Chapter 5. Conservation Challenges and Threats to Native Ecosystems

Relevant Required Elements: **#3** – Descriptions of problems which may adversely affect Species of Greatest Conservation Need or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats.
Focus of Chapter 5: This chapter presents a brief overview of the ecological planning model that forms the basis of the SDWAP; that is, the impact of direct and indirect habitat and ecosystem changes since European settlement. These conservation threats to native ecosystems are initially discussed from a broad perspective. A change from the previous SDWAP is the use of a standardized approach to describing conservation threats. This allows easier categorization within the state and across state and international boundaries. The CMP and the IUCN developed this system, which is used for habitat systems, SGCNs, and the 8 habitat categories defined for this revision. Conservation challenges associated with terrestrial, riparian-wetland, and aquatic systems are examined in detail, using the relevant CMP/IUCN categories. Following this evaluation is a similar assessment of conservation threats to SGCNs. SGCNs are evaluated individually, with results available in a conservation threats appendix. Within the chapter is a discussion of the most common conservation threats categories by SGCN taxonomic groups. An additional discussion of climate change impacts to SGCNs shares relevant results of a Competitive State Wildlife Grant (CSWG) project award to the MAFWA.

5.1 Introduction

Native ecosystems and habitats of South Dakota have and continue to be directly and indirectly altered by human activities. Native Americans interacted and influenced this landscape for thousands of years. Those influences are incorporated in the historical reference. However, it is the extent of human influence over the last 100 years that is of primary interest when considering the cumulative impacts to native ecosystem diversity and the associated biodiversity of South Dakota. Better understanding the extent of these impacts can help guide conservation practitioners in designing actions to address conservation challenges. Land conversion to cropland, domestic pasture, urban uses, and roads are the most obvious changes. However, there are also less obvious changes. The implications of a century of alterations to and interruptions of natural disturbance regimes on native ecosystem diversity have only begun to be assessed and much is still unknown. As stated previously, studies have shown that the suppression, alteration, or cessation of natural disturbance have gradually changed ecosystem processes and the species composition, structure, and function of ecosystems.

More specifically, two primary types of human impacts have occurred across South Dakota and have contributed to the cumulative changes to native terrestrial ecosystem diversity observed on the landscape today. These impacts are: 1) the direct conversion of native ecosystems to some other land type or use, and

2) the indirect alteration of native ecosystems through the suppression of natural disturbance processes or alteration of species compositions, structures, or functions resulting from human activities and spread of nonnative species. The primary causes for direct conversion of native ecosystems in South Dakota include agriculture and to a lesser extent urbanization. This can be seen in expanding cities and development of roads and other infrastructure. Agriculture is sometimes used as a broad category to include activities such as grazing and timber harvest. However, for this effort, agriculture is defined relative to those activities that essentially replaced native ecosystems with a crop or domestic plant community. For riparian-wetland ecosystems, additional causes of direct conversion may include wetland draining, surface water diversion, water impoundments, dams, ponds for water supply, and stream channelization. The primary causes of indirect alteration of ecosystems include fire suppression, altered grazing regimes, timber harvest in forested ecosystems, renewable energy, prairie dog control, beaver control/dam removal, flood control, pollution, as well as accidental or intentional introduction of nonnative species that degrade the quality and function of native species, habitats, and ecosystems.

Habitat loss that impacts native wildlife species can result from direct conversion of habitat and indirect alteration of native ecosystems, which is described in greater detail below. Habitat loss and its effects on biological diversity can be viewed as having four associated aspects:

1. the actual loss or conversion of habitat from favorable conditions that support a species to unfavorable conditions that will not support a species (Noss and Scott 1995),
2. changes in ecosystem structure, function, or composition (Franklin et al. 1981, Noss and Scott 1995) that severely reduce the habitat quality of an ecosystem for a particular species,
3. the reduction in the size of the remaining patches that may not provide enough area in one patch to support a species (MacArthur and Wilson 2001), and
4. habitat changes that slowly or quickly cause a single population within the landscape to become a metapopulation, consisting of many independent populations that only interact with occasional dispersal of individuals. Metapopulations may be further influenced by continued habitat loss to the point that interruption of demographic or genetic support to the metapopulation occurs (Hanski and Gaggiotti 2004) resulting in the subsequent loss of the entire population.

Developing a better understanding of ecosystem conditions in South Dakota today helps in identifying and quantifying cumulative changes to native ecosystem diversity and its corresponding influence on the habitat conditions of native wildlife species. The following sections explore conservation challenges and threats associated with conversion and alteration of native ecosystems in South Dakota. Table 5.1 evaluates challenges and threats to 8 primary habitat classification types found across South Dakota. While there are varying degrees of threats to these habitat types across the state, this table depicts threats each habitat may be facing from a broad perspective. The cultivated land and urban/developed categories are removed from Table 5.1 since they are not considered “habitat.” They are included in Figure 3.2 to showcase the current landscape of South Dakota.

This chapter begins with general descriptions of how habitat conversion and alteration of historical disturbance regimes have impacted terrestrial, riparian-wetland, and aquatic systems. Those descriptions are followed by more specific conservation threat discussions, also sorted by the three main systems.

Table 5.1. An Evaluation of Challenges and Threats to Eight Primary Habitat Types Found Across South Dakota.

Challenges and Threats to Habitat Types	Grasslands	Forest	Shrublands	Badlands	Riparian Areas	Wetlands	Lakes/Reservoirs	Rivers/Streams
1. Residential & Commercial Development								
1.1 Housing & Urban Areas	X	X	X		X	X	X	X
1.2 Commercial & Industrial Areas	X	X	X		X	X	X	X
1.3 Tourism & Recreation Areas		X	X	X	X	X	X	X
2. Agriculture & Aquaculture								
2.1 Annual & Perennial Non-Timber Crops	X		X		X	X	X	X
2.2 Wood & Pulp Plantations								
2.3 Livestock Farming & Ranching	X	X	X		X	X	X	X
2.4 Marine & Freshwater Aquaculture								
3. Energy Production & Mining								
3.1 Oil & Gas Drilling	X		X	X				
3.2 Mining & Quarrying	X	X				X		X
3.3 Renewable Energy	X		X		X	X		
4. Transportation & Service Corridors								
4.1 Roads & Railroads	X	X	X	X	X	X		X
4.2 Utility & Service Lines								
4.3 Shipping Lanes								
4.4 Flight Paths								
5. Biological Resource Use								
5.1 Hunting & Collecting Terrestrial Animals								
5.2 Gathering Terrestrial Plants	X	X						
5.3 Logging & Wood Harvesting		X			X			
5.4 Fishing & Harvesting Aquatic Resources								
6. Human Intrusions & Disturbance								
6.1 Recreational Activities		X		X	X	X	X	X
6.2 War, Civil Unrest & Military Exercises								
6.3 Work & Other Activities								
7. Natural System Modifications								
7.1 Fire & Fire Suppression	X	X		X	X	X		X
7.2 Dams & Water Management / Use					X	X	X	X
7.3 Other Ecosystem Modifications					X	X	X	X
7.4 Removing / Reducing Human Maintenance					X	X	X	X
8. Invasive & Problematic Species, Pathogens & Genes								
8.1 Invasive Non-Native / Alien Plants & Animals	X	X	X	X	X	X	X	X
8.2 Problematic Native Plants & Animals						X	X	
8.3 Introduced Genetic Material							X	X
8.4 Pathogens & Microbes								
9. Pollution								
9.1 Household Sewage & Urban Waste Water					X	X	X	X
9.2 Industrial & Military Effluents				X		X	X	X
9.3 Agricultural & Forestry Effluents	X	X	X	X	X	X	X	X
9.4 Garbage & Solid Waste						X	X	X
9.5 Air-Borne Pollutants						X	X	X
9.6 Excess Energy								
10. Geological Events								
10.1 Volcanoes								
10.2 Earthquakes / Tsunamis								
10.3 Avalanches / Landslides								
11. Climate Change								
11.1 Ecosystem Encroachment	X	X	X	X	X	X	X	X
11.2 Changes in Geochemical Regimes	X	X	X	X	X	X	X	X
11.3 Changes in Temperature Regimes	X	X	X	X	X	X	X	X
11.4 Changes in Precipitation & Hydrological Regimes	X	X	X	X	X	X	X	X
11.5 Severe / Extreme Weather Events	X	X	X	X	X	X	X	X

5.2 Terrestrial Systems

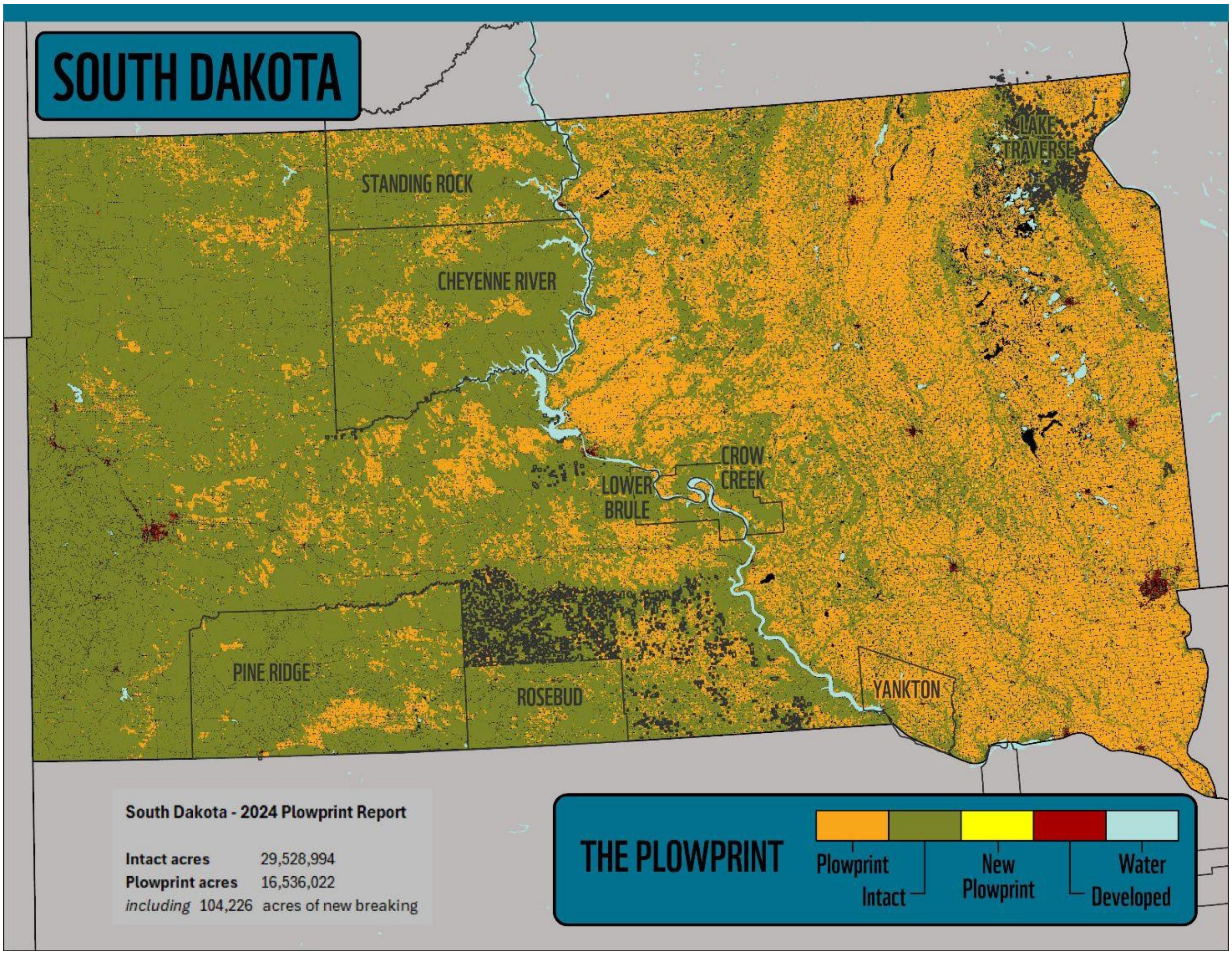
Direct conversion of native ecosystems

The primary causes for direct conversion of native ecosystems in South Dakota are identified as agriculture and to a lesser extent urbanization that includes city/town expansion, roads, utilities, renewable energy development, mining, logging and other development infrastructure.

Increasing human population and continued market support for agricultural products have contributed to an increase in conversion of grasslands to corn and soy agricultural land use across South Dakota. Wright and Wimberly (2012) compared crop data layers for 2006 and 2011 and found that 1,561,706 acres of grasslands had been converted to corn or soy fields during that time in South Dakota. A higher rate of conversion is occurring in eastern South Dakota as compared to western. However, crop genetics have advanced in recent years and crops are becoming more drought tolerant and will likely continue to expand westward (McFadden et al. 2022). It was not possible to differentiate native grasslands from domestic grasslands with the data layers used but the results of this analysis suggest additional concern for maintaining native grassland ecosystems in South Dakota. The expansion and impacts of cropland and urbanization spread beyond grasslands and include conversion of other habitat types, such as riparian areas, wetlands, shrublands, and forest in some locations. Analysis of conversion of these habitat types would clarify impacts to native species and habitats, although grasslands remain the highest converted habitat type across South Dakota.

The World Wildlife Fund (WWF) 2024 Plowprint Report provides a more recent perspective of grassland conversion. The 2024 Plowprint Report, which uses 2022 data, shows 1.9 million acres of grasslands were plowed up for cropland in the US and Canadian portions of the Great Plains during the year. In South Dakota, approximately 104,000 acres of grassland were converted during 2022. The crop drivers in South Dakota continued to be corn and soybean production (World Wildlife Fund 2024). Figure 5.1 provided by WWF shows the footprint of intact habitat, the existing agricultural plowprint, new agricultural plowprint, developed areas, and roads/water. The conversion rate as shown in the figure is much greater in the eastern half of South Dakota but continues to push westward.

Figure 5.1 World Wildlife Fund Plowprint Map of South Dakota From the 2024 Report Showing Where Lands Have Been Converted to Row Crop Agriculture or Developed and Those Acres That Remain Intact.



The 2024 WWF Plowprint Report defines the categories within Figure 5.1 as the following:

- Intact: Remaining habitat (including grasslands, shrublands, wetlands, and forest) after masking cropland, development, and open water. Intact does not necessarily equate to native vegetation or state of ecological function.
- Plowprint: Cumulative footprint of cropland since 2012 defined as annually planted agricultural commodity (e.g. corn, soybean, wheat, etc.) or fallow agricultural land.
- New Plowprint: Area of row crop agriculture for the first time within the temporal boundaries of the analysis (2010-present year). A 2-year verification rule requires two subsequent years of cropland cover before verification as Plowprint to avoid over-estimating from misclassifications of satellite imagery.
- Developed: Land cover classification that includes urban and exurban, industry (e.g., energy development), and roads.
- Roads/Water: Land cover types that are excluded from the Intact, Plowprint, and the Developed data and include open water (e.g. lakes and rivers) and primary, secondary, and local roads.

Natural disturbance processes

Since European settlement, many changes have occurred in the natural disturbance regimes that influence native ecosystem diversity across South Dakota. Fire still occurs, however the amount of land influenced by naturally occurring wildfire is greatly reduced due to fire suppression efforts. Where wildfire does occur today, a century of altered vegetation conditions has changed the magnitude and intensity of how wildfire now occurs in the landscape compared to what occurred historically. Future climate change is expected to exacerbate this problem. Some land managers use prescribed fire to mirror this natural process, but there remain considerable challenges to replicating the timing and intensity of natural fire regimes to produce the desired effects on vegetation.

In addition, the important interaction of fire and grazing animals has been altered. Historically, grazing animals like bison would preferentially select recently burned areas on grass-shrub ecological sites and graze these areas heavily for 1-2 seasons after a fire. This fire and grazing relationship is not typically used in current ranching practices for prescribed burning and cattle grazing programs. In general, fire suppression and grazing alteration have had a profound impact on landscape heterogeneity and dynamic ecosystem processes. Grazing trends on private land in the Great Plains, on average, have been toward moderate levels. Grasses that benefit from this grazing approach have increased, while grasses that require different levels or timing of grazing have been reduced (Truett 2003). The patchy mosaic of different grazing intensities interacting with natural fire regimes is all but gone from grass-shrub systems of South Dakota. In addition to changes in fire and grazing regimes, the loss of thousands of acres of prairie dog colonies has further impacted many wildlife species dependent on their disturbance influence for suitable habitat conditions.

In the forested systems of South Dakota, the suppression of natural fire regimes over the last 100 or more years has caused significant changes to ecological processes, structure, and species composition. Fire suppression and timber production have had a particularly marked effect on low to mid-elevation ponderosa pine forests. The forest conditions documented by early explorers and trappers in their journals, drawings, and even black and white photographs, often depict conditions quite different from those observed today (Parrish et al. 1996, Horsted 2006). Starting in the late 1800s, several activities occurred that changed these ecosystems. First, intensive grazing by cattle and sheep reduced the understory vegetation that carried fires across the landscape. Second, logging began with an emphasis on removing large ponderosa pines. Third, fire exclusion policies initiated in the early 1900s further reduced the occurrence of high-frequency fires. The ponderosa pine ecosystems, characterized by large pine trees, were adapted to the short-interval fire regime, having thick bark that protected them from the frequent understory fires. The suppression of natural wildfire has resulted in a dramatic increase in the number of trees per acre occurring today. This is particularly evident for ponderosa pine on many low to mid elevation ecological sites. Timber harvest methods that emphasize clear-cutting also contribute to even-aged stands of dense ponderosa pine. Without the natural thinning effect of frequent wildfires, the favorable growing conditions for ponderosa pine will frequently lead to extremely dense stand conditions that exclude other plant species from occurring on these sites. Ironically, these dense stand conditions will stress the trees thereby making them more vulnerable to insect outbreaks from species such as pine beetles. The result is an overall decrease in plant species and structure diversity on these ecological sites throughout low to mid elevation forest ecosystems. When fires do occur, they are usually lethal, stand replacing fires. As these fires burn the remaining stands that contain large remnant trees, the ability to restore historical conditions in the near future decreases. Thus, the risk of further impacts and population declines for species dependent upon historical ponderosa pine forests is very high. Forest management and fire management policies that emphasize the return of historical stand conditions are needed to provide the structure, species composition, and spatial arrangement of native forest ecosystems on the landscape.

Mid- to high-elevation forests have been less impacted by fire suppression activities as long-interval fires are more similar to their HRV. However, the size and distribution of these fires have decreased with improvements in modern firefighting capabilities. While the pattern and distribution of stand-replacing fires has arguably changed on the landscape, the impacts at the ecosystem level have been much less evident in terms of species composition and structure compared to low and mid-elevation forests. In general, the heterogeneous conditions produced from the combined influences of short, mixed, and long- interval fire regimes have been significantly reduced on the landscape. Fires that break out in modern times can often be characterized as long-interval, stand replacing events. Forest management could help restore some landscape heterogeneity. Unfortunately, forest management objectives do not always encompass historical structures and species compositions required to maintain native ecosystem and biological diversity

5.3 Riparian-Wetland Systems

Direct conversion of native ecosystems

In the glaciated PPR, more conversion of riparian and wetland ecosystems has occurred where crop-based agriculture is prevalent, similar to terrestrial systems. The PPR (Figure 5.2) encompasses a vast and diverse landscape stretching from the tallgrass prairies of northern Iowa and southwestern Minnesota across the mixed-grass prairies of the Dakotas and northwestward toward the dry mixed-grass glaciated prairies of Montana. The PPR is a unique mixture of remaining grasslands, croplands, and millions of depressional wetlands, or potholes, left behind by retreating glaciers roughly 10,000 years ago. This region provides critical breeding habitat for a myriad of grassland and wetland dependent birds. Of crucial importance, the PPR supports over 50% of North America's breeding waterfowl with South Dakota representing an important portion (Figure 5.3).

Figure 5.2. U.S. Portion of the Prairie Pothole Region (PPR).

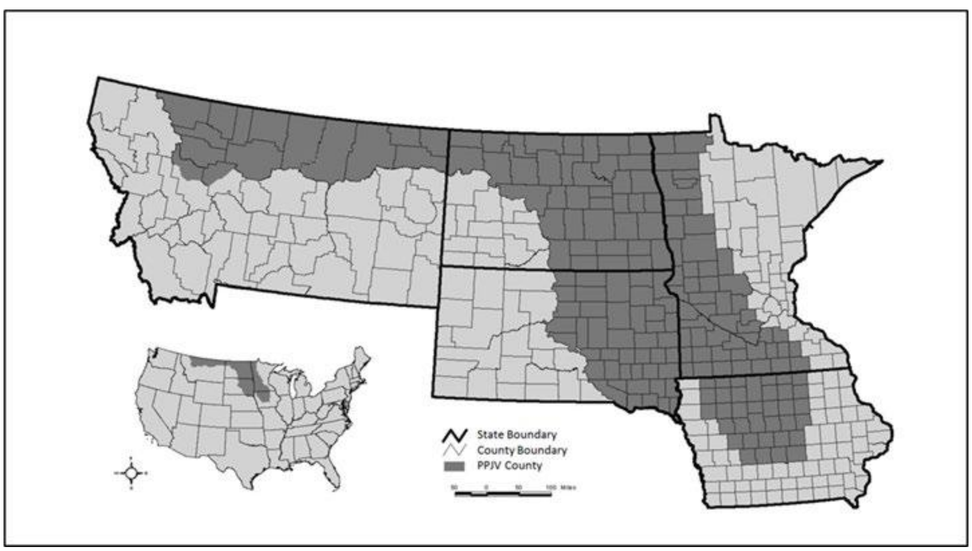
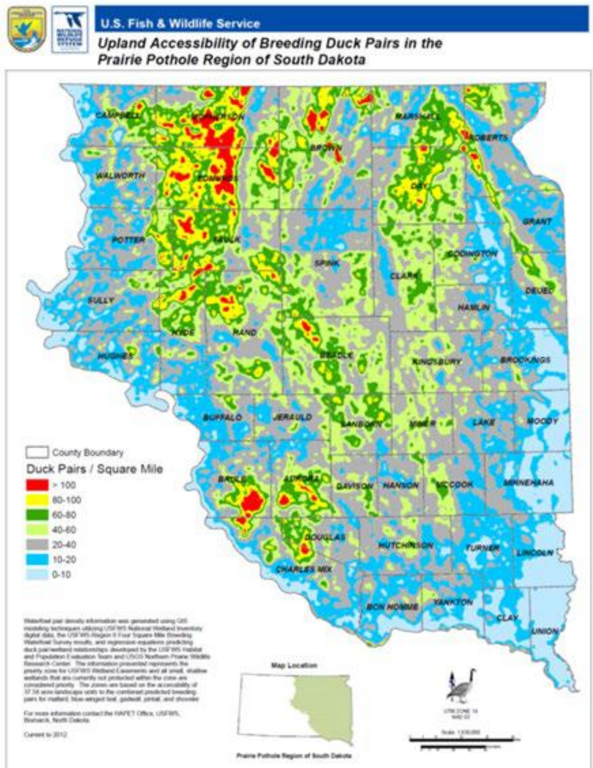


Figure 5.3. Upland Accessibility of Breeding Duck Pairs in the SD PPR (Thunderstorm Nap). Mallard, Northern Pintail, Gadwall, Blue-winged Teal, and Northern Shoveler are Included in the Model.



Wetland drainage, degradation, and consolidation have escalated in South Dakota and across the PPR. According to Dahl (2011) wetland losses across the PPR can be attributed to "efforts to increase drainage on farm fields as a result of economic and climatic conditions." It was estimated that by the early 1990's South Dakota had lost approximately 35% of its natural wetlands, leaving roughly 2.2 million acres of intact prairie wetlands today (Figure 1; Johnson and Higgins 1997). Tile drainage is moving rapidly north and west into areas of South Dakota not historically impacted by this drainage technique. Increased surface ditching activity also has continued over the last decade. Johnston (2013) estimated an annual National Wetland Inventory (NWI) wetland loss of 0.28% per year for the PPR areas of North and South Dakota. Dahl (2014) estimated that 2.8% of all wetlands in the SD PPR were drained from 1997-2009. Oslund et al. (2010) estimated that 4.3% of remaining wetland habitats disappeared between 1980 and 2007 from the Minnesota PPR, likely because of improved tile drainage. Wright and Wimberly (2013) estimated roughly 247,000 acres of grasslands in South Dakota within 100m of adjacent pothole wetlands were converted to agriculture from 2006-2011. Over time, these losses and degradations have and will continue to impact the carrying capacity of the PPR to support breeding ducks and other wetland dependent species in South Dakota.

Many areas within the PPR experiencing intensification in wetland drainage also undergo significant wetland basin consolidation. Wetland consolidation occurs in closed basin drainage watersheds when small wetlands are drained downstream into typically larger, more permanent wetland basins. This artificial increase in wetland inflow due to drainage can impact wetland productivity by altering the frequency of drawdowns the basin experiences, reducing invertebrate populations, and impeding nutrient cycling (Anteau 2012). Increased wetland connectivity through consolidation drainage may also increase sedimentation and favor invasive aquatic species and permanency of fish, further degrading the value of larger wetlands and shallow lakes for waterfowl (Anteau 2012). Work completed in South Dakota by Janke (2016) documented direct body condition reduction in spring migrating ducks when correlated with fish density in wetlands. Wetland consolidation also has dramatic impacts to water budgets and hydrology within watersheds. Consolidation of water from many basins to a few basins increases frequency of basin overflow and decreases evapotranspiration rates within watersheds, all of which result in decreasing overall watershed capacity (Dumanski 2015, McCauley et al. 2015, Wiltermuth 2014).

Riparian and wetland areas adjacent to agricultural fields are often degraded by agricultural runoff and sedimentation. Tilled wetlands experience a higher influx sediment deposition and a resultant significant increase in water turbidity compared to untilled wetlands (Dieter 1991). Greater turbidity reduces the photic zone for wetland macrophytes negatively impacting vegetation establishment and persistence. Even miniscule amounts of sedimentation can preclude vegetation germination during the drawdown phase and reduce invertebrate emergence. Aquatic macrophytes not only provide habitat and a direct food source for aquatic invertebrates but also a substrate for microbes and algae colonization, which are subsequently ingested by aquatic invertebrates.

Recently, changes in the definition of waters of the United States protected under the Clean Water Act (CWA) have rendered many isolated, depressional wetlands unprotected under CWA. Voluntary, incentive-based conservation programs such as the Wetland Reserve Easement Program (WRE), the Conservation Reserve Program (CRP), and Swampbuster provisions of the Farm Bill may reduce the rate of conversion and minimize some of the impacts from adjacent runoff.

Primary threats to riparian areas include overutilization by grazing livestock, conversion of riparian woodlands to pastures, and human development. Overgrazing by livestock in riparian areas can negatively affect herbaceous plant communities and reduce regeneration of native woody vegetation. Woody habitat removal in riparian areas to expand grazing pastures can alter habitat suitability for plant and animal species. Excavation, to increase water storage capacity for livestock and irrigation purposes, can also change hydrology and vegetation communities. Direct human development, especially in the Black Hills, can lead to increases in stream sedimentation and reductions to overhead vegetative cover impacting aquatic and terrestrial wildlife species.

Water control structures, such as impoundments, have had the effect of converting flowing water to non-flowing water systems on some of the larger rivers and streams. This has also led to the inundation of the adjacent riparian ecosystems. For example, many of the historical riparian and wetland ecosystems of the Missouri River system have been inundated and lost to the series of dams and large reservoirs present today. The river has been impacted by channelization and maintenance dredging activities, as well as construction of impoundments by private interests and government agencies. These have all isolated the river from its historical floodplain. Water impoundment and channelization activities have led to:

- a 98% reduction in the number of islands and sandbars;

- the elimination of riparian forests and stream channels in areas of flooded reservoirs;
- a reduction in channel diversity through the loss of side channels, backwater sloughs, and meandering;
- in certain areas, a change in shoreline substrate from a dominance of silt, sand, and wood to rock riprap (rock and concrete);
- a decline in suspended sediment. This has led to channels deepening, banks eroding, and the drainage of remnant backwaters downstream from dams; and
- the modification of the natural flow regime - eliminating the periodic flood pulse, thereby substantially changing the annual hydrograph, sediment loads, temperature regime, and nutrient budgets.

Natural disturbance processes

Like the discussion of impacts to terrestrial ecosystems, the suppression or alteration of natural disturbance processes in South Dakota has reduced the heterogeneity of riparian and wetland ecosystems. Dams have been placed on many streams to provide livestock water, control flooding, store water for irrigation, and other human uses. Water management programs reduce the effects of flood events and thereby prevent many flood-adapted plant species from regenerating. The result is more homogenous riparian and wetland ecosystems. Channelization and water diversion projects can impact the extent, species composition, and structure of the remaining ecosystems. Cottonwood reproduction has been significantly impacted because of its reliance on a river's ability to flood its banks, as well as meander and create new land for cottonwoods to colonize. Remaining cottonwood stands, historically the most abundant and ecologically important species on the floodplain, are declining, and new groves are not appearing to replace them. In addition, the loss of the river-floodplain connection has reduced the amount of shallow water riparian and wetland habitat. These habitats traditionally supported abundant plant and shrub communities that, in turn, supported many wildlife species.

Off-stream water impounding and diverting for stock ponds and urban areas has also led to changes in levels and timing of in-stream flows. Reduced in-stream flow impacts the function and integrity of vegetation communities as well as the size and extent of the riparian zone adjacent to streams and drainages. The cumulative effects of thousands of small impoundments (such as stock dams) in arid environments are poorly understood but may be having major impacts on the hydrologic regime of thousands of miles of small, intermittent prairie streams (Sauer and Masch 1969). Potential groundwater recharge into an aquifer is expected to occur primarily in intermittent alluvial stream channels. Therefore, reducing the amount of water that enters a downstream alluvial channel implies a loss of potential groundwater recharge. Further, the introduction of nonnative fish/aquatic species to these stock ponds can also negatively impact native species in the event of a dam blow-out or overflow that enables stock pond waters to enter streams and rivers during heavy precipitation events.

Historically, depressional prairie wetlands in South Dakota experienced dynamic hydrology with even large basins periodically going dry. This, along with very few surface connections to other waters kept most prairie potholes free of fish (McCauley et al. 2015). Without fish for competition and predation, biomass of invertebrates increased substantially. This provided enhanced food resources for other wetland-dependent species, including many species of migratory birds (Anteau 2012). For some wetland and grassland habitats, particularly those in eastern South Dakota, grazing by native herbivores is no longer as common as it was historically, which has further reduced the diversity of plant species and structures within riparian and wetland communities. Where cattle grazing occurs today, land managers frequently use a season-long moderate grazing level that contributes to a reduced diversity of species and structures in riparian and wetland ecosystems when compared to historical conditions (Fuhlendorf and Engle 2001). Bison grazing is known to have historically caused streambank erosion when herds congregated near water. However, they were typically migratory, so it is believed that revegetation occurred periodically. Today's cattle herds are often grazing the same pastures repeatedly, contributing to continuous or frequently recurring streambank erosion in riparian and wetland areas. The long-term impact to water quality is expected to be more impactful than from bison. In addition to groundwater pumping and water diversion projects, fire suppression efforts have increased adjacent woodland areas. In the case of the Black Hills region, increased tree densities of surrounding forests result in a reduction to in-stream flows. Consequently, the water available to adjacent riparian vegetation has been reduced and the width of the riparian zone has decreased in response to reduced soil moisture.

5.4 Aquatic Systems

Many stressors directly and indirectly impact aquatic ecosystems and habitats (Richter et al. 1997). A multitude of stressors and disturbances affect riverine ecosystems, many of which are cumulative in nature. Such impacts, along with the fact that these stressors and disturbances are often greatly removed from the site of interest, make determining the primary causes of species and habitat loss difficult (McCartney 2002).

Nine primary challenges/threats associated with maintaining aquatic ecosystem diversity in South Dakota include: 1.) the direct alteration or conversion of ecosystems, 2.) agriculture and aquaculture, 3.) energy production and mining, 4.) transportation and corridors, 5.) human intrusions and disturbance, 6.) natural system modifications, 7.) pollution, 8.) invasive and problematic species, pathogens and genes, and 9.) climate change.

Natural system modifications

When modifications are mentioned in relationship to aquatic systems the natural tendency is to think about anthropogenic changes. But not all modifications are anthropogenic. Fires can happen either by humans or natural events (e.g., lightning strikes). The Black Hills National Forest (BHNF) has seen an increase in frequency of fires since the 1880 with 53% of fires occurring between 2000-2014 (USDA Forest Service 2014). Paul et al. (2022) states that wildfires increase overland water flows, which cause increased erosion and frequency of debris and sediment entering streams. These increased flows reorganize stream channel and riparian habitats, which can ultimately alter aquatic food web dynamics (Jones et al. 2012, Paul et al. 2022). Another anthropogenic aquatic system modification is placement of dams on lotic (running water, such as rivers and streams) systems. The most drastic change to these systems is alteration from a once flowing system into a reservoir system. This type of change has severe implications to the available habitats, disrupts the natural flow regime, and affects water temperature, all of which have major consequences on aquatic life found in these systems. Many fish species found in lotic systems require flowing water to persist (Schlafke et al. 2024) while reservoirs are usually dominated with lentic (still water, such as lakes and ponds) habitats. Other aquatic ecosystem modifications that are underestimated in their impact to aquatic life are related to altering the shorelines or banks of lakes and streams (e.g., riprap, beach construction, altering riparian vegetation from grasses to trees etc.). These shoreline/bank modified areas can negatively affect fishes. Schmetterling et al. (2001) observed native fishes displaced by exotic species due to the placement of riprap, which caused the loss of overhanging vegetation, undercut banks, and limited gravel recruitment and potential of large woody debris along riprapped areas.

5.5 Conservation Threats

Nonnative and invasive species - Terrestrial Systems

More recently, the accidental or intentional introduction of nonnative species has had a major impact on native species and ecosystems. Nonnative invasive plant species are a challenge in all South Dakota ecoregions and across all ecosystem types. They are of particular concern to maintaining the ecological integrity of historical ecosystems. Nonnative invasive species will often reduce the overall biodiversity of a vegetative community by displacing native species and altering normal ecological processes (e.g., nutrient and water cycles) (Mack et al. 2000). Where heavy infestations of nonnative invasive plants occur, many of the habitat values of that ecosystem will be converted to conditions no longer favorable to native wildlife. Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) are two nonnative cool season grasses that have invaded most of the grassland habitats across the state as well as many types of ecosystems. These two invasive grasses have degraded grassland habitat and been aided by fire suppression and altered grazing regimes. Grassland degradation has negative ramifications for a wide range of ecosystem functions including biological diversity, wildlife habitat, pollination, hydrologic systems, and nutrient cycling (Grant et al 2020). In addition to these grass species, noxious weeds (such as Canada thistle and leafy spurge) are found throughout South Dakota and cover thousands of acres of previously native ecosystems. These noxious weeds can impact wildlife habitat and forage, deplete soil and water resources, and reduce plant and animal diversity (DiTomaso 2000).

As discussed previously, humans have altered the natural disturbance process primarily though fire suppression and altered grazing patterns of grasslands. This alteration has given way to another threat to grassland habitats, woody species encroachment. Due to the lack of naturally occurring fires, woody species that would have been previously reduced have expanded into some grasslands in South Dakota. Some historical grasslands have moved through successional stages and become forest. Many of these woody species are native to South Dakota but are now considered invasive as they expand across the landscape. One example is eastern redcedar (ERC) (*Juniperus virginiana* L.), which has been referred to as the most rapidly spreading woody species in the NGPs due to fire suppression, planting in windbreaks, and overgrazing (Holm 2023). The expansion of species like ERC degrades grassland habitat for grassland-obligate species and subsequently transitions those landscapes to support traditional woodland or forest species when they become the dominant woody species. The decline of these grassland habitats equates to less habitat available to pollinators and grassland birds, less nesting habitat, and less forage for wildlife. This threat to grasslands also impacts ranchers as it reduces forage production for livestock. The Rangeland Analysis Platform tool was developed by the University of Montana in partnership with Working Lands for Wildlife (an initiative of the USDA's NRCS) and the Bureau of Land Management (BLM). This tool (https://rangelands.app/) uses more than three decades of vegetation and production trends data to provide information regarding the risk of wildfire, tree encroachment, and forage production.

Another valuable reference is the Central Grasslands Roadmap (CGR). This collaborative effort between sovereign Indigenous Nations, private landowners, state/provincial wildlife agencies, federal wildlife agencies, academia, foundations, and conservation organizations helps guide conservation of North America's Central Grasslands. Grasslands span over 700 million acres across Indigenous Lands, Canada, the United States, and Mexico. The CGR (Figure 5.4) provides a visual representation of converted/altered grasslands and identifies vulnerable grasslands (depicted in yellow) that may be at risk of conversion due to agriculture, woody encroachment, or development. Areas in green are core grasslands that remain. More information can be found at https://www.grasslandsroadmap.org/. The CGR can be useful for strategic conservation planning.

Land and water management practices are often tied to local priorities. Where grassland habitat and associated grassland-dependent species are priorities for private and public land managers, woody encroachment is a challenge to address. In other areas or situations, riparian and upland shrublands and forests may be the desired ecosystems to meet wildlife needs (see Table 8.3 later in this document).

Nonnative and invasive species – Riparian-wetland Systems

In riparian-wetland habitats, European common reed (*Phragmites australis* L.) and purple loosestrife (*Lythrum salicaria* L.) have invaded thousands of acres of previously native ecosystems (Deneke et al. 2010). Hybrid cattail *Typha* X *glauca* (a hybrid between common cattail *T. latifolia a*nd narrowleaf cattail *T. angustifolia*) has become invasive in many prairie wetlands across the NGPs, including South Dakota. Historically, common cattail was an uncommon native species in South Dakota. Narrowleaf cattail was found mainly on the eastern seaboard of North America. Anthropogenic introduction of narrowleaf cattail into the Great Plains put it into direct contact with native common cattail allowing it to hybridize freely (Bansal et al. 2019). The resulting hybrid cattail exhibits hybrid vigor, outcompeting both parental stocks as well as other native emergent aquatic vegetation. *T.* X *glauca* often forms dense, monotypic stands within wetland basins, reducing habitat value for many wetland-dependent species (Cressey 2016). These aggressive cattail species can quickly close off what once was a mosaic of open water and emergent vegetation, rendering shallow basins less suitable to support a greater diversity of wetland obligate species.

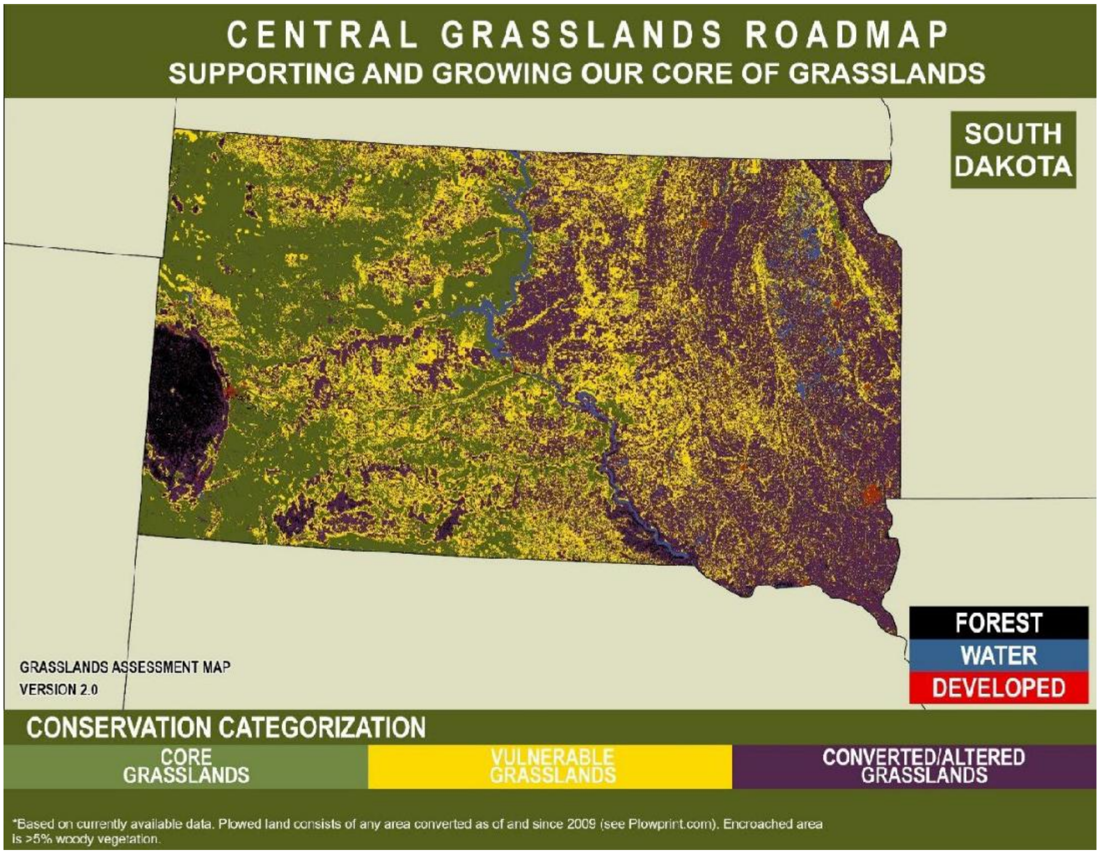
Invasive and problematic species, pathogens and genes – Aquatic Systems

Aquatic invasive species (AIS) are non-native species that are a threat to the environment, as well as to water suppliers, industry, power generation, recreation and ultimately, the U.S. economy. The negative impacts of AIS may include clogged municipal, agricultural, and industrial water intakes and water delivery systems and damaged power generating equipment, increased flooding risk due to clogging of water control structures, decreased recreational opportunity, physical danger to water users, changes in water quality, decreased property value, and damage to boats and marina infrastructure. South Dakota focuses primarily on invasive invertebrates such as zebra mussels (*Dreissena polymorpha*), red swamp/rusty crayfish (*Faxonius rusticus*), invasive plants such as curly leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*), and silver carp (*Hypopthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*). For more on AIS see: https://sdleastwanted.sd.gov/.

Screening of fish for microbial (viral, bacterial, parasitic) pathogens is defined in Department regulations. For more on pathogens of regulatory concern see:

https://gfp.sd.gov/userdocs/docs/fish_importation_regs_update_01-2021.pdf.

Figure 5.4. The Central Grasslands Roadmap of South Dakota (c. 2023) with Grasslands Categorized as Core Grasslands, Vulnerable Grasslands, and Converted/altered Grasslands. Map Derived from https://www.grasslandsroadmap.org/ Where More Information and Map Updates Can Be Found As They Become Available.



Climate change – Terrestrial Systems

In the last 30 years, a growing recognition of the threat of climate change as a causal agent for indirect conversion has also accelerated. A conclusion of the report of the U.S. Global Change Research Program (2009) is that "global warming is unequivocal and primarily human-induced." While there is a preponderance of scientific evidence on the occurrence and causes of climate change, understanding its likely effects at state and local levels is more challenging. This is especially so for fish and wildlife populations as our knowledge of their habitat needs is often limited and understanding stressors to populations is difficult enough without having to incorporate the additional projected effects of climate change.

Responding to climate change will require collaboration and thinking and working at multiple spatial scales. Fish and wildlife habitat often encompasses large areas of multiple ownerships. Management actions must consider not only site level conditions but also the influences of the surrounding landscape. As the effects of climate change make these considerations more complex, agencies such as SDGFP will need to work collaboratively with conservation partners and at larger scales to develop appropriate actions and strategies that emphasize adaptation and mitigation to minimize the potential negative consequences.

While many unknowns remain related to climate change effects, understanding how ecosystems will respond to climate change is important to evaluating the potential effects on fish and wildlife habitat (Saxon 2003). Terrestrial ecosystems are expected to change in regard to plant species compositions, structures, and processes. Site-level changes to species compositions may result from shifts in ecological factors (e.g., temperature and precipitation) that no longer allow a particular species to occur. In addition, climate change may alter species competition at a site. Some ecosystems may become more vulnerable to invasion by nonnative invasive species. Native species composition and associated ecosystem relationships may be altered. Primary productivity of ecosystems may change depending on changes to temperature and precipitation. Frequency and severity of natural disturbance regimes may be altered with temperature and precipitation changes. The presence or amounts of some plant communities may also change with these influences. Similarly, riparian and wetland ecosystems may change in amounts and types resulting from changes to available water and temperatures. While many potential changes from climate change may be difficult to predict with great accuracy, models of projected climate change can help inform future management planning.

For the purposes of evaluating climate change impacts on the grass-shrub ecosystems of the Great Plains, one approach has concentrated on evaluating the response of species by traits such as photosynthetic pathway (Dukes 2007). There are two photosynthetic pathways, C_3 and C_4, which characterize most of the grass species in the Great Plains. The primary difference between these two functional types is the difference between the photosynthetic pathway where C_3 grasses produce 3 carbon molecules and C_4 grasses produce 4 carbon molecules during photosynthesis.

C_3 grass species are frequently referred to as cool season grasses and C_4 species as warm season grasses. Both cool and warm season grasses occur in South Dakota in what is often referred to as a mixed-grass condition. Today, the distribution of cool season to warm season grasses occurs within a general gradient within the state with cool season grasses increasing from south to north and warm season grasses increasing from north to south (Sage et al. 1999). Put more simply, warm season grasses generally occur in warmer locations and cool season grasses generally at cooler locations. In addition, the physical characteristics of each functional type also vary on a general gradient within the state with the warm season grasses appearing taller than the cool season grasses in the eastern portion of the state but then appearing shorter than the cool season grasses as they move westward across the state.

As the balance between C_3 and C_4 dominance within a plant community is believed to be responsive to climate change, this is often the focus of discussions aiming to predict future climate change conditions in the Great Plains (Collatz et al. 1998, Hattersley 1983, von Fischer et al. 2008). In general, there are three primary consequences of climate change on plant communities: elevated levels of CO_2 in the atmosphere, changes in average temperature, and changes in average precipitation. Elevated CO_2 improves photosynthesis in C_4 plants but also leads to higher productivity in C_3 plants. However, increasing temperatures generally decrease the productivity of C_3 plants, potentially counteracting the advantages of elevated CO_2 levels. Precipitation, depending on when it occurs, can have positive effects on productivity levels for both C_3 and C_4 species.

Morgan et al. (2008) described the expected effects of climate change on North America and the Great Plains:

> *"Along with rising global temperatures, predictions are for more frequent and longer-lasting heat waves, higher atmospheric humidity, more intense storms, and fewer and less severe cold periods. Warming in North America is expected to be greater than for the overall planet. Precipitation will tend to increase in Canada and the northeastern United States and decrease in the southwestern United States. Seasonality of precipitation is also predicted to change, with relatively more precipitation falling in winter and less in summer. The desiccating effect of higher temperatures is expected to more than offset the benefit of higher precipitation, resulting in lower soil water content and increased drought throughout most of the Great Plains."*

Review of the downscaled climate change data from the 2014 SDWAP indicates that over the next 80 years precipitation will be greater in the winter and spring (for most of South Dakota), variable but slightly reduced during the growing season (especially summer), and temperatures will increase fairly significantly. Cochrane and Moran (2011) prepared a climate change analysis for the 2014 SDWAP, which included projections to 2099 (Appendix R, Executive Summary; Appendix N, Full Report). The combination of higher temperatures during the growing season coupled with slightly decreasing precipitation will mean that available moisture for plants is likely to be reduced. An additional confounding effect is that weather events are expected to be more extreme (Ojima and Lackett 2002) including heavier but shorter rainstorms and prolonged drought. All of these will add stressors to plant communities that make accurate projections of changes in plant compositions and structures difficult.

While some believe the ability to predict how climate change will impact plant community compositions is limited (Morgan et al. 2008), other researchers have been evaluating variables that may be used to help predict how change may occur. Common variables that have been and continue to be evaluated are the use of temperature and precipitation to predict the future balance of C_3 to C_4 plant communities in the Great Plains. Some researchers believe temperature plays a major role in determining the C_3/ C_4 balance of grasslands (Ehleringer et al. 1997, Epstein et al. 1997). As an example, von Fischer et al. (2008) analyzed the soil organic matter (SOM) and fine roots from 55 native grassland sites widely distributed across the US and Canadian Great Plains to examine possible indicators of the relative production of C_3 vs. C_4 plants at the continental scale. They observed the following:

> *"Our results reveal that not all climate indices are equally strong predictors of %C_4. In particular, the results…. indicate that %C_4 in the North American Great Plains grasslands are especially sensitive to the climate in July, suggesting that the outcome of competition between C_3 and C_4 plants was particularly sensitive to climate during this narrow window of time. Mixed C_3 and C_4 systems persist in Great Plains grasslands where July average temperature is 70.7 $\pm$ 5.6 ^{O}F; systems are C_3 dominated (<33% C_4) below this range and C_4 dominated (>66% C_4) above it."*

Although precipitation appears to play a secondary role in determining competitive advantage, C_4 grasses are also able to use the reduced summer moisture resources more effectively than C_3 species, indicating that C_4 species will likely become more dominant under the von Fischer et al. (2008) model.

While the future climate and its impacts are yet to be fully understood, Figures 5.5, 5.6, and 5.7 (NOAA National Centers for Environmental Information 2024) provide a snapshot in change over the past approximately 130 years. These figures were generated and retrieved in August of 2024 from NOAA's Climate at a Glance Statewide Time Series website. Figure 5.5 shows an average increase in temperature in South Dakota of about 0.2 degrees Fahrenheit per decade. Figure 5.6 shows change in precipitation over this same time period with an average increase of 0.18 inches per decade. Lastly Figure 5.7 captures the severity of drought, as expressed by the Palmer Drought Severity Index (PDSI).

Figure 5.5. South Dakota Average Temperature from 1895 to 2023 (NOAA National Centers for Environmental Information 2024).

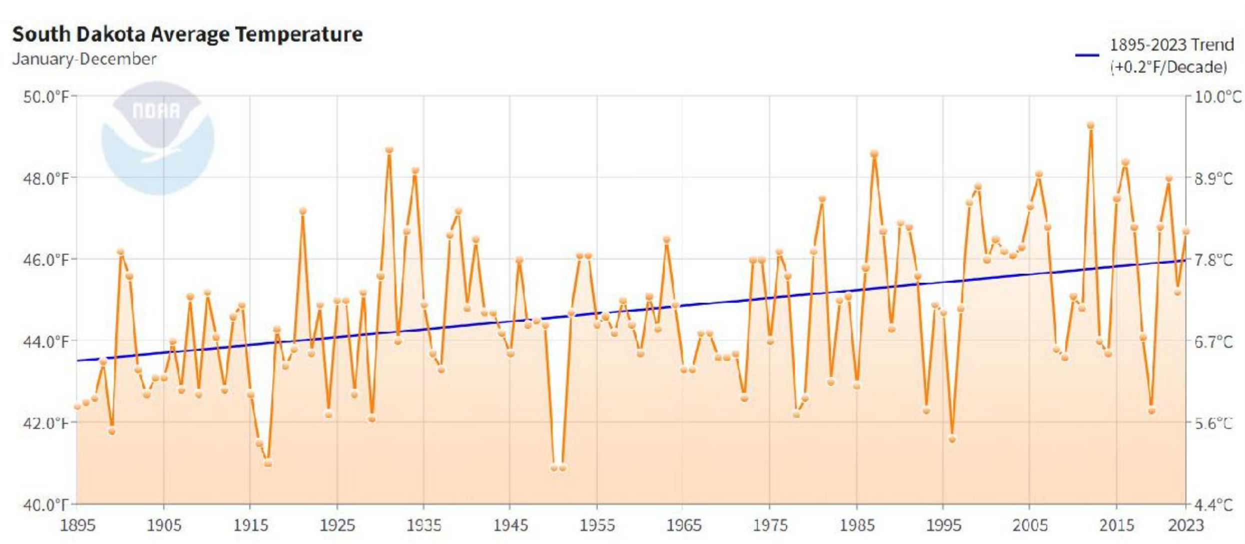


Figure 5.6. South Dakota Average Precipitation from 1895 to 2023 (NOAA National Centers for Environmental Information 2024).

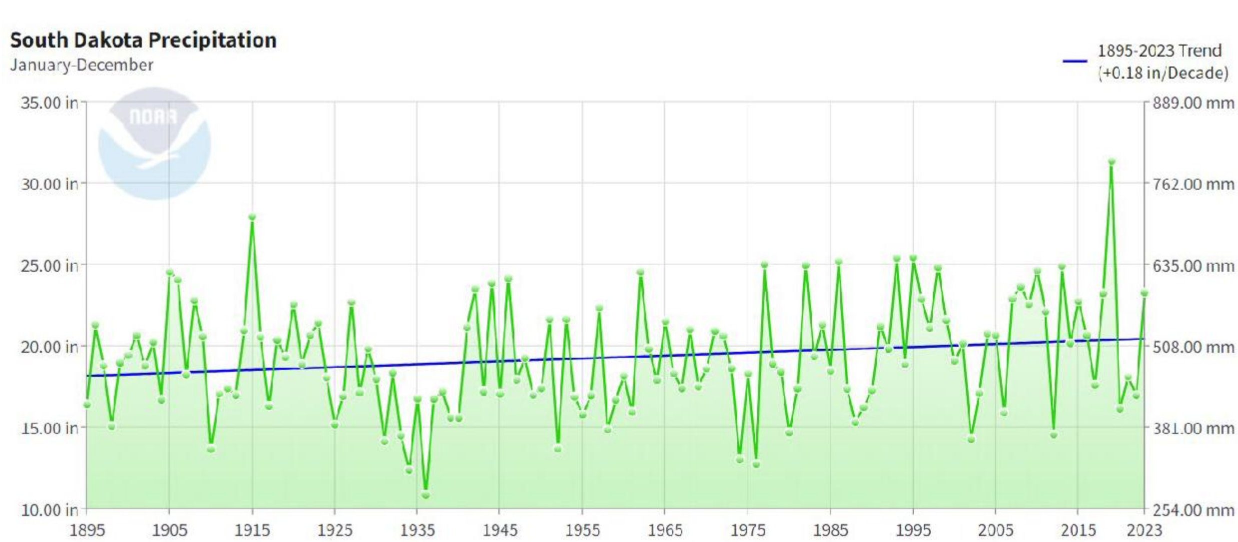
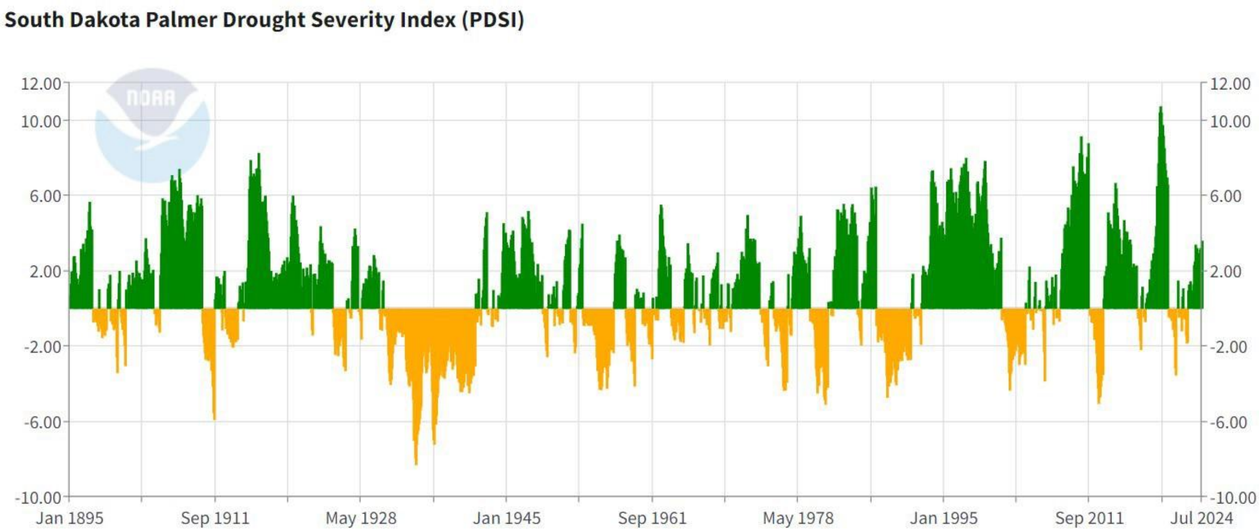


Figure 5.7. South Dakota Palmer Drought Severity (PDSI) Index Starting January 1895. PDSI is Classified by the Following: Extremely Wet 4.00 or more, Very Wet 3.00 to 3.99. Moderately Wet 2.00 to 2.99, Slightly Wet 1.00 to 1.99, Incipient Wet Spell 0.50 to 0.99, Near Normal 0.49 to -0.49, Incipient Dry Spell -0.50 to -0.99, Mild Drought -1.00 to -1.99, Moderate Drought -2.00 to -2.99, Severe Drought -3.00 to -3.99, and Extreme Drought -4.00 or less (NOAA National Centers for Environmental Information 2024).



Given the above discussion of possible effects of climate shifts on historic plant community species composition, it is important to be aware of these possible impacts so we can consider which species will be supportable in the future, while maintaining similar function and habitat structures for wildlife species. Depending on climate changes, management toward historical ecosystems may not be possible, which may require changes in management objectives for flora and fauna.

The goal of the SDWAP for terrestrial ecosystems is to maintain and restore large blocks of native habitat in appropriate locations throughout the state. Ecological sites provide the basis for identifying desired reference plant communities, and climate change analysis can suggest shifts in conditions to provide for sustainable plant communities in the future. Some SGCNs will be able to use these adjusted conditions. Efforts should be made to maintain similar structures to their current reference communities even with a shift in species compositions. Other SGCNs may fully depend on the specific C_3 plant compositions. These species may not be able to persist in their current locations. However, if similar shifts in restoration practices are followed in neighboring states or provinces, these species may be able to use new areas representing favorable plant communities in future locations under climate change.

Climate change – Riparian-wetland Systems

As with terrestrial ecosystems, understanding how riparian and wetland ecosystems will respond to climate change is important to evaluating the potential effects on fish and wildlife habitat. To evaluate the potential effects of climate change on riparian and wetland ecosystems in South Dakota, the Downscaled Global Climate Model (DGCM) datasets and results (Appendix N) were used for this evaluation. Furthermore, existing literature was reviewed for its applicability to the DGCM results and is summarized as follows.

Several studies have investigated the significance of temperature increases on wetlands, with the following major findings:

- An increase in spring precipitation and snowmelt runoff amounting to 10% of the total growing season precipitation was the only condition that compensated for increased water loss from evapotranspiration due to a 2°C temperature increase. (Poiani et al. 1995).
- "It is apparent from this simulation that a 20% increase in precipitation would generally compensate for a 3°C rise in temperature if applied uniformly" (Johnson et al. 2005), which is consistent with the findings of Johnson et al. (2010) "simulations showed that all three permanence types of wetlands lost significant hydroperiod under both 2°C and 4°C warming scenarios, unless accompanied by a minimum increase in precipitation of 5% to 7% per degree of warming."

When these relationships are graphed in comparison to projected climate conditions, overall effects on wetlands can be evaluated. Figure 5.8 shows a comparison to a 2°C rise in temperature and a 10% increase in spring precipitation (Poiani et al. 1995), while Figure 5.9 shows a comparison to a 3°C increase in temperature with a 20% increase in precipitation (Johnson et al. 2010).

Understanding the influence of the HGM class on riparian and wetland ecosystems within South Dakota is critical to understanding some of the potential impacts of climate change. Results of the DGCM evaluation indicate precipitation levels across South Dakota will be higher overall, particularly during winter and spring. However, precipitation will be slightly lower than or similar to present levels for most ecosystems during the summer months. A pattern of slightly greater precipitation increases in the eastern part of the state and smaller increases in the western portions is expected. This, coupled with much higher temperatures during the growing season, will lead to higher levels of evaporation/evapotranspiration occurring during the summer months. What this will mean for South Dakota riparian-wetland ecosystems will likely vary depending on the HGM class and hydrology sub-class. The increase in winter-spring precipitation levels should result in more runoff to riparian-wetland ecosystems. For wetlands with hydroperiods primarily spanning the spring and early summer timeframe (such as depressional-ephemeral, temporary, and seasonal) the increased winter-spring precipitation could result in additional water inputs to those basins with the capability to capture and hold additional water. This may push some basins into the next hydrology sub-class of greater size and depth. Wetlands that have terrain features that allow for greater water capture would fall into this category. For those wetlands that do not have terrain features that would allow capture of the additional winter and spring water, the effects are likely to be an increased rate of drying as the increased evaporation rates are expected to occur mid- to late summer with the increasing temperatures (Johnson et al. 2010). For those wetlands with hydroperiods that span the full summer (such as depressional semi-permanent and permanent) higher temperatures and similar or reduced precipitation in the summer may result in more rapid rates of evaporation and a shortening of the overall hydroperiod for these sub-classes (Johnson et al. 2010). This would be expected unless they are able to capture the increased winter and spring precipitation.

Depressional basins receiving groundwater inputs may benefit from the increased winter-spring precipitation rates, especially during periods of drought. Likewise, riparian-wetland ecosystems that are associated with the riverine and lacustrine HGM class will potentially have additional surface and sub-surface water inputs from increased winter and spring precipitation that may ameliorate the increased evaporative rate during the summer months and moderate the effects of drought on surface wetlands.

These findings are generally consistent with modeling results of Johnson et al. (2010). They found reduced hydroperiods for temporary and seasonal wetlands and a reduction in functional semipermanent wetlands in much of the PPR under a potential 4^o C rise in temperature. When combined with a 10% increase in precipitation, there was a shift in location of functional wetlands. In their modeling, they did not analyze the different projected amounts of precipitation increases. Suppose the projections of greater increases in precipitation amounts in the eastern part of South Dakota prove to be correct. In that case, the impact on wetlands in the western part of the state is likely to be even more pronounced (similar to the 4^o C rise in temperature without the 10% increase in precipitation as modeled by Johnson, Werner et al. 2010). Changes to wetlands in the eastern part of South Dakota may be similar to the predictions of Johnson et al. (2010).

Thus, projected increases in temperatures coupled with the projected increases and decreases in seasonal precipitation amounts are likely to have substantial effects on wetlands in South Dakota. Negative effects to biodiversity and waterfowl productivity are likely in the western part of South Dakota. Effects in the eastern part of the state are likely to be ameliorated by increases in precipitation amounts, particularly in the spring (Poiani et al. 1995). However, this is only to be expected in those wetland complexes that can capture and hold this additional precipitation and runoff. More rapid evaporation during the summer will shorten the hydroperiod of wetlands not able to capture the additional precipitation or that are not fed from groundwater or riparian sources. This will reduce the productivity and functionality of these wetlands. Protecting and restoring wetlands in the eastern part of the state, particularly in locations that can capture and hold additional spring precipitation, are important conservation activities to help address projected climate change effects.

Figure 5.8. Projected Climate Change for the Range of Conditions for 2021–2050 and 2070–2099 from the Downscaled Climate Change Analysis of this Report. Findings Suggest that a 10% Increase in Spring Precipitation is Needed to Offset Effects on Wetlands of a 2°Clincrease in Temperature Reported by Poiana et al. (1995).

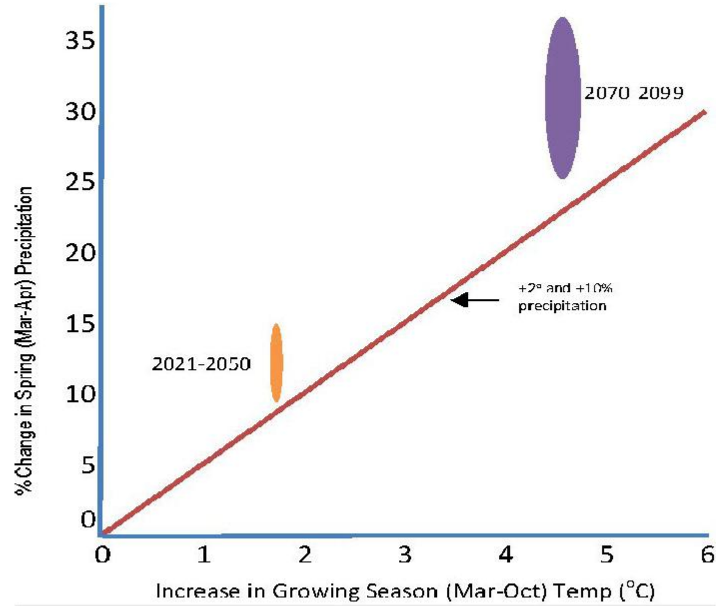
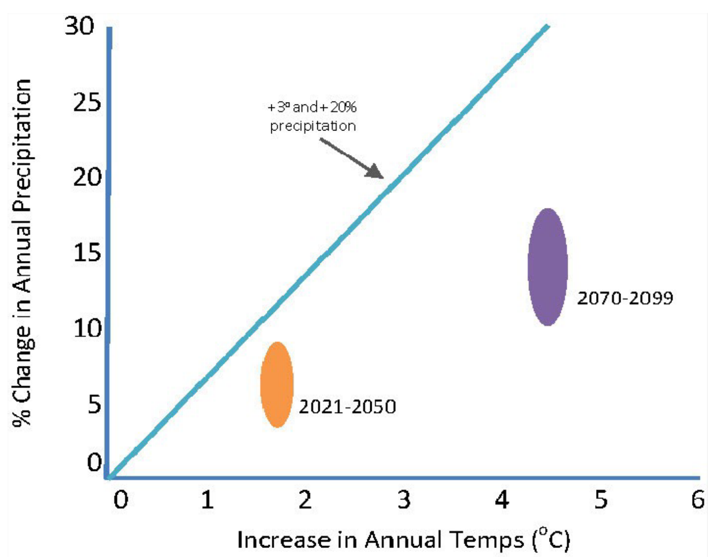


Figure 5.9. Comparison of Projected Climate Change for the Range of Conditions Projected in 2021–2050 and 2070–2099 from the Downscaled Climate Change Analysis of this Report. Findings Suggest that a 20% Increase in Overall Precipitation is Needed to Offset Effects on Wetlands of a 3°C Increase in Temperature as Reported by Johnson et al. (2005). This is Similar to the Relationship Reported by Johnson et al. (2010).



Climate change – Aquatic Systems

South Dakota is predicted to become warmer and drier (Burgess 2013). Lakes, rivers, and streams are expected to become warmer, and water levels will change. For cold water species, we may see a decline in distribution, while warmer water species on the northern edge of their distribution may experience range expansions. Stronger storms are expected to bring short duration, high intensity precipitation, which would increase flooding and increase nutrient runoff from agricultural lands. In addition to short duration storms, we are also likely to see an increase in drought and an increase in human demands for water. The resulting habitat loss will affect nursery grounds and spawning areas for aquatic communities.

Energy production and mining – Terrestrial Systems

Energy and mineral development in South Dakota are impacted by transitional energy sources, technological advances, and continuing exploration, which factor into determining economic viability of existing land and mineral resources. Mining exploitation of several different types of ore bodies is ongoing, including uranium, gold, bentonite, dimensional stone, taconite, and many isolated deposits of critical industry minerals and aggregates. Better mining economics and technological advances have and will continue to lead to new mineral resource areas. Mining methods continually improve, leading to exploration at greater depths and the return to profitability of what were once uneconomical relic surface deposits. Nonrenewable fossil fuel generation is currently complemented by transitional energy products, which include geothermal, carbon sequestration, biofuels, wind, solar, and hydro. These invariably lead to increased mineral needs and land use needs. Energy and mineral development can negatively impact wildlife and habitats. To lesson resource impacts, resource managers must remain engaged in energy and mineral development to inform industry of state and federal laws and provide proven and innovative methods and technologies.

Energy and mineral development creates landscape level change through direct and indirect impacts. Direct impacts are those easily measured, such as counting mortalities or acres of habitat converted to energy and mineral development. Indirect impacts are more subtle and result from such impacts as fragmentation of habitat by building roads and fences (i.e., edge effects) or the erection of other obstacles that impact habitat or wildlife needs. Indirect impacts may increase an animal's metabolic rate, stress, and evasive movements, which consume energy that would otherwise sustain a population or an individual's health. Production techniques like wind, geothermal, and well drilling that clear vegetation for pads have about 5% of their impact from the direct removal of habitat while the remaining 95% of the impact is from fragmented habitat (McDonald et al. 2009).

Mining methods in South Dakota include surface, underground, and potentially in-situ recovery. Direct and indirect impacts to topography, native habitat, and species must be expected from mining. The extent of direct impacts to habitat from mining is determined by mining method and the ecological significance of habitat. Proposed mine areas must be clearly defined, and priority terrestrial and aquatic habitats identified for adequate protection. Indirect impacts depend upon the amount and intensity of disturbance, arrangement of disturbance, and quality of affected habitats (Sawyer et al. 2002).

Within the mineral rich Black Hills area, various types and variable extents of mining are likely to continue. Throughout the remainder of South Dakota, aggregate mines and quarries exploit areas that precluded agricultural development due to topography or soils. Relic and active aggregate mines and rock quarries are sometimes locally numerous. Individual mine areas may be small, but complexes of smaller operations can directly impact a significant amount of area. Statewide, mining will directly and indirectly impact intact habitats and SGCNs.

Current oil and gas production in South Dakota is almost exclusively located at the southern extent of the Williston Basin in the far northwestern corner of the state. Much of the activity occurs in the intact, native ecosystems dominated by sagebrush. Although oil and gas exploration is ongoing, extensive exploration will likely be delayed ten to twenty years as technology allows operators to pursue targets in oil shale or similar productive plays (SD DENR 2018b).

Geothermal energy in South Dakota is used in small-scale direct heat applications, including individual spas, swimming pools, residences, barns, and other buildings. There is no utility-scale electricity generation from geothermal energy in the state (EIA 2024).

Biofuels include ethanol, biodiesel, and other fuels made from various forms of vegetation biomass. Biofuels accounted for two-thirds of the direct land conversion from US energy development, despite comprising only 6% of total energy production (Taylor et al. 2015). An International Energy Agency (IEA) analysis forecasts that biofuel use will increase dramatically in importance and areal extent (IEA 2023). Nationally, cropland is largely shifting from urban-fringe farmlands to western states' rangeland (Emili and Greene 2014). Biofuel's indirect landscape level impacts are second only to oil and gas in the liquid fuel "energy sprawl" (Taylor et al. 2016). State and federal mandates and incentives promote biofuel development in the United States (EIA 2024). All these factors increase demand for crop and crop products that correspondingly increase competition for land use. Direct impacts from biofuel production should be expected as demand for fuel increases.

Habitat conversion and alteration through fragmentation are top concerns regarding renewable energy development, especially with Great Plains grasslands. Every energy source requires land to be temporarily or permanently converted to accommodate energy infrastructure pads, power stations, transmission lines, and new service roads (Ott et al. 2021). Threats from the development of renewable energy infrastructure apply to other habitat types besides grasslands. However, wind and solar development have primarily impacted grasslands within the state. These two common types of renewable energy infrastructure are increasing in South Dakota.

As of 2022, South Dakota had approximately 1,400 wind turbines with a total capacity of roughly 2,000 megawatts (American Wind Energy Association 2022). A modern wind turbine requires approximately 3 acres of land, including the turbine pad and access roads (Arnett et al. 2007). With almost nine-tenths of South Dakota identified as "suitable" for large-scale wind development, wind facilities could be proposed in virtually all areas of the state (EIA 2018). The National Renewable Energy Laboratory (NREL) estimates that South Dakota could generate many times its current electricity needs from wind. These data suggest that over time, wind generated energy development will occupy a significant amount of surface area in South Dakota.

Solar is a much smaller industry within the state with around 40 utility-scale solar farms and a total capacity exceeding 400 megawatts (Solar Energy Industries Association 2023). Moderate solar photovoltaic (PV) potential exists across most of the state, with the greatest solar resources in the southwestern corner of South Dakota. The Fall River Solar Farm in southwestern South Dakota was operational in 2023, and the Wild Springs project was expected to come online in mid-2024. The NREL suggests that 5 to 10 acres of land is needed to produce one megawatt of power through solar (Labratory 2023). This would mean the 400 megawatts produced in South Dakota impact between 2,000 and 4,000 acres of land.

Wind and solar energy are continuously evolving as more wind and solar farms are developed. The most up-to-date information can be found by consulting the American Clean Power Association (www.cleanpower.org), the U.S Department of Energy (www.energy.gov), the Solar Energy Industries Association (www.SEIA.org), the Solar Beneficial Management Practice Database provided by AFWA (https://www.fishwildlife.org/solar-beneficial-management-practice-database#home/), and for local updates on developments at the South Dakota Public Utilities Commission (PUC) website at www.puc.sd.gov.

Energy production and mining – Riparian-wetland Systems

Clean energy progress will continue with or without oil and gas producers (EIA 2024). Direct impacts to terrestrial and aquatic habitats from exploration drill pads, production tank batteries, roads, and pipelines is individually small. Indirect impacts from expansive ancillary facilities can cause a larger wildlife concern especially when placed near important habitat or when industrial-scale production occurs. On the state's 274,000 surface acres and around 1.7 million subsurface acres of federal mineral estates, operational stipulations safeguard significant wildlife needs. For example, except for essential road and utility crossings, disturbance is prohibited within riparian areas of wetlands, streams (intermittent, ephemeral, or perennial), and rivers (BLM 2024).

Renewable energy production, particularly wind energy, has increased dramatically across South Dakota. According to South Dakota PUC, South Dakota currently has 3.057 GW of production capacity over 23 operational wind farms. Most of this has become operational in the last 10 years. Potential direct impacts to South Dakota wetlands include draining or filling basins to facilitate pad and road construction. Research on indirect impacts to wetland dependent species has been mixed. Gue et al. (2013) found no impact to breeding mallard and blue winged teal survival near wind farms while Loesch et al. (2013) reported a 21% reduction in ducks settling near wind farms when compared to control sites. A long-term study (Shaffer and Buhl 2016) showed 7 of 9 common grassland bird species were displaced by wind turbines out to 300 meters.

Surface mining at all scales includes some degree of ore removal and waste handling. This direct impact of vegetative cover removal indirectly reduces the value of stable terrestrial habitat with altered soil horizons, introduced plant species, and weed infestation. Altered environments at more expansive mine operations require control of large volumes of storm water and often chemical solutions associated with metal recovery. Accumulated volumes of storage ponds containing chemical solutions and altered stormwater must be treated to certain water quality standards before being released into the downstream environment. Downstream wetland and riparian habitats are potentially indirectly impacted from unmanaged discharges, sediments, metals sorption, changed flow, and temperature regimes.

Energy production and mining – Aquatic Systems

Water management from mining operations and potential environmental impacts to surface and ground water vary greatly depending on the size of the project, its proximity to water resources, the commodity mined, the type of deposit, the method of ore processing, and mining method (SME 2022). Mining at all scales includes some degree of ore removal and waste handling. When established native vegetative is removed, storm runoff is more likely to erode newly establishing habitat with now altered soil horizons, introduced plant species, or weed infestations. Downstream aquatic ecosystems can potentially be directly and indirectly impacted from unmanaged sediments, metals sorption, and changed flow and temperature regimes, which hinder aquatic biodiversity. Stormwater and storage ponds with accumulating volumes of chemical solutions require treatment to meet water quality standards before being discharged into the downstream environment. However, even with current regulations, surface mining affects fish and aquatic resources from dewatering of wetlands, diverting and channelizing streams, and unanticipated chemical discharges to surface and ground water (Starnes and Gasper 1995).

Recreational activities – Terrestrial Systems

Wildlife and land management agencies may have differing individual missions, but many share a dual purpose of managing for fish and wildlife species and their habitats and promoting sustainable use of these resources. Many state fish and wildlife agencies originated because species were being exploited without regard to the future of fish and wildlife populations or the importance of stewardship for future generations of users. Regulated outdoor activities, such as fishing, hunting, trapping, camping and visits to fee areas, and use and harvest of trees or hay all provide revenue to agencies and, often, local communities.

Participation and related expenditures for the 3 most common wildlife-associated recreation types are periodically estimated by the USFWS through user surveys. The most recent summary of this effort surveyed users about their activities during 2022 (U.S. Dept. of Interior, USFWS 2022A). Key findings at the national scale were:

- Fishing: 39.9 million participants spent $99.4 billion during 2022;
- Hunting: 14.3 million participants spent $45.2 billion during 2022;
- Wildlife watching at home: 146.5 million participants during 2022;
- Wildlife watching away from home: 73 million participants during 2022; and
- Wildlife watchers in both categories spent $250.2 billion during 2022.

In addition to mental and physical benefits (Kaczynski and Henderson 2007), outdoor activities help connect users to wildlife and habitat resources and promote stewardship commitments; assist in managing wildlife and fish populations through hunting and fishing; expenditures contribute to jobs and local economies; and these activities support the purchase of archery equipment, fishing tackle, firearms, ammunition, and motorboat fuel. These expenditures boost the amount of manufacturers' excise taxes collected on these goods. These taxes help support conservation funding (U.S. Dept. of Interior, USFWS 2022A).

Despite these benefits, few activities have entirely positive impacts. Increasingly, the study of "recreation ecology" has provided the forum to consider potential negative impacts of outdoor recreation and promote more responsible management. Several literature reviews on this topic have described direct and indirect impacts of outdoor recreation to wildlife and habitats (Dertien et al. 2021, Eisen et al. 2021, Kerlinger et al.

2013, Marion 2019).

Examples of potential conflicts between outdoor recreationists and SGCNs can be found in species accounts within this document. Examples include impacts to nesting American Dippers and Peregrine Falcons. The remainder of this section focuses on impacts from a broader perspective.

Direct impacts of outdoor recreation include fish and wildlife population changes and behavioral responses associated with the pursuit and harvest of game and fish, snag habitat removal during firewood cutting and collection, and feeding wildlife either intentionally or not. Indirect impacts may include disturbance of nontarget species, trampling of vegetation, introduction of undesirable plant species to natural areas, pollution from burning of boat motor fuel and snowmobile and ATV exhaust, and soil erosion around trails and campsites (Marion 2019).

Winter recreation can further stress wild animals already faced with the challenge of finding food and shelter. At a broader scale, winter recreation impacts may be additive to other conservation threats facing wildlife. Wildlife tend to respond more strongly to unpredictable recreation, such as off-trail or off-road activities. Trails can fragment habitat needed to avoid unnecessary movements during winter. The soundscape impact refers to the tendency of motor vehicle sounds to travel farther in back-country areas, increasing wildlife stress and disrupting animal communication. Resource impacts include snow compaction, which can increase soil erosion and soil runoff, and vegetation impacts, such as to tree samplings and riparian plant communities (Eisen et al. 2021).

Dertien et al. (2021) discuss potential impacts of nonconsumptive recreational users on wildlife. They reviewed studies for insights into thresholds at which recreation would cause wildlife to have a behavioral or physiological change. The most common study subjects were shorebirds and ungulates, with a lack of study for amphibians, reptiles, and invertebrates. Planners and resource managers need solid information to design recreation infrastructure and manage users, especially in protected or sensitive areas. The authors concluded that the assumption should not be made that nonmotorized recreation does not disturb wildlife.

Cole and Landres (1995) describe that outdoor recreation impacts vary with the activity’s intensity, timing, and extent. An additional consideration is the rarity or vulnerability of the impacted habitat. Some plant species are more tolerant than others of recreational disturbance. Variables may include plant size, growth form, leaf flexibility, ability to produce a large quantity of seeds, and whether the plant is an annual. Pole-sized trees and saplings may be reduced intentionally to facilitate recreation activities or because of an activity’s habitat impacts. Downed trees and brush piles tend to decline in recreation areas.

Although South Dakota-specific studies on impacts of outdoor recreation to South Dakota habitats are lacking, the greatest threats are assumed to be to forest habitats, primarily in the Black Hills, and badlands areas. The BHNF, an area of 1.2 million acres, has 3,800 miles of motorized travel options, including 700 miles of system trails available for off-highway vehicles, 450 miles of hiking trails, and 350 miles of trails groomed by the South Dakota Snowmobile Program.

In these two ecosystems, heavy foot traffic and off-road vehicle use cause soil erosion and compaction, disrupt local flora, and lead to sedimentation in waterways (Barlow and Gude 2009, National Park Service 2017). These activities can also disturb wildlife, introduce and move invasive species, create fire risk, fragment habitat, and leave behind litter and waste.

Recreational activities – Riparian-wetland Systems

Threats to riparian areas and wetlands in South Dakota mirror those mentioned in the terrestrial section of this chapter and include soil erosion and compaction, vegetation damage, wildlife disturbance, and invasive species spread. Additionally, in riparian areas and wetlands, much of the foot traffic and particularly off-road vehicle use can damage habitats because of wet conditions. As the soil is disturbed it can erode into nearby water and cause sedimentation (McCaffery and Tilley 2002). In some cases, this leads to changes in hydrology that impact the entire ecosystem (Baird and Huges 2000).

Human intrusions and disturbance – Aquatic Systems

The recreational activity of riding on existing and non-existing trails across South Dakota in off-road vehicles is more prevalent in the western part of the state. In 2021, off-road vehicle activities generated more than $235 million statewide and $109 million in the Black Hills alone (Southwick Associate 2022). While these recreational activities stimulate South Dakota's economy, they impact aquatic ecosystems and biodiversity through increased sedimentation, degraded stream habitat, and water quality effects (Allan and Castillo 2007, Wilkerson and Whitman 2010).

Pollution – Terrestrial Systems

As the human population grows there is invariably an increase in pollutant-creating activities. These include the development of urban areas, oil and gas activities, renewable energy development, and habitat conversion to row crop agriculture.

Row crop agriculture uses herbicides, fertilizers, insecticides, and fungicides to ensure crop health. These chemicals can move by means of wind, water, and soil erosion to all adjoining habitat types. As an example, neonicotinoids (neonics) are a class of systemic insecticides commonly applied to seed in row crop agriculture. Their use has raised significant concerns regarding habitat impacts. During planting, neonic-coated seeds can release dust particles containing these chemicals. Wind can carry this dust from fields, leading to contamination of surrounding areas, including natural habitats (Bonmatin et al. 2015). Neonics have been shown to negatively impact pollinator populations (Goulson 2013). Zhao et al. (2020) describe the extent of neonic use for foliage spraying and soil and seed treatments during crop planting. Neonic persistence in the soil and surface runoff into wetlands threaten non-target organisms, including zooplankton, algae, earthworms, bees, insectivorous birds, and humans (Zhao et al. 2020). Neonic impacts to non-target organisms, including beneficial insects and other wildlife, can have cascading effects on ecosystem dynamics (Basley 2018).

Habitats like the badlands, while more distant from row crop agriculture and urban development, still face threats from pollution. The National Park Service (NPS) reports that there are some nearby sources of air pollution affecting Badlands National Park. These include oil and gas production, power plants, agriculture, and vehicles (National Park Service 2024).

The Badlands Bombing Range in southwestern South Dakota is an area of approximately 300,000 acres that was used by the U.S. Defense Department from the 1940s until the 1960s. Concerns about environmental contamination of this area increased with the plan to return some of this property to the Oglala Lakota Sioux Tribe (Andrews et al. 2001). The NPS provides background about the Badlands Aerial Gunnery Range (https://www.nps.gov/articles/000/aerial-gunnery-range.htm). The 341,726-acre area was

within the Pine Ridge Reservation and included 337 acres from Badlands National Monument. In today's terms, the area was primarily within the South Unit of Badlands National Park. Military uses included air-to-air and air-to-ground gunnery ranges. The South Dakota National Guard continued using the area after World War II. Unexploded Ordnance (UXO) describes explosive or chemical munitions that did not activate. The NPS continues to share information about the presence and danger of UXOs and asks that the public report these to the White River Visitor Center.

The South Dakota Natural Heritage Program was contracted by Ellsworth Air Force Base in 1998 to conduct a biological inventory of the Badlands Bombing Range in northeastern Oglala Lakota County. Ode and Backlund (1999) summarized findings for a variety of terrestrial plant and animal species. A fish survey was contracted to Eco-Centrics, based in Omaha, Nebraska. SDGFP was subcontracted by the U.S Fish and Wildlife Service to conduct pollinator surveys during 2022-2023. None of these surveys included environmental contaminants analyses of terrestrial or aquatic habitats.

Habitats near urban areas face specific threats from pollution. Urban areas often experience higher levels of air pollution from vehicles and industries, which can adversely affect human and wildlife health. Increased particulate matter and ozone can affect respiratory health and contribute to habitat degradation (Hamin and Gurran 2009).

Pollution – Riparian-wetland Systems

Lakes and wetlands across South Dakota are subject to a host of potential pollution sources. Runoff from agriculture and residential sources can impact the nutrient dynamics of basins by adding nitrogen and phosphorus, leading to eutrophication. Pesticides found in runoff can also have widespread impacts on aquatic systems. Neonicotinoid insecticides are now nearly ubiquitous in planted crops with 80% of seeds being treated by 2008 (Jeschke and Nauen 2008). Neonicotinoids are neurotoxins that are extremely toxic to insects at very low concentrations. In addition, most of these pesticides are water soluble and have long chemical half-lives leading to persistence and increasing concentrations in the environment. Main et al (2014) found that 91% of wetlands sampled in Prairie Canada contained neonicotinoid pesticides after spring runoff. Non-target and bottom-up trophic impacts from this class of insecticides are not known but sublethal effects have been documented in quail (Tokumoto et al. 2013) and chukar partridge (Lopez-Anita et al. 2013), which included reduced chick survival and adult mortality.

South Dakota has 11,929 miles of perennial rivers and streams and 135,128 miles of intermittent and ephemeral streams. The state's comprehensive review of water quality from 6,148 stream miles and 180 of the state's 577 lakes and reservoirs were assessed in the 2024 Integrated Report (IR). About 80% of tested rivers, streams and lakes did not support one or more beneficial use classifications (SD DANR 2024).

Nonpoint source pollution is the most serious and pervasive threat to the quality of South Dakota's waters. Nonpoint sources include fertilizer, herbicide, topsoil runoff from agricultural fields, livestock waste deposited in or near streams from unfenced livestock, sediment runoff from overgrazed pastures, manure applied to frozen fields, pet waste in urban areas, sediment from construction sites, sediment from improper logging techniques, leaking contents from failing septic tanks, drainage of acids or metals from abandoned mines, and improperly applied chemicals and fertilizers in agricultural and urban environments. Runoff carrying sediment and nutrients from agricultural land is the most significant source of nonpoint pollution (SD DANR 2024).


American Dipper Mandy Pearson

The 2024 IR found the major water quality problems in South Dakota lakes are excessive nutrients and algae due to nonpoint source pollution (primarily agricultural). Mercury in fish tissue also accounts for the low number of lakes and reservoirs meeting all state assigned beneficial uses. The primary source of mercury, however, is from global atmospheric deposition. Therefore, the high incidence of nonsupport lakes is unlikely to improve until measures to reduce mercury are implemented at a global scale (SD DANR 2024).

Pollution – Aquatic Systems

In 1972, Congress passed the federal Clean CWA. The CWA requires that each state develop standards for their waters to ensure that beneficial uses, such as swimming and fishing, are protected. South Dakota's Department of Agriculture and Natural Resources (SD DANR) Watershed Protection Program is the regulatory agency that works to assess, improve, restore, and maintain the health of South Dakota's waters. They assess waterbodies for impairment, prepare Total Maximum Daily Load (TMDL) reports for impaired waters, make recommendations to the Nonpoint Source Task Force for water quality improvement projects under Section 319 of the CWA, monitor water quality, and oversee the statewide streamflow monitoring network. Nonpoint source pollution is the leading cause of pollution in South Dakota. Runoff from agricultural areas, construction sites, urban areas, mining, and forestry practices can carry related pollutants into South Dakota's lakes and streams. According to the 2024 IR for Surface Water Quality, 78.1% of the assessed stream miles did not support one or more beneficial uses (SD DANR 2024).

Residential and commercial development – Aquatic Systems

Residential and commercial development is needed for South Dakota to prosper, but such development can negatively impact both lentic and lotic ecosystems. Increased impervious surfaces from housing and urban areas, commercial and industrial areas, and tourism and recreational areas accumulate extra chemicals, debris, sediment, and other contaminates during water runoff, making their way into aquatic systems. This runoff has harmful impacts on water quality and aquatic biota (Frazer 2005, Hoogestraat 2020, Wang et al. 2001).

Agriculture and aquaculture – Aquatic Systems

Changes in land use have led to increased grazing along riparian areas, which has increased sedimentation and nutrient loads into aquatic ecosystems. In areas of intense cultivation, streams are often channelized for irrigation, and tile drainage may be installed to improve field drainage for more easily accessible fields for crop production. These practices reduce stream habitat quality and heterogeneity for aquatic communities by significantly altering water temperature, aquatic vegetation, and stream flow (Adelsperger et al. 2024).

Transportation and service corridors – Aquatic Systems

Stream connectivity is crucial for fish movement and genetic diversity in fragmented landscapes. Road and railway corridors via culverts and bridges are known to disrupt fluvial connectivity across the United States (Blanton and Marcus 2009). This disrupted connectivity frequently negatively impacts aquatic species by impeding passage and fragmenting critical habitat for predator avoidance (Harvey 1991), foraging (Clapp et al. 1990), thermal refuge (Webb 2023), and reproduction (Bouska and Paukert 2010, Lorenzen 2016, Pess et al. 2003).

5.6 Species-level Conservation Challenges

The SDWAP's coarse and fine filter approach recommends that native ecosystem diversity be managed with historical disturbance regimes to the extent possible. Implementing this approach makes it likely that the needs of most fish and wildlife species and their habitats can be accommodated. The approach also reinforces a basic purpose of wildlife action plans; the needs of all species should be considered, not only rare species. Some species require more specific or more intensive management. Those needs are identified during the fine filter part of the process. An example of a state SGCN with specific needs is the Peregrine Falcon, which may not be habitat limited but rather limited by availability of specific nesting sites and negative impacts of human disturbance during the nesting season.

Two primary challenges will help determine the persistence of species in South Dakota. First is the loss or degradation of habitat resulting from impacts to native ecosystem diversity and the related changes to historical disturbance regimes. Second are the non-habitat related impacts. Conservation actions are needed to address the many conservation threats facing South Dakota's biodiversity. To facilitate this discussion, threats and conservation challenges will be discussed in this section at the SGCN level.

Many species in South Dakota are facing decline and even extinction. For this revision, we are using the IUCN-CMP Unified Classification of Direct Threats (version 2) to level 2 to describe ongoing threats to species and their habitats (CMP 2016). Appendix O provides the full list of state SGCNs and known or suspected threats using this system. With some exceptions, most threats indicated pertain to South Dakota. Individual SGCN accounts may include more state-specific threats. The use of the IUCN-CMP tool allows generalizations and grouping of threats by species groups and comparison of threats analyses with other conservation plans. Table 5.2 and Table 5.3 show the number of SGCNs impacted by the IUCN-CMP threats analysis at level 1 and level 2, respectively.

Table 5.2. Number of Species of Greatest Conservation Need Affected by Conservation Threats to Level 1 in the IUCN-CMP Threats System.

Threat	# species impacted
7. Natural system modifications	224
2. Agriculture and aquaculture	224
9. Pollution	175
11. Climate change & severe weather	135
8. Invasive & other problematic species, genes & diseases	106
1. Residential & commercial development	82
5. Biological resource use	53
4. Transportation & service corridors	43
6. Human intrusions & disturbance	33
3. Energy production & mining	32
10. Geological events	0

Table 5.3. Conservation Threats to Level 2 in the IUCN-CMP Threats System Sorted by the Number of Species of Greatest Conservation Need Affected.

Threat	# species impacted
2.1 Annual & perennial crops	117
2.3 Livestock farming & ranching	106
7.3 Other ecosystem modifications	86
9.3 Ag. & forestry effluents	85
7.2 Dams & water management/use	72
8.1 Invasive nonnatives	69
7.1 Fire & fire suppression	56
9.1 Household sewage/urban waste	52
11.3 Changes in temp. regimes	48
1.1 Housing & urban areas	45

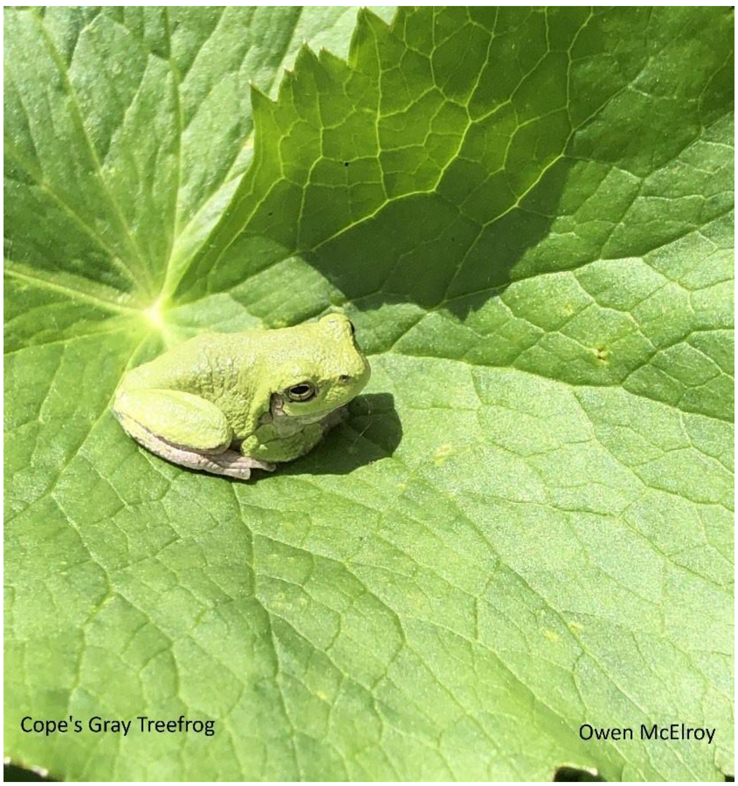
Conservation threats described by taxonomic groups

Amphibians and reptiles

Many amphibians and reptiles (herps) are rarely seen or heard. They are also not usually at the top of the list for people's favorite animals. All this contributes to herps often being overlooked when it comes to conservation.

Habitat loss and degradation is by far the greatest threat to herps in South Dakota. Much of the state (particularly the eastern half) has been converted to intensive agriculture, which has typically involved the destruction of native prairie. In addition, modern agriculture requires tremendous amounts of inputs (e.g., fertilizer, pesticides, etc.). Many of these chemicals will wind up in waterbodies as runoff and affect water quality. Many waterbodies in the state are so polluted they no longer support one or more beneficial uses, including public recreation (https://apps.sd.gov/NR92WQMAP). This pollution affects all species that live in or utilize these water bodies, but amphibians are especially sensitive. Many frogs live and breed in wetlands. Amphibians have very permeable skin, which makes them very susceptible to environmental contaminants. Technological advances have caused an acceleration in practices such as drain tile, where previously unusable land (aka, wetlands) can now be drained and used for agricultural fields.

Another major conservation challenge for herps has been the alteration of the hydrology of the Missouri River. The Missouri River historically was a relatively shallow, meandering, warm-water river with periodic flooding. With the installation of four major dams, much of the river has essentially been converted into deep, cold-water reservoirs, challenging many species to adapt to this new environment. The historical cycles of flooding and weaving would create abundant sandy banks and sandbars, which species like turtles would use to build nests. As the river has become more stabilized and channelized there is much less new sandy habitat created, leading to fewer suitable nesting sites.



Two additional conservation challenges worth noting are emerging diseases and climate change. Amphibians around the world have been devastated by Chytrid fungus and ranaviruses. Chytrid fungus is believed to have originated in Africa and has since spread to amphibian populations around the world, causing massive die-offs and declines. Ranaviruses are a group of viruses that also impact amphibians and have been linked to amphibian declines. Both disease groups have been detected in South Dakota, although their exact impact is not clear. The effect of climate change to South Dakota herps may be a bit of a mixed bag. On the one hand, a warmer and drier climate could lead to more droughts and negatively impact species that depend on wetlands, such as frogs. However, there may also be more rainfall, which could offset to some degree increases in temperature and evapotranspiration. There may even be some SGCNs that benefit from climate change. Species adapted to a more arid environment, such as ornate box turtles and common lesser earless lizards, may see their range expand if their associated habitat types increase.

Aquatic insects

Ten aquatic insect SGCNs are included in this revised plan, including six new species. Due to a lack of internal expertise for these aquatic invertebrate groups, SDGFP relied heavily on experts in universities, staff with other agencies, and naturalists with experience gained from personal experience and dedication for input on many of the new SGCNs in this category. SGCN accounts were not prepared for crayfish species but relevant information about them is described in a summary table (Appendix E). The three most common general threat categories to level 1 of the IUCN-CMP threats system for aquatic invertebrates were agriculture and aquaculture (10 species), natural system modifications (10 species), and pollution (10 species).

Birds

Fifty-two bird SGCNs are included in this plan, including 12 species new to the list. Conservation threats are described in species accounts and summarized to broader categories (Appendix O; https://gfp.sd.gov/UserDocs/nav/SDConsThreats.xlsx).

The North American Bird Conservation Initiative (NABCI) releases an annual report called the "State of the Birds." Take-home messages from the 2025 report are that one third (229 species) of American bird species need conservation help. Closer to home, duck populations in the PPR have declined in recent years and are now 10% below the long-term average. Grassland birds continue to show some of the largest population declines, based on eBird trend data. LeConte's Sparrow, Lark Bunting, Western Meadowlark, and Bobolink show some of the largest declines. South Dakota's SGCN list include 3 of these 4 species. NABCI categorizes species as:

- Tipping point species – red alert. "Birds with perilously low populations and steep declining trends."
- Tipping point species – orange alert. "Birds showing long-term population losses and accelerated declines in recent decades."
- Tipping point species – yellow alert. "Birds with long-term population losses, but relatively stable recent trends." (NABCI 2025)

Additional categories include watchlist species, common birds in steep decline, and species of low concern. These categories are not discussed further in this document, aside from mentions in bird SGCN accounts in Appendix D.

South Dakota SGCN list includes the following red alert species: Greater Sage-Grouse, Greater Prairie-Chicken, Hudsonian Godwit, Chestnut-collared Longspur, Thick-billed Longspur, and Baird's Sparrow. Orange alert species on South Dakota's list include Chimney Swift, Whooping Crane, Piping Plover, Buff-breasted Sandpiper, Semipalmated Sandpiper, Least Tern, LeConte's Sparrow, Sprague's Pipit, and Bobolink. Yellow alert species included for South Dakota are Lewis's Woodpecker and Pinyon Jay.

From a general perspective, conversion of grassland and wetland habitat for urban and suburban development and agricultural uses; loss of historical disturbance regimes, such as fire suppression and modified grazing practices; impacts of prey species reduction due to direct control or pesticide use; and disturbance of nesting birds by outdoor recreationists are common themes as conservation challenges for bird species.

The five most common general threat categories to level 1 of the IUCN-CMP threats system were natural system modifications (35 species); agriculture and aquaculture (26 species); invasive and other problematic species, genes, and diseases (21 species); biological resource use (16 species); and human intrusions and disturbance (14 species). Whooping Cranes are vulnerable to striking wind turbines or associated powerlines during weather with poor visibility. Considering level 2 threat categories, the highest impacts were due to natural system modification – other ecosystem modification (22 species), annual and perennial non-timber crops (16 species), problematic native species/diseases (14 species), recreational activities (14 species), and livestock farming and ranching (10 species). Conservation threats covered in the "Other Threats" category were primarily related to direct or indirect impacts of pesticides or poisons. Indirect effects may refer to secondary poisoning or impacts to prey populations.

Crayfish

Four crayfish species are included as SGCNs in this plan. Conservation threats are described in species accounts and summarized to broader categories (Appendix O; https://gfp.sd.gov/UserDocs/nav/SDConsThreats.xlsx). SGCN accounts were not prepared for crayfish species but relevant information about them is described in a summary table (Appendix F).

The five most common general threat categories to level 1 of the IUCN-CMP threats system were agriculture and aquaculture (4 species); transportation and service corridors (4 species); natural system modifications (4 species); invasive and other problematic species, genes and diseases (4 species); and pollution (4 species).

Fishes

Twenty-eight fish SGCNs are included in this plan, including seven species new to the list as of the 2022 minor revision. Conservation threats are described in species accounts and summarized to broader categories (Appendix O; https://gfp.sd.gov/UserDocs/nav/SDConsThreats.xlsx).

Habitat loss and degradation is by far the greatest threat to fish in South Dakota. Natural grasslands and wetlands continue to be converted to agricultural lands and used for concentrated feedlot operations. Changes in land use have led to increased grazing along riparian areas, which has increased sedimentation and soil erosion. This has increased agricultural effluent in the form of nutrient loading from fertilizer run-off, herbicide run-off, and manure from feed lots. In addition, in areas with intense cultivation, streams are often channelized from irrigation and tile drainage.

Another major conservation challenge for fish has been the natural system modifications through the construction of dams and road stream crossings that can act as major barriers to fish movement and significantly alter stream hydrology. Stream and river connectivity provide access to habitat associated with food, shelter, temperature refuges, and spawning habitat (MacDonald and Davies 2007). Habitat fragmentation prevents access to these habitats and results in decreased recruitment (i.e., offspring surviving to sexually mature adults), loss of genetic variability, and reduced relative fitness (i.e., health) all of which contribute to extirpation and species loss (Benton et al. 2008, Lundqvist et al. 2008, Kemp and O'Hanley 2010, Savage and Brenchley 2013).

The Missouri River, nicknamed the "Big Muddy" because of its high turbidity from frequent flooding and shifting channels, was historically a relatively shallow, warm-water river. The Missouri River is no longer a free-flowing river. Between the late 1930s and the early 1960s, six mainstem dams (4 in South Dakota) were constructed for flood control, commercial navigation, power generation, irrigation, water quality management, and recreation. It has been a conservation challenge for many large riverine fish species to adapt to this new environment.

The five most common general threat categories to level 1 of the IUCN-CMP threats system were natural system modifications (28 species); pollution (23 species); agriculture and aquaculture (22 species) climate change and severe weather (14 species); and invasive and other problematic species, genes and diseases (12 species).

Freshwater mussels

Eleven freshwater mussel SGCNs are included in this plan, including two species new to the list as of the 2022 minor revision. Conservation threats are described in species accounts and summarized to broader categories (Appendix O; https://gfp.sd.gov/UserDocs/nav/SDConsThreats.xlsx).

The decline of freshwater mussels during the past century has been linked to a variety of threats. Mussels are primarily sedentary but can move extremely slowly with the use of their muscular "foot" making them highly vulnerable to changes in water conditions. The most significant conservation threat category is natural system modifications and agriculture and aquaculture through the destruction and loss of habitat via conversion of grasslands to row crop agriculture, damming, dredging, and channelization of streams, which have all led to the destruction of mussel habitat (Richter et al. 1997; Allan 2004). Pollution is another conservation challenge to freshwater mussels. Loss of riparian habitat has increased erosion, silt, and nutrient loading from fertilizer run-off and herbicide run-off (Downing et al. 2010). Two invasive bivalve species occur in South Dakota, the Asian Clam (*Corbicula fluminea*) and the Zebra Mussel (*Dreissena polymorpha*), both of which can pose serious threats to native freshwater mussel species (Schneider et al. 1998, Vanderbush et al. 2021).

The five most common general threat categories to level 1 of the IUCN-CMP threats system were natural system modifications (11 species); pollution (11 species); agriculture and aquaculture (11 species), transportation and service corridors (10 species); and invasive and other problematic species, genes and diseases (9 species).

Gastropods

Five terrestrial snail species were included as SGCNs in this revision; 4 species previously included and one new species. The known state distribution for each of these species is restricted to the Black Hills (Appendix G). The five most common general threat categories to level 1 of the IUCN-CMP threats system were pollution (7 species), human intrusions and disturbance (3 species), residential and commercial development (2 species), agriculture and aquaculture (2 species), transportation and service corridors (2 species), and biological and resource use (2 species). Considering level 2 threat categories, the highest impacts were due to agricultural and forestry effluents (4 species), household sewage and urban wastewater (3 species), tourism and recreation areas (2 species), livestock farming and ranching (2 species), roads and railroads (2 species), and logging and wood harvesting (2 species). These species have limited home ranges in the Black Hills, making them vulnerable to environmental impacts from such factors as polluted waterways, road salt applications, and livestock grazing.

Mammals

Eighteen mammal species, including 3 new species, are SGCNs in this revision. The majority of mammal SGCNs are bat species (10), including 2 new species. Conservation threats are described in species accounts and summarized to broader categories (https://gfp.sd.gov/UserDocs/nav/SDConsThreats.xlsx).

SDGFP led the effort to develop a statewide bat management plan (SDBWG 2004). A companion planning effort during this SDWAP revision was contracting for an updated bat conservation and management plan to staff at SDSU. That document will be completed by the end of June 2025.

Bat Conservation International (BCI) recently summarized the critical situation for North America's 44 bat species. Seven species are considered imperiled (G2), 26 are vulnerable (G3), and only 11 are apparently secure (G4) or secure (G5). The most serious conservation threats bats face are climate change; habitat loss, including destruction and disturbance of bat roosts, particularly caves; wind energy; and white-nose syndrome (WNS), which has caused a 90% decline in populations of the little brown myotis, northern long-eared bat, and tricolored bat. The next 15 years are pivotal, because 47% of North American bat species are at risk of population declines during that period (BCI 2023).

For mammal SGCNs, the five most common general threat categories to level 1 of the IUCN-CMP threats system were human intrusions and disturbance (10 species); energy production and mining (9 species); invasive and other problematic species, genes and diseases (9 species); biological resource use (6 species); and agriculture and aquaculture (5 species). Considering level 2 threat categories, the highest impacts were due to renewable energy (7 species), logging and wood harvesting (5 species), recreational activities (5 species), work and other activities (5 species), and invasive nonnative/alien species/diseases (5 species). Because more than half of the mammal SGCNs are bats, their most serious conservation challenges are reflected in the lists above, including mortality from wind turbine collisions, known and anticipated impacts of WNS, and disturbance impacts to hibernating bats from cavers and too-frequent surveys. Other threats identified for mammal SGCNs related to impacts of rodenticide poisoning and broader impacts of pesticide application to prey species. Sylvatic plague decimates prairie dog colonies. In addition to impacting their sources of prey and shelter, plague can also kill black-footed ferrets directly. Wind turbines and associated infrastructure pose significant threats to migratory bat species.

Plants

So many living species (including humans) rely on plants to carry out daily functions. Despite this, plants are often overlooked when it comes to species protection. For decades, scientists have used the term plant blindness. The more recent term is plant awareness disparity (PAD). Both terms address the problem of people overlooking plants and the value they provide to the biosphere and society (Parsley 2020). Plants are not unlike other species that migrate, fly, run, or crawl; they too are living and have threats that affect their existence.

Forty plants are included as SGCNs in this SDWAP revision. Most of these species are facing similar threats as

the animal SGCNs. The threats to species include invasive species (25 species), habitat conversion (20 species), and livestock management (19 species). These top three threats are not hard to miss. Invasive species are taking over grasslands and shrublands. Habitat is being converted to cropland and urban sprawl at an alarming rate. The replacement of free-ranging wild bison with domesticated pastured livestock has degraded plant health. Other prominent threats plants are facing include fire suppression (12 species), native species encroachment or depredation (11 species), and alteration of hydrology (11 species). The presence of fire can be detrimental to species such as big sagebrush (*Artemisia tridentata*), but the absence of fire can be detrimental to species such as compass plant (*Silphium laciniatum*). Woody encroachment, particularly eastern red cedar (ERC) trees, is spreading in grasslands, leading to an overall loss in biodiversity (Hartfield and Van Leeuwen 2018; Kaur et al. 2020). Hydrological alterations, through wetland drainage or steam channelization, can have major impacts on water levels and plant communities. This can ultimately lead to species population losses. Other plant related threats include mining, roads and infrastructure, lack of management, pollution, climate change, and individual species limitations (e.g., low seed production).

Terrestrial insects

Forty-five terrestrial insect SGCNs are included in this revised plan, including 33 new species. Most new species were butterflies (8), bumble bees (7), or solitary bees (7). The remainder of new species were tiger beetle (2) and others (3 coleopterans, 5 orthopterans, and 1 lepidopteran). Due to a lack of internal expertise for these taxonomic groups, SDGFP relied heavily on experts in universities, staff with other agencies, and naturalists with experience gained from personal experience and dedication for input on many of the new SGCNs in this category. SGCN accounts were prepared for new butterfly and tiger beetle species. The remainder of the species and relevant information for them are described in (Appendices H-I). Although state-specific analyses were not conducted on all South Dakota SGCNs during this plan revision, taxonomic experts predict that a variety of terrestrial invertebrates found on South Dakota's list, particularly butterflies and bumble bees, may be impacted by climate change due to changes in temperature regimes or precipitation.

The five most common general threat categories to level 1 of the IUCN-CMP threats system for this group of species were agriculture and aquaculture (29 species); climate change and severe weather (22 species); natural system modifications (18 species); invasive and other problematic species, genes and diseases (18 species); and pollution (13 species). Considering level 2 threat categories, the highest impacts were due to annual and perennial non-timber crops (19 species), housing and urban areas (16 species), commercial and industrial areas (13 species), agricultural and forestry effluents (13 species), and changes in temperature regimes (13 species). Although specific threats are unknown for some species, habitat loss and conversion, direct and unintended impacts of pesticide use, negative impacts from managed pollinator colonies, and loss of historical disturbance regimes are common conservation threats for this diverse group of species.

Climate Change Impacts to SGCNs

As temperature and precipitation patterns change, fish and wildlife species may be affected in various ways. Species with very narrow tolerances for change are less likely to persist than those with a greater ability to tolerate changes or adapt to them. The ability to tolerate or adapt to predicted climate change is called adaptive capacity (AC). A familiar example of how a species must deal with drastic changes in habitat due to climate change is the polar bear. Climate change and severe weather events as conservation challenges have received increasing attention in recent years. Most important for wildlife management agencies is to seek out the most relevant information to help facilitate management and conservation strategies to help prevent future endangered species listings and, more importantly, avoid species extirpations and extinctions.

SDGFP partnered with several Midwestern states to gain information on this topic. Using a USFWS CSWG award, three Michigan entities (Michigan Natural Features Inventory, Michigan Department of Natural Resources, and Michigan State University Extension) analyzed adaptive capacities for 400 animal SGCNs submitted from the states of Indiana, Minnesota, Missouri, and South Dakota. Of the species analyzed, 134 were Midwest RSGCN (Terwilliger Consulting and MLI 2021). Plant species were not included in these analyses. Wildlife Diversity staff in Nebraska analyzed 138 species using the same techniques. This section provides a brief overview of the methodology and results pertinent to South Dakota but is not a substitute for the final report or associated species results (Earl et al. 2024; Appendix O).

The analysis used a rapid AC assessment tool that built on work by Thurman et al. (2020, 2022) and used a Microsoft Excel interface developed by the U.S. Geological Survey (USGS). The analysis framework considers 37 attributes at the species or population level organized into 7 attribute groups (Table 5.4). For each attribute, a value is assigned to indicate how that facet of the species' life cycle or demography may be able to respond to climate change. Those values include an average AC level (low, moderate, high, and values in between) and a numerical score ranging from 0 (lowest AC value) to 1 (highest AC value) for each of the 7 attribute groups and an overall score and level.

For the 400 species assessed, insects had low to moderate AC scores. Most bird species had moderate AC scores. Mammal species had the highest average AC of the taxonomic groups evaluated, although bat species had lower AC scores than other mammals. Most fish and crayfish species had moderate ACs. Mollusks had various AC scores. Amphibians and reptiles had moderate to moderately high ACs.

Table 5.5 lists South Dakota animal SGCNs included in this assessment, with associated overall AC scores and levels. AC scores and levels for each attribute group by species can be found in files associated with Earl et al. 2024 (Appendix O).

Results for South Dakota SGCNs mirrored the general results described above for taxonomic groups. One-third of evaluated terrestrial invertebrates (6 of 18) had scores associated with the moderately low AC level. Three of 4 gastropod species evaluated had AC scores considered at the moderately low level. Two of 3 aquatic invertebrate species evaluated had AC scores assigned to the moderately low level. Species evaluated from the amphibian, bird, mammal, fish, freshwater mussel, and reptile groups had scores primarily considered at the moderate to moderately high level.

SDGFP will continue to monitor climate change assessment tools. Important resources include the USGS Climate Adaptation Science Centers, NatureServe's Climate Change Vulnerability Index (CCVI), and state-specific information maintained by South Dakota State University Extension.

Table 5.4. Adaptive Capacity Groups and Descriptions; from Earl et al. 2024.

AC Attribute Group	Traits Assessed	Description
Distribution	Extent of Occupancy, Area of Occupancy, Habitat Specialization, Commensalism with Humans, Geographic Rarity	Where the species is found, how common the species is across the landscape.
Movement	Dispersal Syndrome, Dispersal Distance, Dispersal Phase, Site Fidelity, Migration Phenology, Migration Distance	How far and how often the species moves, how likely the species is to move and establish in new habitats.
Evolutionary Potential	Genetic Diversity, Population Size, Hybridization Potential	How genetically viable the species is, how likely is inbreeding to occur.
Ecological Role	Enemies, Diet Breadth, Diversity of Obligate Species	What the species eats, how dependent it is on other species, and other biotic interactions or relationships that impact the species.
Abiotic Niche	Seasonal Phenology, Climatic Niche Breadth, Physiological Tolerances, Behavioral Regulation of Physiology, Disturbance Tolerances	What range of climatic conditions the species can tolerate. How sensitive the species is to changes in natural disturbances.
Life History	Reproductive Phenology, Reproductive Mode, Mating System, Fecundity, Parity, Sex Ratio, Sex Determination, Parental Investment	How the species reproduces. How often, how many offspring, and how are offspring cared for.
Demography	Life Span, Generation Time, Age of Sexual Maturity, Age Structure, Recruitment	How populations of the species are composed. How old they can live and how likely juveniles are to survive to reproduce.

Table 5.5. Overall Climate Change Adaptive Capacity Scores and Levels for Representative Animal Species of Greatest Conservation Need for South Dakota Wildlife Action Plan Revision of 2025 (Earl et al. 2024).

Scientific Name	Common Name	Overall AC Score	Overall AC Level
Amphibians			
Acris blanchardi	Blanchard's Cricket Frog	0.67	Moderately high
Anaxyrus cognatus	Great Plains Toad	0.63	Moderately high
Aquatic Invertebrates			
Perlesta dakota	Dakota Stone	0.39	Moderately low
Epitheca petechialis	Dot-winged Baskettail	0.57	Moderate
Analetris eximia	Extraordinary Bow-legged Minnow Mayfly	0.30	Moderately low
Birds			
Cinclus mexicanus	American Dipper	0.53	Moderate
Accipiter atricapillus	American Goshawk	0.58	Moderate
Falco sparverius	American Kestrel	0.71	Moderately high
Pelecanus erythrorhynchos	American White Pelican[1]	0.49	Moderate
Haliaeetus leucocephalus	Bald Eagle	0.65	Moderately high
Picoides arcticus	Black-backed Woodpecker	0.50	Moderate
Chlidonias niger	Black Tern	0.53	Moderate
Athene cunicularia	Burrowing Owl	0.59	Moderate
Aquila chrysaetos	Golden Eagle	0.62	Moderately high
Ammodramus savannarum	Grasshopper Sparrow	0.67	Moderately high
Ammospiza leconteii	LeConte's Sparrow	0.54	Moderate
Numenius americanus	Long-billed Curlew	0.47	Moderate
Lanius ludovicianus migrans	Migrant Loggerhead Shrike[2]	0.48	Moderate
Falco peregrinus	Peregrine Falcon	0.68	Moderately high
Charadrius melodus	Piping Plover	0.47	Moderate
Asio flammeus	Short-eared Owl	0.62	Moderately high
Melanerpes erythrocephalus	Red-headed Woodpecker	0.63	Moderately high
Bartramia longicauda	Upland Sandpiper	0.53	Moderate
Phalaropus tricolor	Wilson's Phalarope	0.50	Moderate
Fish			
Ictalurus furcatus	Blue Catfish	0.83	High
Lota lota	Burbot	0.60	Moderate
Couesius plumbeus	Lake Chub	0.61	Moderately high
Acipenser fulvescens	Lake Sturgeon	0.53	Moderate
Polyodon spathula	Paddlefish	0.54	Moderate
Sander canadensis	Sauger	0.67	Moderately high

Chrosomus erythrogaster	Southern Redbelly Dace	0.56	Moderate
Percopsis omiscomaycus	Trout-perch	0.58	Moderate
Freshwater Mussels			
Lasmigona compressa	Creek Heelsplitter	0.49	Moderate
Obovaria olivaria	Hickorynut	0.44	Moderate
Lampsilis higginsii	Higgins Eye	0.45	Moderate
Arcidens confragosus	Rock Pocketbook	0.51	Moderate
Gastropods			
Vertigo arthuri	Callused Vertigo	0.48	Moderate
Oreohelix strigosa cooperi	Cooper's Rocky Mountainsnail	0.34	Moderately low
Catinella gelida	Frigid Ambersnail	0.32	Moderately low
Discus shimekii	Striate Disc	0.35	Moderately low
Mammals			
Myotis lucifugus	Little Brown Myotis	0.67	Moderately high
Glaucomys sabrinus	Northern Flying Squirrel	0.79	Moderately high
Lasiurus cinereus	Northern Hoary Bat	0.66	Moderately high
Myotis septentrionalis	Northern Myotis	0.56	Moderate
Vulpes velox	Swift Fox	0.77	Moderately high
Perimyotis subflavus	Tricolored Bat	0.57	Moderate
Reptiles			
Holbrookia maculata	Common Lesser Earless Lizard	0.54	Moderate
Sceloporus graciosus	Common Sagebrush Lizard	0.59	Moderate
Graptemys pseudogeographica	False Map Turtle	0.68	Moderately high
Aspidoscelis sexlineata	Six-lined Racerunner	0.67	Moderately high
Opheodrys vernalis	Smooth Greensnake	0.57	Moderate
Terrestrial Invertebrates			
Bombus pensylvanicus	American Bumble Bee	0.55	Moderate
Nicrophorus americanus	American Burying Beetle	0.49	Moderate
Hesperia dacotae	Dakota Skipper	0.38	Moderately low
Pieris oleracea	Eastern Veined White	0.52	Moderate
Cicindela lepida	Ghost Tiger Beetle	0.58	Moderate
Amblycheila cylindriformis	Great Plains Tiger Beetle	0.61	Moderately high
Cicindela nevadica makosika	Indian Creek Tiger Beetle	0.40	Moderate
Atrytone arogos iowa	Iowa (Arogos) Skipper	0.31	Moderately low
Euchloe ausonides	Large Marble	0.47	Moderate
Danaus plexippus	Monarch	0.54	Moderate
Erynnis martialis	Mottled Duskywing	0.29	Moderately low
Hesperia ottoe	Ottoe Skipper	0.35	Moderately low
Speyeria atlantis pahasapa	Pahasapa Fritillary	037	Moderately low
Oarisma poweshiek	Poweshiek Skipperling	0.23	Moderately low

Speyeria idalia	Regal Fritillary	0.48	Moderate
Phyciodes batesii	Tawny Crescent	0.48	Moderate
Bombus terricola	Yellow-banded Bumble Bee	0.56	Moderate
Bombus fervidus	Yellow Bumble Bee	0.54	Moderate

[1]American White Pelican was on previous list but was not included on 2025 SD SGCN list.

[2]Loggerhead Shrike species (*Lanius ludovicianus*) is included on 2025 SD SGCN list, but not this subspecies.

Wildlife and Plant Health

The complex conservation challenges associated with this topic are beyond the scope of this revision, although various terrestrial SGCNs face serious threats from diseases and pathogens. Examples include the impact of WNS to bat species, direct and indirect effects of sylvatic plague to species associated with prairie dogs, and the emerging threat of chytrid fungus to amphibians. Big game hunters are aware of the impacts of chronic wasting disease (CWD) and epizootic hemorrhagic disease (EHD). Similar to human populations, healthy wildlife populations are better able to deal with disease threats, revealing the complexity of wildlife health issues. Monitoring and alleviating as many environmental and habitat challenges faced by rare species as possible will produce healthier populations better able to cope with existing and emerging wildlife health issues. See Appendix K for an introduction to the topic of Wildlife Health (Haynes and Kunkel no date).

Although also beyond the scope of this plan, resource and habitat managers must be vigilant about the impacts of plant pests and diseases. USDA-APHIS hosts information on this topic: https://www.aphis.usda.gov/plant-pests-diseases. State-specific information is available at the SD DANR website: https://www.aphis.usda.gov/plant-pests-diseases, and tree pest alerts are posted on the SDSU Extension website: https://extension.sdstate.edu/tree-pest-alert

5.7 Conservation Challenges and Threats Summary

This chapter addressed significant conservation challenges and threats affecting native ecosystems across South Dakota as well as species-level conservation challenges.

Summary of Key Conservation Threats

Direct conversion of native ecosystems and natural system modifications

Native habitats, especially grasslands, are increasingly converted to agricultural lands due to rising demand for corn and soybean production. This trend is more pronounced in the east, with implications for overall ecosystem diversity. Expansion of grazing lands has converted habitats, especially riparian areas, to pastures. This trend is more pronounced in the west and to a much lesser absolute rate of change compared to row crop agriculture expansion. A broader statewide impact comes from conversion of native habitats for expansion and further development of urban areas. Fire suppression and altered grazing patterns have disrupted the natural cycles of vegetation renewal and species distribution. Dam construction changes water flow patterns from their natural range of variation and not only fragments and alters aquatic habitats but can also drastically change water temperatures.

Natural disturbance processes

Fire suppression and altered grazing patterns disrupt the natural cycles of vegetation renewal and species distribution. These practices have reduced landscape heterogeneity, impacting habitats like ponderosa pine forests that relied on periodic wildfires to sustain diversity and loss of diversity in grassland ecosystems that relied on natural fires and rejuvenation from bison grazing impacts.

Invasive and problematic species and diseases

Non-native plants such as Kentucky bluegrass and smooth brome encroach upon grasslands, reducing native biodiversity. Additional threats come from invasive woody species like ERC, whose spread impacts grassland ecosystems and native species dependent on open habitats. AIS include plants and animals, which can cause significant disruptions to native ecosystems. AIS can completely change a habitat and outcompete native species, which impacts the biodiversity of the ecosystem, the local food chain, predator/prey relationships, and other ecosystem processes.

Climate change

Rising temperatures and variable precipitation patterns are expected to impact species distributions and water availability, particularly affecting wetlands and aquatic ecosystems, which are sensitive to shifts in hydroperiods and water chemistry.

Energy production and mining

Expansion of wind, solar, and biofuel energy, along with mining, poses a risk to terrestrial and aquatic habitats due to land fragmentation and pollution. Conservation strategies are needed to balance energy needs with ecological integrity.

Pollution

This conservation challenge includes a variety of ways to impact species and habitats, including sewage, wastewater and related discharges from households, towns and cities, agriculture, forestry, industrial sites, and military lands, Pollution also includes air-borne pollutants and excess energy, which refers to light, heat, or sound sources that affect wildlife. Impacts to air and water also affect humans directly, making this a continued challenge for cooperative efforts at levels ranging from individual properties to watersheds. Water-borne pollutants from non-point runoff from urban areas and agricultural effluents in the form of sediments, nutrient loading from fertilizer run-off, herbicide run-off, and manure from feed lots degrade stream habitat and water quality.

Residential and commercial development

Residential and commercial development are needed for the state to prosper. However, conversion of native habitats for these uses can leave a substantial footprint on aquatic systems.

Agriculture and aquaculture

Farming and livestock production are the predominant land use types in South Dakota. Conversion of native habitats for expanded corn and soy production is more prevalent in eastern South Dakota, while conversion of habitats from grazing expansion and grazing practices is more prevalent in the western part of the state.

Transportation and service corridors

Stream connectivity is crucial for fish movement and genetic diversity in fragmented landscapes. Road and railway corridors via culverts and bridges are known to disrupt fluvial connectivity across the U.S.

Recreational activities and human intrusions and disturbance

This conservation challenge includes intentional and unintentional species and habitat impacts from outdoor recreation. Off-road vehicle use, particularly in western South Dakota, affects aquatic ecosystem through increased sedimentation and degradation of stream habitat and water quality.