MINNESOTA'S WILDLIFE ACTION PLAN 2025-2035

CONSERVING HABITATS AND BIODIVERSITY

AMPHIBIANS





DEPARTMENT OF NATURAL RESOURCES

NONGAME WILDLIFE PROGRAM

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Amphibians

Overview

Minnesota is home to 22 species of amphibians – 14 frogs and toads, and 8 salamanders. In 1944 Walter Breckenridge published Reptiles and Amphibians of Minnesota, marking the state's beginning of modern herpetology. At the time only 13 species of frogs and toads and 5 species of salamanders had been documented in the state. Breckenridge's publication was considered Minnesota's standard herpetological reference until Amphibians and Reptiles Native to Minnesota was published by Oldfield and Moriarty in 1994, followed by an update in 2014 (Moriarty & Hall). In the late 1970s, the Minnesota DNR's Nongame Wildlife Program was established and has coordinated breeding frog call surveys and funded studies on Northern leopard frogs and Blanchard's cricket frogs. The Minnesota Biological Survey, initiated in 1987, surveyed counties across the state targeting rare wildlife and collecting records on common species. Their work has helped establish Minnesota's list of amphibian SGCNs and has added thousands of records of amphibians to the DNR's Natural Heritage database.

Amphibians are the most threatened vertebrate group worldwide due to the compounding effects of habitat conversion, contaminants, invasive species, disease, and climate change, with 40% of species at risk of extinction (Campbell et al., 2024; Luedtke et al., 2023). This is especially concerning given the wide range of benefits amphibians provide. In their ecosystems, amphibians function as both predator and prey, assist with energy and nutrient flow between terrestrial and aquatic systems, and enhance soil aeration and productivity (IUCN SSC Amphibian Specialist Group, 2024). Amphibians also decrease the transmission of dangerous pathogens to humans through their predation on mosquitoes and flies and are frequently used to further the field of human medicine (IUCN SSC Amphibian Specialist Group, 2024). They are often sensitive indicators of environmental contaminants and serve as gauges of environmental health. Lastly, encountering amphibians in the wild at a young age can foster a positive attitude toward conservation. Many people have fond memories of catching frogs in a local pond or finding a salamander under a log on a hike through the forest. These moments can be the first spark that instills an interest in conservation action.

Photo: Spotted salamander, Andrew Herberg

Despite all of this, lack of funding for amphibian conservation is a persistent issue (Bishop et al., 2012). Many amphibian species in Minnesota live cryptic lives and are not frequently encountered, so people might not even know they have some living in their own backyard. Our frogs, toads, and salamanders use a variety of terrestrial and aquatic habitats and exhibit a multitude of life history strategies. Therefore, we need to take a wide range of conservation actions to address the stressors detailed below, including monitoring and public engagement efforts, such as the Minnesota Frog and Toad Calling Survey (see inset) that actively involves citizen scientists in the goal of learning more about our amphibian fauna. The Minnesota Herpetological Society is another important venue for public education and promoting the study and conservation of both reptiles and amphibians. On a larger scale, Midwest Partners in Amphibian and Reptile Conservation (PARC) is an important network dedicated to the conservation of reptiles and amphibians that provides an avenue for collaborative conservation initiatives, outreach and education resources, and more.

Case Study: Engaging the Public in Frog and Toad Monitoring

A volunteer-based community science program, the Minnesota Frog and Toad Calling Survey monitors the distribution and abundance of all 14 of Minnesota's frog and toad species across the state. Over 100 routes along roads have been established, each with approximately 10 stops where volunteers stop to listen and record the species that are calling. Routes are sampled three times during the breeding season to cover the breeding seasons of all species. The original survey ran from 1994 through 2017, collecting thousands of records. The survey was re-launched in 2023 with updated tools and protocols and continues to develop and grow. The survey not only provides critically important information on a group of species that is often overlooked, but it has become a vital part of many volunteers' spring season. As one volunteer, Nick Krueger, reflected: "The frogs and toads add to the diversity of nature here, but they're also part of the beauty for us, the beauty of the soundscape. It's good to take time to be amazed at the world."

One of our rarest frogs, the Blanchard's cricket frog, has a unique history in Minnesota. Thought to have been lost from Minnesota by the late 1980s, the species was rediscovered in the late 1990s. Upon rediscovery, the Blanchard's cricket frog remained at very low population levels until new populations began to turn up in the 2010s and 2020s (Moriarty & Hall, 2014; Smith, 2018). As a state-listed, protected species, it is critical for regulators and scientists to understand occurrence and occupancy patterns for this tiny frog. Given the challenges with fitting surveys for Blanchard's cricket frogs into busy workloads, DNR staff searched for alternative methods to track what we hope is this species' recovery. From this need was born a partnership between DNR Nongame Wildlife Program staff and a community science, non-profit organization called HerpMapper. HerpMapper is designed to gather and share information about amphibian and reptile observations across the planet. The Blanchard's Cricket Frog Survey asks Minnesotans to help find and document Blanchard's cricket frogs on the HerpMapper website or smartphone app. This effort combines community science with cutting edge species study and recovery efforts to help this enigmatic rare species click-and clack their way across Minnesota again.

Photo: A family participating in the Frog and Toad Calling Survey

SGCN and SNI Summary Information

Seven amphibian species have been designated Species in Greatest Conservation Need (SGCN) - two frogs, one toad, and four salamanders. Four of these are state-listed as Species of Special Concern, and one, Blanchard's cricket frog (*Acris blanchardi*), is State Endangered. Most of the amphibian SGCN species are also Midwest Regional SGCN and have documented declines and significant stressors affecting populations across their range in Minnesota. One species that was listed as a SGCN in the 2015 State Wildlife Action Plan (SWAP), the Eastern red-backed salamander (*Plethodon cinereus*) was removed given that populations currently appear to be stable in Minnesota's northern forests. One species, the Western tiger salamander (*Ambystoma mavortium*), has been designated a Species in Need of Information (SNI). The Western tiger salamander is visually similar to the Eastern tiger salamander (*Ambystoma tigrinum*), and their ranges overlap in Minnesota. More research, likely using molecular techniques, is needed to determine the extent of Western tiger salamander populations across the state. A complete list of both SGCN and SNI species can be found in Appendix B.

Habitat Associations

The amphibian SGCN utilize a variety of habitats, but all are associated with some type of aquatic habitat due to their life histories. Table 2.3 provides a summary of their association with the habitats discussed in the 2025-2035 SWAP. 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. Detailed tables associating each SGCN with the primary 15 habitats in the 2025-2035 SWAP can be found in Appendix D.

Table 2.3. Numbers of Amphibian Species in Greatest Conservation Need (SGCN) associated with each of the habitat types (only showing habitats with amphibian SGCN associations).

Habitats	Primary Habitat	Secondary Habitat	Total
Prairie and Other Grasslands	1	0	1
Upland Conifer Forest and Woodland	0	3	3
Upland Deciduous Forest and Woodland	3	0	3
Mesic Hardwood Forest	3	0	3
Deciduous Wet Forest	0	3	3
Riparian and Floodplain Forest	2	0	2
Non-forested Wetlands	4	1	5
Rivers and Streams	3	0	3
Lakes	2	1	3
Vernal Pools	3	0	3
Urban and Other Developed Lands	0	1	1

Minnesota's seven amphibian SGCN were associated with an average of four primary habitats each. Several species use upland habitats in addition to wet habitats, and overall amphibians are associated with 11 of the primary 15 habitats. The habitat associated with the greatest number of species was non-forested wetlands supporting five of the seven SGCN.

The Great Plains toad (*Anaxyrus cognatus*) is the only amphibian SGCN that is primarily associated with open grassland habitats. It may be found in remnant prairies, wet meadows, and even agricultural fields, where it breeds in shallow wetlands and flooded fields that form after heavy rain in the early summer. The toads spend much of their time in underground burrows throughout the rest of the year.

Blanchard's cricket frogs are strongly associated with permanent water bodies like lakes, ponds, streams, and rivers, utilizing both the aquatic habitat and the adjacent shoreline. Pickerel frogs (*Lithobates palustris*) are found in similar habitats, though prefer cool streams and often forage in wet meadows and grasslands in the summer.

Three of the salamander SGCN – spotted (*Ambystoma maculatum*), four-toed (*Hemidactylium scutatum*), and Eastern newt (*Notophthalmus viridescens*) – are strongly associated with mature forest habitats. They primarily occupy deciduous forests but will also occur in mixed deciduous-conifer forest types. These species rely on forested wetlands such as vernal (springtime) pools for spring breeding. Eggs are laid in or near the water, and larvae remain in the pools until metamorphosis occurs. Four-toed salamanders typically lay their eggs in moss hummocks adjacent to open water.

Eastern newts use a wide range of aquatic habitats, including lakes, ponds, and streams. Their unique life history includes the development of egg to larvae in aquatic habitat followed by a lengthy terrestrial juvenile stage that lasts a few years. Upon reaching maturity, adults undergo additional transformations as they revert to being primarily aquatic. To read about a study monitoring four-toed salamanders in relation to forest management activities on, see the Case Study: Four-toed Salamanders and Forest Management in the Vernal Pools Sub-chapter of Chapter 2.

The mudpuppy (*Necturus maculosus*) is Minnesota's only fully aquatic salamander and is restricted to medium or large rivers and lakes. They take cover under submerged rocks or logs, which are important components of their habitat. Females attach their eggs to the underside of such structures and guard them until they hatch.

Photo: Mudpuppy, Jeff LeClere

Primary Stressors for Amphibians

Stressors are factors that pose direct or indirect challenges to vulnerable plant and wildlife species. Habitat loss and degradation are generally considered the primary threat for most SGCN, and some stressors reduce the quality of those habitats. Other stressors may operate more directly on the SGCN, such as disease and pathogens. In some cases, stressors may operate both directly and indirectly. For example, roads, trails, and railroads can directly harm SGCN through vehicular strikes, or operate indirectly through habitat fragmentation and reduced landscape connectivity. The stressor list below is adapted from an internationally recognized threats classification developed by the International Union for the Conservation of Nature (Salafsky et al., 2024). For more information, see the “Stressors” section of Chapter 1: Species in Greatest Conservation Need.

It is important to note that some 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 (e.g. catastrophic wildfire following a prolonged period of fire suppression) while serving as valuable conservation tools in others (e.g., appropriately planned and applied prescribed fire).

Information about a subset of primary stressors specifically affecting this species group is included below, followed by a set of conservation actions addressing those stressors.

Development

Development for residential communities, recreation, or commercial and industrial areas can eliminate, degrade and fragment amphibian habitat. This leads to a variety of negative effects that influence survival and reproduction of amphibians, such as desiccation (loss of moisture), reduced reproductive output, exposure to higher temperatures, reduced dispersal ability, increased exposure to contaminants, and reduced foraging success (Eakin et al., 2019; IUCN SSC Amphibian Specialist Group, 2024). It also makes traversing the landscape more difficult and dangerous (see also Roads, Trails, and Railroads).

Crop Production

Conversion of amphibian habitat to agriculture eliminates, degrades and fragments amphibian habitat. This can lead to a variety of negative effects on amphibians, including desiccation, reduced reproductive output, exposure to higher temperatures, reduced dispersal ability, and reduced foraging success (IUCN SSC Amphibian Specialist Group, 2024). Drainage also plays a key role in row crop agriculture but has adverse effects on aquatic and terrestrial habitats that amphibians depend upon (Blann et al., 2009; Schottler et al., 2013; Schulz et al., 2015). The loss of wetlands due to agricultural practices can eliminate important wetland habitats, resulting in wetlands being separated beyond the species’ normal dispersal distance. The presence of grassland and wet meadow habitats between wetlands provides cover and foraging habitat for dispersing frogs, improving the potential for successful migration.

Livestock Management

Grazing by livestock can help to maintain open canopy habitats for dependent amphibian species. Nevertheless, the overall effects of livestock operations depend on management details such as stocking rates and whether livestock have direct access to water bodies. Amphibians are generally sensitive to water quality parameters such as levels of dissolved oxygen and nitrate concentration. Amphibians may be affected by livestock operations where waterways are not buffered, which affects shoreline habitat as well as water quality from manure, fertilizer, pesticide, and sediment runoff (Howell et al., 2019).

Mining and Quarrying

Mining and quarrying may cause changes in habitat, such as in water chemistry, hydrology (the movement, and distribution of water), or the physical structure of wetlands, which could affect amphibian species composition and abundance.

Wind and Solar Energy Infrastructure

There is insufficient research on how wind and solar facilities affect amphibians and what measures might be effective to reduce any negative effects. Wind and solar farms may affect amphibians through physical habitat alteration and noise and light pollution (de Oliveira et al., 2025; Chock et al., 2020).

Roads, Trails, and Railroads

The proliferation of roads fragments and destroys amphibian habitat. This reduces the dispersal capabilities of individuals and may result in genetic isolation of populations on either side of the road. Many amphibian species attempt to cross roads, especially during breeding seasons, and experience high levels of road mortality. Roads also increase human access to natural habitats and increase the spread of invasive species that may degrade the habitat or outcompete native amphibian species (Andrews et al., 2008, Schmidt & Zumbach, 2008). Research by Fahrig et al. (1995) indicated that traffic mortality had a significant negative effect on local frog and toad populations.

Utility Corridors

Amphibians are underrepresented in studies addressing direct and indirect effects and response thresholds to pipelines and powerlines (Richardson et al., 2017). There are existing and proposed transport pipelines in Minnesota with potential to affect amphibians via habitat loss, degradation and fragmentation (Brown et al., 2023). Amphibians may also be affected in the event of pipeline spills (see Water-borne Pollution).

Hunting and Collecting Animals

In Minnesota, frogs, toads, and salamanders are classified under “protected wild animals.” A person may not take, buy, sell, transport, or possess a protected wild animal unless allowed by the game and fish laws (M.S. 97A). There are stricter rules for state endangered or threatened species (M.S. 84.0895). Minnesota fishing regulations allow people with a fishing license to take, use, buy, and sell an unlimited number of frogs up to 6” long for bait, except for the state-endangered Blanchard’s cricket frog. A special license is needed to take frogs for any purpose other than bait. Current fishing regulations do not allow taking of any native salamander species as bait.

Even though these rules are in place, illegal collection still occurs. People might not be aware of the rules or purposefully break them. Anecdotal reports of tadpoles mixed with minnows at bait shops indicate that there are cases where unintentional movement of frogs occurs. It is very difficult to monitor illegal take and appropriately enforce the rules.

Timber Harvest

Timber harvest is a forest management tool that can affect wildlife habitat by changing forest structural and compositional diversity. Forest management decisions, including inaction, typically have positive effects for some species and negative effects for others. Depending on the way in which it is designed, timber harvest could have negative effects on forest-dwelling amphibians, especially SGCN salamanders. Timber harvest can alter microhabitats (increased temperature, decreased moisture), increase soil compaction and desiccation if applied outside of frozen ground conditions, and reduce habitat complexity (Rothermel & Luhring, 2005; Rittenhouse et al., 2008; Todd & Rothermel, 2006; Semlitsch et al., 2009). Clearcuts are often the most damaging; some studies suggest it may take decades for populations to recover after a clearcut (Pough et al., 1987; deMaynadier & Hunter, 1995). However, silvicultural practices that leave adequate microhabitat structure and adequate buffers may be able to mitigate effects, and long-term effects of forest harvesting on amphibians vary (deMaynadier & Hunter, 1995).

Forest-dwelling salamanders like spotted salamanders, four-toed salamanders, and eastern newts prefer high levels of canopy cover, up to 90% (Faccio, 2003). One study found that spotted salamanders were absent where forest cover was reduced to below 30%, and eastern newts were absent where forest cover was reduced to below 50% (Gibbs, 1998). In Minnesota, forests are regenerated after timber harvest, meaning loss of canopy cover at a site is not permanent. However, it can take decades for a harvested site to develop mature forest habitat characteristics. While more generalist, highly-mobile amphibians (such as northern leopard frog or gray treefrog) may be able to more readily recolonize forested habitat as it regenerates and develops suitable understory conditions, SGCN forest-dwelling salamanders have limited dispersal ability and adjacent source populations may not be present to assist with recolonization (Loehle et al., 2021).

Most woodland salamanders require both forested upland and wetland habitat to complete their life cycles. Many small wetlands (i.e. vernal pools) are undocumented and unprotected; initial checks using aerial imagery coupled with on-the-ground verification may be helpful in planning management appropriately to prevent negative effects on these critical habitats during timber harvest operations.

Photo: Four-toed salamander, Andrew Herberg

Fishing

Mudpuppies (a species of salamander) are occasionally caught by anglers, and may be killed accidentally, or purposefully by individuals who mistakenly believe mudpuppies are poisonous or venomous. Reports submitted to the DNR indicate that most mudpuppies are released unharmed.

Fish releases into wetlands and shallow lakes (e.g. release of unused bait fish) – particularly previously fishless water bodies – is known to reduce abundance, density, and/or species richness of amphibians; these effects can be from fish that are either native or non-native and are not limited to predatory fish (Hecnar & M'Closkey, 1997; Herwig et al., 2013; Holbrook & Dorn, 2015).

Recreation

Recreation can have a have a wide range of effects on amphibian species depending on the type of activity, although more research is needed on this topic. Motorized and non-motorized forms of recreation such as riding off-highway vehicles, bikes, or horses, particularly beyond designated trails, can destroy sensitive habitat or run over small, slow-moving amphibians. The presence of people or vehicles may alter amphibian behavior, leading to increased time spent under cover or away from favored areas, and indirect effects such as introduction of pathogens, invasive species, or trash can also affect habitat conditions (Amphibian and Reptile Conservation Trust, 2021).

Fire Management

Fire suppression increases the growth and spread of woody vegetation in open upland habitats used by some amphibian species like the Great Plains toad. It can also lead to larger wildfires due to a buildup of vegetation on the landscape. Amphibians are slow-moving and may find it difficult to escape wildfires if they are on the surface; however, since many amphibian species utilize underground burrows, most individuals might be able to avoid harm.

More research is needed on the response of amphibians to fire on the landscape (Hossack & Pilliod, 2011).

Dams and Water Management

Water management is comprised of many diverse actions such as water level manipulation, dams, drainage, dredging, water deposition and transfer, and more. These can greatly alter hydrology, stream geomorphology (physical features), and water quality which in turn can affect amphibians. Dredging and even beneficial practices like stream restoration often involve construction, heavy equipment use, and excavation which can result in direct injury or mortality of amphibians. Increased drainage can cause downstream flooding and high flows, erosion, and runoff of chemicals and nutrients (Schottler et al., 2013). Dams reduce connectivity to key habitats and separate populations so they can no longer breed with each other. Water management can convert or degrade wetland and lake habitats. Ephemeral prairie wetlands have been drained for row crop production, severely reducing native breeding habitats for the Great Plains toad. Removal and placement of dredged material should avoid potential negative effects on amphibian SGCN, such as the Blanchard's Cricket Frog. Placing dredge spoil materials into breeding sites and/or altering the hydrology associated with overwintering sites could be detrimental to local populations.

Invasive Species (Problematic Non-native Species)

In Minnesota, the American bullfrog is considered to be non-native and invasive outside of the extreme southeastern corner of the state. Populations occur in many other counties, likely due to intentional releases. This could eventually displace other native amphibian species in aquatic habitats throughout Minnesota due to predation and competition for resources, if left unchecked (Bucciarelli et al., 2014; Moriarty & Hall, 2014). Research has found that invasive plants such as buckthorn reduce hatching success and larval survival of some amphibians and may contribute to amphibian declines (Sacerdote & King, 2014).

Problematic Native Species

The introduction of fish into previously fishless wetlands and shallow lakes can reduce abundance, density, and/or species richness of amphibians (Hecnar & M'Closkey, 1997; Herwig et al., 2013; Holbrook & Dorn, 2015). Fish can be introduced through ditches, floodwaters, or by release of bait.

Diseases and Pathogens

Infectious diseases are one of the top causes of amphibian decline globally (IUCN SSC Amphibian Specialist Group, 2024). Ranavirus is transmitted through contaminated water, physical contact, and ingestion of infected tissues and may present as abnormal behavior, lethargy, swelling, fluid accumulation, and skin hemorrhage or ulcers (Cornell University, 2025a). Chytridiomycosis is caused by the waterborne fungus *Batrachochytrium dendrobatidis* and infects the keratin layer of the skin, causing weight loss, lethargy, skin shedding, red skin, and abnormal behavior (Cornell University, 2025b). Another more recently discovered fungus, *Batrachochytrium salamandrivorans*, has decimated salamander populations in Europe. It also infects the skin, causing reddening and ulcers, as well as lethargy and weight loss (Cornell University, 2025c). This fungus has not yet been found in North America, but if it does spread here, it could have major effects on our salamander populations. Of note, one of Minnesota's SGCN, the eastern newt (*Notophthalmus viridescens*), has been found to be highly susceptible to the fungus in research trials (Cornell University, 2025c). Major contributors to the spread of pathogens like these include the pet trade, biological supplies industry, and people using contaminated equipment or footwear. Challenges to addressing this threat include lack of funding and the high workload and short response window needed to research amphibian diseases.

Water-borne Pollution

Amphibians are very susceptible to water-borne pollutants, including salt from roads and water softeners, endocrine disrupters, hormones from birth control, herbicides, fertilizers, and more. These can affect the growth, development, and survival of eggs and larvae through direct and sublethal effects that influence survival (Ocampo et al., 2022; Thompson, 2022; Benli, 2024; Tornabene et al., 2024). Frog malformations have been a topic of concern in Minnesota after high rates of malformed frogs were found in a variety of ponds and wetlands in the 1990s. The cause of malformations is likely related to combinations of chemical, biological and physical factors (U.S. Geological Survey, 2001). Effects associated with acid rain include direct toxicity and developmental abnormalities, as well as indirect effects on food availability and aquatic vegetation (Croteau et al., 2008).

Light and Noise Pollution

Reproductive behaviors of amphibian species can be altered by artificial lights at night. Studies have found that artificial light can inhibit amphibian movement to and from breeding areas and decrease mating call activity (Longcore & Rich, 2004). A quick increase in the amount of light can cause a reduction in vision that can last for minutes or hours (Longcore & Rich, 2004).

Noise pollution is also problematic for frogs and toads, which rely on acoustic communication. Noises from many sources (urbanized areas, traffic, energy production) influence calling activity, alter mate selection, and cause physiological changes such as increased stress, suppressed immune function, and coloration change (Zaffaroni-Caorsi et al., 2022).

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 & 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.

Amphibians are micro-habitat specialists and thus are very sensitive to changes in temperature. Current studies generally suggest that extreme heat stress can suppress amphibian immune responses. Elevated temperatures can also alter microbial communities in amphibian skin and gut, which may reduce resistance to pathogens. Studies also suggest that increasing temperatures may cause reductions in body size, which may then lower reproductive success (Sheridan & Bickford, 2011; Hernández-Pacheco et al., 2020).

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, amphibians are very sensitive to changes in precipitation and moisture. Droughts can suppress amphibian immune responses (Rollins-Smith & Le Sage, 2023). Blanchard's cricket frogs are negatively affected by river flooding in the winter because they cannot survive inundation in anoxic (low oxygen) water for more than 24 hours nor in initially oxygenated water past 10 days (Irwin et al., 1999). If precipitation increases due to climate change and results in the inundation of overwintering sites, Blanchard's cricket frog mortality will also increase. In the long-term, climate change could result in drastic changes to the landscape. Extensive periods of drought and/or elevated temperatures could eliminate shallow wetlands critical as amphibian breeding sites and recruitment of young (McMenamin et al., 2008).

Photo: Great plains toad, Jeff LeClere

Priority Species Conservation Strategies

To implement the SGCN Goal of this Plan, to conserve rare, declining, and vulnerable wildlife and plant SGCN through targeted actions, three strategies were identified:

Strategy 1. Survey, monitor and research to document the distribution and trends of SGCN, assess the threats they experience, and evaluate conservation actions that support resilient populations.

Strategy 2. Collaborate to deliver conservation actions that support resilient populations of SGCN and their habitats in partnerships with agencies, Tribes, non-governmental organizations, private landowners, and others.

Strategy 3. Develop and share informational material to guide conservation actions for SGCN wildlife, such as species accounts, threat assessments, recovery plans, relevant regulations, avoidance measures, and beneficial habitat management practices.

Examples of conservation actions are grouped below under these three 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 combine multiple strategies, in which case we present it under the one it fits best. Actions such as those focused on monitoring might not always be tied to a specific stressor; these are labeled with not applicable (NA) in the stressor column.

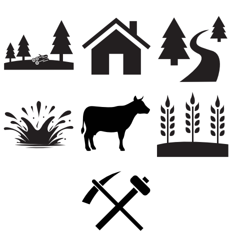
Potential Conservation Actions for Amphibians

1. Survey, monitor and research to document the distribution and trends of SGCN, assess the threats they experience, and evaluate conservation actions that support resilient populations.

Stressor	Action
	Develop citizen science programs to safely identify stretches of road that are mortality hotspots for amphibians, especially during spring and fall breeding migrations.
	Conduct effectiveness monitoring to assess responses of SGCN to specific management activities to refine evidence-based management recommendations and avoidance measures for SGCN (Binley et al., 2025), such as monitoring the effects of forest management activities on the populations of forest species.
	Support research on effects of recreation on SGCN amphibians, including thresholds for response and avoidance of significant adverse effects. Prioritize specific recreation types and habitats based on assessment of need in environmental review. Identify sensitive areas and avoid promoting recreational use and development in those areas. Enforce closures in sensitive areas.
	Monitor the status of bullfrog populations to help establish where they may be a problem for native species in central and northern Minnesota.
	Prioritize amphibian disease monitoring to understand effects on populations and to facilitate early detection of *Batrachochytrium salamandrivorans* (Bsal) if it arrives in North America. Increase capacity of amphibian disease surveillance and response through collaboration between the DNR and external partners, such as the USGS National Wildlife Health Center and its Wildlife Health Information Sharing Partnership (WHISPers) and the North American Bsal Task Force.

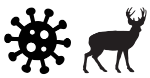
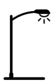
Stressor	Action
	Investigate mudpuppy mortality events. Conduct surveys to better understand mudpuppy habitat use. Work with state and federal partners to develop and test hypotheses related to stressors. Engage citizens by soliciting reports of amphibian mortality events.
NA	Engage the public in community science to help survey and monitor amphibians. Example opportunities include: Minnesota Frog & Toad Calling Survey and Minnesota Amphibian & Reptile Survey.
NA	Resurvey/monitor amphibian SGCN populations whose last observations in the Natural Heritage Information System (NHIS) database are over 10 years old to confirm continued presence of the species, assess population status, and identify specific conservation needs.
NA	Conduct wetland surveys focusing on identifying and mapping ephemeral wetlands like vernal pools (Hofmeister et al., 2022). Create a citizen science program or app for reporting locations of ephemeral wetlands.
NA	To help address data gaps which hinder conservation, support continued research on efficacy of tools like environmental DNA (eDNA) to augment standard survey and monitoring techniques for rare SGCN amphibians such as spotted salamanders and mudpuppies in various environments.
NA	Increase collaboration with universities to further research and monitoring of selected amphibian SGCN.

Strategy 2. Collaborate to deliver conservation actions that support resilient populations of SGCN and their habitats in partnership with agencies, Tribes, non-governmental organizations, private landowners, and others.

Stressor	Action
	Work with MnDOT, cities, and counties to develop under-road wildlife crossing tunnels and surmountable curbs in areas close to amphibian breeding sites such as ponds and vernal pools, especially those identified as road mortality hotspots. Consider additional options such as road closure or speed reduction during amphibian breeding seasons and signage informing drivers of amphibian crossings (Gunson et al., 2016; Marcelino et al., 2024).
	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 (Semlitsch & Bodie, 2003).
	Promote protection and restoration of native shoreline habitats (Restore Your Shore; Rivers and Streams).
	Encourage collaboration among all stakeholder groups and across ownerships to promote effective management for the health and resilience of forests and their ability to provide ecological, wildlife habitat, and other values.

Stressor	Action
	Work with road authorities to implement culvert designs that improve stream connectivity and aquatic organism passage (Hernick et al., 2019).
	Restore wetlands to benefit a variety of amphibians, including seasonal and temporary wetlands that do not sustain fish.
	Support intra and inter-agency drainage teams focused on evidence-based best practices such as: • Control drainage to strategically manage water levels and mimic natural drainage and adapt to climate change to improve water quality, reduce flooding and support ecological functions • Restore and protect wetlands for water filtration, flood control and wildlife habitat • Reduce runoff • Incorporate native perennial plantings and cover crops • Establish shallow drainage systems to help maintain wetlands • Establish two-stage ditches designed to slow and filter runoff, reduce erosion and improve water quality • Restore river and stream connectivity via properly designed passage structures and removing dams
	To mitigate effects of dams and changes in water management regimes, focus on dam removal and stream restorations that avoid or minimize unintended negative effects – for example, employ special precautions and conduct at a time of year that is less detrimental to stream-dwelling amphibians. Stream restoration should include naturally associated off-channel habitats (e.g. oxbows) and stream bank specifications conducive to rare amphibians, where indicated. Because SGCN amphibians can co-occur with SGCN from other wildlife groups it is important to consider their needs as well for a more integrated approach.
	Incentivize renewable energy that "piggybacks" on existing infrastructure versus developing new facilities on currently undeveloped sites (e.g. example, atop buildings, parking lots and ramps, etc.). Explore examples from other countries.
	Limit creation of new utility line corridors in important wetland and shallow lake areas. Develop best management practices for creation and maintenance of utility lines. Reduce chemical vegetative control methods.
	Maintaining and improving landscape connectivity is a key strategy to support amphibians in the face of climate change. For example, maintaining and restoring a diverse set of interconnected, healthy aquatic and terrestrial habitats and ensuring there are safe movement corridors that may also allow them to track shifting conditions (Uden et al., 2014; Souza et al., 2023). SGCN such as Blanchard's cricket frog (Badje et al., 2021) and Great Plains toad (Bragg, 1940) are among the many amphibian species that would benefit from improved dispersal options to access overwintering, migration, and breeding habitats. For a given amphibian SGCN, ensure that uplands adjacent to their aquatic habitats are equally suitable and permeable (Youngquist & Boone, 2014).

Strategy 3. Develop and share informational material to guide conservation actions for SGCN wildlife, such as species accounts, threat assessments, recovery plans, relevant regulations, avoidance measures, and beneficial habitat management strategies.

Stressor	Action
	Increase enforcement of nongame illegal take issues; educate conservation officers on the issues and increase monitoring of important areas for poaching.
	Increase public awareness of state rules and regulations around take, possession, purchasing, and selling of native amphibian species and the reasons for these laws. Promote alternatives to appreciate Minnesota's amphibians in their native habitats.
	Educate land managers, including private landowners, about habitat needs of rare forest species.
	Increase public education and outreach about how releases of captive animals (including wild-caught individuals) can spread disease.
	Increase public education and outreach about best management practices for artificial lights at night, such as suggested by Dark Sky International. Advocate for increased regulation of light and noise pollution, especially near important amphibian breeding sites.

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