lakes, including coldwater and small shallow lakes, are vulnerable to rising temperatures driven by climate change. Coldwater lakes capable of supporting species like lake trout (*Salvelinus namaycush*) and cisco (*Coregonus artedii*) require cool, oxygen-rich waters to sustain their sensitive aquatic communities. However, as average temperatures rise, particularly in winter and summer, these lakes are experiencing thermal stress that threatens the long-term viability of cold-adapted species (Jacobson et al., 2010; Fang et al., 2012). Warming water reduces the volume of suitable cold, oxygenated habitat, often referred to as an "oxythermal squeeze," which can lead to population declines or local extirpations (Jane et al., 2024).

Rising air temperatures have also disrupted the natural freeze-thaw cycles of Minnesota's lakes.

Ice-in now occurs later in the fall and ice-out earlier in the spring, significantly shortening the duration of seasonal ice cover. These shifts change the probability of winterkill in shallow lakes, alter stratification and mixing patterns, and affect the timing and productivity of aquatic food webs (Magnuson et al., 2000; Sharma et al., 2019).

The ecological and recreational consequences of these changes may be severe. Angling opportunities for coldwater species may diminish, while lakes become more susceptible to algal blooms and invasive species like [common carp \(*Cyprinus carpio*\)](#) and [Eurasian watermilfoil \(*Myriophyllum spicatum*\)](#), which thrive in warmer, nutrient-rich conditions.



Changes in Precipitation and Hydrology related to Climate

From 1895 to 2020, Minnesota's average annual precipitation increased by 3.4 inches ([Climate Trends](#)). The state has also seen a notable rise in the frequency and intensity of heavy precipitation events. Since 2000, very heavy rains (6 inches or more in a single day) have occurred two to three times more frequently than during the 20th century (Williams-Sether & Sanocki, 2025; [NOAA National Centers for Environmental Information State Climate Summaries 2022: Minnesota](#)). These extreme events have led to a corresponding increase in flooding, which can disrupt ecosystems, human infrastructure and water quality (Williams-Sether & Sanocki, 2025).

Future projections indicate continued increases in annual precipitation, especially during the winter and spring months, which are likely to exacerbate flooding risks. The same climate models also forecast an increase in late summer drought events, underscoring the variability and unpredictability of hydrologic patterns under a changing climate ([Climate Change in Minnesota](#)). By mid-century (2040-2059), average annual precipitation is projected to increase by up to 1.2 inches, depending on emissions scenario (Liess et al., 2022;

[Climate Change in Minnesota](#)). This seemingly counterintuitive pattern — wetter winters and springs, punctuated by hotter, drier late summers — has profound implications for water availability, wetland health, soil stability, and species dependent on seasonal hydrologic cycles (Runkle et al., 2022). For more information and resources for climate-adapted management strategies, see the Climate Adaptation Section in Chapter 6: Implementation.

More specifically in lake systems across Minnesota, an anticipated higher incidence of heavy storms may increase flooding, runoff, affect water level fluctuations in lakes and alter hydroperiods in shallow lakes. Also, high wind events on large lakes can generate intense wave action which threatens shorebird nesting habitat and aquatic plant establishment. Snow on frozen lakes acts as an insulating barrier, and influences ice formation and ice melt, and light penetration during winter. Changing patterns of snowfall will accordingly affect lakes as well ([Climate trends affecting lakes and rivers, Minnesota DNR](#)).

Case Study: Monitoring Minnesota's Lakes

In the Land of 10,000 Lakes, a suite of complementary lake monitoring programs provides necessary information for proper lake management. Below, we highlight several of the DNR's lake monitoring programs.

Lake Index of Biotic Integrity: The DNR and Minnesota Pollution Control Agency (MPCA) monitor the health of many lakes by tracking the fish and plants with indices of biological integrity ([Lake Index of Biotic Integrity](#)). Indices of biotic integrity (IBI) use the diversity and species composition of community to describe the relative health or impairment of the ecosystem as compared to what would be expected if the ecosystem was undisturbed by anthropogenic activities. When applied to plants these are termed 'floristic quality indices' (FQI). For Minnesota lakes, aquatic ecosystem health is described by the fish community with a fish IBI, supplemented by a plant FQI. The fish IBI was developed for four different lake types to accurately evaluate different expectations for their associated fish communities: deep lakes with complex shaped shorelines, moderately deep lakes with rounder shorelines, moderately shallow, heavily vegetated lakes, and shallow lakes (where more than 80% of the lake is 15 feet or less deep). Fish-based IBI scores are used by DNR staff to place lakes into one of six assessment categories: exceptional, fully supporting, vulnerable, not supporting (impaired), inconclusive information and insufficient information.

Lake Water Quality Monitoring: All lakes over 500 acres and a subset of smaller lakes are assessed for water quality by MPCA ([Lake Water Quality Monitoring](#)). The goal of this monitoring is to determine if water quality supports recreation, compare regional differences in water quality, and identify long term trends. Based on these results, a total maximum daily load (quantity of pollutants a watershed can receive without violation quality standards) and a watershed and restoration and protect strategy are completed for each watershed. These reports are the foundation for restoration and protection projects in each watershed, and acknowledge various unique needs of different waters (e.g. oxygen and temperature standards for coldwater lakes) ([Lake aquatic life and recreation, Minnesota Pollution Control Agency](#)).

Fisheries Surveys: Routine lake surveys by the DNR Section of Fisheries include monitoring of fish populations, water chemistry, and fish habitat to guide fisheries management. Lake survey data is used to track fish population trends, evaluate the effectiveness of management actions such as stocking, and establish management goals for a given lake. On average, the Section of Fisheries conducts 650 lake surveys each year. Most of the important fishing lakes are surveyed once every 3-5 years. The 11 largest lakes, including Mille Lacs, Superior, and Lake of the Woods, are surveyed annually. Fisheries and other information helpful to the public is shared in the popular [Lake Finder](#) website.

Sentinel Lakes Program: This program is an intensive, long-term lake ecosystem monitoring program created to detect and understand the physical, chemical and biological changes occurring in Minnesota's lakes. Long-term monitoring on a set of 25 Sentinel Lakes includes water chemistry, fisheries, zooplankton, phytoplankton, habitat, groundwater as well as watershed development (see [Monitoring Minnesota's Changing Lakes](#)). This program documents biological, physical and chemical trends, identifies mechanisms behind them, and directs management solutions for long-term sustainability.

Watershed Health Assessment Framework: The Watershed Health Assessment Framework (WHAF) is program that assesses three components of aquatic ecosystem health: biology, hydrology, and water quality. The WHAF integrates numerous metrics to derive lake health scores for about 4000 Minnesota lakes ([Watershed Health Assessment Framework - Lakes](#)).

Lakes of Biological Significance: High-quality lakes based on biological sampling are listed and updated every five years by DNR. The list is used to focus lake protection efforts. Unique plant and animal presence is the primary measure of a lake's biological significance. Lakes are rated and grouped for each of the following communities: aquatic plants, fish, birds and herpetofauna (amphibians and a turtle species). Lakes are assigned to one of three biological significance classes (Outstanding, High, or Moderate); see [Lakes of Biological Significance - Resources - Minnesota Geospatial Commons](#).

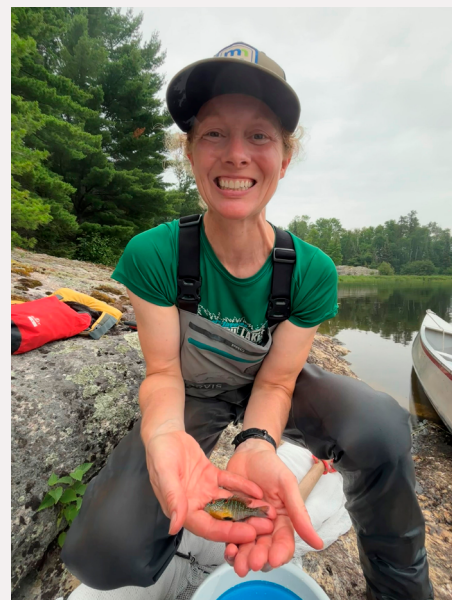







Photo: DNR Fisheries staff with northern sunfish during lake surveys

Priority Habitat Conservation Strategies




To implement the Habitat Goal of this Plan, to protect and enhance the resilience, function and ability of habitats to support biodiversity, especially for SGCN, five strategies were identified:

- 
Strategy 1. Protect, buffer, and connect high quality habitats to optimize biodiversity, SGCN, and landscape benefits, particularly across the Conservation Action Network.
- 
Strategy 2. Restore, enhance, and maintain lands and waters to benefit SGCN, biodiversity, and ecosystem resilience
- 
Strategy 3. Collaborate with conservation partners and landowners to enhance conservation delivery, particularly in the Conservation Action Network and Conservation Opportunity Areas
- 
Strategy 4. Monitor SGCN, native plant communities, habitats, and ecosystems for changes through time including responses to natural disturbances, conservation actions, and climatic conditions
- 
Strategy 5. Connect to develop, innovate, incentivize, and disseminate evidence-based habitat management practices to benefit SGCN habitat management practices to benefit SGCN

Examples of conservation actions are grouped below under these five strategies and tagged with icons for the stressor(s) that they address. Some of these actions are widely in place as best practices while others may be more novel. Some actions will combine multiple strategies, in which case we present it under the one it fits best. Also note that some strategies, such as Strategy 3, collaborating with partners, could truly be applied to all actions to most broadly and effectively implement them. Other actions, such as those related to monitoring, might be difficult to relate to a specific stressor, in which case they are marked as not applicable (NA).



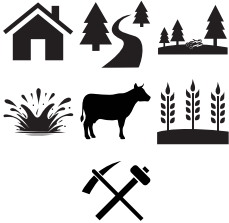




Potential Conservation Actions for Lakes

- 
Strategy 1. Protect, buffer, and connect high quality habitats to optimize biodiversity, SGCN, and landscape benefits, particularly across the Conservation Action Network.

Stressor	Action
	Utilize Aquatic Management Areas to protect shorelines and wetlands (Aquatic Management Areas, Minnesota DNR).
	Prevent loss or degradation of all types of shallow lakes. Preserve shallow lakes and wetlands, especially in the Eastern Broadleaf Forest and Prairie Parkland provinces. Focus on protecting larger shallow lakes (> 4 acres [10 hectares]) and shallow lake and wetland complexes. Protect known nesting areas of black terns and Forster's terns.
	Enforce wetland protection regulations (“no-net loss”) as they pertain to shallow lakes and wetlands.







Strategy 2. Restore, enhance, and maintain lands and waters to benefit SGCN, biodiversity, and ecosystem resilience

Stressor	Action
	Restore large complexes of shallow lakes and wetlands, with attention to the habitat features required by SGCN.
	Enforce shoreline development and aquatic vegetation removal restrictions.
	Maintain vegetated buffers comprised of locally native vegetation adjacent to waterways. Avoid or reduce mowing, burning, grazing or chemical application on these buffers. Support and promote state and federal programs incentivizing buffers and other best practices for lakes, streams, wetlands and ponds.
	Manage the spread of new invasive species, particularly in rare very deep-water habitats. Manage the encroachment of invasive plants in shallow lakes. See the DNR's Aquatic Invasive Species webpage for up-to-date information on the DNR's suggested actions regarding reducing the spread.
	To address altered hydrology of shallow lakes, encourage restoration of wetlands and grasslands and natural hydrological function in the watershed.
	Manage for natural water regimes in lakes.
	Prevent problematic practices in key watersheds to reduce external nutrient loading in lakes.





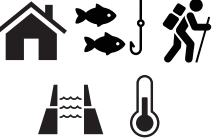
Strategy 3. Collaborate with conservation partners and landowners to enhance conservation delivery, particularly in the Conservation Action Network and Conservation Opportunity Areas.

Stressor	Action
	To address boat traffic and wake boats disturbing nesting habitat and causing erosion, ensure appropriate provisions are in place to limit the use of wake boats to protect loon nesting habitat. Work with lake associations and county governments. Ensure there is sufficient enforcement. Invest in research and education on the topic.
	When SGCN shorebirds are nesting on lakeshores, temporary beach restrictions can be beneficial to protect the nests from recreational disturbance. Participation by agency, conservation partners, and volunteers can help to implement, explain, and enforce the closures. Seasonal beach restrictions protect nesting and foraging areas of birds such as piping plovers and common terns (Hillman et al., 2015). Wildlife sanctuary signage placed around breeding habitat reduces recreational disturbance to these sites. Local support from landowners, conservation partners and enforcement officers is important in supporting these beach closures.

	<p>Encourage anglers to voluntarily phase out lead tackle through education and outreach. Provide a directory of non-toxic tackle manufacturers. Encourage tackle retailers to stock non-toxic lead alternatives for anglers. There are several programs underway with partnerships with the Minnesota Pollution Control Agency aimed at these goals, linked under key partnerships below.</p>
	<p>Promote early coordination on utility corridor design and siting. Avoid routing lines near or across lakes where feasible.</p>






Strategy 4. Monitor SGCN, native plant communities, habitats, and ecosystems for changes through time including responses to natural disturbances, conservation actions, and climatic conditions.

Stressor	Action
	<p>Continue surveys, monitoring, and research into the health and biodiversity in Minnesota's lakes (see Case Study: Monitoring Minnesota's Lakes); work to maintain long-term funding for these programs.</p>
	<p>Examine efficacy of floating artificial nest platforms for common loons. Floating platforms may improve reproductive success on waterbodies with considerable water-level fluctuations (Artificial Nesting Platforms (ANPs) for common loons, Minnesota DNR).</p>
	<p>Long term monitoring efforts are underway for loons. Two different volunteer programs, the Minnesota Loon Monitoring Program and the Volunteer LoonWatcher Survey continue to provide useful data about the status of loons and will be critical to keep track of long-term population trends. The Minnesota Loon Restoration Project partnership continues to protect habitat, deploy and measure the efficacy of Artificial Nesting Platforms, support non-lead tackle initiatives, and monitor loon populations.</p>



Strategy 5. Connect to develop, innovate, incentivize, and disseminate evidence-based habitat management practices to benefit SGCN

Stressor	Action
	<p>To protect lake shorelines from development pressure, promote initiatives to preserve sensitive shorelines, promote shoreline restorations, and implement shoreline setbacks. Lack of education and public buy-in can be addressed by education at the local level within communities (e.g. lake associations, see Loon Restoration Case Study), governments, and managers. Develop BMPs for technical staff. In addition, more funding is needed for lakeshore preservation, restoration, and research to inform decision-making.</p>
	<p>Continue outreach, education and enforcement regarding movement of invasive species, including Watercraft Inspection Program, mobile invasive species decontamination sites, DNR's What You Should Do actions for different water activities like kayaking and waterfowl hunting, and Clean in, Clean Out laws that reduce invasive species spread.</p>
	<p>Consider changes in regulation of ditching, tiling, and erosion to prevent shallow lake losses due to sedimentation. Support agricultural policies for crop production incentives to further develop and deliver programs that are lucrative for landowners to maintain working lands that protect and restore habitat.</p>

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