2025–2035

Utah Wildlife Action Plan

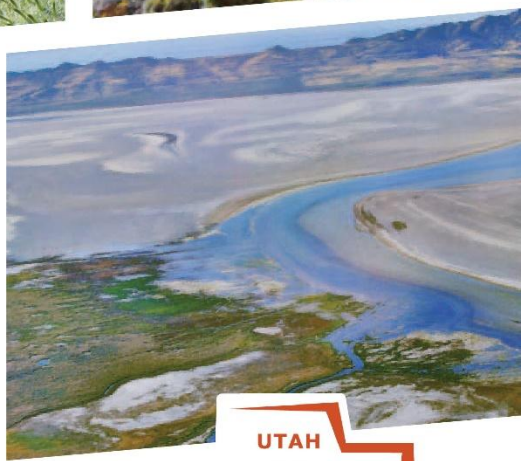
A road map for managing native species and their habitats to prevent Endangered Species Act listings









DWR PUBLICATION 25-23

UTAH DNR WILDLIFE RESOURCES

Recommended Citation:

Utah Wildlife Action Plan Core Team. 2025. *2025–2035 Utah Wildlife Action Plan: A Road Map for Managing Native Species and Their Habitats to Prevent Endangered Species Act Listings*. DWR Publication 25-23. Salt Lake City: Utah Division of Wildlife Resources.

A copy can be downloaded from the Utah Division of Wildlife Resources website at https://wildlife.utah.gov/pdf/WAP/Utah_WAP.pdf.

Cover photographs from left to right show the following species and habitats:
Top row: American pika, Wilson's phalarope, western pearlshell (left), winged floater (right)
Middle row: Ute ladies'-tresses, Lowland Sagebrush Key Habitat, Nokomis/silverspot butterfly, Gila monster
Bottom row: Least chub, northern leopard frog, Saline Lakes/Great Salt Lake Ecosystem Key Habitat

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Acknowledgements

A great number of people helped complete this plan. Some of these people were involved from start to finish, whereas others were active during specific phases or for specific tasks. Some roles were occupied by a series of two or three people as retirements, promotions, relocations, and other changes occurred in people's lives. The following people are a subset of all who helped develop and refine this plan. Partners who participated in Utah Wildlife Action Plan subcommittees are listed in Appendix A. Whether or not a participant is listed here, their contributions are appreciated and live on in the 2025–2035 Utah Wildlife Action Plan.

The Utah Wildlife Action Plan Core Team is the overarching partner team that included participation from any interested Utah native species conservation group/agency. The team met quarterly to help guide the revision, disseminated information within their group/agency, and reviewed the plan.

The Utah Wildlife Action Plan Utah Division of Wildlife Resources Implementation Team is primarily an internal team that includes participation from Utah State University liaison positions in the native plant and insect conservation programs. This team ensures the Utah Division of Wildlife Resources is implementing the Utah Wildlife Action Plan effectively; external affiliations are noted if applicable.

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Foreword

The Utah Wildlife Action Plan (UWAP) was developed and written by a broad-based team of diverse stakeholders, nongovernmental organizations, and other governmental agencies. Although the Utah Division of Wildlife Resources compiled and edited the plan, broad partner engagement has created a 2025–2035 UWAP that is truly a plan for everyone working on native species conservation efforts in Utah.

The goal of the UWAP is: *To manage native wildlife and plant species, including mammals, birds, fish, insects, mollusks, crustaceans, amphibians, and reptiles, and their habitats sufficient to prevent the need for additional listings under the Endangered Species Act.* The scope of work required to achieve this goal is beyond what any single organization can accomplish on its own. It will require collaborative, creative, solution-based partnerships. These partnerships will provide the mechanisms to develop jointly identified objectives and conservation actions for species and habitats and the basis for investment of time and effort to pursue mutually desired outcomes.

This plan should be viewed as the framework for an inclusive discussion of what the shared priorities and methods should be, focusing on solutions as well as respecting the vital importance of a credible process in creating fair, enduring, satisfying outcomes.

The UWAP guides partnership-driven, landscape-scale conservation work to help maintain the full array of Utah's native species and also improve habitat health. The goal of reducing the number of listed species in Utah requires broad societal support. Everyone is invited to get involved and help shape the future for Utah’s native species.

Executive Summary

Congress passed legislation authorizing the State and Tribal Wildlife Grants Program in 2001 in recognition of the need to support states with additional native species funding. The intent of this program was to help slow the rate of new listings under the Endangered Species Act. To ensure that the funds would be well spent, this legislation required that each participating state and territory develop a state wildlife action plan by 2005. All 56 U.S. states and territories chose to participate in this new conservation program, and each completed a plan by the 2005 deadline.

In addition, Congress conditioned ongoing participation in the State and Tribal Wildlife Grants Program on states' reviewing and revising their plans at least once every 10 years. Accordingly, the Utah Division of Wildlife Resources led a conservation planning partnership to update the Utah Wildlife Action Plan (UWAP) by 2015 and to create this 2025 iteration. This partnership includes state and federal natural resources agencies, academics, tribal nations, and conservation and agriculture advocates. Through 2024, Utah Division of Wildlife Resources has received over $19 million in federal State and Tribal Wildlife Grants Program appropriations to implement the 2005 UWAP (Sutter et al. 2005) and 2015 UWAP (UWAP Joint Team 2015), an amount which has been doubled by 1:1 matching with state funds. The UWAP has also brought together many partners who have contributed additional private, state, and federal funding to help with its implementation.

Among the 50 states, Utah ranks tenth in overall biological diversity and fifth for endemism (species found only in one state). Unfortunately, it also ranks fifth in terms of species extinction risk, mainly among its fishes, and seventeenth in actual extinctions (Stein 2002). Utah’s diversity of life is derived from its physical geography and its geological history. Its high plateaus and mountain ranges are separated by low, dry basins, and its river systems have three distinct outlets: they drain into the north Pacific via the Columbia River, the Gulf of California via the Colorado River, or internally into the Great Basin's saline lakes and playas. Utah’s borders encompass approximately 220,150 square kilometers (85,000 square miles), making it the eleventh largest state in land area.

Utah's arid climate and limited water resources present challenges for conservation, particularly in the context of flourishing growth of the state's human population (Steed 2024; Wurtsbaugh et al. 2016). Water is essential for all life, and the extraction and consumption of water and the accompanying alteration of aquatic habitats are the single most significant source of stress to Utah's wildlife and habitats. Compounding this stress is periodic drought, which is becoming

more frequent and extreme (Williams et al. 2020). Non-native species are the second leading critical problem for terrestrial and aquatic species and habitats in Utah. The combined effects of wildfire and, paradoxically, fire suppression are also a critical problem. Fire is now occurring where it virtually never did before, and it has been long excluded from where it naturally occurred on a regular basis. In addition to the issue of timing, the frequency and intensity of fire also has greatly diverged from long-term norms. Lastly, climate change and data gaps have been identified as major threats. These problems need to be understood better before effective conservation action can take place.

The Utah Division of Wildlife Resources has been working with other management agencies and conservation organizations to revise the UWAP. Species of greatest conservation need have been identified, as have the habitats they require for survival. Threats and limiting factors, as well as data gaps, also have been identified. This document provides strong, clear guidance for developing actions that could be effective for managing all of these problems. If this plan were effectively implemented, the result would be healthier habitats and wildlife populations, thereby reducing and preventing listings under the Endangered Species Act. The 2025 edition of the UWAP is organized into eight principal sections:

- Introduction
- Chapter 1: Species of Greatest Conservation Need – Distribution and Abundance
- Chapter 2: Key Habitats – Location and Condition
- Chapter 3: Climate Adaptation
- Chapter 4: Threats, Data Gaps, and Conservation Actions
- Chapter 5: Monitoring and Adapting
- Chapter 6: Partnerships, Implementation, and Regional Collaboration
- Literature Cited

The introductory materials provide some state background and context and discuss approaches to develop the UWAP as well as progress that has been made toward the conservation of Utah's native species since the 2015 UWAP was approved.

Rare plants and rare insects were fully incorporated into the 2025 UWAP, which increased the number of species and habitats. There are 256 species of greatest conservation need and 19 key habitat types identified (see Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance and Chapter 2, Key Habitats – Location and Condition). New to the 2025 UWAP was the addition of species of greatest information need, which are species that

qualified as species of greatest conservation need, but their qualification was largely due to data deficiencies. The species of greatest information need list contains species and species groups (e.g., genera and families) for which additional information is needed before effective conservation actions can take place.

A climate adaptation chapter was added to the 2025 UWAP. Chapter 3, Climate Adaptation, outlines the current climate and projected climate changes for Utah. A climate refugia analysis was completed that identifies priority Utah Hydrologic Unit Code (HUC) 12s for biodiversity management. These high-priority HUC-12s represent areas that are not only biodiversity hotspots but also act as climate refugia, where management actions are likely to have long-lasting impacts in spite of climate change.

Threats to these species and habitats were assessed using consistent, standardized terminology and metrics. Threats across all species and habitats were collated. A ranking process was applied to the whole set of threats to identify the ones that are the most detrimental to the most species and habitats. Chapter 4, Threats, Data Gaps, and Conservation Actions, is organized around these priority threats.

Potential conservation actions were designed to abate priority threats using standardized terminology and metrics. Many of the priority threats are accompanied by a case study, describing successful real-life instances of partners developing actions to abate the threat. Each potential action includes at least one potential objective. Each potential objective lists potential indicators of progress, a number of potential program(s) and project actions, and likely conservation authorities, stakeholders, and partners.

Chapter 5, Monitoring and Adapting, is organized around periodic status assessment and effectiveness monitoring (and its prerequisite, implementation monitoring). This content foreshadows the implementation chapter, and it also draws on the objectives and indicators from the potential conservation actions and on the indicators for species, habitats, and threats.

Chapter 6, Partnerships, Implementation, and Regional Collaboration, identifies many of the partners, expectations, and mechanisms of UWAP implementation. It also describes the collaboration among partners and stakeholders that will be required to create broadly acceptable objectives, indicators, and actions to abate the priority threats. New to the 2025 UWAP, this chapter includes a regional collaboration section that highlights the need and opportunities for state wildlife action plan collaboration at a larger, western geographic scale. This may be the most important chapter in this plan.

This UWAP is supported by five appendices. Appendix A lists partners who participated in UWAP subcommittees. Appendix B provides a glossary defining certain terms used throughout the plan. Within the plan, these terms are highlighted in orange and, upon their first occurrence in each chapter, are linked directly to the glossary for easy reference. In addition, rather than writing out scientific names for species at first mention within the document, all scientific names have been collected and listed in Appendix C. Appendix D provides additional details on how key habitats were ranked and conditions measured in Chapter 2, Key Habitats – Location and Condition. Appendix E provides additional detail on the ranking process for Utah's priority threats in Chapter 4, Threats, Data Gaps, and Conservation Actions.

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List of Abbreviations

°F	degrees Fahrenheit
AFWA	Association of Fish and Wildlife Agencies
AIM	Assessment, Inventory, and Monitoring
BAIT	Barrier Assessment and Implementation Tool
BCT	Bonneville cutthroat trout
BDA	beaver dam analog
BLM	Bureau of Land Management
Board	Utah Wildlife Board
BpS	LANDFIRE Biophysical Settings
cm	centimeter
CMP	Conservation Measures Partnership
Core Team	Utah Wildlife Action Plan Core Team (2025 revision)
DNR	Utah Department of Natural Resources
DWQ	Utah Division of Water Quality (a division of Utah Department of Environmental Quality)
DWR	Utah Division of Wildlife Resources (a division of Utah Department of Natural Resources)
DWRe	Utah Division of Water Resources (a division of Utah Department of Natural Resources)
DWRi	Utah Division of Water Rights (a division of Utah Department of Natural Resources)
E. coli	*Escherichia coli*
E-ROI	Ecological Return on Investment
EDRR	early detection and rapid response
EMC	Eagle Mountain City
EPA	U.S. Environmental Protection Agency

ESA	Endangered Species Act
EVT	LANDFIRE Existing Vegetation Type
FAC	full annual cycle
FFSL	Utah Division of Forestry, Fire and State Lands
GDP	gross domestic product
GIP	Utah Grazing Improvement Program
GIS	geographic information system
GLORIA	Global Observation Research Initiative in Alpine Environments
GSL	Great Salt Lake
HUC	Hydrologic Unit Code
IPCC	Intergovernmental Panel on Climate Change
Joint Team	Utah Wildlife Action Plan Joint Team (2015 revision)
JSRIP	June Sucker Recovery Implementation Program
km	kilometers
km^2	square kilometers
LCF	Landscape Conservation Forecasting
LED	light-emitting diode
m	meter
NAMC	National Aquatic Monitoring Center
NAWCA	North American Wetlands Conservation Act
NGO	nongovernmental organization
NHDPlus	National Hydrography Dataset Plus
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
OHV	off-highway vehicle
RAC	Regional Advisory Council

RCN	resilient and connected networks
RCP	Representative Concentration Pathways
RDCC	Resource Development Coordinating Committee
SDHM	Species Distribution and Habitat Suitability Models
SGCN	species of greatest conservation need
SGIN	species of greatest information need
SNOTEL	snow telemetry
Springs App	Springs Assessment Inventory Application
SSI	Springs Stewardship Institute
STWG Program	State and Tribal Wildlife Grants Program
SWAP	state wildlife action plan
TLA	Utah Trust Lands Administration
TMDL	total maximum daily load
TNC	The Nature Conservancy
UDAF	Utah Department of Agriculture and Food
UDOT	Utah Department of Transportation
UFBF	Utah Farm Bureau Federation
UGS	Utah Geological Survey
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USU	Utah State University
UWAP	Utah Wildlife Action Plan
WAFWA	Western Association of Fish and Wildlife Agencies
WHAT	Wildlife Habitat Analysis Tool
WMNIP	Western Monarch and Native Insect Pollinator
WRI	Watershed Restoration Initiative

Road Map to the Required Elements

The Road Map to the Required Elements is a standard section in a state wildlife action plan (SWAP) to help the U.S. Fish and Wildlife Service in their review of the document to ensure all eight required elements of a SWAP have been sufficiently met.

Required Element 1. Species of Greatest Conservation Need

Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance, outlines the Utah species in need of conservation attention for the 2025 Utah Wildlife Action Plan (UWAP). The Species of Greatest Conservation Need (SGCN) Subcommittee revised the 2015 UWAP rubric that was used for SGCN selection to account for the addition of native plants and insects in the 2025 UWAP. NatureServe subnational conservation status ranks (i.e., S-ranks) and threats were recalculated for species (both current and candidate SGCNs) whose status had potentially changed. These species were moved through the SGCN rubric to determine if they qualified as SGCNs. Species that qualified as SGCNs primarily due to data gaps were termed species of greatest information need. An overview of key updates and progress between the 2015 and 2025 UWAP is also provided in the Introduction.

Highlights include the following:

- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 1 changes between the 2015 and 2025. UWAP.
- Chapter 1 (see the entire chapter).
    - Figure 2. Species of Greatest Conservation Need Decision Process Rubric (page 27) was used in the selection of SGCNs, with the left side being the species status assessment and the right side being the consequences and opportunities if a species were to become listed as threatened or endangered under the Endangered Species Act.
    - Table 2. Overview of Species of Greatest Conservation Need Changes from the 2015 to 2025 Utah Wildlife Action Plans by Species Type (page 33) summarizes changes to SGCNs between the 2015 and 2025 UWAP.
    - Table 3. 2025 Utah Species of Greatest Conservation Need (page 36) shows the updated list of SGCNs for the 2025 UWAP.
    - Table 4. 2025 Utah Species of Greatest Information Need (page 51) shows the species of greatest information need for the 2025 UWAP.

Required Element 2. Habitats

Chapter 2, Key Habitats – Location and Condition, outlines the process used to select and determine the extent and condition of key habitats for the 2025 UWAP. An overview of key updates and progress between the 2015 and 2025 UWAP is also provided in the Introduction. Appendix D provides details on how terrestrial key habitats were selected and how habitat extent and condition were measured.

Highlights include the following:

- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 2 changes between the 2015 and 2025 UWAP.
- Terrestrial key habitats.
    - Chapter 2's Terrestrial Key Habitats section (page 70) outlines the process used for terrestrial key habitat selection and determining condition through time.
    - Chapter 2's Table 6. Summary of Terrestrial Key Habitats in Utah (page 71) identifies the terrestrial key habitats and their extent.
    - Chapter 2's Terrestrial Key Habitat Descriptions section (page 80) describes general characteristics of each terrestrial key habitat and provides maps showing the extent and condition of each.
    - Appendix D provides a more detailed explanation of how terrestrial key habitats were selected and how habitat extent and condition are measured.
    - Appendix D's **Table D-1.** Criteria for Electing a Full Set of Habitats to Use as the Basis for Identifying Utah Wildlife Action Plan Key Habitats (page D-1) identifies the terrestrial key habitat data sets that were considered.
- Aquatic key habitats.
    - Chapter 2's Aquatic Key Habitats section (page 74) outlines the process used for aquatic key habitat selection and determining condition through time.
    - Chapter 2's Table 7. Summary of Aquatic Key Habitats in Utah (page 75) identifies the aquatic key habitats, data sets used, and their extent.
    - Chapter 2's Aquatic Key Habitat Descriptions section (page 199) describes general characteristics of each aquatic key habitat and provides a map showing the extent of each.

Required Element 3. Threats/Stressors

Chapter 4, Threats, Data Gaps, and Conservation Actions, outlines priority threats to SGCNs and their habitats, including how the threats were selected. An overview of key updates and progress between the 2015 and 2025 UWAP is also provided in the Introduction. Appendix E provides details used to create the Utah threat assessment.

Highlights include the following:

- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 3 changes between the 2015 and 2025 UWAP.
- Chapter 3, Climate Threats
- Chapter 4 (see the entire chapter).
    - The Standardized Threats System section (page 260) outlines the national standard threats designated for SWAPs and the local threats identified for Utah.
    - The Statewide Threat Assessment section (page 261) outlines how threats were ranked and prioritized.
    - Table 29. Summary of the Results of the Level-2 Threat Prioritization Process (page 264) provides the list of UWAP priority Level-2 threats.
    - Table 30. Summary of the Results of the Level-3 Threat Prioritization Process (page 265) provides the list of UWAP priority Level-3 threats.
- Appendix E provides a more detailed methodology on how the UWAP threat assessment was created.
    - Table E-1. 2025 Utah Wildlife Action Plan Threats with Priority Threats in Highlighted Rows (page E-3) lists the complete list of national standard threats for SWAPs and highlights the UWAP threats that ranked as priority threats for this revision.

Required Element 4. Actions

Chapter 4, Threats, Data Gaps, and Conservation Actions, outlines conservation actions that can be implemented to address the priority threats and data gaps that hamper effective management of SGCNs. An overview of key updates and progress between the 2015 and 2025 UWAP is also provided in the Introduction. Appendix E provides a complete list of standard national conservation actions identified for SWAPs.

Highlights include the following:

- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 4 changes between the 2015 and 2025 UWAP.
- Chapter 3, Climate Actions
- Chapter 4 (see the entire chapter).
    - The Standardized Conservation Actions System section (page 268) summarizes the national standard conservation actions designated for SWAPs and identifies how essential conservation actions were developed for Utah.
- Appendix E's Table E-2. Conservation Actions (page E-21) shows the complete list of national standard conservation actions identified for SWAPs.

Required Element 5. Monitoring

Chapter 5, Monitoring and Adapting, identifies provisions for monitoring and assessing SGCNs, key habitats, threats, data gaps, effectiveness of conservation actions, and overall UWAP effectiveness. An overview of key updates and progress between the 2015 and 2025 UWAP is also provided in the Introduction. Some discussion of monitoring is also included in Chapter 6, Partnerships, Implementation, and Regional Collaboration.

Highlights include the following:

- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 5 changes between the 2015 and 2025 UWAP.
- Chapter 5 (see the entire chapter).
    - The Periodic Status Assessments of Species of Greatest Conservation Need section (page 406) provides details on monitoring SGCNs.
    - The Periodic Status Assessments of Key Habitats section (page 410) provides details on monitoring key habitats.
    - The Measuring the Effectiveness of Conservation Actions section (page 421) provides details on monitoring and adapting conservation actions.
- Chapter 6 (see Implementation Mechanisms)
    - The Utah's Watershed Restoration Initiative section (page 448) provides an overview of this initiative and how it is used by the Utah Division of Wildlife Resources and partners to prioritize conservation projects that implement UWAP

or have the greatest impact on SGCNs, key habitats, or reducing the threats that impact SGCNs or key habitats.

Required Element 6. Review and Revision

The Introduction provides an overview of the review and revision process for UWAP as well as key updates and progress between the 2015 and 2025 UWAP.

Highlights include the following:

- The Review and Revision section of the Introduction (page 2) provides an overview of the review and revision process.
- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 6 changes between the 2015 and 2025 UWAP.

Required Element 7. Partner Involvement

Chapter 6, Partnerships, Implementation, and Regional Collaboration, outlines the extent of partner involvement during the 2025 UWAP comprehensive revision and general UWAP implementation. An overview of partner involvement and key updates and progress between the 2015 and 2025 UWAP is also provided in the Introduction. A complete list of partners that participated in the UWAP revision is provided in Appendix A.

Highlights include the following:

- The Utah's Perspective on the Utah Wildlife Action Plan section of the Introduction (page 4) summarizes Utah's perspective on involving stakeholders in developing and implementing the UWAP and the UWAP as a conservation guide for Utah.
- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 7 changes between the 2015 and 2025 UWAP.
- Chapter 6 (see the entire chapter).
    - Table 47. Agencies and Other Organizations that Participated in the Utah Wildlife Action Plan Revision (page 425) provides a list of partners that participated throughout the revision process.
    - The Collaborative Planning and Implementation section (page 426) outlines how partners were included in the 2025 UWAP.
    - The Tribal Engagement section (page 427) outlines the steps taken to engage Utah's tribal nations in the UWAP revision and implementation.

    - The Regional Collaboration section (page 427) summarizes Utah's efforts to facilitate cooperation with adjacent state wildlife agencies and local, state, and regional organizations to improve range-wide SGCN conservation in Utah.
    - The Regional Initiatives section (page 428) provides an overview of regional initiatives in which Utah participates.
- Appendix A provides lists of subcommittees created to complete the UWAP revision and the partners that participated in each of the subcommittees.

Required Element 8. Public Involvement

Chapter 6, Partnerships, Implementation, and Regional Collaboration, outlines the extent of public participation in the UWAP revision and implementation. An overview of public involvement and key updates and progress between the 2015 and 2025 UWAP also is provided in the Introduction.

Highlights include the following:

- The Utah's Perspective on the Utah Wildlife Action Plan section of the Introduction (page 4) summarizes Utah's approach to including the public in UWAP revisions.
- The Key Utah Wildlife Action Plan Updates and Progress section of the Introduction (page 6) summarizes significant Element 8 changes between the 2015 and 2025 UWAP.
- Chapter 6 (specifically pages 436-450).
    - The Local and Statewide Initiatives section (page 436) outlines local and statewide initiatives in Utah to better engage the public, including communications and outreach efforts and how community science projects involve the public in UWAP implementation.
    - The Partnerships with Agricultural Producers section (page 443) identifies the importance of agricultural producers in UWAP implementation.
    - The Implementation Mechanisms section (page 444) outlines mechanisms vital to implementation of the UWAP and public involvement.

Introduction

The goal of the UWAP is:
To manage native wildlife and plant species, including mammals, birds, fish, insects, mollusks, crustaceans, amphibians, and reptiles, and their habitats sufficient to prevent the need for additional listings under the Endangered Species Act.

Congress passed legislation authorizing the State and Tribal Wildlife Grants (STWG) Program in 2001 in recognition of the federal need to support states with additional native species funding. The intent of the STWG Program was to help slow the rate of new listings under the Endangered Species Act (ESA). To ensure that the funds are well spent, this legislation requires that each participating state and territory develop a state wildlife action plan (SWAP) by 2005. All 56 U.S. states and territories chose to participate in this new conservation program, and each completed a SWAP by the 2005 deadline.

In addition, Congress conditioned ongoing participation in the STWG Program on states' reviewing and revising their plans at least once every 10 years. Accordingly, the Utah Division of Wildlife Resources (DWR) has led a conservation planning partnership to update the Utah Wildlife Action Plan (UWAP) in 2015 and to create this 2025 iteration. Although DWR compiled and edited the UWAP, broad partner engagement has created a 2025–2035 UWAP that is truly a plan for everyone working on native species conservation efforts in Utah. This partnership includes state and federal natural resource agencies, academics, tribal nations, and conservation and agriculture advocates. Through 2024, DWR has received over $19 million in federal STWG Program appropriations to implement the 2005 UWAP (Sutter et al. 2005) and 2015 UWAP (UWAP Joint Team [Joint Team] 2015), an amount which has been doubled by 1:1 matching with state funds. The UWAP also has brought together many partners who have contributed additional private, state, and federal funding to help with its implementation.

This document provides strong, clear guidance for developing actions that could be effective for managing Utah's native species. If this plan were effectively implemented, the result would be healthier habitats and wildlife populations, thereby reducing and preventing listings under the ESA.

The goal of the UWAP is: *To manage native wildlife and plant species, including mammals, birds, fish, insects, mollusks, crustaceans, amphibians, and reptiles, and their habitats sufficient to prevent the need for additional listings under the Endangered Species Act.* The scope of work required to achieve this goal is beyond what any single organization can accomplish on its own.

It will require collaborative, creative, solution-based partnerships. These partnerships will provide the mechanisms to develop jointly identified objectives and conservation actions for species and habitats and the basis for investment of time and effort to pursue mutually desired outcomes. Utah also has worked with surrounding states to strategize ways in which to use consistent categorizations to identify regional conservation priorities, species of greatest conservation need (SGCN), ecoregions, key habitats, shared resources, and cross-border management where appropriate.

The UWAP identifies fundamental objectives that help evaluate possible conservation actions and outcomes. These objectives are the cornerstone in native species decision-making processes and represent what the UWAP is trying to achieve:

- Avoid and prevent the need for future ESA listings
- Recover species currently listed as threatened or endangered under the ESA so they no longer need protections under the ESA
- Keep animal and plant management under state-led authority
- Maintain healthy animal and plant populations and healthy habitats to ensure these resources are available for future generations of Utahns
- Maintain healthy lands and water in Utah
- Increase opportunities to support the voluntary stewardship efforts of ranchers, farmers, and private landowners (e.g., keep working lands)
- Increase community engagement in UWAP implementation

This plan should be viewed as the framework for an inclusive discussion of what the shared priorities and methods should be, focusing on solutions as well as respecting the vital importance of a credible process in creating fair, enduring, satisfying outcomes. The UWAP will guide partnership-driven, landscape-scale conservation work to help maintain the full array of Utah's native species and also improve habitat health. The goal of reducing the number of listed species in Utah requires broad societal support.

Approach

Review and Revision

Every 10 years, each state and the District of Columbia are instructed by the U.S. Fish and Wildlife Service (USFWS) and Association of Fish and Wildlife Agencies (AFWA) to review and, if necessary, revise their SWAPs to receive federal wildlife conservation and restoration account

funds. The 2025 UWAP is considered a comprehensive major revision and was reviewed by a regional review team composed of USFWS and state wildlife agency leaders. The UWAP will drive native species management and conservation in Utah for the next 10 years, from 2025 to 2035. SWAPs are developed to identify SGCN and landscape conservation efforts that will improve their status.

Reviewing and revising the 2015 UWAP (Joint Team 2015) required approximately 3 years of hard work by many individuals and organizations. To ensure adequate time for the 2025 UWAP revision, a partner meeting was held in March of 2022 to begin the revision process, and work on the revision began in earnest during the summer of 2022. Having been through the revision process twice, 3 years seems to be the requisite amount of time needed to accomplish this task, and a similar time frame is recommended for the next UWAP revision, which is due in October 2035. A 10-year revision process, however, hinders the UWAP from being a living document that evolves and adapts as needed. Three minor amendments to the 2015 UWAP were completed in 2020, 2021, and 2022 (DWR 2020, 2022). These revisions added and removed SGCN and updated their habitats and threats. Minor amendments are not time intensive, and the UWAP Core Team (Core Team) recommends submitting minor amendments as needed to keep the UWAP updated and relevant between comprehensive revisions.

National Requirements and Guidance

The 2025 UWAP followed the AFWA/USFWS guidance for SWAP review and revision and incorporated the eight required elements of a SWAP (AFWA and USFWS 2017):

1. Species: The distribution and abundance of species of wildlife, including low and declining populations as each state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's SGCN (see Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance).
2. Habitats: The location and relative condition of key habitats and community types essential to the conservation of each state's SGCN (see Chapter 2, Key Habitats – Location and Condition).
3. Threats/Stressors: The problems that may adversely affect SGCN or their habitats and priority research and surveys needed to identify factors that may assist in restoration and improved conservation of SGCN and their habitats (see Chapter 4, Threats, Data Gaps, and Conservation Actions).

4. Actions: The actions necessary to conserve SGCN and their habitats and the priorities for implementing such conservation actions (see Chapter 4, Threats, Data Gaps, and Conservation Actions).
5. Monitoring: The provisions for periodic monitoring of SGCN and their habitats, for monitoring the effectiveness of conservation actions, and for adapting conservation actions as appropriate to respond to new information or changing conditions (see Chapter 5, Monitoring and Adapting).
6. Review and Revision: Each state's provisions to review its SWAP at intervals not to exceed 10 years (see the Review and Revision section above).
7. Partner Involvement: Each state's provisions for coordination during the development, implementation, review, and revision of its SWAP with federal, state, and local agencies and tribal nations that manage significant areas of land or water within the state, or administer programs that significantly affect the conservation of species or their habitats (see Chapter 6, Partnerships, Implementation, and Regional Collaboration).
8. Public Involvement: Each state's provisions to provide the necessary public participation in the development, revision, and implementation of the SWAP (see Chapter 6, Partnerships, Implementation, and Regional Collaboration).

Additional SWAP guidance used during the 2025 UWAP revision consisted of the following:

- *Leading At-Risk Fish and Wildlife Conservation: A Framework to Enhance Landscape-Scale and Cross-Boundary Conservation Through Coordinated State Wildlife Action Plans* (AFWA 2021a)
- *Perspectives On and Voluntary Guidance for Improving Tribal Engagement in State Wildlife Action Plans* (AFWA 2023)
- *Climate Adaptation Strategy for America's Fish, Wildlife, and Plants* (National Fish, Wildlife, and Plants Climate Adaptation Network 2024)
- *Integrating Connectivity into State Wildlife Action Plans (SWAPs): Threats, Actions, and Recommendations* (Hance et al. 2024)

Utah's Perspective on the Utah Wildlife Action Plan

The UWAP addresses an expansive array of native wildlife and plant species, including mammals, birds, fish, insects, mollusks, crustaceans, amphibians, and reptiles, and their habitats across the entire state of Utah. The inclusion of plants and insects is a new addition to the UWAP. The UWAP is intended to be a 10-year strategic plan rather than a prescriptive, short-

term action plan. This plan aims to facilitate and guide coordinated action among the various members of Utah's wildlife conservation community. These members include DWR, other state and federal natural resource agencies, and tribal nations as well as interested local governments, industry partners, nongovernmental organizations, and individuals. It also aims to motivate the wildlife conservation community toward deeper engagement with other sectors of society. These other sectors drive Utah's economic growth and development and have their own mandates and interests for delivering crucial goods and services such as energy, water, food, and recreation. These other mandates and interests can at times be a source of conflict with the needs of SGCN and key habitats, and with the interests—and in some cases, the mandates—of the conservation community. There are diverse, competing societal interests, viewpoints, and values in addressing the state's conservation of SGCN and their habitats. Understanding relationships and valuing other valid perspectives minimizes conflict and is essential to effective conservation.

Successful conservation projects often rely on bringing together diverse stakeholders and reaching across agency borders. When common ground is found, partnerships and conservation efforts begin. The UWAP has relied on these partnerships in determining conservation and management priorities and strategies. Community attitudes determine how conservation proceeds. The UWAP is conceived as a conservation guide for Utah's entire community: agricultural producers, wildlife enthusiasts, industry groups, advocacy organizations, and agencies. The guiding principles of this strategy are as follows:

- Acknowledge and respect the pivotal role that local stakeholders play in conservation and encourage participation by all stakeholders in the UWAP revision process.
- Enhance and integrate, not replace or diminish, other planning efforts.
- Maintain an atmosphere of inclusiveness and cooperation among wildlife managers, landowners, private and public land managers, and other stakeholders while planning and implementing conservation actions.
- Maintain enough flexibility to incorporate research and management innovations into conservation actions.
- Manage for healthy habitats, for the benefit of all species.
- Identify and tackle the highest-priority conservation threats and minimize distractions by minor, inessential, or low-priority concerns.

Representatives from agencies such as the Bureau of Land Management, Natural Resources Conservation Service, U.S. Forest Service (USFS), USFWS, Utah Department of Transportation,

and the Utah Trust Lands Administration participated in the preparation of this plan. Nonetheless, those agencies will by necessity consider this plan as noncompulsory guidance as they follow their own planning processes and satisfy their own legal requirements while developing project proposals, preparing decision documents, and implementing collaborative conservation actions.

The UWAP is not a singular plan for one agency or entity. The task of preserving and managing Utah's SGCN is far too large and complex for one agency to achieve alone. The intention of the UWAP is to facilitate cooperation with adjacent state wildlife agencies as well as with local, state, and regional organizations to more successfully achieve range-wide species conservation within Utah's area of influence.

The intention of the UWAP is to facilitate cooperation with adjacent state wildlife agencies as well as with local, state, and regional organizations to more successfully achieve range-wide species conservation within Utah's area of influence.

Over the next decade of UWAP implementation, the Core Team will apply new knowledge and skills to these ongoing tasks as the team continues to learn about the species and habitats at risk; however, there also are new actions that need to be initiated, or substantially expanded, to adequately abate the overarching threats to species and habitats. Most of these new actions are ones for which the wildlife conservation community lacks the authority or the capacity to undertake. DWR has identified agencies and organizations that have the authority and capacity to undertake these actions (see the Likely Authorities, Stakeholders, and/or Partners sections in Chapter 4) and is actively working to build relationships with these organizations. These relationships will be vital to the successful employment of this plan as well as implementing conservation actions.

The UWAP identifies a set of primary conservation challenges, from a statewide perspective, and then offers a framework for addressing them. The framework can be used by anyone as a resource for planning, building partnerships, and designing projects. At a minimum, the framework will help direct the allocation of DWR staff and funding. Ideally, it also will help guide conservation efforts undertaken by DWR's partners and thereby better focus statewide efforts to conserve SGCN and their habitats in Utah.

Key Utah Wildlife Action Plan Updates and Progress

In 2022, members from the Core Team and other partner organizations developed and approved a plan to review and revise the 2015 UWAP (Joint Team 2015) and thereby develop the 2025

edition. Nine subcommittees (Appendix A) were formed to address UWAP deficiencies or larger aspects of the plan that needed to be updated. The 2015 edition was restructured, updated, and expanded, resulting in a major, comprehensive revision for the 2025 edition. Principal updates and changes from the 2015 UWAP, organized by required element, consist of the following:

Required Element 1. Species of Greatest Conservation Need

- Fully incorporated native plants and insects into all aspects of the UWAP.
    - Added 146 plants and 16 insects as SGCN.
- Added 34 SGCN to the mammals, birds, fish, and mollusk categories.
- Removed 63 SGCNs. A total of 36 were reclassified as species of greatest information need, 20 were removed because they no longer qualify as SGCN due to improved status and/or improved knowledge on their conservation status, and seven were removed due to changes in taxonomic status. See Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance, for more details.
- Included a species of greatest information need list that encompasses species and larger taxonomic groups that qualify as SGCN due to data deficiencies.
- Updated NatureServe state conservation ranks for more than half of the 2025 SGCN.

Required Element 2. Habitats

- Fully incorporated native plants and insects into all aspects of the UWAP.
    - Revisited and revised UWAP key habitats to accommodate native plants and insects and to be more consistent with other western states.
- Revised the aquatic key habitats because water is limiting to Utah's SGCNs.
    - Aggregated diverse 2015 UWAP wetland habitats into a single, simplified 2025 UWAP wetland habitat.
    - Added Saline Lakes/Great Salt Lake Ecosystem Key Habitat, which highlights the importance of the Great Salt Lake (GSL) ecosystem to SGCNs.
    - Added Springs Key Habitat, which highlights the importance of springs to SGCNs.
    - Developed the DWR Springs Database and Springs Assessment Inventory Application (Springs App) to better track the extent and condition of springs in Utah.

Required Element 3. Threats/Stressors

- Fully incorporated native plants and insects into all aspects of the UWAP.

    - Revisited and revised UWAP priority threats to accommodate native plants and insects.
- Created or updated threat assessments for 18 key habitats (a threat assessment was not done for the Other Habitats Key Habitat).
- Updated NatureServe state conservation ranks, which included threat assessments for more than half of the 2025 SGCN.
- Developed the Barrier Assessment and Inventory Tool (BAIT) that standardizes data collection among UWAP partners, which helps prioritize restoration of aquatic barriers to SGCN movement.

Required Element 4. Actions

- Fully incorporated native plants and insects into all aspects of the UWAP.
    - Revisited and revised UWAP priority actions to accommodate native plants and insects.

Required Element 5. Monitoring

- Fully incorporated native plants and insects into all aspects of the UWAP.
    - Revisited and revised the UWAP monitoring chapter to accommodate native plants and insects (see Chapter 5, Monitoring and Adapting).

Required Element 6. Review and Revision

- Set up committees that will not sunset between revisions.
    - Progress will continue between revisions so that the next revision requires less effort. This will provide better continuity between revisions.

Required Elements 7 and 8. Partner Involvement and Public Involvement

- Included new partners and public outreach programs specific to plants and insects.
- Included ecoregions consistent with other western states to facilitate regional collaboration and conservation across borders.
- Added a regional collaboration section to Chapter 6, Partnerships, Implementation, and Regional Collaboration.
- Made the 2025 UWAP more interactive and easier to navigate, including links to navigate within the UWAP and to information sources.

Other Updates

- Incorporated climate adaptation throughout all eight required elements.

- Added a climate adaptation chapter.
- Identified Utah climate refugia at a Hydrologic Unit Code (HUC) 12 scale.

The 2025 UWAP is supported by five appendices. Appendix A lists partners who participated in UWAP subcommittees. A glossary is provided in Appendix B to define certain terms that are used throughout the document. In addition, rather than write out scientific names for species at first mention within the document, all scientific names have been collected and listed in Appendix C. Appendix D provides additional details on how key habitats were ranked and conditions measured in Chapter 2, Key Habitats – Location and Condition. Appendix E provides additional detail on the ranking process for Utah's priority threats in Chapter 4, Threats, Data Gaps, and Conservation Actions.

Background and Context

History of Species

In the United States of America, individual states hold primary management authority for most of the wildlife species found within their borders. Native migratory birds, marine mammals, and species listed under the ESA constitute the major exceptions; the federal government holds the principal management responsibility for these species. There also are some exceptions based on land tenure: states do not hold primary management authority for wildlife within national parks, national wildlife refuges, or on tribal lands, though they very frequently partner with these entities to manage wildlife on their lands. Tribal nations are sovereign entities that manage their lands unless there is a nexus with other entities. In Utah, no state entity holds management authority over native plants or insects. Utah law defines wildlife in Utah as crustaceans, mollusks, and vertebrate animals living in nature (Utah Code 23A-1-101(65)). All other members of the animal kingdom are not jurisdictional wildlife in Utah and were not included in previous versions of the UWAP, but because the UWAP is a native species conservation plan for all partners, plants and insects were included in the 2025 UWAP.

State and federal wildlife managers have developed a long and distinguished record of wildlife conservation successes since they began earnest work in the first half of the twentieth century. This work followed the mid-nineteenth to early twentieth century extinctions of several species or subspecies of native North American wildlife, including the eastern elk, passenger pigeon, heath hen, Carolina parakeet, spectacled cormorant, Caribbean monk seal, and Steller's sea cow. These extinctions preceded modern wildlife management and helped trigger an expanding national awareness of—and eventual response to—the need to actively manage wildlife

populations impacted by human activities, such as unregulated harvest or widespread modification or destruction of critically important wildlife habitats.

The record of conservation successes includes many species for which people hunt, trap, or fish and some species that are not harvested by hunters or anglers. Many common species that are pursued by hunters and anglers today would have been considered endangered during the early twentieth century if the current ESA had been in existence. The fact that many then-diminished wildlife species have been recovered so widely and successfully serves as a testament to several important actions:

- The wisdom and efficacy of the state-federal conservation partnership first created with passage of the Wildlife Restoration Act of 1937, later followed by the similarly modeled Sport Fish Restoration Act of 1950.
- The dedication and commitment of generations of local, tribal, state, and federal wildlife management professionals and the public who supported them politically and financially, making their work possible.
- The cumulative rate of return on the diverse and tremendous financial investments made in soil, water, land, and air conservation.
- The willingness and ability of tribal, state, federal, and local agencies, and (more recently) conservation nongovernmental organizations to successfully manage wildlife and habitats.

Wildlife Funding

Nationwide, much of the funding for these conservation successes has traditionally come from hunter and angler license fees and habitat stamps and from federal excise taxes on shooting, boating, and fishing equipment. These excise taxes are collected at the point of sale, deposited into a dedicated trust fund, and distributed annually to the states in a formula-based process that is off limits to annual Congressional appropriation. These federal distributions are matched with state revenues collected through the sale of hunting and fishing licenses, stamps, and tags to provide dependable support for wildlife conservation and management. Although the amount raised and distributed varies significantly year by year, and there are also longer-term trends at play (for instance, greater urbanization of the human population and fewer license-buying hunters per capita in the population), and the certainty that there will be some level of funding every year has proven critical to long-term conservation.

In most states, the use of this excise tax and license funding has been directed mainly toward the conservation of hunted or fished species; however, the majority of wildlife species are not

hunted or fished. Although a few states have chosen to use these federal excise taxes to directly fund the management of diverse wildlife species, in general, most species in Utah have not been the direct beneficiaries of this reliable funding mechanism (though they have often benefitted indirectly from such activities as habitat acquisition and management).

Some states have developed local funding solutions to address the challenge of funding native species management, such as sales taxes, impact fees, or dedicated proceeds from lottery sales (see AFWA 2021b for a more detailed list). Many of these local funding solutions, however, appear out of reach or impractical for many states and tribal nations.

The shortage of dedicated native or nongame species funding has inhibited the development, implementation, and sustainability of long-term state conservation programs for species that are not typically sought by hunters and anglers. One of the unintended consequences of this situation has been a long series of federal interventions, via the specific authority granted under the ESA, to force attention onto these species that previously had not received adequate conservation focus.

In 1997, as part of the state water tax, the Utah Legislature created the Species Protection Account, which significantly expanded the funding base for what are now considered UWAP species identified as SGCN. The Species Protection Account has contributed to the development, implementation, and continuance of species conservation in Utah, both directly and indirectly, by supplying matching funds that have enabled the funds to be leveraged for greater benefit to species management.

Species Protection Account funding and funding from many other sources are now routed through the Utah Department of Natural Resources' Watershed Restoration Initiative (WRI). The WRI was established in 1993 and reconvened in 2003 but has gained the most traction in terms of dollars invested, partners involved, and projects completed over the last 15 years. The WRI is a partner-based program that allows partners (i.e., state, local, and federal agencies, tribal nations, and nongovernmental organizations) to pool dollars for projects that improve watershed health and biological diversity, water quality and yield, and opportunities for sustainable uses of natural resources. Since 2005, the WRI and partners have completed over 2,700 projects and provided over $350 million dollars in funding that has improved 2.5 million acres of priority watersheds in Utah (Utah Department of Natural Resources 2024a). The WRI is the primary vehicle for UWAP implementation.

The WRI is the primary vehicle for UWAP implementation.

Over the past 30 years it has become apparent that reliable funding sources for the conservation of fish, wildlife, plants, and invertebrates are needed if additional species are to be kept from becoming listed as threatened or endangered under the ESA. Throughout the mid- and late 1990s, a national coalition of conservation-minded agencies, organizations, and businesses lobbied Congress for passage of legislation required to allow for such funding. This lobbying campaign, known as Teaming with Wildlife, was partially successful. The U.S. Department of the Interior and Related Agencies Appropriations Act of 2002 created the federal STWG Program, which enables Congressional appropriators to consider funding wildlife and habitat conservation on a year-to-year basis. This law requires that each state has a current, approved SWAP to remain eligible for any STWG Program funding that Congress appropriates. States that choose to participate in the STWG Program must review and revise their SWAPs at least once every 10 years to maintain their eligibility. Utah's initial SWAP was completed and approved in 2005 (Sutter et al. 2005), revised in 2015 (Joint Team 2015), and again in 2025.

Overview of Utah

Utah is the eleventh largest state and one of the most arid states in the nation (Sowby 2024) with an average of 33 centimeters (13 inches) of precipitation per year. Elevation extremes in Utah range from a low of 664 meters (m) (2,178 feet) above mean sea level in the Beaver Dam Wash to a high of 4,123 m (13,528 feet) above mean sea level in the Uinta Mountains. Most of the 29 counties in Utah have mountain peaks over 3,048 m (10,000 feet), with valley bottoms below 1,524 m (5,000 feet). Various federal government agencies administer approximately 64% of the land surface; state agencies administer 10%; tribal nations administer 5%; and private owners administer 21%.

Utah's climate varies greatly with elevation and regional terrain and, to a lesser extent, by latitude. Generally, the north receives more precipitation and has lower evapotranspiration than the south. Statewide, winter precipitation is more important and more abundant than summer precipitation; in Utah, most precipitation falls as snow. Eastern Utah, and particularly southeastern Utah, receives more summer rain than the rest of the state, being more influenced by the North American monsoon.

Local climates in all regions are diverse with a range of ecosystems from desert to alpine, often with stark differences over just a few miles. Most of the state's precipitation falls in its mountainous regions, whereas more than two-thirds of the state receives less than 30

centimeters (12 inches) of total precipitation per year. Temperatures in Utah have risen more than 2.5 degrees Fahrenheit since the beginning of the twentieth century (Frankson et al. 2022). Droughts have intensified across the state, and it is predicted that more water will fall as rain rather than snow in the near future (Hegewisch and Abatzoglou 2024a, 2024b). Drought, as measured by the Palmer Drought Severity Index, has varied substantially over the last few decades (Rhee and Carbone 2007). In general, the period from 1977 to 1986 in Utah did not have drought conditions, whereas the period from 1987 to 2003 did. The subsequent decade saw a stretch of rather moderate, occasionally wet conditions from 2004 to 2011, drought from 2012 to 2014, wetter conditions from 2014 to 2017, and then drought conditions from 2017 to 2018 and 2020 to 2023. The majority of Utah was under "Exceptional Drought" from 2020 to 2022 (National Drought Mitigation Center et al. 2025). Aquatic habitats within Utah are highly impacted by drought and need to be protected to provide an essential refuge from these climatic shifts.

Utah is globally renowned for the species diversity associated with the GSL ecosystem, which is a high-priority landscape for DWR and many conservation partners. Because of its importance to a diversity of wildlife species, saline lakes (specifically, the GSL ecosystem) were identified as a key habitat in the 2025 UWAP. More than 1,500 square kilometers (579 square miles) of wetlands exist on the margins of GSL, where freshwater flows toward the lake (Downard 2024), making these wetlands a desert oasis for migrating birds. The lake provides essential stopover habitat for a great diversity of shorebird and waterfowl species, numbering in the millions of individuals. GSL is known as a site of hemispheric importance by the Western Hemisphere Shorebird Reserve Network due to the use of the area by hundreds of thousands of shorebirds, including over 500,000 Wilson's phalaropes during fall migration. The lake has also been used by up to 5 million eared grebes, which at times represents 90% of the North American population; up to 20,000 American white pelicans; and over 21% of the continental population of snowy plovers (DWR 2023). The water elevation in GSL varies with precipitation and evaporation. Since record keeping began in 1850, its surface elevation has fluctuated from a historic low of 1,276.7 m (4,188.5 feet) in 2022 to a historic high of 1,284 m (4,212 feet) in 1986. The historic low in November 2022 has raised concern for the fragile ecosystem, which requires water to sustain brine shrimp and two species of brine flies, prevent toxic dust storms, and provide habitat to millions of birds. This vertical displacement can shift the shoreline a dozen miles or more in some areas, which translates to a surface area ranging between approximately 600,000 and 1,500,000 acres. This lake-level fluctuation ensures the long-term survival of the lake's dynamic habitats and the bird species that frequent those habitats. The global conservation significance of GSL cannot be overstated.

The complexities of Utah's topography and climate result in biologically diverse habitats. Important habitat types in Utah include a diversity of wetlands, sagebrush steppe and shrublands, mountain shrub and pinyon-juniper woodlands, aspen-conifer forests, and desert grasslands and shrublands. Approximately 80% of Utah's wildlife depends on wetlands (Utah Geological Survey 2022). Aspen-conifer communities are second to riparian areas in species diversity and abundance. Utah's habitats support approximately 940 species and subspecies of wildlife, including mollusks and crustaceans (DWR et al. 2025), more than 3,000 plants (Welsh et al. 2015), and thousands of species of invertebrates. These species are organized into diverse animal communities occupying the habitats mentioned above.

Ecoregions

Ecoregion designations are an important addition to the 2025 UWAP. The Core Team chose to include ecoregions in this revision to facilitate regional collaboration with SWAPs of other western states. Ecoregions are areas where habitats (and the type, quality, and quantity of environmental resources) are generally similar. The U.S. Environmental Protection Agency (EPA) and USFS each have defined ecoregions. The Core Team chose to use EPA ecoregions (EPA 2023) rather than USFS ecoregions (Cleland et al. 1997; USFS 1994). The EPA ecoregions are hierarchical with the following four levels:

- Level I – 12 ecoregions in the conterminous United States (broadest level)
- Level II – 25 ecoregions in the conterminous United States
- Level III – 105 ecoregions in the conterminous United States
- Level IV – 967 ecoregions in the conterminous United States

EPA Level III ecoregions were chosen for the 2025 UWAP for the following reasons:

- EPA Level III ecoregions offer more regional specificity than Level I or II but still provide coarse detail that allows for broader conservation aimed at landscape scales.
- UWAP terrestrial key habitats were identified using LANDFIRE Existing Vegetation Types (EVTs) (LANDFIRE 2020a), which are based on EPA Level III ecoregions.
- Other southwestern states, including Nevada and New Mexico, use EPA ecoregions, and consistency will facilitate regional collaboration.

The EPA ecoregions are multiagency and multinational. The Commission for Environmental Cooperation, an international organization created by Canada, the United States, and Mexico to support the conservation and protection of the North American environment, identifies North American ecoregions by evaluating patterns and composition in several biotic and abiotic

factors, including geology, landforms, soils, vegetation, climate, land use, wildlife, and hydrology (Omernik 1987, 1995). For more detail on how these ecoregions were created, please see Omernik and Griffith (2014), Omernik (1995, 2004), and Commission for Environmental Cooperation (1997).

The incorporation of EPA Level III ecoregions into the UWAP paves the way for collaboration with adjacent states that have similar SGCN, SWAP habitats, priorities, and conservation concerns. This action addresses the first principle of AFWA guidance for landscape conservation initiatives: develop and use a common lexicon and classification system for species, habitats, threats, and conservation actions (AFWA 2021a).

Utah is composed of arid deserts and canyonlands, salt flats, wetlands, semiarid shrublands, irrigated valleys, woodlands, forested mountains, and glaciated peaks, resulting in enormous ecological diversity and comprising seven EPA Level III ecoregions, which are shown in Figure 1 and described below.

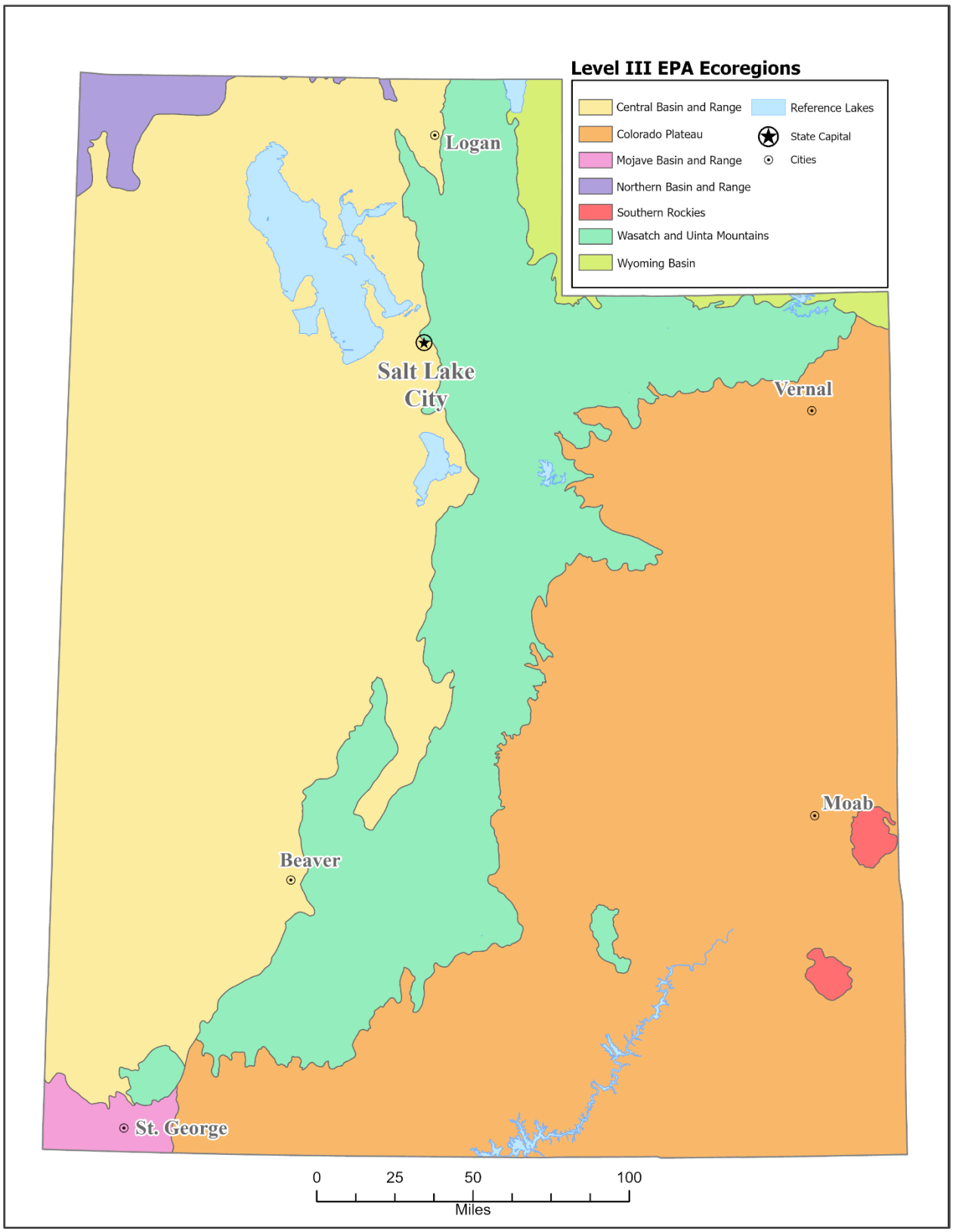


Figure 1. *U.S. Environmental Protection Agency Level III Ecoregions Used in the 2025 Utah Wildlife Action Plan*

Central Basin and Range

The Central Basin and Range ecoregion in western Utah covers 25.1% of the state (Soulard 2012) (see Figure 1). This ecoregion has hot summers and mild winters with a dry, desert climate. The ecoregion includes mountains separated by broad, dry basins and valleys that include playas, salt flats, and sand dunes. Common plant species in basins and valleys include Parish's Great Basin sagebrush, shadscale saltbush, winterfat, black sagebrush, Wyoming big sagebrush, Mormon tea, rabbitbrush, Indian ricegrass, and wheatgrass species, with greasewood, Nuttall's saltbush, and alkali sacaton in more saline areas. Lower-elevation mountains may have single-leaf pinyon, Utah juniper, sagebrush species, antelope bitterbrush, serviceberry species, snowberry species, and bluebunch wheatgrass. Higher elevations may contain Douglas-fir, white fir, limber pine, or quaking aspen (EPA 2013; Wiken et al. 2011).

Colorado Plateau

The Colorado Plateau ecoregion in eastern and southern Utah covers 43% (EPA 2013) of the state (see Figure 1). The climate in this ecoregion is characterized by hot, dry summers and cold, dry winters. This ecoregion exhibits rugged topography with sometimes abrupt changes in relief. Vegetation in low-lying basins and canyons is sparse, and common species are four-wing saltbush, blackbrush, shadscale saltbush, and galleta. In the uplands and higher valleys, common species include Wyoming big sagebrush, black sagebrush, and pinyon-juniper woodland. Common species in higher elevations include Gambel oak, quaking aspen, mountain mahogany, and Douglas-fir (Wiken et al. 2011).

Mojave Basin and Range

The Mojave Basin and Range ecoregion in southwestern Utah covers 1% (EPA 2013) of the state (see Figure 1). The climate in this ecoregion is characterized as dry, subtropical desert with hot summers and warm winters. Desert vegetation is sparse, and common species include creosote bush, white bursage, Joshua tree and other yuccas, and blackbrush. Common species on alkali flats include saltbush species, saltgrass, alkali sacaton, and iodinebush. Common species in the mountains include sagebrush species, juniper, single-leaf pinyon, ponderosa pine, white fir, limber pine, and bristlecone pine (Wiken et al. 2011).

Northern Basin and Range

The Northern Basin and Range ecoregion in northern Utah covers 2% (EPA 2013) of the state (see Figure 1). This ecoregion is arid and has hot summers and cold winters, and the climate is characterized as steppe or desert. Common species in low-lying areas include mountain big

sagebrush, Wyoming big sagebrush, low sagebrush, bluebunch wheatgrass, rabbitbrush, Idaho fescue, and Thurber's needlegrass with some scattered juniper. Common species in mountains at low to mid-elevations are mountain big sagebrush, mountain mahogany, juniper, and Idaho fescue. Common species in mountains at high elevations are Douglas-fir and quaking aspen (Wiken et al. 2011).

Southern Rockies

The Southern Rockies ecoregion in southeastern Utah encompasses 1% (EPA 2013) of the state (see Figure 1). In Utah, this ecoregion consists of exclaves surrounded by the Colorado Plateau ecoregion and is characterized by steep, rugged mountains and some middle-elevation high intermontane valleys. The climate in this ecoregion is characterized as humid with substantial temperature variations between seasons and a subarctic climate at higher elevations. This ecoregion has warm to cool summers and severe winters with no distinct dry season. The vegetation communities display elevational banding. Common vegetation at low elevations consists of grass and shrubs with sagebrush, mountain mahogany, pinyon pine, juniper, or scattered Gambel oak woodlands. Common vegetation communities at low to middle elevations comprise a variety of vegetation types, including juniper-oak woodlands, ponderosa pine, Douglas-fir, and aspen species. Common vegetation at middle to high elevation consists of forests composed of Engelmann spruce, subalpine fir, and quaking aspen. Common vegetation at the highest elevations consists of alpine low shrubs, cushion plants, sedges, and krummholz vegetation of stunted Engelmann spruce, subalpine fir, and limber pine (Wiken et al. 2011).

Wasatch and Uinta Mountains

The Wasatch and Uinta Mountains ecoregion encompasses 25% (EPA 2013) of Utah, occupying a band down the center of the state for almost its entire length (see Figure 1). The terrain includes high, steep mountains with narrow crests and valleys and dissected plateaus and open high mountains in some areas. The climate in this ecoregion is considered to be humid and severe with great temperature variation between seasons. Typically, the summers are warm to hot and the winters are severe with no distinct dry season. The vegetation communities display elevational banding. Common vegetation communities at low to middle elevations comprise a variety of vegetation types, including juniper-oak woodlands, ponderosa pine, Douglas-fir, and aspen species. Common vegetation at middle to high elevation consists of forests composed of Engelmann spruce, subalpine fir, and quaking aspen, with ponderosa pine at lower elevations. In contrast to the Southern Rockies ecoregion, the more common middle-elevation species include quaking aspen, juniper-pinyon, and oak. The vegetation at the highest elevations

typically consists of Douglas-fir, quaking aspen, subalpine fir, Engelmann spruce, and limber pine. The valleys primarily consist of grasses, sagebrush, pinyon, and Utah juniper (Wiken et al. 2011).

Wyoming Basin

The Wyoming Basin ecoregion in northeastern Utah covers 2% (EPA 2013) of the state (see Figure 1). This ecoregion has warm to hot summers and cold winters, and the climate is characterized as dry steppe and desert. This ecoregion is a broad basin with some high hills and low mountains. There are areas of badlands. The vegetation is primarily arid grasslands and shrublands. Common species in the sagebrush steppes of this ecoregion include Wyoming big sagebrush, black sagebrush, prairie sagebrush, rabbitbrush, western wheatgrass, needle and thread grass, blue grama grass, and prairie junegrass. Common species in the desert shrublands include greasewood, Gardner's saltbush, shadscale saltbush, and bud sagebrush. Common species at higher elevations include big sagebrush and pinyon-juniper woodland (Wiken et al. 2011).

Chapter 1. Species of Greatest Conservation Need – Distribution and Abundance

Introduction

The Utah Division of Wildlife Resources (DWR) has management authority, as defined in Utah Code (23A-1-101(65)), over more than 940 species of wildlife, including mammals, birds, amphibians, reptiles, fish, mollusks, and crustaceans (DWR et al. 2025). Previous Utah Wildlife Action Plans (UWAPs) (e.g., 2005 and 2015) only considered these DWR jurisdictional wildlife as species of greatest conservation need (SGCN) because DWR leads UWAP planning efforts. State wildlife action plans (SWAPs), however, are plans for all partners working on native species conservation efforts. Although DWR does not have management authority over plants and insects, these taxa 1) are important to maintain ecosystem health and biodiversity; 2) are being managed by UWAP partners; 3) can often benefit through UWAP wildlife projects if they are considered during project planning; and 4) can impact all Utahns if populations decline and imperiled species become listed as threatened or endangered under the Endangered Species Act (ESA).

A total of 30 plant and five insect species were added to the UWAP SGCN list in a 2021 addendum to the 2015 UWAP and their habitats were added in a 2022 addendum (DWR 2022). During the 2025 UWAP comprehensive revision, the Plant and Insect Integration and SGCN Subcommittees ensured that conservation needs for additional at-risk Utah plants (more than 3,000) and insects (more than 300) were considered and, where justified, included as SGCN to fully integrate these taxa into the 2025 UWAP.

An essential feature in the development and evaluation of any SWAP is the equitable prioritization of conservation targets, because not all species warrant the same degree of conservation concern or effort. Finite funding and limited personnel availability to carry out conservation work further focuses resources and effort on the species most in need of conservation attention. Many prioritization schemes already exist for individual taxonomic groups; species are often classified to their relative degree of imperilment, population trends,



Black Rosy-Finch. Photograph by Tory Mathis, DWR, Duchesne County, 2025.

how secure their habitat is, and the breadth of their distributions. The challenge is to develop an equitable, transparent, and credible approach that spans all taxa.

A rubric (Figure 2) was developed to determine which species were included as SGCN for the 2015 UWAP (UWAP Joint Team [Joint Team] 2015). The three fundamental factors considered during development were the likelihood of an ESA listing, the consequences of such a listing, and the ability of the State of Utah to influence a listing decision. The 2025 SGCN Subcommittee discussed the UWAP rubric in its first meeting and agreed to maintain the same criteria for determining SGCN that have been used since the rubric was developed and agreed upon by UWAP partners. The subcommittee recognized that the rubric had been useful in developing the 2015 SGCN list, including SGCN additions and deletions in subsequent minor revisions. Modifications were made to the rubric to accommodate plants and insects, because these taxa were not considered in the 2015 UWAP (Joint Team 2015).



Morrison's Bumble Bee. Photograph by Jeff Witters, Wayne County, 2024.

NatureServe national and subnational conservation status ranks (N- and S-rank, respectively) are integral in evaluating whether a species should be considered a UWAP SGCN. Ranks range from 5 (secure) to 1 (critically imperiled) and are based on a species' distribution, population abundance and trends, and threats (NatureServe 2020). Wildlife species with ranks of N1, N2, and N3 are eligible for inclusion as SGCN within the rubric; however, too many Utah plants and insects exist with these status ranks to provide a useful prioritization for these taxa. The SGCN Subcommittee decided to predominately consider N1 (critically imperiled) and N2 (imperiled) plants and insects, as well as S1 and S2 plants and insects for inclusion as SGCNs. Umbrella species also were considered for inclusion as 2025 SGCNs. Umbrella species are those whose conservation confers protection to other co-occurring species, promotes ecosystem function, or facilitates habitat connectivity. Three types of umbrella species were considered for the 2025 UWAP:

- Keystone species – species that have an outsized influence in supporting the populations of other species and ecosystem function.
- Indicator species – species that can represent the health of or specific processes within an ecosystem such as environmental changes, species richness, or population densities of other species.

- Ecosystem engineer – species that modify the biophysical environment in ways that increase or maintain habitat diversity and thereby impact species richness in an ecosystem.



Black-Footed Ferret. Photograph by Tory Mathis, DWR, Uintah County, 2019.

Frequently, more information is needed to understand whether species are truly declining on the landscape or if a rank is simply reflecting bias of the available data. For example, NatureServe ranks can indicate rarity if little distributional information is known for a species. Several species (e.g., many mollusks) were included as SGCN in the 2015 UWAP (Joint Team 2015) primarily due to limited information. Many data gaps result from a lack of appropriate monitoring methods or unresolved taxonomy. Data gaps can prevent effective management if they indicate that species need conservation attention that is actually unnecessary. This issue was further highlighted through the process of including plants and insects in the 2025 UWAP, because limited, outdated, or incomplete information exists for many of these taxa. More recently, SWAP revisions are starting to distinguish the species with information needs or data gaps as a subset of SGCNs. The SGCN Subcommittee had several discussions to address the issue of data gaps and agreed that an SGCN category defining species of greatest information need (SGIN) would highlight data-deficient taxa to include in the 2025 UWAP and so prioritize filling data gaps. SGIN criteria were based closely on criteria identified in Idaho's recently finalized SWAP (Idaho Department of Fish and Game 2023).

SGIN are species that qualify as SGCN through the UWAP SGCN rubric largely due to a lack of current scientific knowledge for a given taxon or information critical to understanding its conservation needs. Identifying species as SGIN allows UWAP partners to prioritize actions or complete studies (e.g., surveys or monitoring, genomic analyses, habitat association modeling) to better understand distribution, taxonomy, or ecology for a given species. As these knowledge gaps are filled for SGINs, they can be re-evaluated through the UWAP SGCN rubric to be considered for SGCN designation or removed entirely if their revised status no longer warrants conservation attention. Species were identified as SGIN due to one or more of the following factors:

- Taxonomic uncertainty (further study is necessary to clarify a species' taxonomy)

- Distributional uncertainty (additional occurrence and inventory data needed to confirm species' distribution and range)
- Ecological uncertainty (e.g., population trends, species-specific response to anthropogenic or environmental threats and stressors, uncertain habitat requirements)

This chapter presents a summary of the distribution and abundance information on the 256 SGCN identified during the selection process and highlights additional species identified as SGIN. Specifically, this chapter presents state and national NatureServe ranks, which provide an integrated, weighted index of rarity, trends, and threats, with rarity (the inverse of abundance) assigned most of the weight. Utah-specific information about rarity, trends, and distribution is also presented in this chapter (threats are discussed in Chapter 4, Threats, Data Gaps, and Conservation Actions). Important points about these ranks and the way they were used to identify SGCN in Utah are as follows:

- No single rank, index, or score can possibly give the whole picture, but the NatureServe conservation status assessment method (NatureServe 2025) provides a uniform, credible, and documented approach.
- This approach may be applied across taxonomic groups, states, and jurisdictional boundaries.
- NatureServe ranks are updated periodically with new inventory and assessment data from DWR and many partners.



Uinta Basin Hookless Cactus. Photograph by Tory Mathis, DWR, Uintah County, 2024.

To help interpret the material presented in this chapter, a brief explanation of the various ranks is provided below.

Global, National, and Subnational Levels

NatureServe conservation statuses are applied at all three geographic levels (the 2025 UWAP uses two of these levels, N and S):

- G–ranks are designated at the global (or range-wide) level.
- N-ranks are designated at the national level for a particular nation.
- S-ranks are designated at the subnational or state level.

Commonly Encountered Conservation Status Ranks

Conservation status ranks mainly consist of numbers, which are sometimes replaced by or used with letters or punctuation marks, as follows (NatureServe 2024a):



Green Sucker. Photograph by Ben Nadolski, DWR, Weber County, 2012.

- 1 – "Critically imperiled – At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors."
- 2 – "Imperiled – At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors."
- 3 – "Vulnerable – At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors."
- 4 – "Apparently Secure – At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors."
- 5 – "Secure – At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats."



Desert Tortoise. Photograph by Phil Tuttle, DWR, Washington County, 2024.

Thus, for example, an N3 species is *nationally vulnerable*" and an S2 species is *state imperiled* for the state in which the rank is assigned. According to NatureServe convention, a state numerical rank cannot imply that the species is more secure at the state level than it is nationally or globally (e.g., a rank of N1/S3 cannot occur), but some exceptions have been made in a few cases for the following reasons:

- State ranks are assigned and maintained by state natural heritage programs and conservation data centers. The Utah Natural Heritage Program is located within DWR, which updates state ranks periodically.
- National ranks are assigned and maintained by NatureServe, a nonprofit organization and a network of over 80 state, provincial, and other subnational (e.g., Navajo Nation,

Tennessee Valley Authority) natural heritage programs. NatureServe updates its national and global ranks at much longer intervals—often 15 to 20 years—than many state programs.

- Logic dictates that a species' actual (versus reported) conservation status would typically change more rapidly in smaller geographic areas (e.g., states) than in much larger ones (e.g., nations). State programs may prefer to maintain, report, and use current information rather than communicate information known to be outdated or inaccurate while waiting for NatureServe to update its ranks. This is the case in Utah.

The letters and punctuation marks used in conservation status ranks are listed below. These (and others not currently applicable in Utah) can be applied at any scale level and can be used in conjunction with ranking numbers or by themselves. The status ranks and definitions were based on NatureServe (2024b) and adapted for the 2025 UWAP:



Monarch Butterfly, Tagged Female. Photograph by Amanda Barth, USU, Uinta County, 2019.

- B – "Breeding—conservation status refers to the breeding population of the species." Follows the numeric part of the rank, if used.
- N – "Nonbreeding–conservation status refers to the nonbreeding population of the species in the nation or state/province."
- H – Historical occurrence but not known if recently extant. Possibly extinct or extirpated, but with some reasonable hope of rediscovery. Routinely applied after 20 years of no observations (whether any surveys were conducted). (Used instead of a number.)
- NNR and SNR – Unranked (i.e., not yet assessed). (Used instead of a number.)
- U – Unrankable due to conflicting or inadequate information. (Used instead of a number.)
- X – Presumed extinct or extirpated, with rediscovery not reasonably expected. Not located despite extensive and intensive searches. Extinction is a global (range-wide) phenomenon, while extirpation applies to loss within a particular national or subnational area, with the entity still extant elsewhere. (Used instead of a number.)
- S#/S# – Range of ranks due to uncertainty (e.g., S2/S3 indicates a state rank ranging from S2 to S3). Limited to two ranks of difference, beyond which the status would be U

for Unrankable (e.g., S1/S4 would instead be listed as SU). Ranged ranks apply to global and national ranks as well.

- ? – Recorded within a nation or state, but local status not available, not yet determined, or indeterminate. (Denotes inexact numeric rank.)

Utah Wildlife Action Plan Rubric

All species considered for inclusion in the 2025 UWAP SGCN/SGIN list were passed through the UWAP rubric's left side (Status Assessment) and—as necessary—its right side (Consequences and Opportunities) (see Figure 2). The following sections describe the rubric and the rationale behind Utah's SGCN listing process.

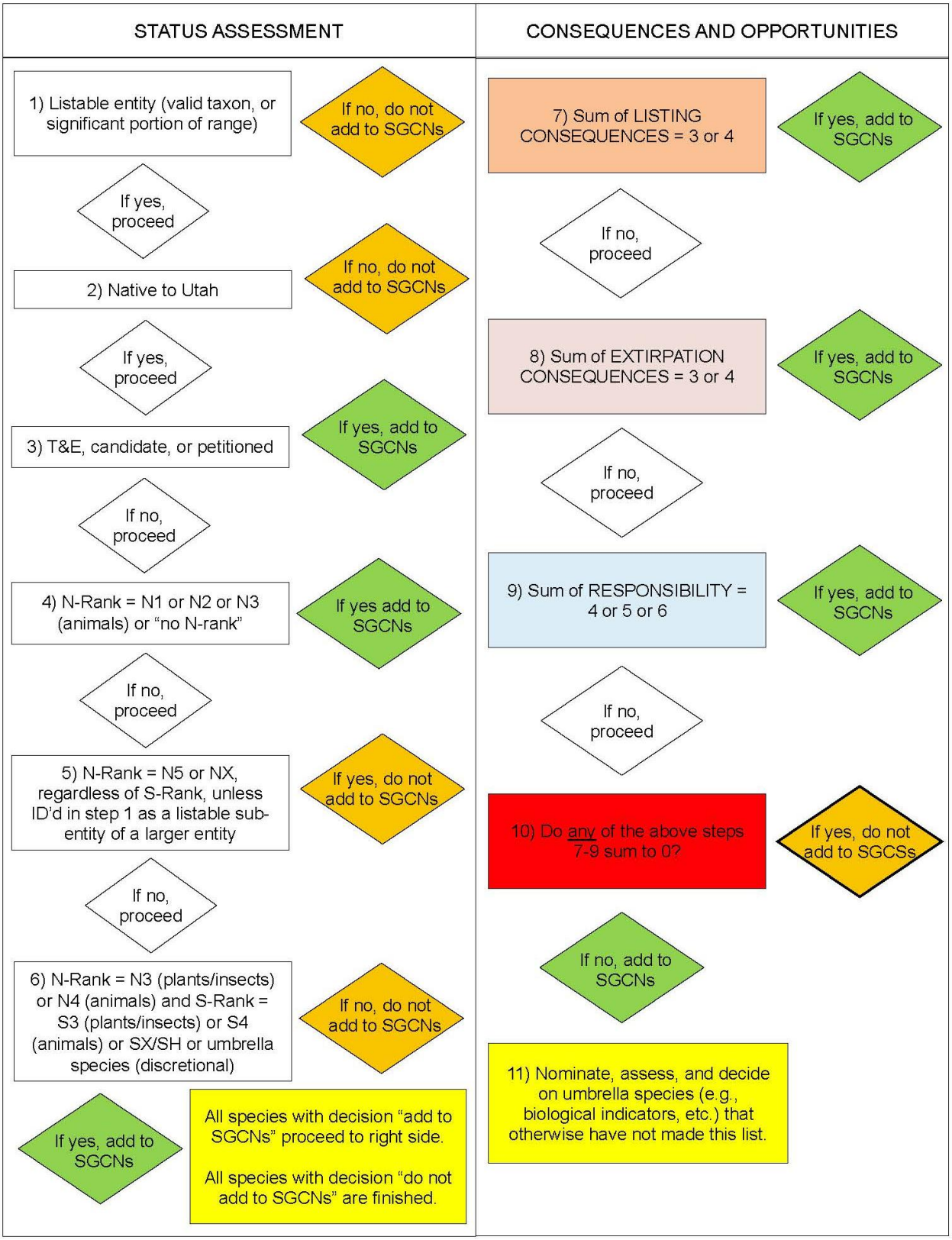


Figure 2. *Species of Greatest Conservation Need Decision Process Rubric*

Note: T&E = threatened and endangered.

Left Side – Status Assessment

The following three essential questions were asked when considering the potential for a native species to face listing under the ESA:

- Is the taxon legally listable?
- Is the taxon native to Utah?
- What is the vulnerability of the taxon to extinction?

Step 1: Listable entity (valid taxon, or significant portion of range)

Because the intended outcome of the UWAP is to prevent additional ESA listings, if the entity under consideration is not an ESA-listable entity (i.e., a recognized taxon or a listable subdivision of a taxon) then it **should not** be considered a Utah SGCN.

Step 2: Native to Utah

Species that are not native flora or fauna of Utah **should not** be designated Utah SGCN.

Step 3: Species with federal status

Species that are federally listed as threatened or endangered under the ESA, considered candidates for federal listing, or undergoing a status review for a petition **should** be designated Utah SGCNs. This step was added to the 2025 UWAP rubric to ensure that all ESA-listed, candidate, and petitioned species were included on the SGCN list.

Step 4: N-rank = N1, N2, or N3 (wildlife) or no N-rank Species that have a NatureServe N-rank of N1 or N2 (all species) or N3 (wildlife, not plants or insects) **should** be considered for designation as Utah SGCN.

N1 = Critically imperiled in the United States

N2 = Imperiled in the United States

N3 = Vulnerable in the United States



American Avocet. Photograph by Tory Mathis, DWR, Uintah County, 2023.

Step 5: N-rank = N5 or NX, regardless of S-rank, unless identified in Step 1 as a listable sub-entity of a larger entity

If a species is nationally ranked as widespread, abundant, and secure in the United States (and thus extremely unlikely to be ESA listed) or nationally

extinct, then it **should not** be considered a Utah SGCN. The only exception would be if there is a significant portion of range or other listable entity in Utah that poses a plausible, credible listing threat.

N5 = Widespread, abundant, and secure in the United States

NX = Extinct in the United States

Step 6: N-rank = N3 (plants and insects) or N4 (wildlife), and S-rank = S3 (plants and insects) or S4 (wildlife) or SX/SH or umbrella species (discretional)

The species ranked in this category can be more widespread with some local or long-term concerns. In general, these species would not meet the criteria to be designated as SGCN, but exceptions can be made for specific circumstances (i.e., if a significant portion of the species' range occurs in Utah and it faces a plausible, credible risk of federal listing; or, if an umbrella species faces declines that could cause cascading ecosystem impacts that imperil other SGCN or SGIN).



Winged Floater and Western Pearlshell. Photograph by Chanté Lundskog, DWR, Box Elder County, 2021.

N3 = At moderate risk of extinction in United States (plants and insects only)

N4 = Usually widespread, abundant, and secure in the United States; some local or long-term concerns (species other than plants)

S3 = Vulnerable in Utah

S4 = Apparently secure in Utah

SX = Extirpated from Utah

SH = Recorded historical occurrence but not known to be recently extant in Utah

Umbrella Species = a species known to have an ecological role as keystone, indicator, or an ecosystem engineer, as described above.

Right Side – Consequences and Opportunities

The purpose of this section of the decision process is to evaluate two aspects of a species becoming ESA listed or facing extirpation: 1) what might happen to its populations in Utah, and 2) what mitigating actions might be taken in Utah. The following considerations are given when conducting such an evaluation:



Desolation Canyon Columbine. Photograph by Zach Coury, Utah State University, Grand County, 2024.

- What are the socioeconomic impacts (severity) and extent (scope) of a species' listing?
- What are the ecological impacts (severity) and extent (scope) of a species' listing?
- What is Utah's responsibility in maintaining the viability of a species?

A summary of definitions is provided in Table 1. An additional four steps on the right side of the SGCN decision process rubric provide reasoning for adding a species as an SGCN or rationale for excluding a species from SGCN consideration.

Step 7: Sum of Listing Consequences = 3 or 4

This step considers the summed scores of two criteria that assess the scope and severity of socioeconomic impacts to Utah of a species' future or current ESA listing (see Table 1). Possible values range from 0 to 4.

If the existing or potential negative socioeconomic consequences of an ESA listing are in the upper half of the possible range, then that species should be considered a provisional Utah SGCN, subject to the results of Step 9.

Step 8: Sum of Extirpation Consequences = 3 or 4

This step evaluates the combined scores of two criteria that determine the scope and severity of potential ecological impacts to Utah due to a species' current or future severe decline or extirpation (see Table 1). Possible values range from 0 to 4.

If the existing or potential negative ecological consequences of a severe decline or extirpation in Utah are in the upper half of the possible range, then that species should be considered a provisional Utah SGCN, subject to the results of Step 9.

Step 9: Sum of Responsibility = 4, 5, or 6

This step evaluates the combined scores of three criteria that determine the extent of Utah's responsibility for a species' viability. The three criteria quantify the role Utah plays in a species' abundance, range, and annual life cycle (see Table 1). Possible values range from 0 to 6.

If Utah's responsibility for a species' viability falls in the upper half of the possible range, that species should be considered a provisional Utah SGCN or Utah SGIN (if qualification is primarily due to data gaps), subject to the results of Step 10.

Step 10: Sum of Listing Consequences, Extirpation Consequences, or Responsibility = 0

This step revisits the scores given to a provisional SGCN for each of the previous three steps. Consider the following possibilities:

- Step 7 – Sum of Listing Consequences = 0
- Step 8 – Sum of Extirpation Consequences = 0
- Step 9 – Sum of Responsibility = 0

If any one of these three possibilities are met, the provisional SGCN species **will not be added** to the final SGCN list.

Step 11: Nominate, Assess, and Decide on Surrogate Species

This final step is a chance to correct any significant oversights or mistakes that are likely to undermine the role of the SGCN list in achieving the purpose of the UWAP. If, for instance, any umbrella species (e.g., keystone, indicator species, or ecosystem engineers) meet conditions outlined in the rubric but have been overlooked thus far, then those species should be named Utah SGCN.



Western Toad. Photograph by Phil Tuttle, DWR, Box Elder County, 2018.

Table 1. *Definitions for Scoring the Right Side of the Utah Wildlife Action Plan Species of Greatest Conservation Need Rubric*

CRITERION	DEFINITION	SCORING
Socioeconomic scope of listing	How extensive in scope would be/are the additional social and economic impacts in Utah if this species is listed under the ESA?	2 = more than four Utah counties directly affected
		1 = two to four counties affected
		0 = one county affected
Socioeconomic severity of listing	How severe would be/are the additional social and/or economic impacts in Utah if this species is listed under the ESA?	2 = species lives in an environment with no other threatened and endangered species
		1 = 1 to 2 listed species already present
		0 = more than two threatened and endangered species already present
Ecological scope of decline or extirpation	How extensive in scope would be/are the additional impacts to other Utah species or habitats due to this species' decline or extirpation?	2 = species currently occupies >10% of Utah or of aquatic/riparian habitat
		1 = species occupies 1 to 10% of Utah or of aquatic/riparian habitat
		0 = species occupies <1% of Utah or of aquatic/riparian habitat
Ecological severity of decline or extirpation	How severe would be/are the additional impacts to other Utah species or habitats due to this species' decline or extirpation?	2 = species is an ecosystem engineer or keystone species, or more than two other species ranked as SGCN depend on it
		1 = species is an ecosystem engineer or keystone species, or 1 to 2 other species ranked as SGCN depend on it
		0 = neither situation applies
Area responsibility	How much of the species' current U.S. geographic range occurs in Utah?	2 = more than 20% of the current conterminous U.S. range is in Utah
		1 = 5 to 20% of the current conterminous U.S. range is in Utah
		0 = <5% of the current conterminous U.S. range is in Utah

CRITERION	DEFINITION	SCORING
Numerical responsibility	What proportion of the current U.S. population resides in Utah at some point in its life cycle?	2 = more than 20% of the current conterminous U.S. population lives in Utah
		1 = 5 to 20% of the current conterminous U.S. population lives in Utah
		0 = <5% of the current conterminous U.S. population lives in Utah
Temporal responsibility	For what portion of the year does the species live in Utah?	2 = all year long
		1 = for a crucial life stage
		0 = only for a brief pass-through

Results

In the 2015 UWAP (Joint Team 2015), 141 species were listed as SGCN (Table 2). The SGCN list has increased to 256 species in this revision with the addition of plants and insects; however, several species that were originally considered SGCNs are now on the SGIN list. The SGCN list is now more representative of species in true decline versus species for which more information is needed to understand population status. The latter species were moved to the SGIN list. The total species for 2025 include species added in minor amendments in 2020 (DWR 2020) and 2021 and 2022 (DWR 2022).

Table 2. *Overview of Species of Greatest Conservation Need Changes from the 2015 to 2025 Utah Wildlife Action Plans by Species Type*

SPECIES TYPE	NUMBER OF SPECIES IN THE 2015 UWAP*	SPECIES ADDED/REMOVED IN 2020 AND 2021/2022 MINOR AMENDMENTS†	NUMBER OF SPECIES IN 2025 UWAP	CHANGES FROM 2015 TO 2025
Amphibians	8	0/3	4	4 removed
Birds	26	1/0	23	9 removed, 6 added
Crustaceans	2	0/2	0	2 removed
Fish	22	0/0	22	1 removed, 1 added
Insects	0	5/0	16	16 added
Mammals	26	3/3	14	13 removed, 1 added
Mollusks	45	3/5	27	25 removed, 7 added
Plants	0	30/0	146	146 added

SPECIES TYPE	NUMBER OF SPECIES IN THE 2015 UWAP*	SPECIES ADDED/REMOVED IN 2020 AND 2021/2022 MINOR AMENDMENTS†	NUMBER OF SPECIES IN 2025 UWAP	CHANGES FROM 2015 TO 2025
Reptiles	12	0/8	4	8 removed
Total	**141**	**–**	**256**	–

* Joint Team (2015).

† DWR (2020, 2022).

Since the 2015 UWAP, 78 species have been retained as SGCN, and 62 species were completely removed as SGCNs. Of these 62 species, 35 were reclassified as SGIN. Of the remaining species, 20 were removed because they no longer qualify as SGCN due to a change in their conservation status. Recent genetic work is redefining mollusk taxonomy in Utah (Linscott and Lucid 2024). Five mollusk species were removed from the SGCN list because they are no longer considered valid species. Genetic work is ongoing, and additional changes to the SGCN/SGIN lists will be likely in the near future. One reptile and one mammal species also were removed due to taxonomic changes.



Woundfin. Photograph by Rick Fridell, DWR, Washington County, 2023.

There were several changes in S-ranks for SGCNs. Of the 78 species retained between the 2015 and 2025 revisions, the S-ranks changed for 22 species: five SGCN became more secure, and 17 species became more vulnerable.

Case Study: Bonneville Cutthroat Trout – Back from the Brink of Extinction

Bonneville cutthroat trout (BCT) is one of seven recognized subspecies within the Rocky Mountain cutthroat trout interim species classification that historically occurred in the western United States (Markle 2018). BCT occurs in the Bonneville Basin of Wyoming, Idaho, Nevada, and Utah, with over 90% of its range in Utah. Like all cutthroat trout, BCT populations have declined due to competition and hybridization with non-native salmonids and habitat loss. In the 1960s and 1970s, genetically pure BCT were thought to have been extirpated because of more than 100 years of stocking of non-native salmonids, particularly rainbow trout and Yellowstone cutthroat trout, into BCT-occupied streams and lakes (Holden et al. 1974; Sigler and Miller

1963). BCT was petitioned to be listed under the ESA in 1979 and remained as warranted but precluded under the ESA through much of the 1980s.

Although genetically pure populations of BCT were thought to have been lost in the early 1970s, additional populations of BCT that appeared pure continued to be discovered from the late 1970s through the 2000s. As genetic testing techniques emerged and improved, pure BCT populations were confirmed. These pure populations became the source for repatriation efforts that helped increase the number of BCT populations in Utah. BCT was again petitioned for listing under the ESA in the 1990s, which led to the development of the Utah conservation agreement and strategy for BCT (Lentsch et al. 1997) and later a range-wide conservation agreement and strategy (Lentsch et al. 2000). These documents solidified the need and commitment for conservation actions for this species. BCT was identified as an SGCN in the 2005 UWAP. The U.S. Fish and Wildlife Service found BCT not warranted for ESA protections in 2008 after another petition to list the species. Significant conservation actions were undertaken by the mid-2010s, and the Utah S-rank for BCT improved to S4. These conservation efforts included habitat improvements, isolating BCT populations from non-native salmonids, removing non-native salmonid populations, and restocking and restoring BCT to historical habitat. Due to the recent ESA evaluation, BCT was retained as an SGCN in the 2015 UWAP.

The BCT Utah S-rank was re-evaluated in 2024 while DWR compiled an updated SGCN list for the 2025 UWAP; the S-rank remained an S4. With an additional 10 years of conservation actions, Utah BCT partners believed this species to be secure in Utah and removed it from the UWAP SGCN list. The BCT is a true conservation success story that was realized because partners prioritized conservation of the species over decades of conservation. Utah's management strategy for BCT populations has switched to maintenance, allowing more effort to be put into conservation for other SGCN species with more immediate need. BCT populations will be monitored to ensure this species—Utah's state fish—remains common and secure into the future.

The 2025 list of SGCN is presented in Table 3. See the DWR Utah species field guide (DWR 2025a) for more information on their abundance and distribution. The 2025 list of SGINs is presented in Table 4.

Table 3. *2025 Utah Species of Greatest Conservation Need*[1]

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Amphibians				
Arizona toad	*Anaxyrus microscaphus*	S2 (2024)	N3/N4	Petitioned
Columbia spotted frog	*Rana luteiventris*	S2 (2023)	N4	Conservation agreement
Northern leopard frog	*Lithobates pipiens*	S3 (2024)	N5	–
Western toad	*Anaxyrus boreas*	S3 (2024)	N4	Conservation agreement
Birds				
American avocet	*Recurvirostra americana*	S3 (2024)	N5B, N5N	–
American goshawk	*Accipiter atricapillus*	S3 (2024)	NNR	Memorandum of understanding
American white pelican	*Pelecanus erythrorhynchos*	S3 (2024)	N4	–
Bendire's thrasher	*Toxostoma bendirei*	S1	N4B, NNRN	–
Black rosy-finch	*Leucosticte atrata*	S2	N4	–
Burrowing owl	*Athene cunicularia*	S2 (2024)	N4B, N4N	–
California condor	*Gymnogyps californianus*	S1 (2024)	N1	ESA section 10(j)
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	S2 (2024)	N3	–
Ferruginous hawk	*Buteo regalis*	S2 (2024)	N4B, N4N	–
Flammulated owl	*Psiloscops flammeolus*	S2 (2024)	N4B	–

[1] Light brown highlighted rows are species that were added to the SGCN list since the 2015 UWAP.

[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Golden eagle	*Aquila chrysaetos*	S3 (2024)	N5B, N5N	Bald and Golden Eagle Protection Act
Greater sage-grouse	*Centrocercus urophasianus*	S3 (2024)	N3N4	Memorandum of understanding
Gunnison sage-grouse	*Centrocercus minimus*	S1 (2024)	N2N3	Threatened
Lewis's woodpecker	*Melanerpes lewis*	S2	N4B, N4N	–
Long-billed curlew	*Numenius americanus*	S3 (2024)	N4	–
Mexican spotted owl	*Strix occidentalis lucida*	S1 (2024)	N3N4	Threatened
Pinyon jay	*Gymnorhinus cyanocephalus*	S3 (2024)	N3	Petitioned
Sagebrush sparrow	*Artemisiospiza nevadensis*	S3 (2024)	N5	–
Snowy plover	*Anarhynchus nivosus*	S2	N3B, N3N	–
Southwestern willow flycatcher	*Empidonax traillii extimus*	S1 (2024)	N2B	Endangered
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	S1 (2024)	N2N3B	Threatened
White-faced ibis	*Plegadis chihi*	S3 (2024)	N4B, N4N	–
Wilson's phalarope	*Phalaropus tricolor*	S3 (2024)	N5B	Petitioned
Fishes				
Bear Lake sculpin	*Cottus extensus*	S1 (2010)	N3	–
Bear Lake whitefish	*Prosopium abyssicola*	S1 (2010)	N1	–
Bluehead sucker	*Pantosteus discobolus*	S3 (2024)	N4	Conservation agreement
Bonneville cisco	*Prosopium gemmifer*	S1 (2010)	N3	–
Bonneville whitefish	*Prosopium spilonotus*	S1 (2004)	N3	–
Bonytail	*Gila elegans*	S1 (2010)	N1	Endangered

[1] Light brown highlighted rows are species that were added to the SGCN list since the 2015 UWAP.

[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Colorado pikeminnow	*Ptychocheilus lucius*	S3 (2010)	N1	Endangered
Colorado River cutthroat trout	*Oncorhynchus virginalis pleuriticus*	S3 (2010)	N2/N3	Conservation agreement
Desert sucker	*Pantosteus clarkii*	S3 (2024)	N3/N4	–
Flannelmouth sucker	*Catostomus latipinnis*	S3 (2024)	N3/N4	Conservation agreement
Green sucker	*Pantosteus virescens*	S1 (2024)	NNR	Conservation Agreement
Humpback chub	*Gila cypha*	S2 (2010)	N1	Threatened
June sucker	*Chasmistes liorus*	S2 (2024)	N2	Threatened
Least chub	*Iotichthys phlegethontis*	S2 (2024)	N2	Conservation agreement
Northern leatherside	*Lepidomeda copei*	S2 (2022)	N3	Conservation agreement
Razorback sucker	*Xyrauchen texanus*	S2 (2010)	N1	Endangered
Roundtail chub	*Gila robusta*	S1 (2024)	N3	Conservation agreement
Southern leatherside	*Lepidomeda aliciae*	S2 (2024)	N2	Conservation agreement
Virgin River chub	*Gila seminuda*	S2 (2024)	N1	Endangered
Virgin spinedace	*Lepidomeda mollispinis*	S3 (2024)	N2	Conservation agreement
Woundfin	*Plagopterus argentissimus*	S1(2024)	N1	Endangered
Yellowstone cutthroat trout	*Oncorhynchus virginalis bouvieri*	S3 (2010)	N2	Conservation agreement
Insects				
American bumble bee	*Bombus pensylvanicus*	S1 (2023)	NU	Petitioned
Brine fly	*Ephydra gracilis*	S4?	NNR	–

[1] Light brown highlighted rows are species that were added to the SGCN list since the 2015 UWAP.

[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Coral Pink Sand Dunes tiger beetle	*Cicindela albissima*	S1 (2023)	N1	Conservation agreement
Crested sallfly	*Gaufinia cristata*	S1 (2022)	N1/N2	–
Giant salmonfly	*Pteronarcys californica*	S2 (2024)	N5	–
Large marble butterfly	*Euchloe ausonides*	S2 (2023)	N5	Petitioned
Mojave poppy bee	*Perdita meconis*	SX (2022)	N2	Petitioned
Monarch butterfly	*Danaus plexippus*	S2 (2023)	N5B, N2N3N	Threatened (proposed)
Morrison's bumble bee	*Bombus morrisoni*	S3 (2023)	N3	Petitioned
Nokomis/Silverspot butterfly	*Speyeria nokomis nokomis*	S1 (2023)	N3	Threatened
Ruddy copper butterfly	*Tharsalea rubidus*	S2 (2024)	N5	–
Suckley's cuckoo bumble bee	*Bombus suckleyi*	S1 (2024)	NU	Endangered (proposed)
Tanner's black camel cricket/Sand treader	*Utabaenetes tanneri*	S2 (2023)	NNR	–
Utah wood-nymph	*Cercyonis pegala utahensis*	S2 (2024)	N2/N3	–
West Coast lady butterfly	*Vanessa annabella*	S3 (2024)	N5	–
Western bumble bee	*Bombus occidentalis*	S1/S2 (2023)	NNR	Petitioned
Mammals				
Allen's big-eared bat	*Idionycteris phyllotis*	S2 (2024)	N3/N4	–
American pika	*Ochotona princeps*	S3 (2024)	N5	–
Black-footed ferret	*Mustela nigripes*	S1 (2024)	N1	Endangered
Dark kangaroo mouse	*Microdipodops megacephalus*	S2 (2024)	N4	–
Gunnison's prairie dog	*Cynomys gunnisoni*	S2 (2024)	N5	–

[1] Light brown highlighted rows are species that were added to the SGCN list since the 2015 UWAP.

[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Hoary bat	*Lasiurus cinereus*	S3 (2024)	N3	Discretionary status review
Kit fox	*Vulpes macrotis*	S3	N4	–
Little brown bat	*Myotis lucifugus*	S3 (2024)	N3	Discretionary status review
Pygmy rabbit	*Brachylagus idahoensis*	S3 (2024)	N4	Petitioned
Spotted bat	*Euderma maculatum*	S3 (2024)	N3/N4	–
Townsend's big-eared bat	*Corynorhinus townsendii*	S3 (2024)	N3/N4	–
Utah prairie dog	*Cynomys parvidens*	S2 (2024)	N2	Threatened
White-tailed prairie dog	*Cynomys leucurus*	S3 (2024)	N4	
Wolverine	*Gulo gulo*	S1 (2024)	N3/N4	Threatened
Mollusks				
Bear Lake springsnail	*Pyrgulopsis pilsbryana*	S3 (2024)	N2	Conservation agreement
Bifid duct pyrg	*Pyrgulopsis peculiaris*	S1 (2024)	N2	Conservation agreement
Black Canyon pyrg	*Pyrgulopsis plicata*	S1 (2024)	N1	Conservation agreement
Carinate Glenwood pyrg	*Pyrgulopsis inopinata*	S1 (2024)	N1	Conservation agreement
Creeping ancylid	*Ferrissia rivularis*	S2 (2024)	N5	
Desert springsnail	*Pyrgulopsis deserta*	S1 (2024)	N2	Conservation agreement
Desert tryonia	*Tryonia porrecta*	S1 (2024)	N2	–
Fat-whorled pondsnail	*Ladislavella bonnevillensis*	S1 (2024)	N3	–
Green River pebblesnail	*Fluminicola coloradoensis*	S3 (2024)	N2/N3	–

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[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Hamlin Valley pyrg	*Pyrgulopsis hamlinensis*	S1 (2010)	N1/N2	Conservation agreement
Lindahl's pyrg	*Pyrgulopsis lindahlae*	S1 (2024)	NRR	Conservation agreement
Longitudinal gland pyrg	*Pyrgulopsis anguina*	S1 (2010)	N1/N2	Conservation agreement
Mountain marshsnail	*Walterigalba montanensis*	SH (2004)	N3	–
Northwest Bonneville Pyrg	*Pyrgulopsis variegata*	S1 (2025)	N2	Conservation agreement
Nuwuvi pyrg	*Pyrgulopsis nuwuvi*	S1 (2024)	NRR	Conservation agreement
Otter Creek pyrg	*Pyrgulopsis fusca*	S1 (2010)	N1	Conservation agreement
Pine Grove pyrg	*Pyrgulopsis pinetorum*	S1 (2024)	NRR	Conservation agreement
Prairie fossaria	*Galba bulimoides*	S1 (2024)	N5	–
Rocky Mountain duskysnail	*Colligyrus greggi*	S1 (2024)	N4	–
Santa Clara pyrg	*Pyrgulopsis santaclarensis*	S1 (2024)	NNR	Conservation agreement
Smooth Glenwood pyrg	*Pyrgulopsis chamberlini*	S1 (2024)	N1	Conservation agreement
Sub-globose snake pyrg	*Pyrgulopsis saxatilis*	S1 (2024)	N1	Conservation agreement
Western pearlshell	*Margaritifera falcata*	S1 (2024)	N3/N4	–
Wet-rock physa	*Physella zionis*	S1 (2024)	N1	–
Winged floater	*Anodonta nuttalliana*	S2 (2024)	N3/N4	–
Wrinkled marshsnail	*Hinkleyia caperata*	S2 (2024)	N4/N5	–
(No common name)	*Galba techella*	S1 (2024)	N3/N4	–

[1] Light brown highlighted rows are species that were added to the SGCN list since the 2015 UWAP.

[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Plants				
APIACEAE				
Canyonlands lomatium	*Lomatium latilobum*	S2 (2024)	N2	–
Mt. Naomi musineon	*Musineon naomiensis*	S2 (2024)	N2	–
Rydberg's musineon	*Musineon lineare*	S2 (2024)	N2	–
Wheeler's angelica	*Angelica wheeleri*	S2 (2024)	N2	–
APOCYNACEAE				
Jones cycladenia	*Cycladenia humilis* var. *jonesii*	S3 (2024)	N3	Threatened
Welsh's milkweed	*Asclepias welshii*	S1 (2024)	N1N2	Threatened
ASTERACEAE				
Alcove rock-daisy	*Laphamia specicola*	S2 (2024)	N2	–
Barneby's rockaster	*Herrickia kingii* var. *barnebyana*	S2 (2024)	N2	–
Beaver Mountain groundsel	*Packera castoreus*	S1 (2024)	N1	–
Cronquist daisy	*Erigeron cronquistii*	S2 (2024)	N2	–
Entrada skeletonplant	*Lygodesmia grandiflora* var. *entrada*	S2 (2024)	N2	–
Garrett's fleabane	*Erigeron garrettii*	S2 (2024)	N2	–
Joanna's thistle	*Cirsium joannae*	S1 (2024)	N1	–
Jones' false goldenaster	*Heterotheca jonesii*	S2 (2024)	N2	–
La Sal daisy	*Erigeron mancus*	S1 (2024)	N1	–
La Sal Mountains' groundsel	*Senecio inexpectatus*	S1 (2024)	N1	–
Last Chance townsendia	*Townsendia aprica*	S2 (2024)	N2	Threatened

[1] Light brown highlighted rows are species that were added to the SGCN list since the 2015 UWAP.

[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Musinea groundsel	*Packera musiniensis*	S1 (2024)	N1	–
Sigurd Easter daisy	*Townsendia jonesii* var. *lutea*	S2 (2024)	N2	–
Stone rubberweed	*Hymenoxys lapidicola*	S2 (2024)	N2	–
Untermann's daisy	*Erigeron untermannii*	S2 (2024)	N2	–
Western Townsend-daisy	*Townsendia mensana*	S2? (2024)	N2	–
BORAGINACEAE				
Argyle Canyon phacelia	*Phacelia argylensis*	S1(2024)	N1	–
Atwood's pretty	*Phacelia pulchella* var. *atwoodii*	S2 (2024)	N2	–
Clay phacelia	*Phacelia argillacea*	S1 (2024)	N1	Endangered
Cronquist's phacelia	*Phacelia cronquistiana*	S1 (2024)	N1/N2	–
Deep Creek stickseed	*Hackelia ibapensis*	S2 (2024)	N1/N2	–
Drab phacelia	*Phacelia indecora*	S1 (2024)	N1	–
Hughes' phacelia	*Phacelia hughesii*	S1 (2024)	N2	–
Johnston catseye	*Oreocarya johnstonii*	S2 (2024)	N2	–
Pavement phacelia	*Phacelia sabulonum*	S2 (2024)	N2	–
Utah phacelia	*Phacelia utahensis*	S2 (2024)	N2	–
BRASSICACEAE				
Barneby ridgecress	*Lepidium barnebyanum*	S1(2024)	N1	Endangered
Barneby's reed-mustard	*Hesperidanthus barnebyi*	S2(2024)	N2	Endangered
Burke's whitlow-grass	*Draba burkei*	S2 (2024)	N2	–
Clay reed-mustard	*Hesperidanthus argillaceus*	S1 (2024)	N1	Threatened
Creeping draba	*Draba sobolifera*	S1 (2024)	N1	–

[1] Light brown highlighted rows are species that were added to the SGCN list since the 2015 UWAP.

[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Frisco Mountains mustard	*Terraria haydenii*	S1 (2024)	N1	–
Garrett bladderpod	*Physaria garrettii*	S2 (2024)	N2	–
Grouse Creek rockcress	*Boechera falcatoria*	S2 (2024)	N2	–
Huber's pepperplant	*Lepidium huberi*	S1/S2 (2024)	N2	–
Kodachrome bladderpod	*Physaria tumulosa*	S3 (2024)	N3	Endangered
Maguire's whitlow-grass	*Draba maguirei* var. *maguirei*	S2 (2024)	N2	–
Mount Belknap draba	*Draba ramulosa*	S1 (2024)	N1	–
Ostler peppergrass	*Lepidium ostleri*	S1 (2024)	N1	–
Pennell's draba	*Draba pennellii*	S1 (2024)	N2	–
Shrubby reed-mustard	*Hesperidanthus suffrutescens*	S1 (2024)	N1	Endangered
Snowbasin rockcress	*Boechera glareosa*	S1 (2024)	N1	–
Uinta Mountains draba	*Draba inexpectata*	S1 (2024)	N1N2	–
CACTACEAE				
Despain pincushion cactus	*Pediocactus despainii*	S2 (2024)	N2	Endangered
Pariette cactus	*Sclerocactus brevispinus*	S1 (2024)	N1	Threatened
Purple-spined hedgehog cactus	*Echinocereus relictus*	S1 (2024)	N1?	–
Siler pincushion cactus	*Pediocactus sileri*	S2 (2024)	N2N3	Threatened
Uinta Basin hookless cactus	*Sclerocactus wetlandicus*	S2 (2024)	N2?	Threatened
Winkler's pincushion cactus	*Pediocactus winkleri*	S2 (2024)	N2	Threatened
Wright fishhook cactus	*Sclerocactus wrightiae*	S2 (2024)	N2	Endangered

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COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
CAPPARACEAE				
Goodrich's cleomella	*Cleomella hillmanii* var. *goodrichii*	S1 (2024)	N1	–
CHENOPODIACEAE				
Giant four-wing saltbush	*Atriplex canescens* var. *gigantea*	S2 (2024)	N2	–
CYPERACEAE				
Navajo sedge	*Carex specuicola*	S1 (2024)	N2/N3	Threatened
FABACEAE				
Ann Kelsey's milkvetch	*Astragalus kelseyae*	S1 (2024)	N1	–
Avon milkvetch	*Astragalus praelongus* var. *avonensis*	S2(2024)	N2	–
Barneby's aromatic scurf-pea	*Pediomelum aromaticum* var. *barnebyi*	S1(2024)	N3	–
Cisco milkvetch	*Astragalus sabulosus*	S1 (2024)	N1	Conservation agreement
Cronquist milkvetch	*Astragalus cronquistii*	S2 (2024)	N2	–
Deseret milkvetch	*Astragalus desereticus*	S2 (2024)	N1	–
Glenwood milkvetch	*Astragalus loanus*	S1 (2024)	N1	–
Goose Creek milkvetch	*Astragalus anserinus*	S2 (2024)	N2?	Conservation agreement
Guard milkvetch	*Astragalus zionis* var. *vigulus*	S1 (2024)	N1	–
Gumbo milkvetch	*Astragalus ampullarius*	S2 (2024)	N2	–
Hamilton's milkvetch	*Astragalus hamiltonii*	S2 (2024)	N2	–
Heliotrope milkvetch	*Astragalus montii*	S3 (2024)	N3	Endangered
Horseshoe milkvetch	*Astragalus equisolensis*	S2 (2024)	N2?	–

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COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Isely's milkvetch	*Astragalus iselyi*	S1 (2024)	N1	Conservation agreement
Kane breadroot	*Pediomelum megalanthum* var. *epipsilum*	S2 (2024)	N2	–
Mesic milkvetch	*Astragalus diversifolius*	S1 (2024)	N2	–
Navajo Lake milkvetch	*Astragalus limnocharis* var. *limnocharis*	S2 (2024)	N1	–
Paradox milkvetch	*Astragalus holmgreniorum*	S1 (2024)	N1	Endangered
Pohl's milkvetch	*Astragalus lentiginosus* var. *pohlii*	S1/S2 (2024)	N1	–
Rollin's sweetvetch	*Hedysarum boreale* var. *gremiale*	S1 (2024)	N1	–
Shivwits milkvetch	*Astragalus ampullarioides*	S1 (2024)	N1	Endangered
Stage Station milkvetch	*Astragalus vehiculus*	S1 (2024)	N1	Conservation agreement
Table Cliff milkvetch	*Astragalus limnocharis* var. *tabulaeus*	S2 (2024)	N1	–
Tuhyi aromatic scurf-pea	*Pediomelum aromaticum* var. *tuhyi*	S1/S2 (2024)	N1N2	–
GENTIANACEAE				
Ackerman green gentian	*Frasera ackermaniae*	S1 (2024)	N1	–
Sunnyside green-gentian	*Frasera gypsicola*	S2 (2024)	N2	–
LILIACEAE				
Chatterley's onion	*Allium geyeri* var. *chatterleyi*	S2 (2024)	N2	–
Passey's onion	*Allium passeyi*	S1 (2024)	N1	–
LOASACEAE				
Arapien stickleaf	*Mentzelia argillosa*	S1/S2 (2024)	N1/N2	–

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COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Goodrich's blazingstar	*Mentzelia goodrichii*	S2 (2024)	N2	–
Horse Canyon stickleaf	*Mentzelia librina*	S1 (2024)	N1	–
September 11 stickleaf	*Mentzelia memorabilis*	S1 (2024)	N1	–
Shultz stickleaf	*Mentzelia shultziorum*	S1 (2024)	N1	–
MALVACEAE				
Gierisch's globemallow	*Sphaeralcea gierischii*	S1 (2024)	N1	Endangered
Jones' globemallow	*Sphaeralcea caespitosa* var. *caespitosa*	S2 (2024)	N2	–
Smoky Mountain globemallow	*Sphaeralcea fumariensis*	S2 (2024)	N2	–
ONAGRACEAE				
Atwood's camissonia	*Chylismia atwoodii*	S2? (2024)	N2	–
Diamond Valley suncup	*Eremothera gouldii*	S1 (2024)	N2	–
Meager camissonia	*Chylismia exilis*	S2 (2024)	N2	–
Murdock's evening primrose	*Oenothera murdockii*	S2 (2024)	N2	–
Narrow-leaf evening primrose	*Oenothera acutissima*	S2 (2024)	N2	–
ORCHIDACEAE				
Ute ladies'-tresses	*Spiranthes diluvialis*	S2 (2024)	N1	Endangered
OROBANCHACEAE				
Aquarius Indian paintbrush	*Castilleja aquariensis*	S2 (2025)	N2	–
Tushar paintbrush	*Castilleja parvula*	S2 (2024)	N2	–
PAPAVERACEAE				
Dwarf bear-poppy	*Arctomecon humilis*	S1 (2024)	N1	Endangered

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COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Wasatch fitweed	*Corydalis caseana* ssp. *brachycarpa*	S2 (2024)	N2	–
POLYGONACEAE				
Comb Wash wild buckwheat	*Eriogonum clavellatum*	S1/S2 (2024)	N2	–
Frisco buckwheat	*Eriogonum soredium*	S1 (2024)	N1	–
Gate Canyon buckwheat	*Eriogonum hylophilum*	S1 (2024)	N1	–
Ibex buckwheat	*Eriogonum ammophilum*	S2 (2024)	N1/N2	–
Kaye's wild buckwheat	*Eriogonum artificis*	S1 (2024)	N1	–
Lost Creek buckwheat	*Eriogonum mitophyllum*	S1/S2 (2024)	N1/N2	–
Scarlet buckwheat	*Eriogonum microtheca* var. *phoeniceum*	S1 (2024)	N1	–
Smith's buckwheat	*Eriogonum smithii*	S2 (2024)	N2	–
Zion buckwheat	*Eriogonum zionis* var. *zionis*	S2 (2024)	N3	–
PORTULACACEAE				
Maguire's bitterroot	*Lewisia maguirei*	S1 (2024)	N2	–
Thompson's flameflower	*Phemeranthus thompsonii*	S2 (2024)	N2	–
PRIMULACEAE				
House range primrose	*Primula domensis*	S2 (2024)	N2	–
Maguire's primrose	*Primula maguirei*	S1 (2024)	N1	Threatened
Utah shootingstar	*Primula utahensis*	S2 (2024)	N1	–
RANUNCULACEAE				
Autumn buttercup	*Ranunculus aestivalis*	S1(2024)	N1	Endangered

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COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Desolation Canyon columbine	*Aquilegia desolaticola*	S2 (2024)	N2	–
Goodrich's columbine	*Aquilegia scopulorum* var. *goodrichii*	S1/S2 (2024)	N1/N2	–
Graham's columbine	*Aquilegia grahamii*	S2 (2024)	N2	–
Link Trail columbine	*Aquilegia rubicunda*	S2 (2024)	N2	–
Lori's columbine	*Aquilegia loriae*	S2 (2024)	N2	–
Noel's columbine	*Aquilegia holmgrenii*	S1 (2024)	N1	–
RHAMNACEAE				
Franklin's ceanothus	*Ceanothus franklinii*	S2 (2024)	N1/N2	–
ROSACEAE				
Angell cinquefoil	*Potentilla angelliae*	S2 (2024)	N2	–
Cottam's cinquefoil	*Potentilla cottamii*	S2 (2024)	N2	–
Holmgren cinquefoil	*Potentilla holmgrenii*	S1 (2024)	N2	–
Ostler's ivesia	*Ivesia shockleyi* var. *ostleri*	S1 (2024)	N1	–
Utah ivesia	*Ivesia utahensis*	S2 (2024)	N2	–
SCROPHULARIACEAE				
Bear River Range beardtongue	*Penstemon compactus*	S2 (2024)	N2	–
Ben's beardtongue	*Penstemon franklinii*	S1/S2 (2024)	N1	–
Canaan Mountain beardtongue	*Penstemon ammophilus*	S2 (2024)	N2	–
Firleaf beardtongue	*Penstemon abietinus*	S2 (2024)	N2	–
Gibben's beardtongue	*Penstemon gibbensii*	S1 (2024)	N1/N2	–
Goodrich's penstemon	*Penstemon goodrichii*	S2 (2024)	N2	–

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[2] All N-ranks were updated in 2024 using NatureServe (2024b).

COMMON NAME	SCIENTIFIC NAME	S-RANK (YEAR LAST UPDATED)	N-RANK[2]	STATUS
Graham's beardtongue	*Penstemon grahamii*	S2/S3 (2024)	N2/N3	Conservation agreement
Idaho penstemon	*Penstemon idahoensis*	S2 (2024)	N2	–
Marcus Jones' penstemon	*Penstemon marcusii*	S2 (2024)	N2	–
Pinyon penstemon	*Penstemon pinorum*	S1/S2 (2024)	N1N2	–
Stemless beardtongue	*Penstemon acaulis*	S2 (2024)	N2	–
Sweet penstemon	*Penstemon angustifolius* var. *dulcis*	S2 (2024)	N2	–
White River beardtongue	*Penstemon scariosus* var. *albifluvis*	S2 (2024)	Not applicable	Conservation agreement
VIOLACEAE				
Frank Smith's violet	*Viola frank-smithii*	S1 (2024)	N1	–
Reptiles				
Arizona mountain kingsnake (formerly pyro mountain kingsnake)	*Lampropeltis pyromelana*	S2 (2023)	N4	–
Gila monster	*Heloderma suspectum*	S2 (2024)	N4	–
Midget faded rattlesnake	*Crotalus oreganus concolor*	S3? (2024)	N4	–
Mojave desert tortoise	*Gopherus agassizii*	S2 (2023)	N3	Threatened

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Table 4. *2025 Utah Species of Greatest Information Need*

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Amphibians		
Relict leopard frog	*Lithobates onca*	DU
Birds		
American bittern	*Botaurus lentiginosus*	DU, EU
Band-tailed pigeon	*Patagioenas fasciata*	DU, EU
Bank swallow	*Riparia riparia*	DU, EU
Black-necked stilt	*Himantopus mexicanus*	EU
Black swift	*Cypseloides niger*	EU
Black tern	*Chlidonias niger*	DU
Black-throated gray warbler	*Setophaga nigrescens*	DU, EU
Boreal owl	*Aegolius funereus*	DU, EU
California gull	*Larus californicus*	EU
Calliope hummingbird	*Selasphorus calliope*	DU
Caspian tern	*Hydroprogne caspia*	EU
Clark's grebe	*Aechmophorus clarkii*	EU
Common nighthawk	*Chordeiles minor*	EU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Amphibians		
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Birds		
Eared grebe	*Podiceps nigricollis*	EU
Evening grosbeak	*Coccothraustes vespertinus*	DU
Gray vireo	*Vireo vicinior*	EU
Greater yellowlegs	*Tringa melanoleuca*	EU
Long-billed dowitcher	*Limnodromus scolopaceus*	EU
Marbled godwit	*Limosa fedoa*	EU
Olive-sided flycatcher	*Contopus cooperi*	EU
Pine grosbeak	*Pinicola enucleator*	EU
Red crossbill	*Loxia curvirostra*	EU
Red-necked phalarope	*Phalaropus lobatus*	DU, EU
Short-eared owl	*Asio flammeus*	DU, EU
Western sandpiper	*Calidris mauri*	EU
Willet	*Tringa semipalmata*	EU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Costa's hummingbird	*Calypte costae*	DU
Crustaceans		
Pilose crayfish	*Pacifastacus gambelii*	DU, EU
Insects		
ANTS	**HYMENOPTERA**	
Pyramid ants	*Dorymyrmex*	DU
BEES	**HYMENOPTERA**	
Cockerell's bumble bee	*Bombus cockerelli*	EU
Cuckoo bees	Nomadinae	DU
Cuckoo bumble bees	Subgenus *Psythirus*	EU
Common loosestrife oil bee	*Macropis nuda*	DU
Digger bees	*Anthophora*	DU
Fairy bees	*Perdita*	DU
Goblin bees	*Macrotera*	DU
Golden-belted bumble bee	*Bombus kirbiellis (balteatus)*	DU
Inept miner bee	*Panurginus ineptus*	DU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Williamson's sapsucker	*Sphyrapicus thyroideus*	EU
Crustaceans		
Utah amphipod	*Stygobromus utahensis*	DU, EU, TU
Insects		
ANTS	**HYMENOPTERA**	
This row intentionally left blank.		
BEES	**HYMENOPTERA**	
Leafcutting bees	*Ashmeadiella*	EU
Mason bees	*Osmia*	EU
Miner bees	*Calliopsis*	DU
Mountain digger bees	*Habropoda*	DU
Nevada nomia	*Dieunomia nevadensis*	EU
Nimble squash bee	*Xenoglossa strenua*	DU
Sunflower sweat bee	*Dieunomia heteropoda*	EU
A sweat bee	*Dieunomia triangulifera*	EU
A sweat bee	*Nomia howardi*	DU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Leafcutter bees	*Megachile*	EU
BEETLES	**COLEOPTERA**	
A checkered beetle	*Trichodes simulator*	DU
Dune scarab beetles	*Polyphylla*	EU
Fireflies	Lampyridae	DU
Spangler's hydroporus diving beetle	*Hydroporus spangleri*	EU
BUTTERFLIES	**LEPIDOPTERA**	
Bauer's blue	*Euphilotes baueri*	DU
California marble	*Euchloe hyantis*	DU
Checkered-skippers	*Pyrgus*	DU
Dainty sulphur	*Nathalis iole*	DU
Desert orange-tip	*Anthocharis cethura*	EU
Ellis' dotted-blue	*Euphilotes ellisii* complex	DU
Fritillaries, crescents, checkerspots	Tribe Melitaeini	DU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Wool-carder and resin bees	Anthidiini	DU
BEETLES	**COLEOPTERA**	
Tiger beetles	Cicindelidae	DU
Utah chaetarthrian water scavenger beetle	*Chaetarthria utahensis*	EU
Utah hydroporus diving beetle	*Hydroporus longiusculus*	EU
Utah limnebius minute moss beetle	*Limnebius utahensis*	EU
BUTTERFLIES	**LEPIDOPTERA**	
Mojave sootywing	*Hesperopsis libya*	DU
Nevada cloudywing	*Thorybes nevada*	DU
Pallid blue	*Euphilotes pallescens* complex	EU
Relict fritillary	*Boloria kriemhild*	DU
Rita blue Sara orange-tip	*Euphilotes rita* complex	DU
Sa'ra orange-tip	*Anthocharis sara*	EU
Sheridan's green hairstreak	*Callophrys sheridanii* complex	DU

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COMMON NAME	SCIENTIFIC NAME	REASON[1]
Giant skippers	*Megathymus*	DU
Grass skippers	Hesperiinae	EU
MacNeill's saltbush sootywing	*Hesperopsis gracielae*	DU
Melissa arctic	*Oeneis melissa*	DU
Mojave blue	*Euphilotes mojave* complex	DU
CADDISFLIES	**TRICHOPTERA**	
Bizarre caddisflies	Lepidostomatidae	DU
Bush-tailed caddisflies	Sericostomatidae	DU
Finger-net caddisflies	Philopotamidae	DU
DAMSELFLIES	**ODONATA**	
Desert forktail	*Ishnura barberi*	DU
DRAGONFLIES	**ODONATA**	
Apache spiketail	*Cordulegaster diadema*	DU
Bleached skimmer	*Libellula composita*	EU
Brimstone clubtail	*Stylurus intricatus*	DU
Silver-bordered fritillary	*Boloria myrina (selene) tollandensis*	DU
Silver-spotted skipper	*Epargyreus clarus*	EU
Small blue	*Philotiella speciosa*	DU
Viceroy	*Limenitis archippus* complex	EU
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CADDISFLIES	**TRICHOPTERA**	
Micro caddisflies	Hydroptilidae	DU
Northern casemaker caddisflies	Limnephilidae	DU
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DAMSELFLIES	**ODONATA**	
Lavender dancer	*Argia hinei*	DU
DRAGONFLIES	**ODONATA**	
Olive clubtail	*Stylurus olivaceus*	DU
Persephone's darner	*Aeshna persephone*	EU
Riffle darner	*Oplonaeschna armata*	DU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Great Basin snaketail	*Ophiogomphus morrisoni*	DU
FLIES	**DIPTERA**	
Alkali fly	*Ephydra hians*	EU
GRASSHOPPERS, CRICKETS, AND KATYDIDS	**ORTHOPTERA**	
Jerusalem crickets	Stenopelmatidae	DU
Katydids	Tettigoniidae	DU
MAYFLIES	**EPHEMEROPTERA**	
Ametropodid mayflies	Ametropodidae	EU
Brushleg mayflies	Oligoneuriidae	DU
Combmouthed minnow mayflies	Ameletidae	EU
Flat-headed mayflies	Heptageniidae	DU
MOTHS	**LEPIDOPTERA**	
Bowman's tiger moth	*Grammia bowmani*	DU
Drooping star-of-Bethlehem	*Pygarctia neomexicana*	DU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
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FLIES	**DIPTERA**	
Hover flies	Syrphidae	DU
GRASSHOPPERS, CRICKETS, AND KATYDIDS	**ORTHOPTERA**	
Sand treader camel crickets	Rhaphidophoridae	DU
Spur-throated grasshoppers	Acrididae	DU
MAYFLIES	**EPHEMEROPTERA**	
Primitive minnow mayflies	Siphlonuridae	DU
Small minnow mayflies	Baetidae	EU
Speed minnow mayflies	Acanthametropodidae	DU
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MOTHS	**LEPIDOPTERA**	
Lichen moth	*Lycomorpha regulus*	DU
Noctuid moths	Noctuidae	DU

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COMMON NAME	SCIENTIFIC NAME	REASON[1]
A geometrid moth	*Sicya crocearia*	DU
Griffin's sheepmoth	*Hemileuca griffini*	EU
STONEFLIES	**PLECOPTERA**	
Needleflies	Leuctridae	DU
Snowflies	Capniidae	EU
TRUE BUGS	**HEMIPTERA**	
Leafhoppers	Cicadellidae	EU
Marsh-treader bugs	*Hydrometra*	DU
Toad bugs	*Gelastocoris*	DU
Treehoppers and thorn bugs	Membracidae	DU
WASPS	**HYMENOPTERA**	
Cuckoo wasps	Chrysididae	EU
Flat wasps	Bethylidae	DU
Redheaded sphecid wasps	*Eucerceris*	DU
Scullen's potter wasp	*Eumenes sculleni*	DU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Notodontid moths	Notodontidae	DU
Wiest's sphinx moth	*Euproserpinus wiesti*	DU
STONEFLIES	**PLECOPTERA**	
Spring stoneflies	Nemouridae	DU
Stripetails	Perlodidae	DU
TRUE BUGS	**HEMIPTERA**	
Water boatmen	*Callicorixa*	EU
Water bugs	*Ambrysus*	EU
Water strider	*Aquarius remigis*	DU
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WASPS	**HYMENOPTERA**	
Shield-handed wasps	*Crabro*	DU
Thread-waisted wasps	Sphecidae	EU
Velvet ants	Mutilidae	EU
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COMMON NAME	SCIENTIFIC NAME	REASON[1]
Mammals		
A subspecies of the American deer mouse	*Peromyscus maniculatus inclarus*	TU
A subspecies of Botta's pocket gopher	*Thomomys bottae minimus*	DU, EU, TU
A subspecies of Botta's pocket gopher	*Thomomys bottae nesophilus*	TU
A subspecies of the chisel-toothed kangaroo rat	*Dipodomys microps alfredi*	TU
A subspecies of the chisel-toothed kangaroo rat	*Dipodomys microps russeolus*	EU, TU
A subspecies of the chisel-toothed kangaroo rat	*Dipodomys microps subtenuis*	DU, TU
A subspecies of the desert woodrat	*Neotoma lepida marshalli*	TU
A subspecies of Ord's kangaroo rat	*Dipodomys ordii cineraceus*	EU, TU
A subspecies of the western harvest mouse	*Reithrodontomys megalotis ravus*	DU, TU
Banner-tailed kangaroo rat	*Dipodomys spectabilis*	DU, EU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Mammals		
Long-eared bat	*Myotis evotis*	EU
Long-legged bat	*Myotis volans*	EU
Long-tailed pocket mouse	*Chaetodipus formosus*	EU
Merriam's shrew	*Sorex merriami*	DU, EU
North American water vole	*Microtus richardsoni*	DU, EU
Oregon jumping mouse	*Zapus oregonus*	DU
Preble's shrew	*Sorex preblei*	DU, EU
Southwestern jumping mouse	*Zapus princeps*	DU
Stephens' woodrat	*Neotoma stephensi*	DU
Western red bat	*Lasiurus blossevillii*	DU, TU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Crawford's gray shrew	*Notiosorex crawfordi*	DU, EU
Dwarf shrew	*Sorex nanus*	DU, EU
Fringed bat	*Myotis thysanodes*	EU
Inyo shrew	*Sorex tenellus*	DU, EU, TU
Mollusks		
Springsnails	*Pyrgulopsis* spp.	DU, EU, TU
(No common name)	Agriolimacidae	DU, EU, TU
(No common name)	Amnicolidae	DU, EU, TU
(No common name)	Cochliopidae	DU, EU, TU
(No common name)	Discidae	DU, EU, TU
(No common name)	Helicodiscidae	DU, EU, TU
(No common name)	Oxychilidae	DU, EU, TU
(No common name)	Physidae	DU, EU, TU
(No common name)	Planoribidae	DU, EU, TU
PLANTS		
	APIACEAE	
Cedar Breaks biscuitroot	*Cymopterus minimus*	DU, EU, TU
Western water shrew	*Sorex navigator*	DU, EU
White-tailed jackrabbit	*Lepus townsendii*	EU
Yuma bat	*Myotis yumanensis*	EU
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Mollusks		
(No common name)	Pristilomatidae	DU, EU, TU
(No common name)	Punctidae	DU, EU, TU
(No common name)	Pupilidae	DU, EU, TU
(No common name)	Sphaerridae	DU, EU, TU
(No common name)	Succineidae	DU, EU, TU
(No common name)	Thysanophoridae	DU, EU, TU
(No common name)	Valloniidae	DU, EU, TU
(No common name)	Vertiginidae	DU, EU, TU
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PLANTS		
	APIACEAE	
Intermountain wavewing	*Cymopterus basalticus*	DU, EU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Clark's lomatium	*Lomatium graveolens* var. *clarkii*	DU, EU, TU
Higgins biscuitroot	*Cymopterus glomeratus* var. *higginsii*	DU, EU, TU
	ASPARAGACEAE	
Out-of-the-way yucca	*Yucca angustissima* var. *avia*	DU, EU, TU
	ASTERACEAE	
Abajo daisy	*Erigeron abajoensis*	DU, EU
Alcove daisy	*Erigeron zothecinus*	DU, EU, TU
Cronquist woodyaster	*Xylorhiza cronquistii*	DU, EU, TU
Different groundsel	*Packera dimorphophylla* var. *intermedia*	DU, EU, TU
Grand Canyon evening daisy	*Haplopappus scopulorum* var. *hirtellus*	DU, EU, TU
Harrison's thistle	*Cirsium harrisonii*	DU, EU, TU
Hidden wirelettuce	*Stephanomeria occultata*	DU, EU
Higgin's fleabane	*Erigeron higginsii*	DU, EU
Huber's daisy	*Erigeron radicatus*	DU, EU, TU
Trotter oreoxis	*Oreoxis trotteri*	DU, EU
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	ASPARAGACEAE	
Spanish bayonet	*Yucca sterilis*	DU, EU
	ASTERACEAE	
Paria sunflower	*Heliomeris soliceps*	DU, EU
Pine Valley goldenbush	*Ericameria crispa*	DU, EU
Podunk groundsel	*Packera malmstenii*	DU, EU
Pritchett Canyon goldenaster	*Heterotheca postpetrinis*	DU, EU
Rabbit Valley greenthread	*Thelesperma subnudum* var. *alpinum*	DU, EU, TU
Ruin Park winterfat	*Krascheninnikovia lanata* var. *ruinina*	DU, EU, TU
Sanderson's bursage	*Hymenoclea sandersonii*	DU, EU, TU
Shiny rabbitbrush	*Chrysothamnus nauseosus* ssp. *nitidus*	DU, EU, TU
Silver-leaf sunray	*Enceliopsis argophylla*	DU, EU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Katie's daisy	*Erigeron katiae*	DU, EU
Mystery wormwood	*Artemisia biennis* var. *diffusa*	DU, EU, TU
Narrow-leaved skeletonplant	*Stephanomeria tenuifolia* var. *uintaensis*	DU, EU, TU
	BORAGINAEAE	
Creutzfeldt-flower	*Cryptantha creutzfeldtii*	DU, EU
Graham cryptanth	*Oreocarya grahamii*	DU, EU
Henry Mountain phacelia	*Phacelia crenulata* var. *orbicularis*	DU, EU
	BRASSICACEAE	
Alpine peppergrass	*Lepidium montanum* var. *alpinum*	DU, EU, TU
Brown's tansy-mustard	*Descurainia browniae*	DU, EU, TU
Claron pepperplant	*Lepidium montanum* var. *claronense*	DU, EU, TU
Claron twinpod	*Physaria chambersii* var. *sobolifera*	DU, EU, TU
Duchesne River twinpod	*Physaria stylosa*	DU, EU, TU
Virgin thistle	*Cirsium virginense*	DU, EU, TU
Zion tansy	*Sphaeromeria ruthiae*	DU, EU
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	BORAGINAEAE	
Yellow-white catseye	*Oreocarya ochroleuca*	DU, EU
(No common name)	*Phacelia demissa* var. *heterotricha*	DU, EU
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	BRASSICACEAE	
Kass rockcress	*Draba kassii*	DU, EU
Mt. Carmel twinpod	*Physaria lepidota* var. *lepidota*	DU, EU, TU
Neese's pepperplant	*Lepidium montanum* var. *neeseae*	DU, EU, TU
Range Creek bladderpod	*Physaria hemiphysaria* ssp. *lucens*	DU, EU
Red Canyon twinpod	*Physaria lepidota* ssp. *membranacea*	DU, EU, TU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Duchesne rockcress	*Boechera duchesnensis*	DU, EU
Goodrich eared rockcress	*Boechera goodrichii*	DU, EU
Graham's twinpod	*Physaria grahamii*	DU, EU, TU
Harrison's rockcress	*Boechera harrisonii*	DU, EU
	CACTACEAE	
Blaine's pincushion	*Sclerocactus blainei*	DU, EU, TU
	CARYOPHYLLACEAE	
Cedar Breaks sandwort	*Arenaria kingii* ssp. *plateauensis*	DU, EU, TU
	EUPHORBIACEAE	
Paria spurge	*Euphorbia nephradenia*	DU, EU
	FABACEAE	
Alpine locoweed	*Oxytropis deflexa* var. *pulcherrima*	DU, EU
Aromatic scurf-pea	*Pediomelum aromaticum* var. *aromaticum*	DU, EU, TU
Basalt milkvetch	*Astragalus subcinereus* var. *basalticus*	DU, EU, TU
Santaquin draba	*Draba santaquinensis*	DU, EU
Slender thelypody	*Thelypodium sagittatum* ssp. *ovalifolium*	DU, EU
Varied peppergrass	*Lepidium integrifolium* var. *heterophyllum*	DU, EU, TU
Wasatch draba	*Draba brachystylis*	DU, EU, TU
	CACTACEAE	
Desert Valley fishhook-cactus	*Sclerocactus spinosior*	DU, EU, TU
	CARYOPHYLLACEAE	
Nachlinger catchfly	*Silene nachlingerae*	DU, EU
	EUPHORBIACEAE	
This row intentionally left blank.		
	FABACEAE	
Jones indigobush	*Psorothamnus polydenius* var. *jonesii*	DU, EU
Maybell loco	*Oxytropis besseyi* var. *obnapiformis*	DU, EU
Modest milkvetch	*Astragalus amphioxys* var. *modestus*	DU, EU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Canyon sweetvetch	*Hedysarum occidentale* var. *canone*	DU, EU
Copper Canyon milkvetch	*Astragalus cutleri*	DU, EU
Currant milkvetch	*Astragalus uncialis*	DU, EU
Cutler's spurred lupine	*Lupinus caudatus* var. *cutleri*	DU, EU, TU
Goodhope oak	*Quercus gambelii* var. *bonina*	DU, EU, TU
House Rock Valley indigobush	*Psorothamnus arborescens* var. *pubescens*	DU, EU
Intrusive milkvetch	*Astragalus laccoliticus*	DU, EU
	HYDRANGEACEAE	
Basin jamesia	*Jamesia tetrapetala*	DU, EU
	IRIDACEAE	
Utah blue-eyed grass	*Sisyrinchium radicatum*	DU, EU, TU
	LILIACEAE	
Sheathed deathcamus	*Anticlea vaginatus*	DU, EU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Peabody's milkvetch	*Astragalus pubentissimus* var. *peabodianus*	DU, EU, TU
Silver milkvetch	*Astragalus subcinereus* var. *subcinereus*	DU, EU, TU
Trelease's alkali milkvetch	*Astragalus racemosus* var. *treleasei*	DU, EU
White flowered lupine	*Lupinus latifolius* ssp. *leucanthus*	DU, EU
Whiting indigobush	*Psorothamnus thompsoniae* var. *whitingii*	DU, EU
Wooly clover	*Trifolium eriocephalum* ssp. *villiferum*	DU, EU
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	HYDRANGEACEAE	
Zion jamesia	*Jamesia americana* var. *zionis*	DU, EU, TU
	IRIDACEAE	
This row intentionally left blank.		
	LILIACEAE	
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[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
	LOASACEAE	
Sevier Canyon stickleaf	*Mentzelia flumensevera*	DU, EU
	ONAGRACEAE	
Eastwood evening-primrose	*Chylismia eastwoodiae*	DU, EU
	OROBANCHACEAE	
Reveal Indian paintbrush	*Castilleja revealii*	DU, EU
	PAPAVERACEAE	
Uinta poppy	*Papaver uintaense*	DU, EU, TU
	POACEAE	
Little alkali-grass	*Puccinellia simplex*	DU, EU
	POLEMONACEAE	
Mussentuchit gilia	*Aliciella tenuis*	DU, EU
Rabbit Valley gilia	*Aliciella caespitosa*	DU, EU
	POLYGONACEAE	
Bulldog Knolls buckwheat	*Eriogonum heermannii* var. *subspinosum*	DU, EU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
	LOASACEAE	
This row intentionally left blank.		
	ONAGRACEAE	
This row intentionally left blank.		
	OROBANCHACEAE	
Tolmie's owl's-clover	*Orthocarpus holmgreniorum*	DU, EU
	PAPAVERACEAE	
This row intentionally left blank.		
	POACEAE	
This row intentionally left blank.		
	POLEMONACEAE	
Tushar gilia	*Ipomopsis spicata* ssp. *tridactyla*	DU, EU
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	POLYGONACEAE	
Logan wild buckwheat	*Eriogonum loganum*	DU, EU, TU

[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
Cottam's buckwheat	*Eriogonum brevicaule* var. *cottamii*	DU, EU, TU
Cronquist wild buckwheat	*Eriogonum cronquistii*	DU, EU
Heil's wild buckwheat	*Eriogonum corymbosum* var. *heilii*	DU, EU
	RANUNCULACEAE	
Atwood's columbine	*Aquilegia atwoodii*	DU, EU, TU
	ROSACEAE	
Duchesne hawthorne	*Crataegus douglasii* var. *duchesnensis*	DU, EU, TU
Glandular cinquefoil	*Drymocallis micropetala*	DU, EU
	SCROPHULARIACEAE	
Blue Mountain beardtongue	*Penstemon scariosus* var. *cyanomontanus*	DU, EU
Dad's penstemon	*Penstemon patricus*	DU, EU
Deseret penstemon	*Penstemon humilis* var. *desereticus*	DU, EU, TU
Duchesne penstemon	*Penstemon duchesnensis*	DU, EU
	VIOLACEAE	
Clausen's violet	*Viola clauseniana*	DU, EU
Mt. Bartles buckwheat	*Eriogonum brevicaule* var. *promiscuum*	DU, EU, TU
Widtsoe wild buckwheat	*Eriogonum aretioides*	DU, EU
Wire-stemmed wild buckwheat	*Eriogonum pharnaceoides* var. *cervinum*	DU, EU
	RANUNCULACEAE	
Foster's columbine	*Aquilegia fosteri*	DU, EU
	ROSACEAE	
La Sal cinquefoil	*Potentilla paucijuga*	DU, EU, TU
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	SCROPHULARIACEAE	
Navajo beardtongue	*Penstemon navajoa*	DU, EU
Penland's beardtongue	*Penstemon yampaensis*	DU, EU
Tushar Range beardtongue	*Penstemon xylus*	DU, EU
This row intentionally left blank.		
	VIOLACEAE	
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[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

COMMON NAME	SCIENTIFIC NAME	REASON[1]
REPTILES		
Black-necked gartersnake	*Thamnophis cyrtopsis*	DU
Common lesser earless lizard	*Holbrookia maculata*	DU

COMMON NAME	SCIENTIFIC NAME	REASON[1]
REPTILES		
Southwestern black-headed snake	*Tantilla hobartsmithi*	DU
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[1] DU = distributional uncertainty; EU = ecological uncertainty; TU = taxonomic uncertainty.

Chapter 2. Key Habitats – Location and Condition

Introduction

Habitat is an important term used across ecological disciplines, and its definition has been the subject of decades of scientific debate (Darracq and Tandy 2019; Hall et al. 1997; Hodges 2008; Kirk et al. 2018; Whittaker et al. 1973). Use of consistent, operational definitions for habitat terminology is paramount for communicating important management needs, developing management goals, and addressing legal issues pertaining to wildlife conservation. Importantly, a key commonality in recent primary literature acknowledges that habitat is fundamentally a species-specific term (Garshelis 2000; Hall et al. 1997; Kirk et al. 2018; Morrison et al. 2006), which implies the emphasis of context when attempting to understand and define habitat and related concepts. Thus, habitat is generally defined as an area with a combination of resources and environmental conditions that produce occupancy (including survival and reproduction) by a given species (or population).

Hall et al. (1997) further clarifies that an organism's habitat is made up of anywhere that an organism is provided with resources and conditions, even temporarily, that allow it to survive, disperse, migrate, and rest (e.g., migratory corridors, land occupied during breeding and nonbreeding seasons). The presence of a species in an area relates to the sum of specific resources needed by that species, more than just vegetation or vegetation structure. The area is considered *suitable habitat* if the organism is present. *Habitat quality* refers to the ability of the environment to provide conditions appropriate for individual and population persistence. *High-quality habitat* is a measurable variable and should not be equated with suitable habitat (Hall et al. 1997; Murphy and Noon 1991). Under Section 3(5)(A) of the Endangered Species Act, *critical habitat* is used primarily as a legal term to describe the physical and biological components essential to the conservation of a species and to support special management considerations or protections for specific geographic areas occupied by a species at the time of listing consideration. Critical habitat is linked to the concept of high-quality habitat.

Habitat is also a variable concept. The combination of resources (e.g., other organisms, shelter, water) and environmental conditions (e.g., temperature, solar input, precipitation, competition or predation pressure) are subject to changes across space, time, and elevation. Estimating a species' habitat should incorporate an understanding of the drivers of community dynamics. Biological communities are inherently plastic. Interactions among species present at a given

time are influenced by changes in species composition at daily, seasonal, and annual scales and are constrained by species' life stages, phenology (timing of biological events), resource preferences, and relative abundances. Species interactions are only possible between species that co-occur (are present at the same time), and efforts to resolve interaction networks and spatiotemporal variation should provide crucial management insights given the rapid environmental changes associated with habitat loss, climate change, and biological invasions.

Related concepts include habitat type, vegetation type, habitat availability, and abundance. *Habitat type* is defined by the type of vegetation association in an area, or the potential of vegetation to reach a specified climax state (Daubenmire 1968). *Vegetation type* refers to the characteristic dominant plant species or a common aspect of the assemblage, such as an elevation range or environmental commonality (Ornduff et al. 2003:112). *Habitat availability* is the accessibility and procurability of physical and biological components of a habitat by organisms, whereas *abundance* refers only to the quantity of resources present in the habitat (Hall et al. 1997). An *ecosystem* is a geographic area wherein the aggregate physical, chemical, and biological processes and services distinguish it from surrounding areas. Ecosystems are the product of the interacting biodiversity within a given habitat. This term is used interchangeably with key habitat and habitat throughout the Utah Wildlife Action Plan (UWAP).

A best practice provides clear definitions for categories, presents logical methods for classifying observations (Hodges 2008), and uses precise language wherever possible to facilitate further ecological syntheses, effective conservation policy and planning, and cross-sector collaboration. It is essential, therefore, to also consider the appropriate scale when mapping habitat to classify distinct environmental units—or suites of species and conditions that distinguish habitats—for informed decision making.

In this chapter, habitats are characterized at a spatial scale large enough to represent the entire state of Utah and include coarse estimates of ecological and landscape heterogeneity that occur at finer geographic scales. Habitats presented must account for the physical, chemical, and biological resources needs of many co-occurring species (including species of greatest conservation need [SGCN] and species of greatest information need [SGIN]). Therefore, the habitats are categorized by habitat type, mapped by vegetation type, and evaluated at varying spatial scales to determine health and threat factors. Methods used to describe terrestrial and aquatic habitats are presented in this chapter, along with the rationale for these processes.

Terrestrial habitats are named according to vegetation units that define the habitat type(s) that best suit the resource needs of most SGCN and other wildlife species, provided that those habitats are intact and appear to be functioning normally. For instance, mountain sagebrush

ecosystems in Utah provide key habitat for the greater sage-grouse and western toad for at least some part of their life cycles. Although these two species may be found in the same location, they have differing food, shelter, and space requirements. The habitat is not defined by their presence alone but by the combined biological inhabitants and the chemical and physical processes that can be identified as one ecosystem in Utah. Therefore, Mountain Sagebrush is identified as a key habitat in Utah for both greater sage-grouse and western toad.

Working closely with partners, the Utah Division of Wildlife Resources (DWR) led the development and implementation of two distinct processes to identify the UWAP key habitats (terrestrial and aquatic). See Appendix D for full documentation of the key habitat process. A total of 14 terrestrial key habitats (Table 5 and Table 6) and five aquatic key habitats (Table 7) were identified. One of the 14 terrestrial key habitats was defined as other habitats, which consists of Badlands, Cliffs and Canyons, Mesic Meadows, Microbialites, and Sand Dunes. These habitats were too small to evaluate using data sets or programs such as LANDFIRE, but the UWAP Core Team (Core Team) chose to highlight them within a key habitat due to their importance to SGCNs. This chapter presents an account for each key habitat and its extent and condition, drawing from the processes described in Appendix D. These accounts include maps depicting the location of each key habitat within Utah.

Table 5. *Location of Utah Wildlife Action Plan Terrestrial Key Habitats in U.S. Environmental Protection Agency Level III Ecoregions*

TERRESTRIAL KEY HABITATS	U.S. ENVIRONMENTAL PROTECTION AGENCY LEVEL III ECOREGIONS						
	CENTRAL BASIN AND RANGE	COLORADO PLATEAU	MOJAVE BASIN AND RANGE	NORTHERN BASIN AND RANGE	SOUTHERN ROCKIES	WASATCH AND UINTA MOUNTAINS	WYOMING BASIN
Alpine	X				X	X	
Aspen-Conifer	X	X		X	X	X	X
Desert Grassland	X	X	X	X	X	X	X
Desert Shrub	X	X	X	X	X	X	X
Lower Montane Mixed Conifer	X	X	X	X	X	X	X
Lowland Sagebrush	X	X	X	X	X	X	X
Mojave Desert Shrub	X	X	X	X	X	X	X
Montane and Subalpine Conifer	X	X		X	X	X	X
Mountain Sagebrush	X	X		X	X	X	X
Mountain Shrub	X	X	X	X	X	X	X
Riparian	X	X	X	X	X	X	X
Salt Desert Shrub	X	X		X		X	X
Subalpine Grassland	X	X		X	X	X	X

Note: Other Habitats Key Habitat is not included in this table because this category represents five different habitat types located throughout Utah. See the Introduction section in this chapter for more details on other habitats.

Terrestrial Key Habitats

The Core Team and the Utah DWR Wildlife Action Plan Implementation Team decided to exclude disturbed, developed, ruderal, and agricultural habitats from consideration as key habitats. Although SGCN use these habitats, DWR and its partners decided to prioritize native key habitats. Sparse vegetation ultimately encompassed multiple habitats, some of which are included in the Other Habitats Key Habitat; consequently, sparse vegetation was not included as its own terrestrial key habitat. Lower montane chaparral also was excluded because of its very small acreage in Utah, and because it is not typical for the state. After these exclusions, the 2015 ranking process (UWAP Joint Team 2015) was not needed because the candidate habitats (after the exclusions described below) became the key habitats. The extent and condition of these key habitats were then measured in LANDFIRE.

More detail on the methods used to determine the extent and condition of terrestrial key habitats can be found in Appendix D. LANDFIRE data (LANDFIRE 2020a, 2020b) for the state of Utah were used to identify key habitats as well as measure their extent (LANDFIRE 2020a) and condition (LANDFIRE 2020b) (each 30-meter [m] pixel had both its Biophysical Settings [BpS] code and its corresponding Existing Vegetation Type [EVT]). The habitats that comprised the candidate set—the candidate habitats—were then identified. Terrestrial habitats were re-evaluated with the full inclusion of native plant and insect SGCN; these species groups were not considered in the 2015 UWAP revision. The Terrestrial Key Habitats Subcommittee developed a proposed list of key habitats, which was presented and discussed in several Core Team meetings before the team decided on the 14 terrestrial key habitats.

Characteristics for each key habitat in this chapter are provided. Summary statistics for 13 terrestrial key habitats appear in Table 6. The summary statistics for the Other Habitats Key Habitat could not be calculated within LANDFIRE because the habitats that compose this key habitat are too small in extent. Despite their small size, these habitats were a priority for the Utah DWR Wildlife Action Plan Implementation Team and the Core Team and were thus included as a key habitat. The Riparian Key Habitat was included with the terrestrial key habitats because LANDFIRE (2020a) was the data set chosen to measure its extent. Utah's land area totals 54,335,566 acres, and the key habitats (excluding the Other Habitats Key Habitat) cover 68.7% of the state (37,319,586 acres) (see Table 6). The Terrestrial Key Habitats Subcommittee met for seven 2-hour meetings between October 2023 and December 2023 to complete threat assessments for these 13 terrestrial key habitats. A threat assessment was not done for the Other Habitats Key Habitat; therefore, it is not included in the table.

Table 6. *Summary of Terrestrial Key Habitats in Utah*

TERRESTRIAL KEY HABITATS	TOTAL LAND AREA IN UTAH	UTAH'S LAND AREA	TERRESTRIAL KEY HABITAT ON PRIVATE LAND IN UTAH	TERRESTRIAL KEY HABITAT ON PUBLIC LAND IN UTAH
Alpine	281,228 acres	0.5%	1.2%	98.8%
Aspen-Conifer	1,916,502 acres	3.5%	31.0%	69.0%
Desert Grassland	155,101 acres	0.3%	40.6%	59.4%
Desert Shrub	5,409,658 acres	10.0%	19.2%	80.8%
Lower Montane Mixed Conifer	10,394,579 acres	19.1%	16.1%	83.9%
Lowland Sagebrush	6,468,051 acres	11.9%	25.7%	74.3%
Mojave Desert Shrub	416,293 acres	0.8%	16.9%	83.1%
Montane and Subalpine Conifer	2,707,821 acres	5.0%	14.2%	85.8%
Mountain Sagebrush	2,348,413 acres	4.3%	41.8%	58.2%
Mountain Shrub	1,868,963 acres	3.4%	40.1%	60.0%
Riparian	377,477 acres	0.7%	41.8%	58.2%
Salt Desert Shrub	4,825,959 acres	8.9%	17.9%	82.1%
Subalpine Grassland	149,542 acres	0.3%	32.5%	67.6%
Total	**37,319,587 acres**	**68.7%**	–	–

Two LANDFIRE data products were used to determine both the extent and condition of terrestrial key habitats: BpS (LANDFIRE 2020b) and EVT (LANDFIRE 2020a). These units are described in more detail in Appendix D. A short summary of each is provided below.

BpS (LANDFIRE 2024a) are physical, biotic units. Each of the BpS express a particular set of factors (e.g., soils, precipitation, climate, elevation, exposure), which leads to a dominant type of vegetation that is expected in a given physical environment, under a natural disturbance regime characteristic of that physical environment. Although BpS are delineated and named by the dominant vegetation expected to inhabit them, BpS are not units of existing vegetation. Instead, BpS represent archetypal habitat conditions in the absence of disturbance or changes in climate. The LANDFIRE program named the BpS and assigned a 5-digit BpS code to each one (NatureServe 2018); these names and codes are listed within each key habitat account.

EVTs (LANDFIRE 2024b) are modeled representations of the current distribution of habitat types across the landscape defined as plant community types that tend to co-occur in similar landscapes with similar ecological processes, substrates, or environmental gradients. EVTs were mapped based on Landsat imagery modeled with elevation, disturbance, biophysical gradients, and field observation data. LANDFIRE also identified uncharacteristic, ruderal, or semi-natural vegetation types within an EVT. Organizations and agencies, including DWR and its partners, provide field observation data to the national LANDFIRE program.

LANDFIRE (2024b) described the EVTs in four ways:

1. A name was assigned to each classified habitat type.
2. A modeled spatial distribution was provided for each habitat type within the landscape.
3. Each EVT was further classified into strata of successional stages (largely determined by vegetation height) (Smith 2024).
4. Some portions of most EVTs were identified as uncharacteristic, reflecting altered conditions resulting from post-settlement human activities, including unnatural disturbances or proactive management and restoration (referred to as the *naturalness factor*).

The naturalness factor broadly separates EVTs into two categories: 1) reference classes and 2) uncharacteristic class. Reference classes reflect sites and vegetation prior to European settlement and generally correspond with advancing age or succession status. The uncharacteristic class could include situations such as the dominance of invasive annual grasses (e.g., cheatgrass); shrublands with a depleted herbaceous understory; a former

floodplain with a decreased gradient and energy flow because of stream-channel downcutting; or even a range or wildlife seeding with crested wheatgrass.

Using the LANDFIRE-assigned distribution percentages for the five reference age classes within each habitat type, a *best condition* was determined for each habitat type and correlated to the biological communities that depend on them. This working hypothesis was particularly applicable to those species referred to as landscape species, such as greater sage-grouse, golden eagle, and wolverine.

A corollary proposition to this working hypothesis was that the best way to help all species that depend on these coarse-scale habitat types is to manage the habitat types toward their expected age-class distribution. This would occur by means of a very large-scale (perhaps even statewide) program of stewardship and restoration. The following are important points to consider with a large-scale approach to managing terrestrial habitat types:

- This management approach is not meant to be applied to the management of those species with very specific and narrow ecological niches and habitat requirements or with very restricted geographic distributions, such as some invertebrates (e.g., tiger beetle, mountain snail species), shorebirds, many plants, and most of the aquatic SGCN.
- This management approach is not meant to replace or diminish management consideration of fine-scale habitats or habitat features embedded within the coarse-scale vegetation units, such as springs, talus slopes, and rock outcrops.
- Specialist species, fine-scale habitats, and habitat features will still need to be managed on a localized, case-by-case basis. Managers will need to take care not to overlook and potentially harm these species when focusing on broader stewardship or restoration efforts that manipulate vegetation classes to achieve coarse-scale habitat goals.
- Many Utah SGCN plants have specialized habitat requirements and/or very limited distribution and are not directly associated with any of the 13 UWAP key habitats identified using LANDFIRE (2020a) (see Table 6) (the Other Habitats Key Habitat was not defined using LANDFIRE [2020a]). Key habitats for some of the Utah plant SGCNs are identified in Endangered Species Act recovery plans or state conservation agreements and strategies. Management of the extent and condition of these habitat types will follow recommendations outlined in these plans.

Ecological departure is a measure of change between succession classes; good or bad conditions must be determined on a case-by-case basis. Some SGCN may thrive in an area exhibiting higher ecological departure.

For each terrestrial key habitat description, two maps are provided. Map A outlines the location (extent) of the terrestrial key habitat within Utah, and Map B depicts the habitat's custom-weighted ecological departure obtained from LANDFIRE (2020b) and modified for more realistic applicability. Custom-weighted ecological departures were used to measure key habitat conditions and presented at the resolution of the Hydrologic Unit Code (HUC) 12 subwatersheds. HUC-12 subwatershed polygons containing a very small portion of the total key habitat were not displayed in order to maintain focus on locations with primary concentrations of key habitats. Custom-weighted ecological departures were calculated for HUC-12 units, binned into five categories, and shown as a percentage of the overall degree of departure from archetypal conditions for that particular habitat. To display bin departures, histogram thresholding was used to select HUC-12 polygons containing a meaningful percentage of the total key habitat. Specifically, only HUC-12 polygons with a percentage of key habitat higher than those in the first interval of an equal-interval histogram were displayed. The ecological departure maps are grouped by percentages into the following five categories: 0% to 20%, 20% to 40%, 40% to 60%, 60% to 80%, and 80% to 100%.

Individual terrestrial key habitat descriptions also include some management recommendations, which are intended to help project managers focus on activities that will help reduce departure and improve landscape-scale habitat condition. The SGCN are not listed by key habitat. Instead, readers are directed to a new tool developed by DWR that will help make the UWAP more actionable by allowing partners (including the public) to spatially view potential projects and their overlap with key habitats and SGCNs. The DWR Wildlife Habitat Analysis Tool (DWR 2024a) allows users to understand the plant and wildlife context for habitat. This tool provides authoritative Utah species information, including information on SGCN, SGIN, and other non-rare plants and animals. DWR compiles this information from a variety of sources, including the UWAP, scientific literature, museum collections, and field surveys. The tool's utility in helping a user to understand the context of a key habitat shines in that a user could, for example, select the Aspen-Conifer Key Habitat as a project area and see the likelihood of SGCN historical occurrence or habitat selection in the project area along with any known migration corridors, game species habitat, and a wealth of other useful information. The report generated from the tool also links to detailed species accounts (DWR 2024a) and the current UWAP.

Aquatic Key Habitats

The Aquatic Key Habitats Subcommittee first identified the 2025 UWAP aquatic key habitats and geospatial data sets that would be used to define the extent of those habitats (see Table 7).

Next, they focused on measuring habitat condition. Substantial time was spent identifying threats to the aquatic key habitats.

The Aquatic Key Habitats Subcommittee revised the number of aquatic key habitats from the 2015 UWAP into the five presented in Table 7. The Aquatic Key Habitats Subcommittee discussed and agreed upon these key habitats, which were then approved by the Utah DWR Wildlife Action Plan Implementation Team and the Core Team. There was no ranking process for aquatic key habitats; all five habitats that were identified were considered key habitats and included in the UWAP. The subcommittee acknowledged that Utah is one of the most arid states in the nation (Sowby 2024; Utah Foundation Research Brief 2009); therefore, most aquatic habitats are extremely important and should be considered key habitats. Each aquatic key habitat's extent in Utah, including acreage value and percentage of land area, and the data sources used to extract this information are presented in Table 7.

Table 7. *Summary of Aquatic Key Habitats in Utah*

AQUATIC KEY HABITATS	TARGETED GEOSPATIAL DATA SET	SIZE	PERCENTAGE OF UTAH'S LAND AREA
Lakes and Reservoirs	National Hydrography Dataset Plus	342,643 acres	0.6%
Rivers and Streams	National Hydrography Dataset Plus	29,663 kilometers (18,432 miles)	N/A
Saline Lakes/Great Salt Lake Ecosystem	1,286-m (4,218-foot) elevation line	1,696,811 acres	3.1%
Springs	DWR Springs Database	>11,000 count	N/A
Wetlands	National Wetlands Inventory	532,240 acres	1.0%

Note: N/A = not applicable.

Unlike terrestrial key habitats, no comprehensive geospatial data set exists that will determine the extent for all UWAP aquatic key habitats. Aquatic key habitats were generally smaller than terrestrial key habitats; therefore, it was determined that LANDFIRE was not the best data source. The Aquatic Key Habitats Subcommittee realized that the data sets chosen to measure extent were not perfect, but the group ultimately moved forward with the data sets shown in Table 7. The data sources are described in more detail below.

The extent of the Lakes and Reservoirs Key Habitat and Rivers and Streams Key Habitat was measured using the National Hydrography Dataset Plus (NHDPlus) data set (U.S. Geological Survey 2025). The NHDPlus is a high-resolution geospatial data set depicting the flow of water

across the nation's landscapes and through the stream network. The data set is a nationally complete watershed boundary data set at a 1:24,000 scale. There is some overlap between the Lakes and Reservoirs Key Habitat and the Wetlands Key Habitat for waterbodies less than 20 acres in size because they can be represented in either key habitat.

The extent of the Wetlands Key Habitat was measured using the National Wetlands Inventory (NWI) data set (U.S. Fish and Wildlife Service [USFWS] 2024a), which describes the location, shape, and broad characteristics of wetlands and other waterbodies, such as small ponds, across the entire nation. In Utah, the Utah Geological Survey (UGS) maps wetlands and contributes updated data to the NWI program, and the Bureau of Land Management (BLM) is working with a variety of contractors to update NWI data on BLM-administered lands. To refine the Wetlands Key Habitat extent, areas that overlapped with the Lakes and Reservoirs Key Habitat features were excluded to prevent double-counting, and areas that overlapped with the Saline Lakes/Great Salt Lake Ecosystem Key Habitat were retained. Clearly artificial wetlands—such as irrigation-created features and wastewater treatment ponds—were removed based on expert opinion and local knowledge to better represent naturally occurring wetland systems. Additionally, NWI features classified as L2US (Unconsolidated Shore) were excluded where imagery indicated that they were rarely inundated.

The extent of the Springs Key Habitat was measured using the DWR Springs Database (DWR 2024b). This database began with a 2023 geodatabase export of more than 11,000 Utah spring data entries from the Springs Stewardship Institute (SSI). During 2023 and 2024, DWR developed a Springs Assessment Inventory Application (Springs App), created in ArcGIS Field Maps, to allow UWAP partners to build on the DWR Springs Database (DWR 2024b). The Springs App will continue to identify the extent of spring habitat in Utah and will provide some level of condition for these habitats. The Springs App was field tested in 2024 by select UWAP partners. Input gathered during the fall of 2024 led to modification of the Springs App, and the final version became available for use in 2025. Prior to the Springs App, springs in Utah were mapped opportunistically, with no consistency for identifying condition metrics.

The 1,286-m (4,218-foot) elevation line around Great Salt Lake (GSL) was used to represent the Saline Lakes/Great Salt Lake Ecosystem Key Habitat. This elevation line is used by agencies for management and planning purposes. The wetlands around GSL that are within this elevation line overlap with wetlands identified in the Wetlands Key Habitat.

Aquatic habitats are dynamic, and comprehensive monitoring to obtain meaningful condition metrics is time intensive. Data on habitat condition were available but were found in multiple

sources rather than one place. Condition measures were often only available for some regions of the state or narrowly focused on one or a few components of condition.

One of the most important aspects of condition—the presence and timing of water—is difficult to measure without expensive instrumentation or many repeated field surveys. After two meetings, the Aquatic Key Habitats Subcommittee determined that it would not be practical to develop habitat condition metrics that all partners could collect moving forward. Challenges in doing so included the following:

1. No single data set shows the extent or provides the condition of the key habitats. Consequently, field data rather than modeled data are needed for estimates of habitat condition.
2. Each UWAP partner has different priorities when working in aquatic systems.
3. Specific projects have different priorities in aquatic systems.
4. UWAP partners do not have the time, staff, or funding to measure an extensive list of habitat condition metrics for every aquatic project, survey, or monitoring event.
5. Condition data do not exist at a statewide level. Good condition data are available for some of the aquatic key habitats. For example, Utah Division of Water Quality (DWQ) collects and reports on data related to water quality, and the UGS collects data on departure from natural wetland condition. However, these data are not available statewide or do not include all of the important aspects of condition, or both, which makes them challenging to use.

These habitat condition discussions highlighted that many UWAP partners measure aspects of aquatic habitat condition that are often not well known or shared outside of their agency or organization. The Aquatic Key Habitats Subcommittee provided the following recommendations for measuring the condition of UWAP key aquatic habitats:

1. Make existing aquatic habitat condition data readily available (see the Aquatic Key Habitat Descriptions section for additional resources for specific aquatic habitats).
2. All UWAP partners should use the Springs App to continue determining the extent and condition for the Springs Key Habitat.
3. All UWAP partners that evaluate potential barriers to fish and aquatic SGCN movement should use the DWR's Barrier Assessment Inventory Tool (BAIT) (DWR 2024c). Using this Survey123 app will standardize the assessment of and information collected on potential barriers to aquatic SGCN movement.

4. More aquatic temperature data need to be collected, especially continuous data through temperature loggers. All Utah aquatic habitat temperature data should be uploaded into the Utah Continuous Water Quality Monitoring Dashboard (DWQ 2025).
5. UWAP partner discussions should continue to identify meaningful aquatic habitat condition metrics and standardize collection of these metrics (or a subset of metrics) by aquatic habitat to the extent possible.

A list of currently available agency sources for condition data is provided in Table 8.

Table 8. *2025 Utah Aquatic Habitats and Data Sets Used to Evaluate their Condition*

HABITAT TYPE	AGENCY COLLECTING DATA	DATA SOURCE	GENERAL TYPES OF METRICS COLLECTED
All aquatic habitats	UGS and U.S. Geological Survey	Utah Groundwater Hub: Water Level Trends (UGS 2025)	Water level trends
All aquatic habitats	U.S. Environmental Protection Agency	National Aquatic Resource Surveys (U.S. Environmental Protection Agency 2024a)	Water quality at national and regional levels
GSL	DWR	GSL Ecosystem Program brine shrimp sampling data (DWR 2024d)	Annual brine shrimp population monitoring and developmental stages
GSL	UGS	UGS GeoData Archive system, GSL Wetlands folder (UGS 2024a)	Reports on water quality, monitoring, and ecological characteristics
Streams and rivers	BLM	BLM National Assessment, Inventory, and Monitoring (AIM) Lotic Indicators Hub (BLM 2024a)	Chemical, physical, and biological indicators of lotic habitat condition.
Streams, rivers, and wetlands	National Aquatic Monitoring Center	Aquatic Invertebrate Database (Utah State University 2025a)	Freshwater invertebrate taxa collected through stream and wetland assessments
Wetlands	BLM	BLM National AIM Riparian and Wetland Indicators Hub (BLM 2023)	AIM data general information on wetlands health and restoration
Wetlands	DWQ	Wetland Monitoring and Assessment: Wetlands Program (Utah Department of Environmental Quality 2024)	Reports

HABITAT TYPE	AGENCY COLLECTING DATA	DATA SOURCE	GENERAL TYPES OF METRICS COLLECTED
Wetlands	UGS	Groundwater and Wetlands Health and Restoration (UGS 2024b)	General information on wetlands health and restoration
Wetlands	UGS	Wetland condition web map (UGS 2024c)	Wetland assessment reports
Wetlands	UGS	Wetland Plant Application (UGS 2024d)	Plant application

Key Habitat Descriptions

Terrestrial Key Habitat Descriptions

Alpine

Alpine habitat (Figure 3 and Figure 4) consists of ecological systems occupying high elevations (generally above 3,400 m [11,000 feet]) that are located above tree line. Localized topography ranges from rock outcrops and scree slopes to ridgetops (Global Observation Research Initiative in Alpine Environments [GLORIA] 2024), exposed saddles, flat ridges, valleys, and basins, as well as gentle to moderate slopes and areas with glacial topography. Flora and fauna in this habitat must deal with harsh conditions, including short growing seasons, high winds, heavy snow and ice, steep terrain, low temperatures, and periods of extreme solar radiation. Vegetation communities in alpine habitat tend to be sparse or absent. When present, vegetation is often low growing (less than 50.0 centimeters [cm] [19.7 inches] in height) and found in stabilized soils that are moist, well drained, and sometimes have a peat layer. Flora and fauna in this habitat type are adapted to harsh conditions but can be distinctly isolated from one another due to the geographic nature of these "sky island" communities across the state (Martin 2001).

Within these communities, net-veined willow can be a dominant shrub (despite an average maximum height of approximately 5 cm [2 inches]), with western Labrador-tea and alpine bog laurel shrub associates. Low-growing or cushion plants are common, such as creeping sibbaldia, moss campion, alpine sorrel, arctic gentian, American alpine speedwell, sky pilot, groundsels, sedge species, shortleaf fescue, Idaho fescue, cushion phlox, Whipple's penstemon, reedgrass, tufted hairgrass, alpine sagebrush, Orpine stonecrop, rockfoil species, dense spikemoss, and whip root clover. Large patches of willows, including barren-ground willow and plane-leaf willow, occur with scant understories.

Pollinator groups (bumble bees, flies, and butterflies) are of particular importance to alpine plant communities. Bumble bee species (such as the western bumble bee and high country bumble bee) are cold-adapted, generalist foragers that can carry larger pollen loads over long distances. These species exhibit high visitation rates and are especially crucial for ensuring reproductive success and gene flow among flowering alpine plant populations.

Often, small areas of wind-affected and stunted Engelmann spruce and subalpine fir can occur near or at timberline, where harsh alpine conditions do not allow for normal tree growth forms. Krummholz formations can be a distinctive character of alpine habitat and often serve as refugia for small wildlife.

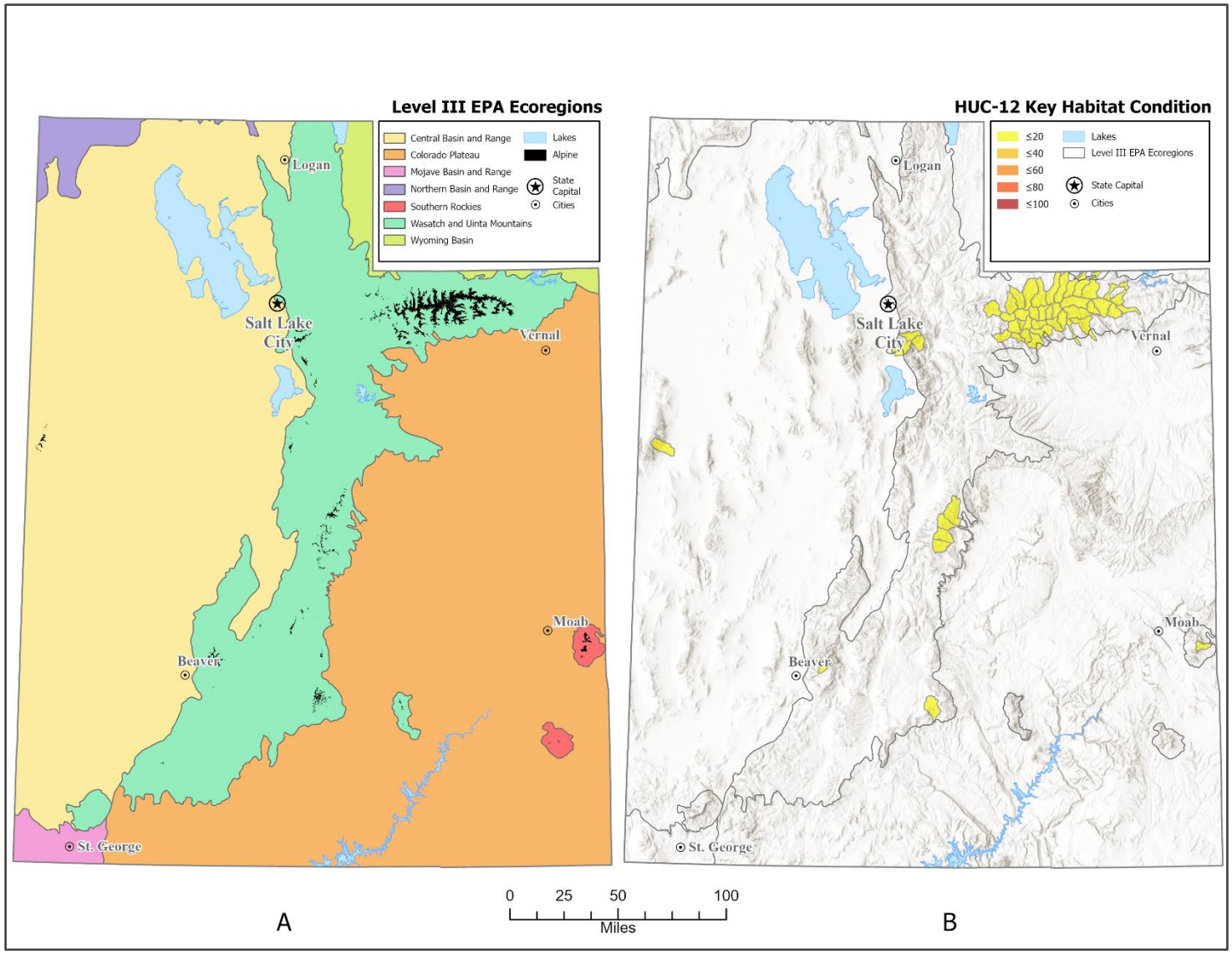


Figure 3. *(A) Alpine Key Habitat Statewide Distribution (B) Ecological Departure for Alpine Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 4. *Alpine Habitat; La Sal Mountains*

Note: Photograph by Zach Coury, DWR, 2022.

Ecoregional Characteristics

Alpine Key Habitat occurs in three Utah ecoregions (making up more than 1% of the area of each ecoregion): Central Basin and Range, Southern Rockies, and Wasatch and Uinta Mountains. Descriptions of alpine vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 1.5% of alpine habitat in Utah occurs within this ecoregion. Alpine sites are found in the Deep Creek Mountains in west-central Utah. This alpine habitat is generally composed of rugged rock outcrops with some interspersed scree slopes where low-growing forbs such as larkspurs, Alpine avens, dwarf alpine Indian paintbrush, wild buckwheat, pink alumroot, mountain coyote mint, alpine shooting star, Whipple's penstemon, heartleaf arnica, Torrey's milkvetch, cinquefoils, fleabanes, alpine buttercup, Western roseroot, and Parry's primrose occur sparsely among rocky soils and near tree line.

Krummholz areas occur in a transitional zone between subalpine forests and alpine habitats, where firs and spruces are stunted due to wind, well-drained soils, and long winters. These

habitats provide important shelter for a number of wildlife species, including alpine endemics as well as big game species.

Dominant species in krummholz areas include mountain avens; alpine avens; bistort; Orpine stonecrop; sedge species such as Bellardi bog sedge, blackroot sedge, dryspike sedge, and spike sedge; shortleaf fescue; Ross' avens; cushion phlox; and whip root clover. Many other graminoids, forbs, and prostrate shrubs can also be found, including reedgrass, tufted hairgrass, spike fescue, arctic bluegrass, rockfoil spp., dense spikemoss, creeping sibbaldia, moss campion, gentians, hairy arnica, groundsels, and Parry's clover (NatureServe 2018).

Southern Rockies

Approximately 3% of alpine habitat in Utah occurs within this ecoregion. Alpine vegetation in the Southern Rockies ecoregion is found only in the La Sal Mountains, where higher elevations receive significantly more precipitation and rock talus and scree are common. Wet meadows, rocklands, glacial till, and talus are often found in the alpine zones of this ecoregion. Alpine habitat in the La Sal Mountains also supports several endemic and unique plant species in Utah, such as the La Sal daisy, dense spikemoss, Eastwood's podistera, Baker's alpineparsley, alpine besseya, dandelion species, and globe sedge (U.S. Forest Service [USFS] 2024).

Wasatch and Uinta Mountains

Approximately 96% of alpine habitat in Utah occurs within this ecoregion. True alpine ecosystems in the Wasatch and Uinta Mountains ecoregion include areas in the High Uinta Mountains and smaller areas in the upper Cottonwood Canyons and the Tushar Mountains. These areas receive more precipitation than the plateaus, mountain valleys, and subalpine zones of this ecoregion.

Extent

- LANDFIRE (2020a) was used to determine Alpine Key Habitat extent in Utah.
- Total current mapped area:
    - 281,232 acres
    - 0.52% of state surface area (see Figure 3)
    - 1,138 square kilometers (km^2) (439 square miles)
- LANDFIRE EVTs (NatureServe 2018) in this key habitat are as follows:
    - Rocky Mountain Alpine Bedrock and Scree
    - Rocky Mountain Alpine Dwarf-Shrubland

- Rocky Mountain Alpine Fell-Field
- Rocky Mountain Alpine Turf

Condition

Alpine areas in the state are generally in good condition, although the collective influences of climate change and historic and current grazing can negatively alter the abiotic and biotic characteristics of the community. As temperature regimes change, induced effects can include range contractions for alpine-restricted species, range shifts of encroaching or introduced species, and phenological mismatches. These collective changes may be irreversible and have cascading effects on community resiliency such as native pollinator abundance (Massa et al. 2024; Miller-Struttmann et al. 2022).

The combination of changing snowmelt timing and chemistry from alpine areas due to atmospheric deposition of both fugitive dust and pollution will affect the growing season, flow of streams and springs (which is noteworthy, given the importance of snowpack to Utah's other habitat types), and wildlife use patterns.

In some localized areas, snowmobiling and skiing can compact snow, which results in colder temperatures at the surface and in the root zone, which can reduce plant biodiversity and reduce the subnivean space available for arvicoline rodents that use alpine habitat.

Improving Condition

An effective strategy for management of alpine habitat in Utah may include the following elements:

- Promoting policies that reduce inappropriate browsing and grazing by domestic livestock and non-native grazers.
- Managing recreation. This is a fragile habitat that will need appropriate and ongoing management. Managers will need to work with recreationalists to allow recreation but still protect this habitat.

Threats

Table 9 summarizes the threats to alpine habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including alpine habitat. White rows indicate threats that are important to alpine habitat but do not impact

as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 9. *Threat Prioritization Exercise Summary Results for Alpine Key Habitat*

ALPINE KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Trail, Trailhead, and Staging Area Development	–			1		
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)		1				
Camping/Campground Development (dispersed)				1		
Hiking/Foot Travel				1		
Mountain Biking				1		
Problematic Animal Species (native)				1		
No Standardized Condition Assessment Method			1			
Atmospheric Deposition and Snowmelt Chemistry		1				
Future Effects of Greater Temperature Variability under Climate Change		1				
Future Effects of Greater Precipitation Variability under Climate Change		1				
Total	**0**	**4**	**2**	**5**	**0**	**11**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact alpine habitats at a fine resolution. Work toward the preservation of those mapped habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to assess alpine habitat condition.

Aspen-Conifer

Aspen-conifer habitats (Figure 5 and Figure 6) support highly biodiverse ecosystems and ecological functions. These habitats include both stable aspen stands (where aspen permanently dominate) and seral-dominant forests (where aspen coexist with conifer species such as white fir, Douglas-fir, Engelmann spruce, and subalpine fir). Typically found at elevations between 2,133 and 3,048 m (7,000 and 10,000 feet), aspen-conifer forests thrive in areas with sufficient moisture and fertile soils that foster a diverse and productive understory (DeByle and Winokur 1985). Their open canopy structure allows significant sunlight penetration, which promotes a rich ground layer of vegetation that sustains numerous wildlife species. These habitats also serve as key water sources, supporting creeks, springs, and wetlands that are essential to supporting biodiversity.

Aspen-conifer forests provide vital refugia and foraging grounds for wildlife, including big game species, breeding birds, and a wide range of insect fauna that contribute to overall ecosystem health. The understory varies in composition from sparse vegetation in conifer-heavy stands to shrub-dominated or herbaceous-rich layers. Key shrubs include snowberry, chokecherry, western serviceberry, blue elder, Scouler's willow, and conifer seedlings and saplings. Other shrubs include Wood's rose, raspberry, common and Rocky Mountain junipers, dogwoods, twinberry honeysuckle, sumac, Saskatoon serviceberry, and Oregon grape.

The herbaceous layer can be dominated by grasses and grasslike plants such as mountain brome, sedges, blue wildrye, and bluegrasses. Forb cover and species richness can vary widely between sites, typically supporting high species richness and turnover. Species such as lupines, asters, golden banners, bluebells, hyssop, stonecrops, buckwheats, lomatiums, fleabanes, beardtongues, larkspurs, monkshood, coneflowers, cinquefoils, osha, wild onions, western blue flag, wild strawberry, hemlock parsley, cow parsnip, false hellebore, blue flax, and columbines contribute to the habitat's botanical diversity and productivity. This diverse plant life supports an abundance of insects, including moths, butterflies, beetles, flies, ants, bees, wasps, springtails, thrips, and hemipterans (Schimpf and MacMahon 1985). Invertebrates in the aspen-conifer understory also play a central role in sustaining forest health and diversity. Forest insects perform essential functions such as decomposition of organic matter, seed and spore dispersal, and population control of other species through predation and parasitism.

In meadows within aspen-conifer landscapes, increased sunlight penetration enables a diverse array of plant life and structural habitat. Pollinating insects such as bumble bees, solitary bees, butterflies, moths, flies, and beetles play a critical role in maintaining plant reproduction and ecosystem resilience. These insects also make up the foundation of the food web, serving as an

essential food source for a variety of wildlife, including nesting birds, amphibians, reptiles, bats, small mammals, and predatory invertebrates (Yang and Gratton 2014).

Natural and anthropogenic disturbances help maintain the ecological integrity of aspen-conifer systems. Wildfires, foraging wildlife, bark beetle infestations, avalanches, and sustainable forestry practices promote aspen regeneration by reducing competition from conifers and creating favorable conditions for new growth. Aspen trees are widely recognized as keystone species due to their outsized role in supporting diverse plant and animal communities (Berrill et al. 2017; Edenius et al. 2011; Kouki et al. 2004; Stohlgren et al. 1997); however, historical undervaluation of aspen in favor of timber production, combined with limited research and gaps in policy, has contributed to their decline (Rogers et al. 2020).

The distribution of aspen-conifer habitats is influenced by elevation, temperature, and moisture availability. At higher elevations, cold temperatures limit their occurrence, making aspen-conifer habitat more common on warmer, south-facing slopes. Conversely, at lower elevations, aspen is constrained by limited moisture and higher temperatures, leading to its prevalence on cooler, north-facing slopes and in mesic microsites such as seeps and drainages. Where adequate moisture is available, these habitat types can establish across diverse topographies, ranging from gentle to steep slopes and extending onto plateaus within the montane and subalpine zones.

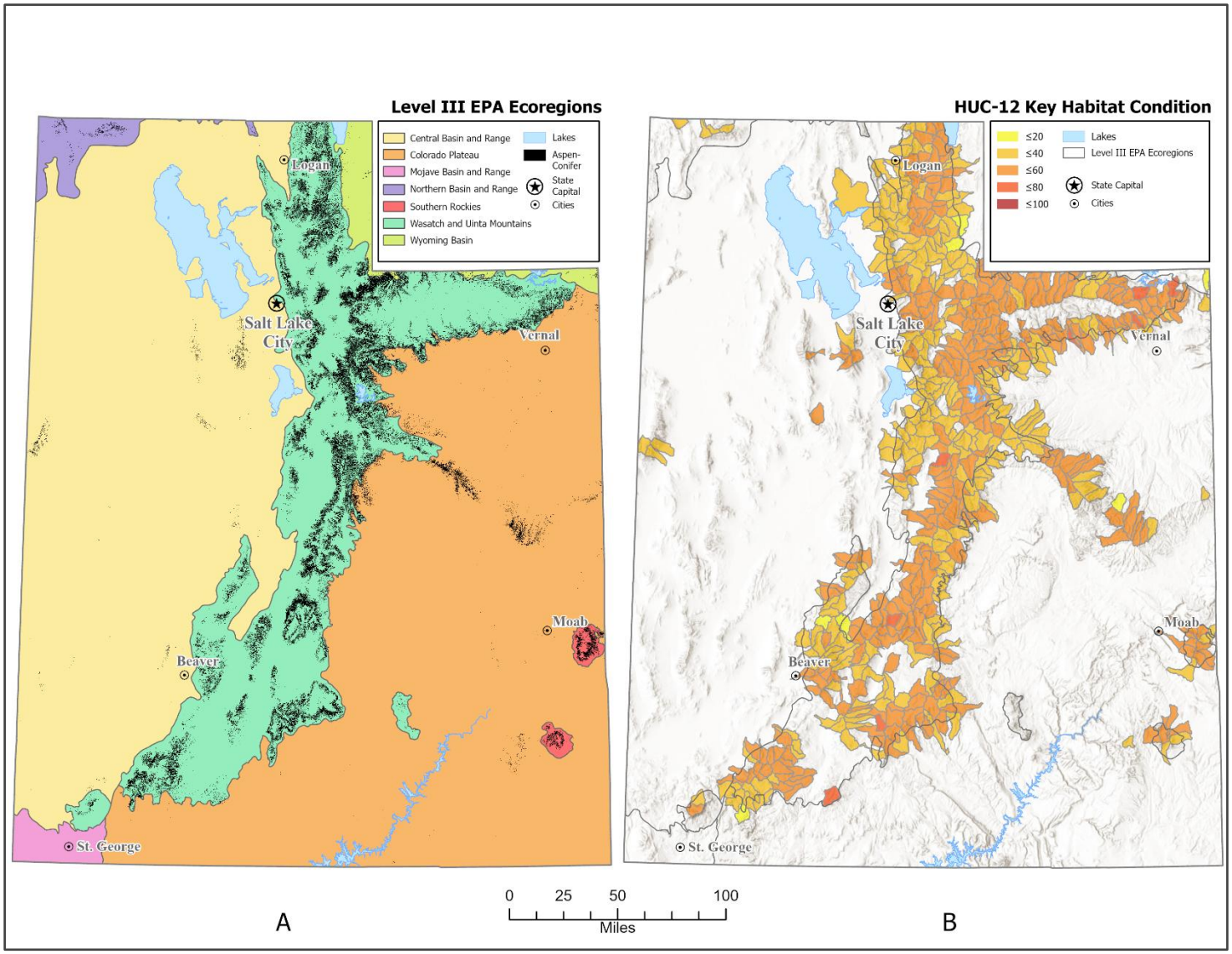


Figure 5. *(A) Aspen-Conifer Key Habitat Statewide Distribution (B) Ecological Departure for Aspen-Conifer Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 6. *Aspen-Conifer Habitat; Salt Lake County.*

Note: Photograph by Mackenzie Anderson-Bell, Utah State University, 2024.

Ecoregional Characteristics

Aspen-Conifer Key Habitat occurs in four Utah ecoregions (making up at least 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, Southern Rockies, and Wasatch and Uinta Mountains. Descriptions of aspen-conifer vegetation communities in those ecoregions are below.

Central Basin and Range

Approximately 1.5% of aspen-conifer habitat in Utah occurs within the Central Basin and Range ecoregion. This collective 28,000 acres occurs mostly in the higher elevations of the Oquirrh, Stansbury, and Deep Creek Mountains, where moisture and cooler temperatures are more prevalent. Conifer species such as Engelmann spruce, bristlecone pine, limber pine, and Douglas-fir are common conifer components to aspen-conifer vegetation communities in this ecoregion.

Colorado Plateau

Approximately 7% of aspen-conifer habitat in Utah occurs within the Colorado Plateau ecoregion. Aspen-conifer habitat within this ecoregion occurs at elevations that receive more precipitation in locations that support mixed aspen-conifer forests with ponderosa pine, Douglas-fir, quaking aspen, and Engelmann spruce. In Utah, the Tavaputs Plateau is a representative aspen-conifer forest in the Colorado Plateau.

Southern Rockies

Approximately 3% of aspen-conifer habitat in Utah occurs within the Southern Rockies ecoregion. This habitat type is found in the La Sal and Abajo Mountains, where cool and moist conditions prevail in the higher elevations above the surrounding Colorado Plateau. Relatively large, intact aspen stands occur on all aspects of the La Sal Mountains, whereas stands in the Abajo Mountains are generally more interspersed with conifers. Subalpine fir, Engelmann spruce, and Douglas-fir are frequently the most common conifer species in aspen-conifer communities in this ecoregion. The understory of aspen-conifer habitat in this region has strong similarities to those in Colorado, where most of the Southern Rockies ecoregion is located.

Wasatch and Uinta Mountains

Approximately 88% of aspen-conifer habitat in Utah occurs within this ecoregion, which hosts the largest area of aspen-conifer communities in the state—from the northern Bear River Mountains to the Markagunt Plateau in the south. The varied topography, geology, and soils create aspen-conifer ecosystems that vary widely in both forest structure and diversity. This vegetation community often occupies higher elevations than aspen-conifer communities in other ecoregions (approximately 2,400–3,000 m [8,000–10,000 feet]) in subalpine forest areas and Douglas-fir forests, as well as aspen parkland communities with white fir and limber pine (Woods et al. 2001).

Extent

- LANDFIRE (2020a) was used to determine Aspen-Conifer Key Habitat extent in Utah.
- Total current mapped area:
    - 1,916,531 acres
    - 3.53% of state surface area (see Figure 5)
    - 7,756 km^2 (2,995 square miles)

- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Rocky Mountain Aspen Forest and Woodland
    - Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland

Condition

Aspen-conifer forests in Utah vary in condition from fair to good. Because aspen and aspen-conifer forests are often used for livestock grazing due to the relatively abundant forage, many of these forests have experienced historic and/or current improper grazing. Grazing has increased the presence of non-native species such as Kentucky bluegrass, smooth brome, orchard grass, timothy, and common dandelion, resulting in displaced or a diminished cover of native grasses and forbs, as well as reduced overall diversity of plant-pollinator networks and species interactions. Additionally, excessive browsing by wildlife and/or livestock can also significantly impact regeneration by suckers in some smaller sites (such as in smaller patch cuts or in wildfire areas) (DeByle and Winokur 1985; Howard 1996).

Absence and/or reduction of wildfire events has also decreased health and vigor of aspen stands because more shade-tolerant conifers are better able to germinate and grow in the understory of aspen. Aspen are considered a mid-seral species, and over time aspen stands are naturally replaced by conifers. Although this is considered a natural process, fire suppression has resulted in conifers completely overtaking many aspen stands in Utah. Given the importance of aspen to wildlife, aspen stand decadence has led to a decrease in the cover and diversity of this important habitat type.

Recently, large wildfires in Utah have burned thousands of acres of aspen-conifer habitat, and secondary succession following fires has reset vegetative communities to grasses and forbs with regenerating aspen communities. Where wildfires burned under high-severity conditions, some aspen clones may have been lost, but in general, extensive aspen regeneration is expected. It will likely take many (100 or more) years for aspen-conifer habitat to re-establish, but the seral grass/forb and aspen habitat types are still high quality and important for wildlife use.

Improving Condition

An effective strategy for management of aspen-conifer habitat in Utah may include the following elements:

- Increase disturbance from either prescribed or natural fire, particularly in aspen stands with a large component of conifer. Recent studies (Krasnow and Stephens 2015) have

shown that larger-scale burns (e.g., 5,000 acres or more) that burn more intensely have been the most successful in terms of aspen regeneration. Higher-intensity burns stimulate greater numbers of young aspen per unit area than lower-intensity burns. A larger treatment area distributes the pressure of browsing by ungulates, which allows most young aspen stems to survive to maturity and helps avoid over-browsing of aspen suckers.

- Apply mechanical disturbance agents such as timber harvest to stimulate aspen regeneration and avoid or reduce conifer invasion, reduce fuel loading, and increase conifer diversity to help reduce the risk of wood-boring beetle infestations (e.g., bark beetles).
- Monitor smaller, naturally occurring or human-created disturbances for ungulate damage, and take follow-up actions such as additional habitat work, fencing, hazing, hunting, and/or domestic grazing management. This may be required to prevent or reduce damage caused by domestic, wild, or feral ungulates. Use of larger treatment areas (for timber harvests or prescribed fire) can help disperse the pressure of ungulate browsing.
- Promote policies that reduce improper and intensive browsing and grazing by domestic livestock. Livestock distribution methods that prevent livestock from concentrating in small areas include using alternative water sources (such as stock tanks), salting, fencing, and virtual fencing.
- Reintroduce beaver where appropriate and install beaver dam analogs (BDAs) where beaver introduction is not feasible.

Threats

Table 10 summarizes the threats to aspen-conifer habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including aspen-conifer habitat. White rows indicate threats that are important to aspen-conifer habitat but do not impact as many species and habitats as priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 10. *Threat Prioritization Exercise Summary Results for Aspen-Conifer Key Habitat*

ASPEN-CONIFER KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Cabin Communities/Development				1		
Expansion of Urban Footprint				1		
Campground Development				1		
Trail, Trailhead, and Staging Area Development				1		
Ski Area Development				1		
Improper Grazing – Livestock (current)		1				
Water Developments for Livestock				1		
Improper Grazing – Livestock (historic)	1					
Utility and Service Lines			1			
OHV Motorized Recreation			1			
Camping/Campground Development (dispersed)				1		
Mountain Biking				1		
Inappropriate Fire Frequency and Intensity	1					
Seeding Non-Native Plants			1			
Insects – Alien Organisms				1		
Problematic Animal Species (native)			1			
Problematic Insects (native)		1				
Problematic Plant Species (native upland)			1			
Ecosystem Encroachment				1		
Droughts			1			

ASPEN-CONIFER KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
No Standardized Condition Assessment Method			1			
Total	**2**	**2**	**7**	**10**	**0**	**21**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map and preserve intact aspen-conifer stands to reduce habitat fragmentation and perforation.
- Create a priority map overlaying aspen and aspen-conifer stands, fire history, and important watersheds to help determine priorities for forest management, prescribed fire, or other restoration work (e.g., mowing or brush hogging).
- Use mechanical treatments where prescribed fire risks are too high, given high fuel loading and proximity to residential areas.

Desert Grassland

Desert grassland habitat (Figure 7 and Figure 8) typically occurs in relatively small, discontinuous patches that form transitional zones between lower-elevation deserts and higher-elevation shrubland and woodland habitats. Typically, these areas are found on alluvial flats between narrow desert mountain ranges, playas, mesas, and plains. Desert grassland habitat occurs at elevations between 1,067 and 1,829 m (3,500 and 6,000 feet) and is the hottest, driest, and sunniest grassland in North America. This habitat receives, on average, between 15 and 41 cm (6 and 16 inches) of precipitation annually. Although considered a grassland, desert grasslands may have limited vegetation and may also include shrubs, succulents, and forbs. Dominant shrub species that may occur as patches within a mosaic of grasslands include Wyoming big sagebrush, saltbush species, blackbrush, Mormon tea species, rabbitbrush species, broom snakeweed, and winterfat. Common grasses in desert grassland habitat include Indian ricegrass, blue grama grass, sand dropseed, needle and thread grass, bluebunch wheatgrass, muhly species, and James' galleta grass (NatureServe 2024b). Annual grasses and crested wheatgrass have invaded many desert grassland communities.

Insect communities in Utah's desert grasslands are remarkably diverse, though still poorly understood. The vegetation, climate, soil, and water availability create myriad micro-ecosystems

that support thousands of insect species across multiple trophic levels. These species, in turn, form the base of a complex food web, serving as important prey for insectivorous wildlife, pollinators of most flowering plants, and drivers of essential ecosystem functions. Hundreds of moth and butterfly species are larval host specialists on plants found in desert grasslands, and their role as prey for nearly all nesting bird species makes them key nutrient cyclers. Countless wasp, bee, and ant species also depend on desert grassland habitats; as primarily ground-nesting species, they aerate soil and facilitate the permeation of water to the deep root systems of perennial vegetation. Desert grasslands are biodiversity hotspots for Utah's native solitary bees, many of which specialize on the pollen from certain desert plants to feed their offspring. It is estimated that there are several hundred species associated with these landscapes (Toler et al. 2005; Wilson et al. 2025). Other important herbivores include grasshoppers, katydids, crickets, true bugs, planthoppers, aphids, beetles, flies, and various species of flies and midges. Predatory and parasitoid insects—such as dragonflies, damselflies, wasps, flies, assassin bugs, and beetles—as well as many other terrestrial arthropods, help regulate prey populations and contribute to nutrient cycling through desert grasslands. Many insects also assist in the decomposition of organic debris, including collembolans, the larvae of several beetles and flies, termites, and other invertebrates such as isopods, millipedes, and nematodes, thereby enhancing soil structure, nutrient availability, water retention, carbon storage, and microorganism diversity in desert grassland soils (Hunt et al. 1987; Martínez-Falcón et al. 2023).

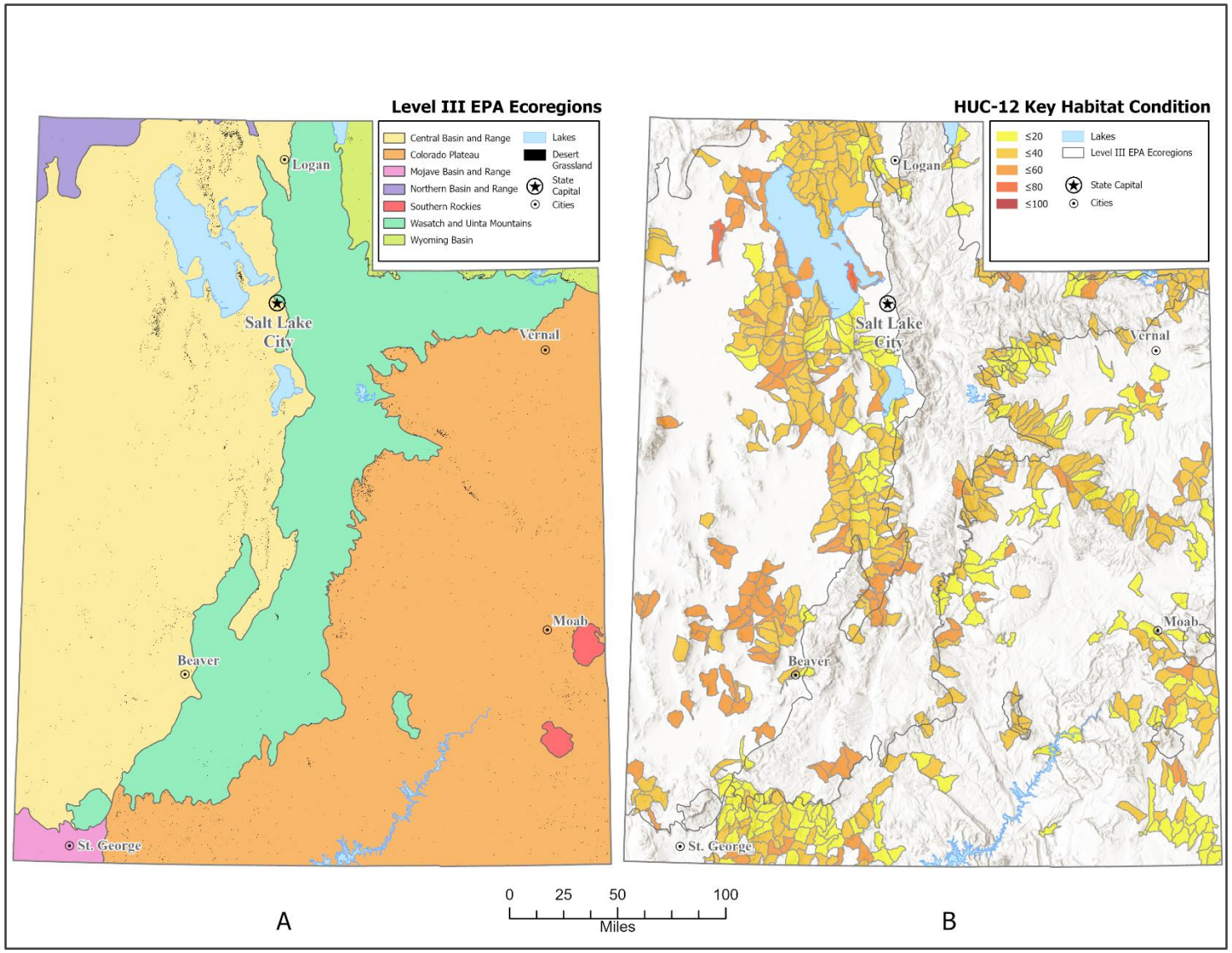


Figure 7. *(A) Desert Grassland Key Habitat Statewide Distribution (B) Ecological Departure for Desert Grassland Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 8. *Desert Grassland Habitat; Desolation Canyon.*

Note: Photograph by Zach Coury, DWR, 2024.

Ecoregional Characteristics

Desert Grassland Key Habitat occurs in four Utah ecoregions (making up more than 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, Wasatch and Uinta Mountains, and Wyoming Basin. Descriptions of desert grassland vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 56% of desert grassland habitat in Utah occurs within this ecoregion. It co-occurs with sagebrush steppe, is semiarid, and typically has a lower density of bunchgrasses than other ecoregions containing desert grassland habitat. Historically, the majority of the grasslands in this ecoregion were composed of cool-season grasses, but much of this habitat has been converted to cheatgrass due to anthropogenic disturbances. Perennial bunchgrass density is greatest at the northern reaches of the Central Basin and Range, where springtime moisture is more available. Common grasses include Indian ricegrass, needle and thread grass, bluegrasses, and James' galleta grass.

Colorado Plateau

Approximately 38% of desert grassland habitat in Utah occurs within this ecoregion. In this ecoregion, desert grassland vegetation is a mix of cool- and warm-season grasses because the influence of summer monsoons is more pronounced. Common grass species include blue grama, bush muhly, sandhill muhly, little bluestem, sand dropseed, and James' galleta grass. In many areas, shrubs have encroached as fire suppression and management has allowed shrubs to become established. Drought conditions can also favor establishment of desert shrubs in some areas.

Wasatch and Uinta Mountains

Approximately 1.3% of desert grassland habitat in Utah occurs within this ecoregion. Species in this vegetation community vary according to elevation, soils, precipitation, and temperature. Big sagebrush is commonly found along the drier foothills, whereas perennial bunchgrasses and mixed forbs can be found at the middle elevations (Grahame and Sisk 2002). Much of this region's grassland communities have been converted to dryland or irrigated agricultural lands.

Wyoming Basin

Approximately 4.3% of desert grassland habitat in Utah occurs within this ecoregion. Desert grassland communities occur in the rain shadow of high mountains on hilly terrain in this ecoregion. In the Wyoming Basin and in the northern portions of the basin and range areas, desert grasslands are typically dominated by cool-season grasses such as bluegrasses and wheatgrasses. Wyoming big sagebrush communities commonly co-occur with desert grassland habitat in a patchwork mosaic.

Extent

- LANDFIRE (2020a) was used to determine Desert Grassland Key Habitat extent in Utah.

- Total current mapped area:
    - 155,104 acres
    - 0.29% of state surface area (see Figure 7)
    - 627.68 km^2 (242 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Inter-Mountain Basins Semi-Desert Grassland

Condition

Historically dominated by grasses, few true desert grasslands are likely to occur in excellent condition in Utah due to a combination of improper livestock grazing, fire suppression, and the presence of non-native and invasive plant species. These factors, coupled with warmer and drier conditions, have led to much of the desert grassland habitat in Utah transitioning to xeric shrub dominance, with the increase of non-native and annual grasses and forbs (such as halogeton) and the loss of biological soil crusts. Many areas now designated as desert grassland habitat in the Great Basin by LANDFIRE (EVTs) may be recently burned sagebrush or treated areas (e.g., converted to dryland agriculture). These areas have often been reseeded with non-native species (such as crested wheatgrass and intermediate wheatgrass) or invaded by cheatgrass. The non-native species' ability to outcompete native species for available soil and water resources makes restoration of the landscape very difficult.

Off-highway vehicle (OHV) recreation in these areas can also be high because the low-growing vegetation makes off-road travel relatively easy. Repeated compaction and disturbance from this activity can negatively affect vegetation vigor and cover and facilitate the introduction and spread of other non-native vegetation such as annual grasses or invasive forbs.

Changes in precipitation amount and timing, as well as temperature highs and lows (particularly higher overnight lows), can have variable effects on desert grassland habitat; however, negative effects such as increasing invasive species, decreased plant cover, increased fire return intervals, and potential flooding with higher-intensity storms are more likely.

Improving Condition

An effective strategy for management of desert grassland habitat in Utah may include the following elements:

- Prioritize use of native grasses in restoration or rehabilitation projects.

- Promote and encourage policies that reduce inappropriate grazing by domestic livestock.
- Develop and deploy techniques to diversify species composition in monoculture or near-monoculture stands of seeded non-native plants (e.g., crested wheatgrass).
- Continue the use of appropriate methods for reducing the spread and dominance of invasive weeds and annual grasses, including early detection and rapid response (EDRR) programs.
- Continue the development of native plant materials suited to this habitat.
- Enhance the prevention and suppression of ignitions in areas that have burned once, which often retain a component of recovering native vegetation and are good candidates for otherwise passive restoration.
- Support fire suppression during periods of extreme drought when damage to perennial grasses is likely.

Threats

Table 11 summarizes the threats to desert grassland habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including desert grassland habitat. White rows indicate threats that are important to desert grassland habitat but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 11. *Threat Prioritization Exercise Summary Results for Desert Grassland Key Habitat*

DESERT GRASSLAND KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas			1			
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)			1			
Mining and Quarrying				1		
Solar Power Facilities				1		

DESERT GRASSLAND KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Wind Power Facilities				1		
OHV Motorized Recreation			1			
Inappropriate Fire Frequency and Intensity		1				
Seeding Non-Native Plants			1			
Invasive Plant Species (non-native)		1				
Feral Domesticated Animals				1		
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Total	**0**	**2**	**8**	**4**	**0**	**14**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact desert grassland habitats at a fine resolution and work toward the preservation of those mapped habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess desert grassland habitat condition repeatedly through time.
- Support aggressive fire suppression during drought periods, when fire damage to perennial grasses is most likely.

Desert Shrub

Desert shrub habitat (Figure 9 and Figure 10) includes arid communities where shrubs provide a dominant characteristic, but grass and forb cover can also be notably dominant. This key habitat occupies mid- to low elevations between 853 and 2,133 m (2,800 and 7,000 feet) on

benchlands, colluvial slopes, windswept mesas, broad basins, alluvial fans, and flats that are nearly flat to moderately steep. Over half of the precipitation in this habitat occurs in the late summer as high-intensity thunderstorms, but snowfall can be an important determinant of grass and forb cover, especially in northwestern Utah.

Dominant species within desert shrub habitats vary geographically but typically include blackbrush; several sagebrush species such as Wyoming big sagebrush, budsage, and sand sagebrush; and Mormon tea. Other common shrubs include species of rabbitbrush and saltbush. As is characteristic of arid ecosystems, the dominance and composition of shrub species shift along gradients of elevation, aspect, and soil type, often forming complex and spatially variable mosaics. Desert shrub communities frequently integrate with adjacent habitat types, including salt desert shrublands and lowland sagebrush ecosystems, resulting in areas of ecological overlap and transition.

Additional shrub species commonly found in desert shrub habitats include broom snakeweed, spiny hopsage, bud sagebrush, winterfat, and horsebrush. The herbaceous layer is typically sparse; however, during years with above-average precipitation, herbaceous cover—particularly grasses and forbs—can be substantially higher. Common herbaceous species include various evening primrose species, scorpionweed species, mallow species, multiple species of locoweed, and an array of cacti. Depending on seasonal precipitation patterns, forbs can occupy a significant proportion of ground cover, with many species germinating and reproducing in early spring to exploit higher soil moisture levels. As temperatures rise and aridity increases through the summer months, forb cover typically declines quickly.

Perennial grasses present in desert shrub habitats include Indian ricegrass, blue grama, bottlebrush squirreltail, western wheatgrass, James' galleta grass, Sandberg bluegrass, muttongrass, and alkali sacaton. In relatively more mesic microsites, such as closed depressions, species such as saltgrass and basin wildrye may occur. Annual herbaceous species are seasonally present and may include trumpet buckwheat, slender phlox, and Pursh's plantain. Noxious and invasive species such as cheatgrass, Japanese brome, Russian thistle, and tamarisk can establish in more mesic areas, often displacing native vegetation and shifting community and ecosystem function.

Insect communities characteristic of desert shrub habitats, like those in desert grasslands, exhibit substantial species diversity but generally support a greater abundance of insects due to increased habitat complexity driven by structural, botanical, and temperature variation. The expanded vegetation cover, especially that of woody plants, supports a vast array of specialist and generalist herbivores, including gall-forming insects, moths, butterflies, beetles,

hemipterans, and grasshoppers. It also creates microclimates that provide shelter from wind, heat, and predators while enhancing carbon storage through accumulation of dead plant matter and organic material in soils.

As with desert grasslands, insect species diversity in desert shrub habitats remains poorly understood due to limited sampling effort. Nevertheless, these habitats also support a complex food web, with insects serving as important prey for insectivorous wildlife, key pollinators, and drivers of essential ecosystem functions. Nearly a thousand species of moth and butterfly species are associated with Utah's desert shrublands, most of which specialize on particular host plants; thus, plant diversity and abundance directly influence the availability of caterpillars, an important food source for nearly all nesting bird species. Desert shrublands have an exceptional diversity of insect pollinator species, including bumble bees, many solitary and pollen-specialist bees, flies, wasps, beetles, moths, and butterflies (Wilson et al. 2025). Many species of predatory and parasitoid insects (e.g., wasps, flies, assassin bugs, mantids, tiger beetles) help regulate prey populations and drive nutrient cycling. Detritivorous insects feeding on plant debris further enrich soil health, which improves moisture retention, plant diversity, and nutrient availability.

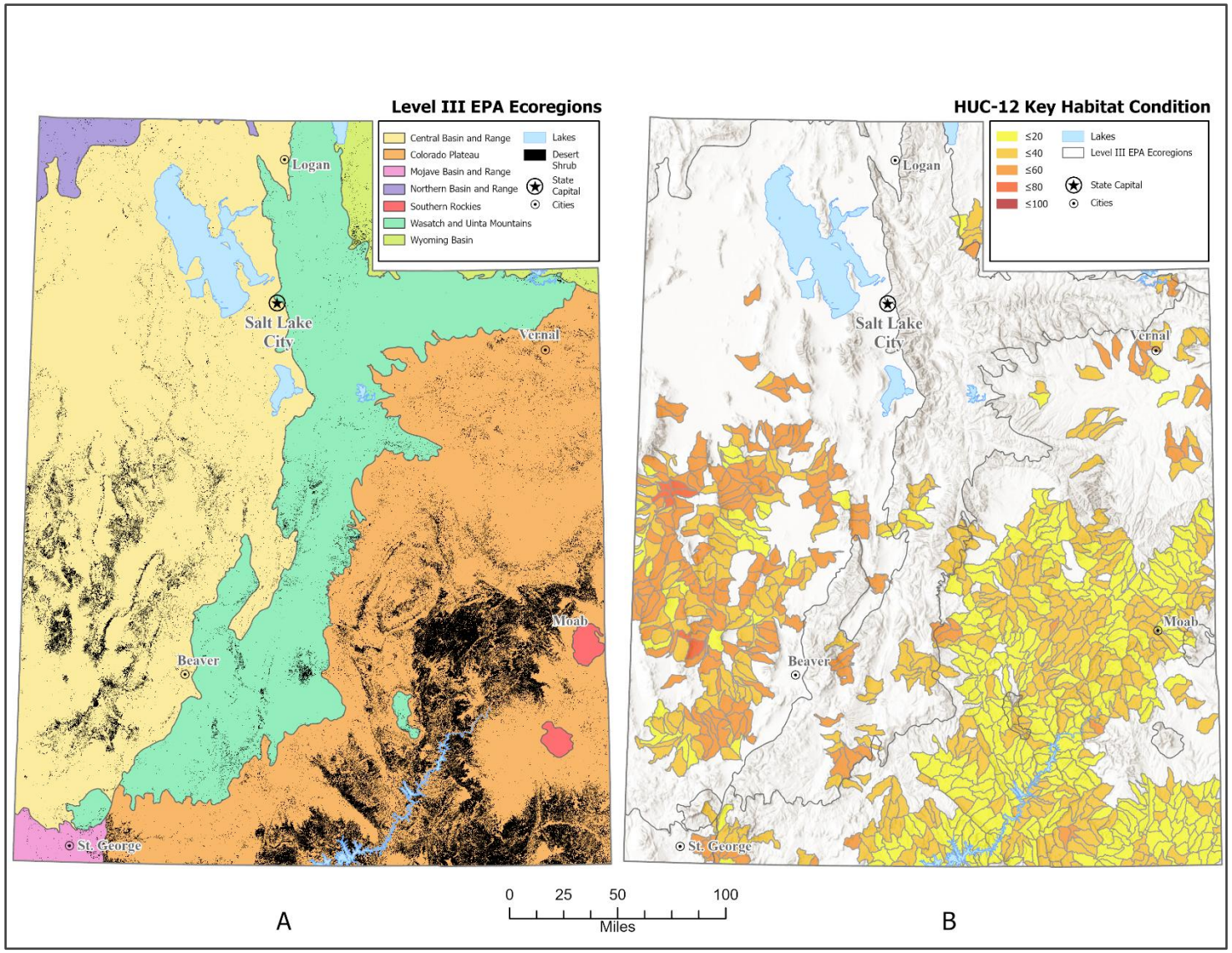


Figure 9. *(A) Desert Shrub Key Habitat Statewide Distribution (B) Ecological Departure for Desert Shrub Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 10. *Desert Shrub Habitat; San Juan County.*

Note: Photograph by Zach Coury, DWR, 2023.

Ecoregional Characteristics

Desert Shrub Key Habitat occurs within three Utah ecoregions (making up more than 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, and Wasatch and Uinta Mountains. Descriptions of desert shrub vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 18.5% of desert shrub habitat in Utah occurs within this ecoregion. The desert shrub vegetation community in this ecoregion is typically sparse. The woody layer is often a mixture of shrubs and dwarf shrubs, although sometimes it can be dominated by a single species. Characteristic species include shadscale saltbush, big sagebrush, Green's rabbitbrush, sticky-leaf rabbitbrush, joint firs, rubber rabbitbrush, broom snakeweed, and winterfat. When big sagebrush or shadscale saltbush are present, they generally do not dominate. The shrub layer can sometimes be dominated by a mixture of rabbitbrushes with interspersed cool-season grasses. In the Great Basin, this habitat type often integrates with salt desert shrub and lowland sagebrush habitats.

In the central Great Basin, this habitat can be dominated by graminoids such as bluebunch wheatgrass, Indian ricegrass, blue grama grass, saltgrass, Sandberg bluegrass, Fendler's bluegrass, alkali sacaton, needle and thread grass, James' galleta grass, and salt wheatgrass (NatureServe 2018).

Colorado Plateau

Approximately 77.3% of desert shrub habitat in Utah occurs within this ecoregion. Desert shrub vegetation in this ecoregion is most often dominated by blackbrush, with a strong component of joint fir species. An increase in sandy substrates increases the dominance of sand sagebrush. Understory cover can vary depending on parent geology, soil types, and annual precipitation patterns. This habitat type occupies basin floors, sand deserts, escarpments, canyonlands, benches, badlands, and mesas. It also occurs in deeper soils on sandy plains, where it may have invaded desert grasslands. The herbaceous layer is sparse and composed of graminoids such as Indian ricegrass, James' galleta grass, and sand dropseed (NatureServe 2018).

Wasatch and Uinta Mountains

Approximately 3.5% of desert shrub habitat in Utah occurs within this ecoregion. Desert shrub habitat in this ecoregion occupies portions of the semiarid foothill and lower-elevation valleys. Vegetation communities in the Wasatch and Uinta Mountains ecoregion often support basin big sagebrush with greasewood, rabbitbrush species, and broom snakeweed (Brooks 2012). Understories are often impacted by annual grasses (e.g., cheatgrass) and agricultural cultivars such as crested wheatgrass.

Extent

- LANDFIRE (2020a) was used to determine Desert Shrub Key Habitat extent in Utah.

- Total current mapped area:
    - 5,409,738 acres
    - 9.96% of state surface area (see Figure 9)
    - 21,892 km^2 (8,453 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Colorado Plateau Blackbrush-Mormon-Tea Shrubland
    - Inter-Mountain Basins Semi-Desert Shrub-Steppe
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Southern Colorado Plateau Sand Shrubland

Condition

Desert shrub habitats are in fair to good condition given the harsh growing conditions; invasive or weedy species sometimes have difficulty becoming established in these habitats. There are exceptions where soil conditions differ, and species such as halogeton, non-native annual grasses, and crested wheatgrass have become established. Impacts from improper historic grazing have reduced the cover of more palatable forbs and grasses, and, in some areas, improper grazing may still be limiting the cover of grasses and forbs, particularly around stock tanks and natural water sources. Given the naturally low vegetation cover, intense precipitation events (i.e., thunderstorms) can produce excessive flooding and erosion events. The ability for washes and gulches to support more well-developed riparian areas is therefore naturally limited.

Due to the naturally open terrain, OHVs can easily leave designated trails and cross open desert areas, leading to significant localized soil and vegetation disturbance. This disturbance reduces plant cover and increases susceptibility to both wind- and water-driven erosion. Existing road networks may be affected by severe erosion events and may also cause localized damage to surrounding vegetation as a result of soil erosion and deposition.

Plant and wildlife species occurring in these habitats exist in very harsh environments. Given this, periods of drought conditions or back-to-back dry years can result in a loss of perennial vegetation cover and a decrease in wildlife abundance. Even the hardiest plants need water, and long periods of drought can quickly reduce plant abundance. Most annual species can persist through a drought (as seeds), but perennial species' recovery from droughts can be prolonged.

Locally, energy development (e.g., oil and gas, renewables) and associated infrastructure, such as roads, pads, power lines, and pipelines, can impact these habitats. Given the difficult growing

conditions, revegetation of disturbed areas can take many years, and establishment of non-native vegetation can be problematic.

Improving Condition

An effective strategy for management of desert shrub habitat in Utah may include the following elements:

- Create and maintain fuel breaks to prevent wildfire from reaching unburned acres, particularly in Great Basin communities where plant cover is higher and annual grass cover is problematic. In habitat still dominated by native plant communities, enhancing the prevention and suppression of ignitions in these unburned areas should be prioritized.
- Continue the search for herbicidal agents and biological controls to use against invasive annual grasses.
- Work with federal land management agencies (e.g., the BLM and the USFS) on OHV management; engage with user groups to help better manage OHV areas to reduce wind and precipitation erosion and habitat impacts.

Threats

Table 12 summarizes the threats to desert shrub habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including desert shrub habitat. White rows indicate threats that are important to desert shrub habitat but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 12. *Threat Prioritization Exercise Summary Results for Desert Shrub Key Habitat*

DESERT SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Campground Development				1		
Trail, Trailhead, and Staging Area Development			1			
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)		1				

DESERT SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Oil and Gas Drilling				1		
Mining and Quarrying			1			
Solar Power Facilities		1				
Wind Power Facilities				1		
Roads – Transportation Network			1			
Roads – Energy Development				1		
Utility and Service Lines				1		
OHV Motorized Recreation			1			
Camping/Campground Development (dispersed)				1		
Mountain Biking				1		
Inappropriate Fire Frequency and Intensity				1		
Groundwater Pumping			1			
Invasive Plant Species (non-native)			1			
Feral Domesticated Animals				1		
Droughts			1			
Severe/Extreme Weather Events				1		
Renewable Energy Impacts			1			
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Total	**0**	**2**	**12**	**10**	**0**	**24**

Note: Level-2 and Level-3 threats are included; yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact desert shrub habitats at a fine resolution and work toward the preservation of those mapped habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess habitat condition repeatedly through time.
- Develop native plant materials for restoration.
- Work with partners and land managers to reduce unmanaged or widespread OHV impacts.

Lower Montane Mixed Conifer

Lower montane mixed conifer habitat (Figure 11 and Figure 12) includes communities occupying warmer, lower montane sites with ponderosa pine, pinyon pine, and juniper dominating the overstory at elevations between 1,188 and 2,438 m (3,900 and 8,000 feet). Although this habitat type is dominated by pinyon-juniper woodlands, it can also include notable areas of ponderosa pine woodland types. Douglas-fir, oak brush (i.e., Gambel oak), and aspen can also occur in this habitat type, but Douglas-fir and aspen are usually only present on steeper and higher-elevation, north-facing slopes. Foothills, mesas, gentle-to-steep slopes, plateaus, valleys, and ridges all may support lower montane mixed conifer habitat. In southern areas, summer monsoons generally start in July and continue through early fall, contributing substantial moisture. Snowfall in some areas also provides important moisture, which is especially important for understory forb communities. This is one of the more widespread vegetation communities in Utah.

Pinyon pine (i.e., two-needle pinyon) and Utah juniper often dominate the tree canopy in this community type. On the extreme west side of the state and into the Stansbury, Onaqui, and Sheeprock Mountains (on the Uinta-Wasatch-Cache National Forest), single-leaf pinyon can be more common than two-needle pinyon. In many areas where pinyon-juniper woodlands occur, vegetation can be dominated by somewhat shorter (less than 3.0 m [9.8 feet] tall) pinyon-juniper woodlands, creating large areas with relatively closed-canopy conditions. In more closed-canopy conditions, understory shrubs can be very infrequent but can occur in more open stands or in larger openings within stands. Associated understory shrubs can include mountain mahogany; curl-leaf mountain mahogany; and a variety of big sagebrush species, including black sagebrush, Wyoming big sagebrush, and basin big sagebrush. Other common shrubs include yellow rabbitbrush, sticky-leaf rabbitbrush, blackbrush, cliffrose, sticky laurel, and antelope bitterbrush.

Ponderosa pine forests and woodlands occur at higher elevations and in areas that receive more consistent moisture during the growing season. In Utah, monotypic stands of ponderosa pine are infrequent, but ponderosa pine can be an important forest type, especially in areas such as the Abajo Mountains, Henry Mountains, Aquarius Plateau, Escalante Mountains, Markagunt Plateau, and Kolob Terrace.

The understory can be quite sparse in more closed-canopy conditions but nonetheless can often be dominated by annual invasive grasses such as cheatgrass and Japanese brome. When a native understory component does occur, grass species include needle and thread grass, sheep fescue, Great Basin wildrye, blue grama grass, James' galleta grass, bluebunch wheatgrass, Sandberg bluegrass, or muttongrass.

Understory forb species can be an important habitat component, and most species bloom in the spring to take advantage of post-snowmelt soil moisture. Common understory forbs include Indian paintbrush, a variety of prickly pear species, phlox species, buckwheat species, and manyflowered stoneseed.

Complex insect communities associated with lower montane mixed conifer habitat play a multitude of roles that profoundly influence ecosystem function and resilience. Foliar insect communities, including herbivorous insects such as caterpillars, aphids, and leaf and bark beetles, directly affect tree and shrub health by feeding on leaves, needles, and stems. Although herbivory can sometimes stress vegetation (especially in conjunction with drought conditions), moderate levels often stimulate plant defenses, promote greater genetic diversity, and influence community structure and successional dynamics. Insect herbivores also serve as an essential food source for higher trophic levels, supporting a wide range of insectivorous birds, mammals, reptiles, and other arthropods.

Ground-dwelling arthropods, including beetles, ants, millipedes, and decomposer species such as isopods, hover flies, and springtails, play critical roles in nutrient cycling and soil formation. These organisms break down humus (horizons of accumulated plant material) and other organic matter on the forest floor, accelerating decomposition processes that return nutrients to the soil. Their activity enhances soil structure, promotes aeration, increases water infiltration, and supports the establishment and health of both conifer and broadleaf vegetation.

Pollinating insects—such as bees, flies, butterflies, moths, beetles, and wasps—contribute significantly to the reproduction and genetic diversity of many understory plants and some flowering trees within these woodlands. Successful pollination enhances plant community richness and resilience, which in turn supports broader food webs and habitat complexity. By linking these multiple pathways—herbivory, decomposition, and pollination—complex insect communities are fundamental to maintaining the diversity, productivity, and long-term stability of lower montane mixed conifer habitat.

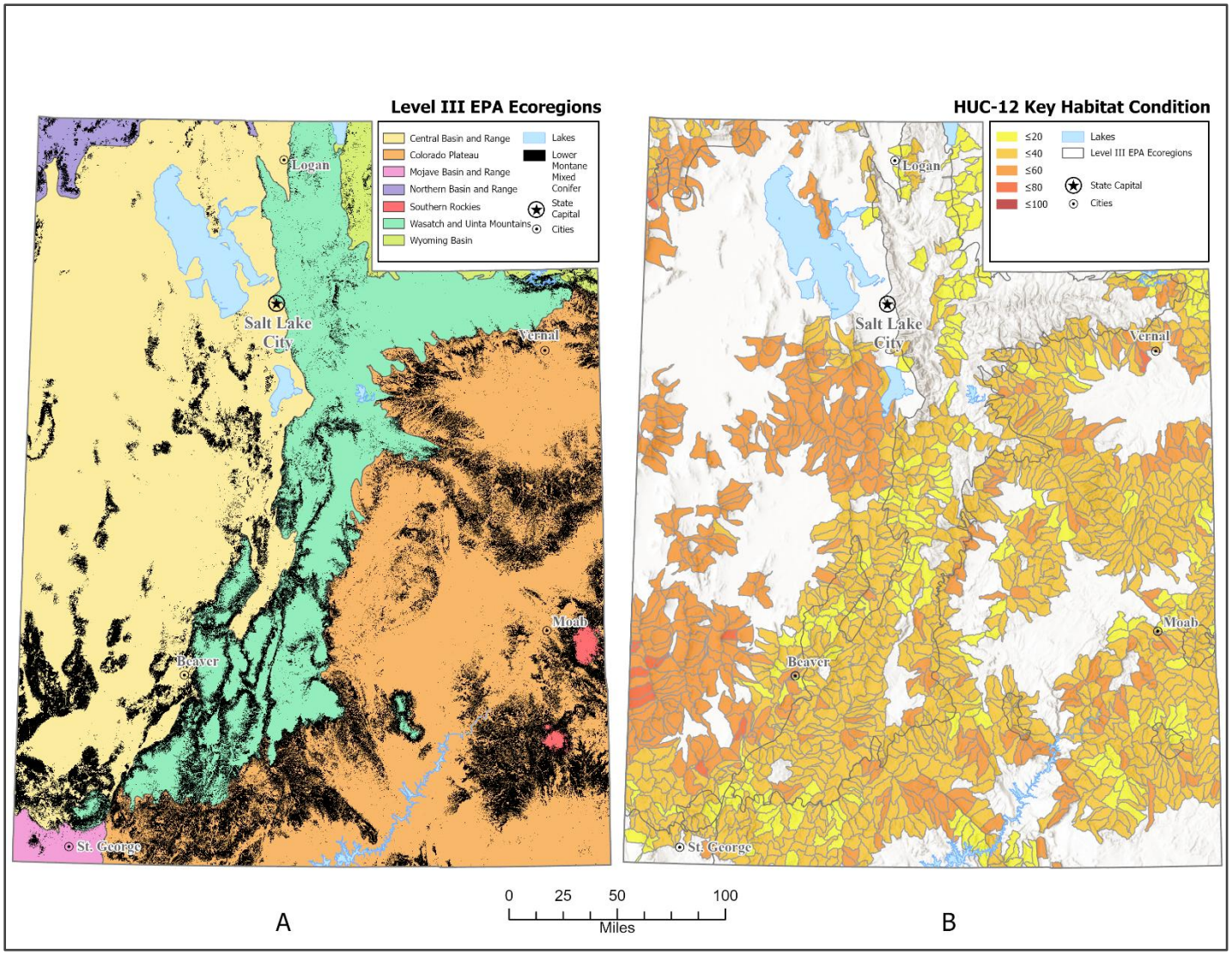


Figure 11. *(A) Lower Montane Mixed Conifer Key Habitat Statewide Distribution (B) Ecological Departure for Lower Montane Mixed Conifer Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 12. *Lower Montane Mixed Conifer Habitat; Wayne County*

Note: Photograph by Zach Coury, DWR, 2023.

Ecoregional Characteristics

Lower Montane Mixed Conifer Key Habitat occurs within four of Utah's ecoregions (making up more than 1% of each ecoregion): Central Basin and Range, Colorado Plateau, Northern Basin and Range, and Wasatch and Uinta Mountains. Descriptions of lower montane mixed conifer vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 21.2% of lower montane mixed conifer habitat in Utah occurs within this ecoregion. Lower montane mixed conifer habitat in this ecoregion is in rocky and rugged terrain and generally does not form large monocultures but is interspersed with sagebrush communities. At lower elevations it can transition into more xeric shrublands (e.g., greasewood or saltbush shrublands). Lower montane mixed conifer habitat is positioned between the drier, lower salt deserts and saline-sagebrush basins and the higher, wetter oak brush shrublands or aspen-conifer habitat.

Colorado Plateau

Approximately 56.1% of lower montane mixed conifer habitat in Utah occurs within this ecoregion. Lower montane mixed conifer habitat occupies the northern slopes of the Uinta Basin as well as portions of escarpments surrounding the Tavaputs Plateau, the Abajo Mountains, the Book Cliffs, and Grand Staircase National Monument. High numbers of perennial streams and outwash deposits set the lower montane mixed conifer habitat in this ecoregion apart from the basin floor, sand-shale deserts, and canyonlands occurring on the Colorado Plateau. Climatic events such as snowfall, frosts, and droughts are believed to limit the distribution of pinyon-juniper woodlands to altitudinal belts on mountainsides. Ponderosa pine forests and woodlands are common in this ecoregion.

Northern Basin and Range

Approximately 1.2% of lower montane mixed conifer habitat in Utah occurs within this ecoregion on mountain hills, slopes, and alluvial fans. Pinyon pine is generally less common as it reaches the northern extent of its range, and understory grasses become more common. Lower montane mixed conifer vegetation in this ecoregion occupies the belt between the high-elevation forests and lower sagebrush and salt desert shrublands.

Wasatch and Uinta Mountains

Approximately 19.7% of lower montane mixed conifer habitat in Utah occurs within this ecoregion. Lower montane mixed conifer vegetation occupies the lower montane zones of this ecoregion, including lower portions of the high plateaus and the semiarid foothills. Juniper and pinyon are common, although a maple-oak scrub matrix is increasingly common toward the northern parts of the state.

Extent

- LANDFIRE (2020a) was used to determine Lower Montane Mixed Conifer Key Habitat extent in Utah.
- Total current mapped area:
    - 10,394,733 acres
    - 19.13% of state surface area (see Figure 11)
    - 42,066 km^2 (16,242 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Rocky Mountain Foothill Limber Pine-Juniper Woodland

- Colorado Plateau Pinyon-Juniper Shrubland
- Colorado Plateau Pinyon-Juniper Woodland
- Great Basin Pinyon-Juniper Woodland
- Inter-Mountain Basins Juniper Savanna
- Southern Rocky Mountain Ponderosa Pine Savanna
- Southern Rocky Mountain Ponderosa Pine Woodland

Condition

Lower montane mixed conifer stands can vary in condition depending on site specificity. In many places they are becoming denser, with relatively uniform closed canopies, shorter-statured trees, and decadent or poor-quality ponderosa pine forests covering large areas. This is due to a number of factors, including a complex relationship between livestock grazing (which in the past has reduced the cover of many understory grasses and forbs and has favored pinyon-juniper seedling establishment) and modified wildfire return intervals. In ponderosa pine forests, areas inaccessible to mechanical harvesting (i.e., logging) or infrequent wildfire or prescribed fire events have resulted in decadent stand types of stunted or smaller pole-sized ponderosa pine, often with pinyon pine, juniper, Douglas-fir, or aspen co-occurring. Historically, grasses and forbs would have carried wildfire through woodlands, creating a more diverse mosaic of this habitat type. Now the uniform, closed-canopy stands are often dominated by annual grass understories in pinyon-juniper woodlands and support high-severity wildfires that can dramatically shift this habitat type to an early seral grassland (often dominated by invasive annuals) or a shrub-scrub habitat type.

Additionally, due to a combination of stand overstocking and more frequent and severe drought events, lower montane mixed conifer habitat is often affected by population outbreaks of bark beetles and other native forest insects. Pinyon pine, mountain pine, and Douglas-fir—along with, less commonly, Utah juniper—can experience significant stress and tree mortality associated with insects such as ips beetles and mountain pine beetles. For example, pine sawflies have recently affected pinyon pines in the Uinta Basin. Although healthy pinyon pines can often recover from sawfly outbreaks, dense, overstocked stands can leave trees more vulnerable to damage, leading to increased mortality from sawfly larvae.

Reintroducing wildfire or prescribed fire to both improve habitat and reduce fuel loading is becoming increasingly difficult due to many stands having high dead fuel loading and closed-canopy conditions. Even with lower-severity prescribed fires, annual grasses can quickly take advantage of improved growing conditions and further decrease native forb, grass, and

understory shrub cover and diversity. In some areas, long-term and/or severe short-term drought conditions can directly or indirectly cause pinyon pine mortality, mostly due to insect (e.g., bark beetles) outbreaks. These events seem to impact pinyon pine more than junipers.

Recent Utah Department of Natural Resources Watershed Restoration Initiative work to reduce pinyon-juniper cover has reduced the risks of high-severity wildfire across thousands of acres. Pinyon-juniper management efforts can substantially reduce the risks of high-severity wildfire that inevitably negatively impact other habitats, usually due to post-fire annual grass (and other noxious weed) infestations and erosion and debris flow events. Pinyon-juniper management efforts have focused on the encroachment of pinyon-juniper into sagebrush systems. More can be learned about best management practices for mature pinyon-juniper stands that continue to infill, resulting in closed canopies, less productivity for understory species, and greater fire risk.

Other threats to lower montane mixed conifer habitat include oil and gas exploration and development (which is generally limited to existing, known fields). Impacts associated with oil and gas development include permanent impacts from roads and pad sites as well as short-term and indirect impacts from pipeline construction and the spread of noxious weeds.

Feral horses can be problematic for understory species cover and diversity in some areas of Utah. Management of wild horses is primarily under the authority of the BLM, and wild horse management is extremely difficult and highly controversial.

Improving Condition

An effective strategy for management of lower montane mixed conifer habitat in Utah may include the following elements:

- Use a variety of mechanical treatments for closed-canopy woodlands to reduce fuel loading and create canopies that are more open. Lower montane mixed conifer stand management often thins or uproots and kills trees. A variety of mechanical treatments, including chaining and mastication, will be an important tool to reduce fuel loading and create more open canopies. These treatments have been shown to improve habitat for sage-grouse species.
- Support mastication (or chipping/grinding) of dense trees or commercial harvest for forest products (e.g., fence timbers, firewood) to reduce closed-canopy conditions. Once fuel breaks and lower fuel loading are established, lower-severity prescribed fire can help improve stand health and improve understory plant cover and diversity. These treatments can be expensive, and invasive annual grasses will always be a threat; timely and aggressive treatment of annual grasses should accompany any stand management.

- Reduce the risks of wildfire. Although lower montane mixed conifer habitat does not commonly support perennial waters, intermittent tributaries flow through this habitat toward important downstream habitats. High-severity wildfire in this community type can increase the risk of post-fire flood and debris flows, which will negatively impact downstream water supplies and mesic wildlife habitats.
- Continue the use of appropriate methods to reduce the spread and dominance of invasive weeds, including EDRR programs.
- Continue the search for herbicidal agents and biological controls to use against invasive annual grasses.
- Continue the search for effective plant restoration materials and methods that can be affordably translated from the research plot scale to the operational project scale.
- Continue the development of new plant materials, especially native forbs, for understory habitat restoration or post-fire revegetation.
- Promote management that includes seeding a diversity of grasses, forbs, and shrubs that will lead to increased resiliency and resistance in the plant community.
- Promote and fund restoration that reduces monotypic or overstocked stand conditions, including cutting or mulching of pinyon and juniper trees and herbicide or mechanical treatment of non-native invasive species.
- Continue monitoring conditions of pinyon-juniper woodlands that have been thinned or treated to reduce fuel loading.

Threats

Table 13 summarizes the threats to lower montane mixed conifer habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including lower montane mixed conifer habitat. White rows indicate threats that are important to lower montane mixed conifer habitat but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 13. *Threat Prioritization Exercise Summary Results for Lower Montane Mixed Conifer Key Habitat*

LOWER MONTANE MIXED CONIFER KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas				1		
Campground Development				1		
Trail, Trailhead, and Staging Area Development				1		
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)		1				
Oil and Gas Drilling			1			
Mining and Quarrying				1		
Roads – Transportation Network				1		
Roads – Energy Development			1			
Utility and Service Lines				1		
Improper Forest Management				1		
OHV Motorized Recreation				1		
Camping/Campground Development (dispersed)				1		
Mountain Biking				1		
Inappropriate Fire Frequency and Intensity		1				
Post-Fire Precipitation/Flooding (resulting water quality issues)			1			
Groundwater Pumping				1		
Brush Eradication/Vegetation Treatments				1		
Seeding Non-Native Plants				1		
Invasive Plant Species (non-native)			1			
Feral Domesticated Animals			1			
Insects – Alien Organisms					1	
Problematic Insects (native)					1	

LOWER MONTANE MIXED CONIFER KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Droughts			1			
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Plant Material Development			1			
Total	**0**	**2**	**11**	**13**	**2**	**28**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact lower montane mixed conifer habitats at a fine resolution and work toward the preservation of those mapped habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess lower montane mixed conifer habitat condition repeatedly through time.
- Prioritize treatments by understanding where juniper invasion of other habitats (such as sagebrush habitats) is occurring and differentiate legacy stands or stands that have old-growth characteristics that are desirable to conserve.
- Work with land managers to help fund fuel loading reduction projects.

Lowland Sagebrush

Lowland sagebrush habitat (Figure 13 and Figure 14) encompasses semiarid sagebrush communities, including open shrublands, steppe, rocky hillslopes, canyons, and ridges. These habitats are commonly found on level benches and in basins, often in proximity to lower montane mixed conifer forests. At lower elevations, they may transition into or overlap with salt desert shrub, desert shrub, and desert grassland communities. At mid-elevations, lowland sagebrush habitats often intermingle with pinyon-juniper woodlands, which may extend to higher elevations. Toward the upper elevational range, they can also intergrade with mountain sagebrush, mountain shrublands, and montane forests dominated by mixed conifer and aspen.

The typical elevational range for lowland sagebrush habitat spans approximately 792 to 1,828 m (2,600–6,000 feet).

Dominant species include basin big sagebrush and/or Wyoming big sagebrush, and on more well-drained sites (with coarser soils), black sagebrush and low sagebrush can occur. Other shrubs can include saltbush species, Mormon tea species, spiny hopsage, bud sagebrush, and horsebrush species. Rubber rabbitbrush and broom snakeweed are common on drier sites and sticky-leaf rabbitbrush and antelope bitterbrush are more common on wetter sites.

The herbaceous layer is often sparse (less than 25% of vegetation cover) and composed of perennial grasses such as Indian ricegrass, blue grama grass, bottlebrush squirreltail, thick-spike wheatgrass, sheep fescue, needle and thread grass, Great Basin wildrye, and James' galleta grass. At higher elevations and in wetter sites, western wheatgrass, Sandberg bluegrass, or bluebunch wheatgrass are common.

Given the lower elevations of this habitat, forbs are more seasonal. Blooming and reproduction occur in the early spring, and then most forbs quickly desiccate and do not make up much of the understory later in the season. Drier conditions make this system less resistant and resilient to disturbance such as invasion by annual grasses. Invasive forbs such as halogeton can be widespread. In areas where past mowing or chaining was followed by the planting of crested wheatgrass, understories may now be heavily dominated by crested wheatgrass.

Insect communities within lowland sagebrush ecosystems vary across both temporal and spatial scales, with many species closely associated with specific plant hosts and environmental conditions such as warmer temperatures and adequate humidity. Notably diverse insect groups include gall-forming species that rely on sagebrush and other shrub hosts, as well as a variety of herbivorous, predatory, and pollinating insects (Spawton and Wetzel 2015). Pollinator communities are particularly diverse and include numerous species of bees, butterflies and moths, beetles, and flies. Importantly, non-bee pollinators contribute valuable pollination services in sagebrush habitats, especially during the hottest periods of the year when bee activity may decline (Rohde and Pilliod 2021). These insect populations also form a critical component of the food web, serving as a primary food source for many bird species—particularly during the nesting season when protein demands are high (BLM 2004). Additionally, insect and arthropod diversity in sagebrush habitats is shaped by ecological interactions such as moderate grazing by ungulates like mule deer and pronghorn. These grazing patterns can influence plant structure and composition, thereby affecting insect habitat and food availability. Decomposer insects—such as flies, wasps, and carrion beetles—also contribute to ecosystem function by breaking down carcasses, recycling nutrients, and supporting secondary food webs (Torma et al. 2023).

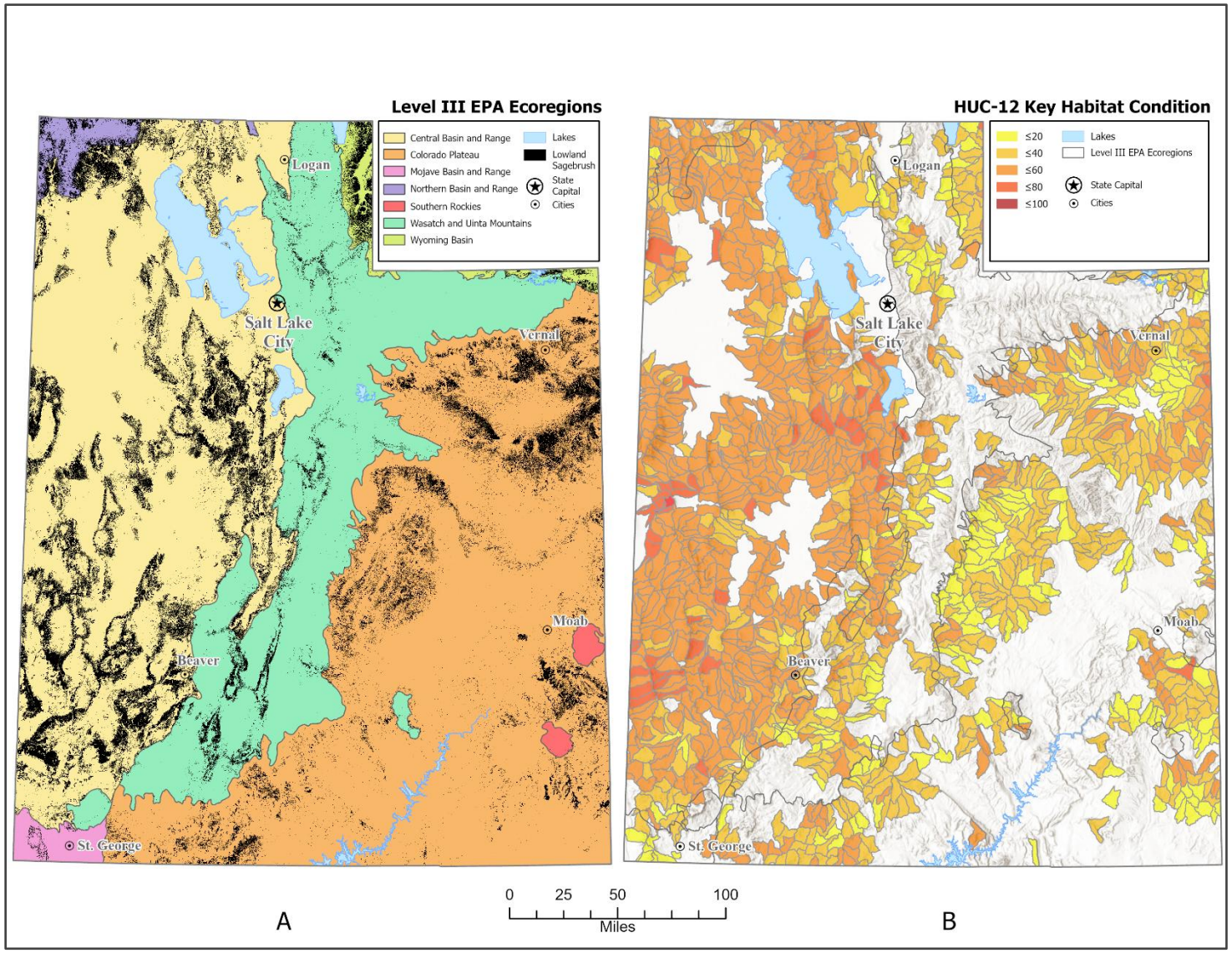


Figure 13. *(A) Lowland Sagebrush Key Habitat Statewide Distribution (B) Ecological Departure for Lowland Sagebrush Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 14. *Lowland Sagebrush Habitat; Beaver County*

Note: Photograph by Steve Fuller, SWCA Environmental Consultants, 2023.

Ecoregional Characteristics

Lowland Sagebrush Key Habitat occurs in five Utah ecoregions (making up more than 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, Northern Basin and Range, Wasatch and Uinta Mountains, and Wyoming Basin. Descriptions of lowland sagebrush vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 56.2% of lowland sagebrush habitat in Utah occurs within this ecoregion. Lowland sagebrush sites are dominated by basin big sagebrush and Wyoming big sagebrush, but perennial bunchgrasses do occur and become increasingly common in more northerly areas as available moisture increases. The sagebrush basins and slopes include valleys, alluvial fans, and mountain flanks that are not as saline nor as arid as salt deserts or saline basins. This habitat is generally less rocky, rugged, and wooded than the woodland and shrub-covered low

mountains and is not as level as the salt deserts or saline basins. Invasion and conversion to annual grasslands following wildfire events is highly common, and thousands of acres are now effectively converted to annual grasslands.

Colorado Plateau

Approximately 30.4% of lowland sagebrush habitat in Utah occurs within this ecoregion. Lowland sagebrush sites are generally below 1,798 m (5,900 feet) on broad, shrub-covered benches and mesas. Dominant species include Wyoming big sagebrush and basin big sagebrush in swales and depressions. Understory grasses are similar to previous descriptions. Forbs often include globemallow, cacti, longleaf phlox, spiny phlox, death camas, stone crop, Indian paintbrush, stoneseed, and western sticktight. Annual grasses and crested wheatgrass can also be very common.

Northern Basin and Range

Approximately 2.6% of lowland sagebrush habitat in Utah occurs within this ecoregion. Lowland sagebrush habitat in this ecoregion occurs as sagebrush steppe and occupies gentle slopes of unforested terraces, basin rims, valley bottoms, and alluvial fans, primarily south of the Raft River Mountains. Much of the lowland sagebrush habitat in this area has been converted to annual grasslands (by wildfire and passive invasion) as well as dryland and irrigated agricultural fields.

Wasatch and Uinta Mountains

Approximately 6.7% of lowland sagebrush habitat in Utah occurs within this ecoregion and can be found in both the semiarid foothill and mountain valley subregions. Vegetation associates can be variable and may include mountain brush species (e.g., pinyon pine, Utah juniper, Gambel oak) or lower and drier species, such as basin big sagebrush.

Wyoming Basin

Approximately 2.6% of lowland sagebrush habitat in Utah occurs within this ecoregion. Lowland sagebrush habitat occurs in an elevational band below mountain sagebrush communities, generally abutting agricultural fields. This habitat mostly occurs on the lower ends of hillslopes along the Monte Cristo and Wasatch ranges. These sites are typically windy and contain shallow, rocky soils that support mostly short shrubs (less than 30 cm [approximately 12 inches] tall). Cool-season grasses and invasive annual grasses are common.

Extent

- LANDFIRE (2020a) was used to determine Lowland Sagebrush Key Habitat extent in Utah.
- Total current mapped area:
    - 6,468,147 acres
    - 11.90% of state surface area (see Figure 13)
    - 26,176 km^2 (10,106 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Colorado Plateau Mixed Low Sagebrush Shrubland
    - Great Basin Xeric Mixed Sagebrush Shrubland
    - Inter-Mountain Basins Big Sagebrush Shrubland
    - Inter-Mountain Basins Big Sagebrush Steppe
    - Wyoming Basins Dwarf Sagebrush Shrubland and Steppe

Condition

In general, lowland sagebrush habitats are in moderate to poor condition, primarily due to invasion by annual grasses, historic livestock grazing, pinyon-juniper encroachment, and repeated drought events. With annual grass invasion (either passive or post-wildfire), control is difficult and retreatment may be necessary. Annual grass can also reduce recruitment of sagebrush. Repeated wildfire events, particularly in the Great Basin ecoregion, have effectively converted thousands of acres of lowland sagebrush habitat to annual grasslands.

To improve livestock grazing and combat erosion, thousands of acres of lowland sagebrush habitat were historically seeded with crested wheatgrass and other introduced grasses. Although this perennial grass is palatable to livestock and some wildlife species, it often outcompetes native forbs and perennial grasses. This competitive displacement reduces habitat quality for several nongame wildlife species, as well as for local endemics such as greater sage-grouse and Gunnison sage-grouse, which rely heavily on native forbs and the associated insect community for forage. The resulting decline in plant diversity has led to cascading ecological effects, including reduced ecosystem productivity, resilience, and overall species richness in many sagebrush systems (U.S. Department of the Interior 2017).

Lowland sagebrush communities are particularly vulnerable to drought, because many occur at the lower, drier end of the elevational range for typical sagebrush-associated species, including

forbs and perennial grasses. Prolonged drought can cause die-offs of these native species, leading to sparse understories that are more prone to invasion by annual grasses and noxious weeds. In severe cases, sagebrush itself may experience widespread mortality. Drought also increases the frequency and intensity of wildfire, which can further degrade these habitats by converting them to annual grasslands.

In the context of these climatic stressors, livestock grazing can exacerbate declines in perennial forbs and grasses. This further diminishes available forage and cover for wildlife, particularly for wintering big game species such as elk, mule deer, and pronghorn, as well as for sage-grouse species that depend on diverse native understories.

Additional habitat pressures arise from energy development. In areas such as the Uinta Basin and eastern Utah, oil and gas activities—including road and well pad construction and temporary pipeline disturbances—directly impact sagebrush habitat. Given ongoing drought conditions, these disturbances often require extended periods for successful revegetation or reclamation and are frequently complicated by the spread of invasive annual grasses and other noxious weeds.

Renewable energy development, particularly utility-scale solar projects, also poses a threat to lowland sagebrush ecosystems. These projects can result in the direct conversion of large habitat areas to renewable energy development, rendering them unsuitable for native wildlife and reducing overall ecological functionality of the landscape.

Improving Condition

An effective strategy for management of lowland sagebrush habitat in Utah may include the following elements:

- Support federal and state land managers in aggressively suppressing wildfires in lowland sagebrush habitat. If wildfires do occur, ensure that revegetation seed mixes are appropriate, will not create additional issues, and contain appropriate sagebrush seed.
- Use effective fuel breaks to help protect intact sagebrush areas.
- Continue with pinyon-juniper encroachment mitigation, where appropriate. Early treatment when trees are small is more cost effective and causes less disturbance.
- Work with federal and state land managers to appropriately site oil and gas and renewable projects outside more intact or effective lowland sagebrush habitat.

Threats

Table 14 summarizes the threats to lowland sagebrush habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including lowland sagebrush habitat. White rows indicate threats that are important to lowland sagebrush habitat but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 14. *Threat Prioritization Exercise Summary Results for Lowland Sagebrush Key Habitat*

LOWLAND SAGEBRUSH KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas			1			
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)		1				
Well Pad Development				1		
Sand and Gravel				1		
Oil Shale				1		
Solar Power Facilities			1			
Wind Power Facilities				1		
Roads – Energy Development				1		
Utility and Service Lines				1		
OHV Motorized Recreation				1		
Camping/Campground Development (dispersed)				1		
Inappropriate Fire Frequency and Intensity	1					
Post-Fire Precipitation/Flooding (resulting water quality issues)				1		
Groundwater Pumping				1		

LOWLAND SAGEBRUSH KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Brush Eradication/Vegetation Treatments			1			
Seeding Non-Native Plants		1				
Invasive Plant Species (non-native)	1					
Feral Domesticated Animals			1			
Problematic Plant Species (native upland)		1				
Ecosystem Encroachment			1			
Droughts		1				
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Plant Material Development			1			
Total	**2**	**4**	**9**	**10**	**0**	**25**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact lowland sagebrush habitat at a fine resolution and work toward the preservation of those mapped habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess lowland sagebrush habitat condition repeatedly through time.
- Manage pinyon-juniper encroachment.
- Develop native plant materials for restoration.
- Support research and management of invasion by annual grasses.

Mojave Desert Shrub

Mojave desert shrub habitat (Figure 15 and Figure 16) occupies the transitional zone between the Sonoran Desert to the south and the cooler Great Basin Desert to the north. This key habitat

is characterized by lower elevations, hotter temperatures, and drier conditions compared to other desert regions in Utah. Vegetation is often sparse, with large expanses of barren ground, and plant community composition varies based on elevation, aspect, and soil type.

Dominant vegetation includes creosote bush, burrobush, blackbrush, and, in Utah's southwestern corner, western Joshua tree. Succulents such as species of prickly pear, cholla, and California barrel cactus are especially common on slopes. Other prevalent species include saltbush species and broom snakeweed.

This habitat occurs at elevations between 670 and 1,371 m (2,200 and 4,500 feet) and across a range of landforms, including basins, washes, bajadas, alluvial fans, valleys, rocky canyons, rocky outcrops, and transitional zones between desert lowlands slopes and evergreen shrublands. At lower elevations, creosote bush and burrobush dominate, and blackbrush and turbinella oak become more prominent at higher elevations. Joshua trees are localized to Utah's southwestern boundary. Annual precipitation is highly variable, with summer monsoon rains playing a key role in the emergence of annual forbs. Compared to Great Basin sagebrush communities, Mojave shrublands are more drought-tolerant but less so than pure saltbush- or creosote bush–dominated systems. Adjacent vegetation includes sagebrush shrublands at upper elevations and creosote bush or saltbush-greasewood communities at lower elevations and in more alkaline soils.

Insect diversity in the Mojave desert shrub habitat is closely tied to vegetation composition and shaped by extreme climatic conditions. Many pollinators exhibit specialized relationships with specific plant species. For example, certain bees collect pollen, resin, or plant materials to construct nests and rear offspring. Moth and butterfly larvae, as well as some beetles and gall-forming insects, rely on particular host plants to complete their life cycles.

Several plant genera serve as keystone resources, supporting a high number of specialist and generalist insect species. These include rabbitbrush, sagebrush, creosote bush, dogbane, biscuitroot, desert marigold, buckwheat, milkweed, yucca, penstemon, primrose, thistle, fleabane, snakeweed, gumweed, jimsonweed, prince's plume, scorpionweed, locoweed, trefoil, lupine, and globemallow. Notably, the decaying trunks of Joshua trees provide essential nesting for carpenter bees and several rare bee species. The pronuba moth, an obligate pollinator of yucca, is critical for yucca reproduction, with its larvae developing within the flowers it pollinates. Many other plant species characterize Mojave desert shrub habitat, including Nevada Mormon tea, desert almond, winterfat, and redberry desert-thorn, and the herbaceous layer may be composed of big galleta, bush muhly, false fluffgrass, broom spurge, three-awn grass, cat's eye, and other perennial grass species.

Pollination services are provided by a wide array of insects, including bees, butterflies, moths, flies, beetles, and wasps, which together support the rich plant diversity of Mojave desert shrub habitat. Herbivorous insects—such as aphids, grasshoppers, crickets, camel crickets, cicadas, and various beetles—as well as detritivores like millipedes, form an essential food base for a variety of desert wildlife. Predatory and parasitic insects and arthropods, including wasps, flies, cuckoo bees, scorpions, tarantulas, mites, and beetles (including glowworm fireflies), contribute to population regulation and nutrient cycling.

The complex and often ephemeral relationships between insect species and native plants drive ecosystem processes and define the structure and function of Mojave desert shrub communities. These interactions are critical to the resilience and biodiversity of this arid and uniquely adapted ecosystem.

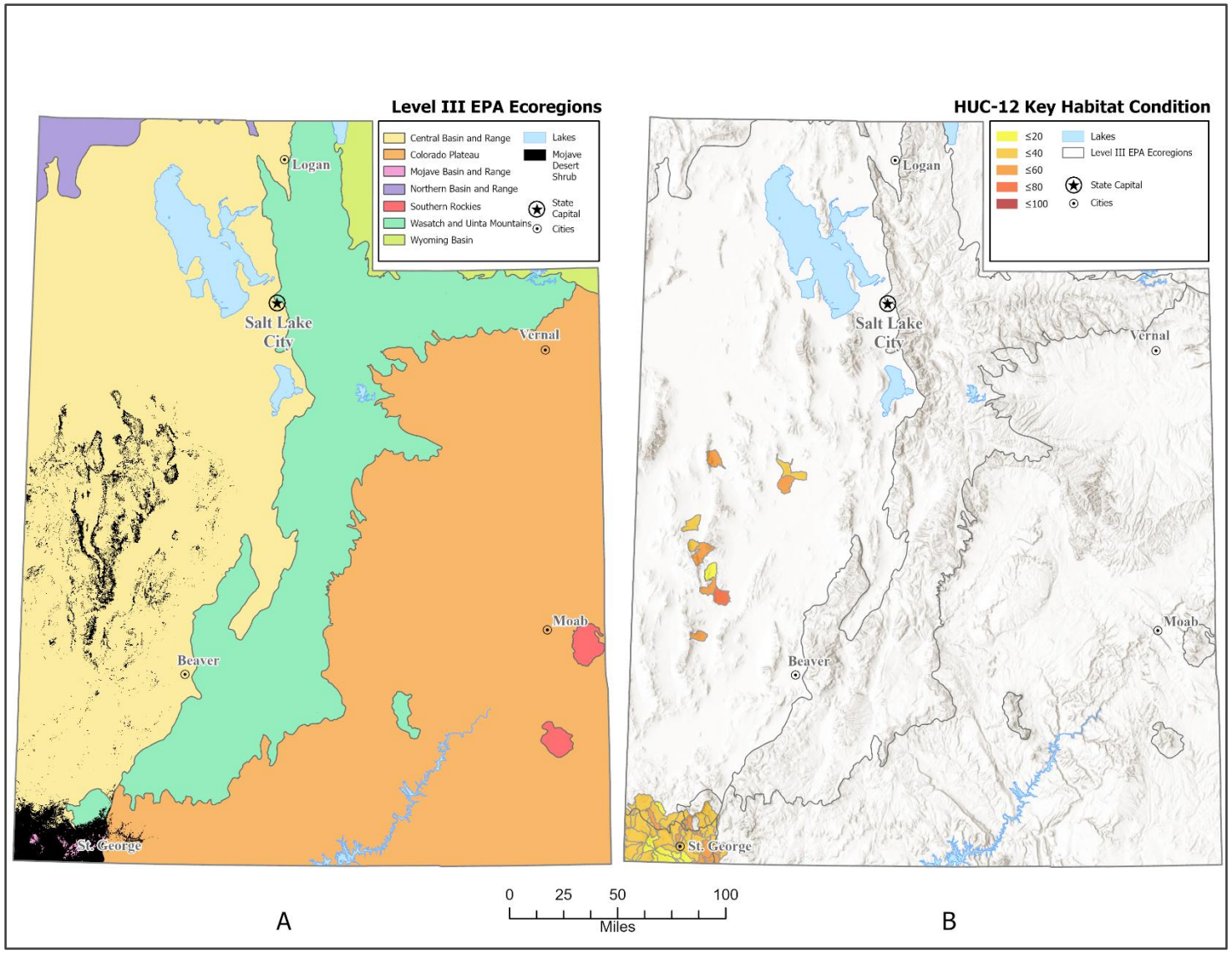


Figure 15. *(A) Mojave Desert Shrub Key Habitat Statewide Distribution (B) Ecological Departure for Mojave Desert Shrub Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 16. *Mojave Desert Shrub Habitat; Washington County*

Note: Photograph by Zach Coury, DWR, 2024.

Ecoregional Characteristics

Mojave Desert Shrub Key Habitat lies at the convergence of three of Utah's ecoregions: Central Basin and Range, Colorado Plateau, and Mojave Basin and Range. Given this, the LANDFIRE descriptions of Mojave desert shrub habitat likely do not encapsulate vegetation diversity because diversity greatly increases in the overlap of these three ecoregions. Descriptions of Mojave desert shrub vegetation communities in these ecoregions are below. A description of this key habitat within the Colorado Plateau ecoregion was not included due to the small extent of the Colorado Plateau ecoregion in Utah.

Central Basin and Range

Approximately 23.5% of Mojave desert shrub habitat in Utah occurs within this ecoregion. In this ecoregion, Mojave desert shrub habitat is slightly cooler in the summer and driven more by winter precipitation than its namesake desert farther south. These areas typically contain more salt-tolerant species, such as winterfat, and often have a slightly more herbaceous understory that includes grasses such as Indian ricegrass, James' galleta grass, and Sandberg bluegrass.

Mojave Basin and Range

Approximately 74.5% of Mojave desert shrub habitat in Utah occurs within this ecoregion. Mojave desert shrub vegetation communities in this ecoregion can be expansive, continuous, and occupy a full range of topography, including basins, foot slopes, and lower woodlands. Vegetation varies with elevation, with creosote bush and burrobush dominating lower elevations; blackbrush, cholla, and perennial grasses dominating middle elevations; and a strong presence of turbinella oak and pinyon-juniper woodlands in the highest Mojave desert shrub habitat in this ecoregion.

Extent

- LANDFIRE (2020a) was used to determine Mojave Desert Shrub Key Habitat extent in Utah.
- Total current mapped area:
    - 416,299 acres
    - 0.77% of state surface area (see Figure 15)
    - 1,684 km^2 (650 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Sonora-Mojave Creosote Bush-White Bursage Desert
    - Sonora-Mojave Mixed Salt Desert Scrub
    - Sonora-Mojave Semi-Desert Chaparral

Condition

Mojave desert shrub habitat makes up less than 1% of the Utah landscape but supports a number of SGCN species that occur in southwestern Utah. The increase in human population and associated development in the city of St. George, Utah, has translated into a sizeable direct loss of habitat and larger areas of indirect impacts through recreation (e.g., hiking, OHV use) and water diversion and use. The area continues to experience high levels of development that will likely result in more habitat loss.

Mojave desert shrub habitat has experienced a rapid increase in annual grasses (e.g., red brome, cheatgrass, common Mediterranean grass). These annual grasses provide continuous fuel for wildfire in this ecosystem, which is not adapted to wildfire, much less wildfire with the high frequency and intensity that has been occurring in the last few decades.

The combination of frequent wildfires, drought, and increasing temperature has decreased the resilience of this habitat. Additionally, restoration efforts are particularly difficult and resource intensive in the harsh conditions of the Mojave Desert.

Long-term, low-density livestock grazing has likely reduced the cover of perennial grasses and some more palatable forb species in this habitat.

Improving Condition

An effective strategy for management of Mojave desert shrub habitat in Utah may include the following elements:

- Prevent and suppress ignitions in unburned areas.
- Promote zoning, policies, and laws that lead to responsible human intrusion and development.
- Promote policies that reduce inappropriate grazing by domestic livestock.
- Continue to research herbicides and biological controls that may be used against invasive annual grasses.

Threats

Table 15 summarizes the threats to Mojave desert shrub habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including Mojave desert shrub habitat. White rows indicate threats that are important to Mojave desert shrub habitat but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 15. *Threat Prioritization Exercise Summary Results for Mojave Desert Shrub Key Habitat*

MOJAVE DESERT SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas		1				
Trail, Trailhead, and Staging Area Development			1			
Improper Grazing – Livestock (current)		1				

MOJAVE DESERT SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Improper Grazing – Livestock (historic)		1				
Hardrock Minerals				1		
Solar Power Facilities			1			
Roads – Transportation Network				1		
Pipelines/Powerlines – Energy Development				1		
Excessive Harvest – Unregulated/Illegal				1		
OHV Motorized Recreation		1				
Camping/Campground Development (dispersed)			1			
Hiking/Foot Travel				1		
Mountain Biking			1			
Inappropriate Fire Frequency and Intensity	1					
Post-Fire Precipitation/Flooding (resulting water quality issues)			1			
Groundwater Pumping				1		
Invasive Plant Species (non-native)	1					
Droughts		1				
Temperature Extremes			1			
Severe/Extreme Weather Events			1			
No Standardized Condition Assessment Method			1			
Plant Material Development		1				
Total	**2**	**6**	**8**	**6**	**0**	**22**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact Mojave desert shrub habitats at a fine resolution and work toward the preservation of those mapped habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess Mojave desert shrub habitat condition repeatedly through time.
- Prevent ignitions wherever possible in this habitat type.

Montane and Subalpine Conifer

Montane and subalpine conifer habitat (Figure 17 and Figure 18) includes spruces, firs, and pines that have adapted to cold winters and warm to cool summers. These communities generally require cool, relatively humid climates and heavy snow cover (Woods et al. 2001). Soils differ for this key habitat but can range from generally shallow, coarse, and rocky soils that originated from sedimentary and metamorphic rocks to limestone or dolomitic substrates in montane to subalpine ridges of the intermountain basins where limber and bristlecone pines can dominate. Annual precipitation in this habitat area varies from 45 to 101 cm (18–40 inches), and elevation ranges between 1,829 and 3,353 m (6,000 and 11,000 feet). Perennial streams located in this habitat provide water to the lower, more arid ecoregions (Woods et al. 2001).

The montane vegetation zone is lower than the subalpine vegetation zone. It typically ranges in elevation from 1,829 to 2,896 m (6,000–9,500 feet) and is dominated by tree species such as Douglas-fir, white fir, and ponderosa pine (National Park Service 2014). Dominant tree species within the higher elevations of this habitat are generally found between 2,682 and 2,896 m (8,800 and 9,500 feet) in elevation and include coniferous species such as subalpine fir, Engelmann spruce, blue spruce, bristlecone pine, limber pine, and lodgepole pine (Utah Division of Forestry, Fire and State Lands 2020 [FFSL]; Woods et al. 2001). Bands of white fir and clustered stands of quaking aspen are also often found distributed throughout this habitat (FFSL 2020).

The composition of the species overstory of this key habitat is influenced by climate, topography, land use history, fire history, and insect activities (National Park Service 2014). The understory may be abundant and diverse to almost absent depending upon these biotic and abiotic features. Common understory species may include huckleberry, common juniper, snowberry, twinberry honeysuckle, elderflower, kinnikinnick, and western prickly gooseberry.

Common herbaceous species may include species with wide-ranging moisture needs, including elk sedge, heartleaf arnica, sweet cicely, spiny milkvetch, and prairie junegrass.

Many flowering plants at higher elevations have evolved generalized relationships with subalpine pollinator communities, exhibiting traits that attract and reward a wide variety of pollinators. Subalpine meadows and wetlands may also support greater local plant species diversity within areas that provide unique microclimates and favor species adapted to those conditions. Animal pollinators in subalpine environments—including bees (especially bumble bees), flower flies, butterflies, moths, wasps, beetles, and hummingbirds—have adaptations such as thermoregulation for cooler temperatures, shorter flight times, and host plant specialization. These plant-pollinator communities are subject to rapid species turnover during the relatively short growing season.

Diverse insect activity in montane and subalpine conifer habitats serves as an ecological indicator of ecosystem health. The presence and abundance of certain herbivorous terrestrial insect taxa—such as moths, beetles, hemipterans, and grasshoppers—can reflect vegetation diversity and may also predict the species richness of insectivorous predators, particularly nesting birds (Bujoczek et al. 2020; Dar and Jamal 2021). Monitoring these ecological indicators can help assess the magnitude of stress and degree of exposure to threats such as drought, habitat loss, and disturbances.

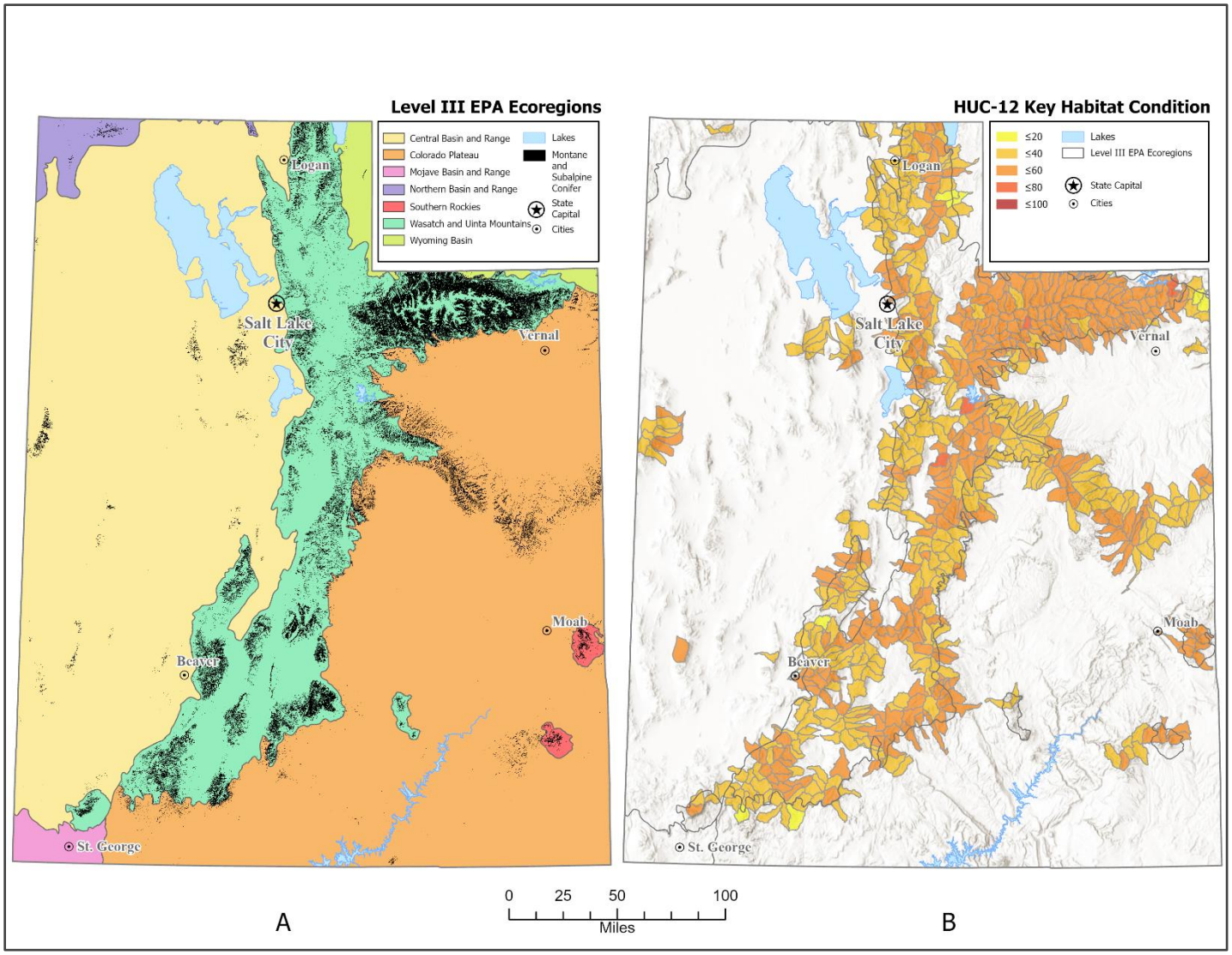


Figure 17. *(A) Montane and Subalpine Conifer Key Habitat Statewide Distribution (B) Ecological Departure for Montane and Subalpine Conifer Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 18. *Montane and Subalpine Conifer Habitat; La Sal Mountains, San Juan County*

Note: Photograph by Zach Coury, DWR, 2022.

Ecoregional Characteristics

The Montane and Subalpine Conifer Key Habitat is found within four ecoregions in Utah, each covering more than 1% of the respective region: the Central Basin and Range, Colorado Plateau, Southern Rockies, and Wasatch and Uinta Mountains. A description of this key habitat within the Colorado Plateau ecoregion was not included due to the small extent of the Colorado Plateau ecoregion in Utah. Below is an overview of the vegetation communities characteristic of these ecoregions.

Central Basin and Range

This ecoregion contains approximately 2.8% of Utah's montane and subalpine conifer habitat. These forested areas are typically isolated, occurring at higher elevations where conditions are wetter than the surrounding lowlands. The region's rugged terrain supports vegetation such as subalpine fir, Engelmann spruce, bristlecone pine, Douglas-fir, mountain big sagebrush, and aspen. The most extensive forest stands may be found on upper, north-facing slopes, where moisture retention is higher (Woods et al. 2001).

Southern Rockies

Montane and subalpine conifer habitat covers approximately 1.2% of this ecoregion in Utah, primarily in the La Sal and Abajo Mountains. Subalpine forests, dominated by Engelmann spruce and subalpine fir, typically occur at elevations between 2,682 and 3,200 m (8,800 and 10,500 feet). These high-altitude forests experience cooler temperatures and substantial snow cover. At mid-elevations (2,286–2,743 m [7,500–9,000 feet]), Douglas-fir, ponderosa pine, and Gambel oak become more prevalent. Lower-elevation forest stands in this ecoregion often have a dense understory of shrubs, including snowberry, Wood's rose, and thimbleberry, along with a diverse array of perennial forbs such as larkspur, rayless coneflower, American vetch, Engelmann aster, showy fleabane, penstemon, and skunk cabbage.

Wasatch and Uinta Mountains

This ecoregion contains the vast majority (approximately 81%) of Utah's montane and subalpine conifer habitat. These forests span a wide range of elevations, from subalpine forests (3,048–3,353 m [10,000–11,000 feet]) to coniferous forests (2,438–3,048 m [8,000–10,000 feet]), encompassing the montane zones of the Wasatch Mountains and portions of high plateaus (2,438–3,353 m [8,000–11,000 feet]). Common tree species include Douglas-fir, Engelmann spruce, lodgepole pine, subalpine fir, ponderosa pine, and aspen. The mid-elevation areas of the Uinta Mountains feature deep canyons with high-quality perennial streams, primarily fed by mountain snowmelt (Woods et al. 2001).

In recent years, large wildfires have burned extensive areas within this ecoregion, resulting in significant aspen regeneration. The understory vegetation in these regenerating forests is similar to that found in other montane and subalpine areas and provides important ecological functions and habitat diversity.

Extent

- LANDFIRE (2020a) was used to determine Montane and Subalpine Conifer Key Habitat extent in Utah.
- Total current mapped area:
    - 2,707,861 acres
    - 4.98% of state surface area (see Figure 17)
    - 10,958 km^2 (4,231 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland
    - Rocky Mountain Lodgepole Pine Forest
    - Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
    - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland
    - Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
    - Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland
    - Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland

Condition

In general, this habitat type is in moderate to good condition, though certain areas present concerns. The majority of these forests are managed by the USFS. Primary anthropogenic impacts include logging (where terrain allows) and extensive livestock grazing. In some regions, mining has caused concentrated environmental disturbances. Although ski area development is localized, it has notable effects, both directly through the clearing of ski runs and indirectly through nearly year-round recreational use, which can disrupt wildlife and habitat integrity.

Historically, logging was widespread in these forests, as evidenced by remnant stumps and younger tree stands. Today, old-growth forests are largely confined to steep, less accessible slopes and designated wilderness areas. Although logging remains a management tool, it is employed far less frequently than in the past due to environmental regulations and reduced industry capacity.

Decades of fire suppression have contributed to unnaturally high fuel loads in many montane and subalpine conifer forests, increasing their vulnerability to high-severity wildfires. Recent, prolonged drought conditions and rising temperatures have also contributed to widespread

susceptibility of conifers to outbreaks of (native and introduced) bark beetles and other forest pests—including mountain pine beetle, fir engraver beetle, spruce budworm, Douglas-fir beetle, and spruce beetle—leading to a dramatic increase in dead and dying trees. Consequently, many areas face an elevated risk of severe wildfires.

Over the past decade, several large wildfires have burned through Utah's montane and subalpine conifer forests, converting them into early seral forb and grass communities. In some areas, aspen has resprouted extensively following fire disturbance; however, high-severity wildfires can generate intense heat pulses that alter soil profiles, creating hydrophobic conditions that inhibit natural revegetation. This, in turn, increases post-fire runoff and erosion, leading to significant downstream impacts to stream and riparian systems, sometimes many miles from the burn scar.

According to the Terrestrial Ecological Classifications description in NatureServe (2018), bristlecone pine and limber pine are experiencing widespread outbreaks of mountain pine beetle populations across much of their range. Under normal conditions, winter temperatures kill up to 98% of the beetle population; however, rising winter and summer temperatures are disrupting the beetle's life cycle, facilitating rapid population growth and range expansion (Carroll et al. 2003). This, combined with prolonged and more frequent severe droughts, fire suppression, and harvesting practices that have resulted in increased stands of aging pines favored by the beetle, has made conifer forests across western North America increasingly vulnerable to infestation.

Western dwarf mistletoe is capable of parasitizing multiple species of conifers. Although it rarely kills trees, it can stunt growth, cause limb damage, increase fuel loads, and significantly reduce the trees' suitability for timber production. Herbivores like deer, elk, squirrels, and porcupines, however, along with specialized insects such as thicket hairstreaks and certain moth species, can help control its excessive growth on host conifers.

Improving Condition

An effective strategy for management of montane and subalpine conifer habitat in Utah may include the following elements:

- Promote forest diversity rather than solely managing for timber production. Both species richness and structural diversity are essential for building long-term resilience. Many forests in Utah face a heightened risk of high-severity wildfires due to forest pest outbreaks and the resulting accumulation of dead and weakened trees, making wildfires an inevitable factor in montane and subalpine conifer ecosystem dynamics.

- Reduce the dominance of overstocked, homogenous forest stands to help mitigate the severity and extent of wildfires while fostering a more balanced and ecologically functional landscape.
- Implement selective logging in areas where it is appropriate, alongside efforts to protect old-growth stands and improve overall forest health.
    - Logging has its own challenges because many forests affected by pest outbreaks are in areas too steep for mechanical treatment such as salvage logging or are located within designated wilderness areas where active management is restricted.
    - Using prescribed fire, a valuable tool for forest health, is particularly challenging in montane and subalpine conifer environments due to narrow windows of suitable weather and fuel conditions, as well as the intensity of fires, even when planned.
    - Logging can alter forest structure and composition, potentially leading to long-term ecological impacts such as fragmented habitat from logging roads and skid trails, increased erosion, loss of stream shading, disruption of coarse woody debris in aquatic ecosystems, and other edge effects.
    - Logging and forest management practices of today are more environmentally sensitive than past approaches. The most significant long-term consequence remains a reduction in old-growth forest conditions.
- Create mosaics of age classes and fuel breaks to limit the spread of high-severity wildfires. This is a key approach to improving forest resilience. Although species such as aspen benefit from fire in the long term, many wildlife and plant species depend on mature and old-growth forests. Large areas dominated by early seral stages can negatively impact forest-dependent species by reducing habitat availability and continuity.
- Manage invasive plant species and recreational impacts.
    - Non-native species such as smooth brome, Kentucky bluegrass, orchard grass, and dandelion can spread widely, outcompeting native grasses and forbs.
    - Effects of forest pest outbreaks on tree health can be intensified by warmer and drier conditions caused by changing climate.
    - Recreation, especially in ski areas and through the increasing use of OHVs, can contribute to habitat degradation. Many older, decommissioned logging roads are now frequently used by OHVs, leading to localized erosion, sedimentation in

streams, and noise disturbances that reduce the productivity of otherwise intact wildlife habitats (through noise and human activity disturbances).

Threats

Table 16 summarizes the threats to montane and subalpine conifer habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including montane and subalpine conifer habitat. White rows indicate threats that are important to montane and subalpine conifer habitat but do not impact as many species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 16. *Threat Prioritization Exercise Summary Results for Montane and Subalpine Conifer Key Habitat*

MONTANE AND SUBALPINE CONIFER KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Cabin Communities/Development				1		
Ski Area Development				1		
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)			1			
Utility and Service Lines				1		
Improper Forest Management			1			
OHV Motorized Recreation				1		
Camping/Campground Development (dispersed)				1		
Inappropriate Fire Frequency and Intensity		1				
Post-Fire Precipitation/Flooding (resulting water quality issues)			1			
Insects – Alien Organisms				1		
Problematic Insects (native)		1				
Droughts				1		

MONTANE AND SUBALPINE CONIFER KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
No Standardized Condition Assessment Method			1			
Atmospheric Deposition and Snowmelt Chemistry			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Total	**0**	**2**	**8**	**7**	**0**	**17**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map and preserve highly intact montane and subalpine conifer stands; reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess montane and subalpine conifer habitat condition repeatedly through time.
- Create a priority map overlaying montane and subalpine conifer stands, fire history, and important watersheds to help determine priorities for forest management, prescribed fire, or other restoration work (e.g., mowing or brush hogging).
- Work with federal land managers to encourage forest management that reduces fuel loading and creates mosaics of different age classes to reduce the risk of widespread wildfires converting large areas to early seral conditions all at once.

Mountain Sagebrush

Mountain sagebrush habitat (Figure 19 and Figure 20) consists of communities where sagebrush species are dominant in mountainous steppe regions. This key habitat is typically found in semiarid areas, occurring between lowland sagebrush habitats and montane or subalpine aspen-conifer forests. It ranges in elevation from 1,829 to over 2,890 m (6,000 to over 9,480 feet), and is widely distributed across Utah; however, its composition varies significantly depending upon latitude, elevation, aspect, and soil conditions.

This habitat can be dominated by several sagebrush species, including mountain big sagebrush, black sagebrush, and snowfield big sagebrush. In some areas, bitterbrush, mountain snowberry, and yellow rabbitbrush may co-dominate or even become the dominant vegetation, depending on elevation and aspect. Mountain sagebrush habitats with long winters and substantial snowfall tend to support a more diverse forb and grass understory. In southern regions, summer monsoonal moisture extends forb and grass production, often leading to abundant herbaceous cover. A well-developed perennial herbaceous layer is common in many areas.

Dominant forbs in this habitat include longleaf phlox, small-leaf pussytoes, woolly locoweed, hedgehog cactus, daisy species, potato cactus, and Indian paintbrush. At higher elevations, more mesic forbs become prevalent. Common grasses are typically cool-season species such as needle and thread grass, muttongrass, slender wheatgrass, mountain brome, Sandberg bluegrass, tufted hairgrass, Idaho fescue, and bluebunch wheatgrass; however, in areas below 2,286 m (7,500 feet), some warm-season grasses, such as blue grama grass, are also common.

At higher elevations, wildfire plays a role in maintaining an open, herbaceous-rich steppe condition. In most areas, however, shrub cover can be up to 40%, with sufficient moisture supporting equally high grass and forb cover.

Much of Utah's mountain sagebrush habitat is managed by the BLM and the USFS. Some areas within this habitat are designated for greater sage-grouse conservation, with management efforts focused on maintaining key habitat components for this species. Beyond greater sage-grouse, mountain sagebrush habitat provides critical range for big game species such as elk, mule deer, and pronghorn, serving as winter range, transitional range, and in some cases, as summer and production range.

Insect communities within mountain sagebrush ecosystems exhibit high levels of biodiversity across both temporal and spatial scales, driven in part by cooler temperatures, higher precipitation, and greater floral abundance and presence compared to lowland sagebrush habitats. These conditions support a rich array of plant species, particularly forbs, which in turn foster a diverse assemblage of insect life. Many insect species have close ecological relationships to specific host plants, including sagebrush and other shrubs.

Pollinator diversity is notably high in mountain sagebrush systems, where the increased availability and diversity of flowering plants support a broad community of bees, butterflies and moths, beetles, and flies. Although early season floral emergence corresponds with visitation by many bumble bee and solitary bee species, non-bee pollinators contribute valuable pollination

services during the hottest periods of the year when bee activity may decline (Rohde and Pilliod 2021).

Beyond pollination, insect populations form the foundation of many food webs in mountain sagebrush habitats. Insects serve as a vital food source for the majority of bird species—particularly during the nesting season when protein demands are high (BLM 2004)—and many other insectivorous wildlife species. Herbivorous insects feed on a wide variety of native forbs, grasses, and shrubs, while predatory and parasitoid insects help regulate herbivore populations and maintain ecological balance. Insect and invertebrate diversity is further influenced by grazing disturbance by native ungulates—such as mule deer, elk, antelope, and bighorn sheep—which affect plant structure and composition, thereby shaping habitat quality and food availability for insect communities. Decomposer and scavenger insects feed on carrion and other organic material, aiding in nutrient cycling and contributing to soil health and secondary food webs (Torma et al. 2023). The overall structure and botanical richness of mountain sagebrush ecosystems creates a favorable environment for a highly diverse and functionally important insect community and contributes to the productivity and broader resilience of these high-elevation habitats.

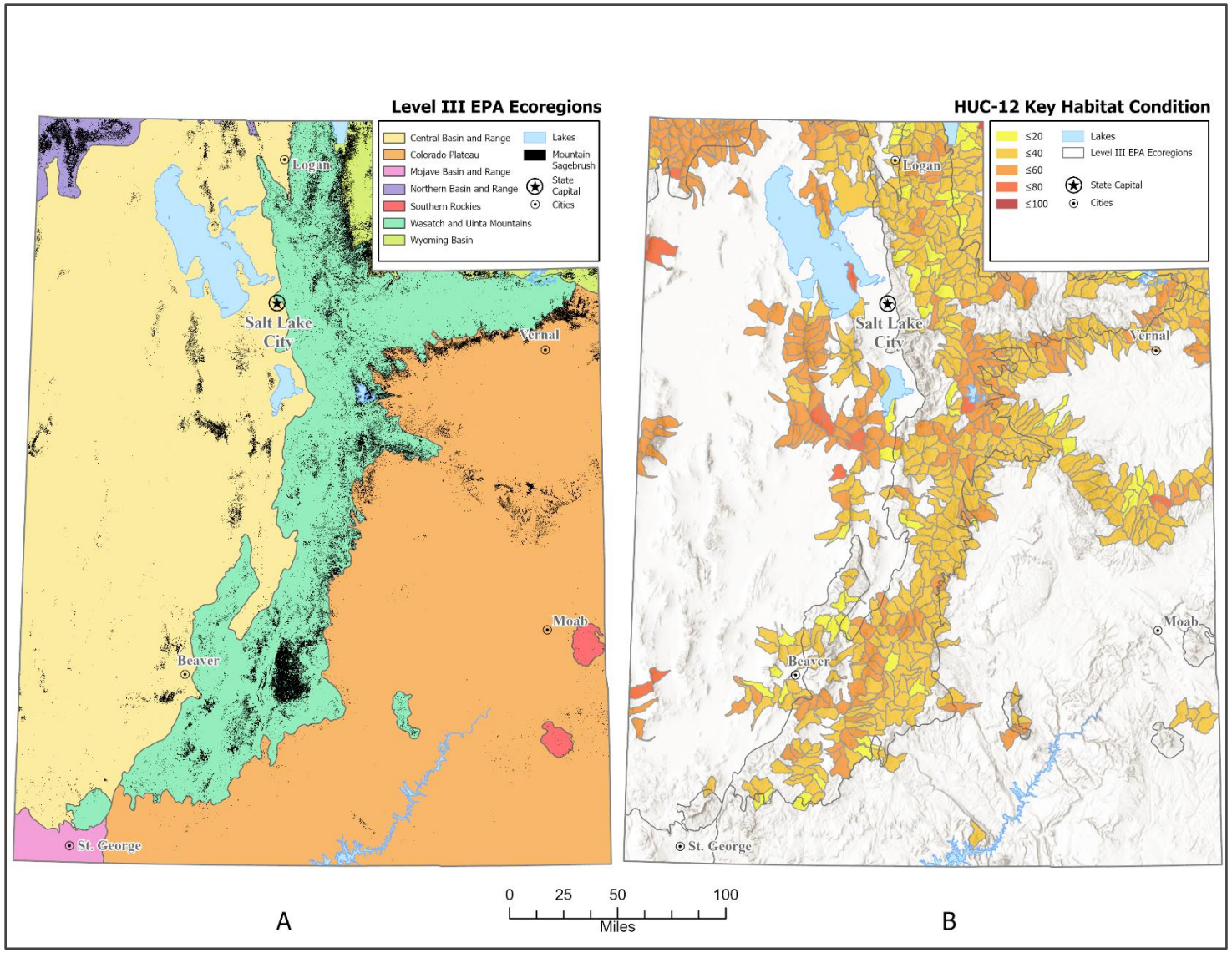


Figure 19. *(A) Mountain Sagebrush Key Habitat Statewide Distribution (B) Ecological Departure for Mountain Sagebrush Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 20. *Mountain Sagebrush Habitat; Cache County*

Note: Photograph by Nate Long, Dugway Proving Ground, 2021.

Ecoregional Characteristics

Mountain Sagebrush Key Habitat occurs within five Utah ecoregions of Utah (making up at least 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, Northern Basin and Range, Wasatch and Uinta Mountains, and Wyoming Basin. Descriptions of mountain sagebrush vegetation communities in those ecoregions are below.

Central Basin and Range

Approximately 13.6% of mountain sagebrush habitat in Utah occurs within this ecoregion. Mountain sagebrush habitat occurs on mountain flanks at mid-elevations. Wyoming big sagebrush and mountain big sagebrush dominate the shrub layer, and perennial bunchgrasses are common, especially in the most northern regions and at higher elevations where precipitation and moisture are higher (NatureServe 2018). Grass cover is chiefly cool-season grasses, but invasive annual grasses are increasing, especially at lower elevations. Non-native species such as smooth brome, orchard grass, dandelion, and other species are not necessarily noxious weeds, but they can be dominant in some areas, outcompeting native grasses and forbs.

Colorado Plateau

Approximately 16.6% of mountain sagebrush habitat in Utah occurs within this ecoregion. Mountain sagebrush habitat occurs on higher slopes and is generally not found in the sagebrush basins (those areas are typed as lowland sagebrush habitat) but can occur higher on slopes and on more north-facing slopes. This vegetation community is often invaded by pinyon-juniper trees and can also see locally problematic invasion by annual grasses (e.g., cheatgrass) at lower elevations. Understory grasses include typical species such as mutton grass, Sandberg bluegrass, and bluebunch wheatgrass, with blue grama grass at lower elevations. Understory forbs are typical sagebrush species such as Indian paintbrush, small-leaf pussytoes, various ball cacti, potato cactus and prickly pear species, mat penstemon, and others.

Northern Basin and Range

Approximately 8.5% of this habitat in Utah occurs within this ecoregion, primarily on the slopes of the Grouse Creek and Raft River Mountains. This area is characterized as the Columbia Plateau Low Sagebrush Steppe in LANDFIRE (NatureServe 2018), where smaller sagebrush species such as little sagebrush and black sagebrush can dominate. Other shrubs and dwarf shrubs may include bitterbrush, buckwheat species, and other sagebrush species. Common graminoids are most often cool-season grasses such as Sandberg bluegrass, mutton grass, and

bluebunch wheatgrass. Crested wheatgrass, an introduced pasture grass, is also common. Mountain sagebrush vegetation communities in this ecoregion can often occur interspersed within Douglas-fir, aspen, or juniper woodlands. Many areas of mountain sagebrush habitat in this area have been mowed for cattle grazing or have seen impacts from wildfires (especially along the Raft River Mountains). On the western slopes of the Grouse Creek Mountains, juniper invasion is quite extensive, as are infestations of annual grass.

Wasatch and Uinta Mountains

Approximately 53.9% of this habitat in Utah occurs within this ecoregion. Mountain sagebrush vegetation communities are found in the semiarid foothills and mountain valleys at lower elevations (between 1,524 and 2,438 m [5,000 and 8,000 feet]) but also at higher elevations up to approximately 2,743 m (9,000 feet). In the semiarid foothills, sagebrush integrates with pinyon-juniper stands, with blue grama grass, mountain mahogany, and Gambel oak. There are large areas of relatively intact mountain sagebrush communities, mainly on BLM-administered and USFS lands. Utah Department of Natural Resources Watershed Restoration Initiative projects have been widespread in some areas and have reduced pinyon-juniper encroachment into this habitat type. There are a number of important mountain sagebrush habitats throughout this ecoregion.

Wyoming Basin

Approximately 7.2% of this habitat in Utah occurs in this ecoregion. In the Wyoming Basin ecoregion, this habitat occurs at higher elevations on hills, mesas, ridges, and outwash fans, primarily on the western slopes of the Monte Cristo and Wasatch ranges. Repeated grazing and fires have increased the presence of annual grasses in this ecoregion (Woods et al. 2001). Mountain sagebrush communities integrate with aspen stands on these mountainsides.

Extent

- LANDFIRE (2020a) was used to determine Mountain Sagebrush Key Habitat extent in Utah.
- Total current mapped area:
    - 2,348,448 acres
    - 4.32% of state surface area (see Figure 19)
    - 9,504 km^2 (3,669 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Columbia Plateau Low Sagebrush Steppe

- Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe
- Columbia Plateau Steppe and Grassland
- Inter-Mountain Basins Montane Sagebrush Steppe

Condition

This habitat type ranges widely in condition, from poor to good, depending upon fire history, land uses, and elevation. The encroachment of both pinyon-juniper and annual grasses into this habitat have reduced habitat quality for many sagebrush obligate species. With the higher moisture levels typically occurring in mountain sagebrush habitats, native grasses and forbs can occupy much of the understory space, which makes it difficult for annual grasses to invade these areas without accompanying disturbance. In some areas of the state, pinyon-juniper encroachment is problematic for both decreasing the overall cover and quality of this habitat type and increasing the risk of higher-severity wildfire. With severe fire regime alteration and extended fire suppression, trees, especially junipers and pinyons, have colonized these shrublands and have gradually excluded the shade-intolerant sagebrush (La Puma 2023).

Pinyon-juniper encroachment can also reduce habitat effectiveness for several sagebrush obligates—most notably, greater sage-grouse and Gunnison sage-grouse). In the past, mowing or spraying (with herbicides such as Tebuthiuron) were common methods of reducing sagebrush cover and increasing grass production to benefit livestock grazing. Although these practices are no longer used as often as they once were, sagebrush mowing (or tilling) on private lands still occurs and can impact large areas. Additionally, seeding with non-native grasses (such as smooth brome or crested wheatgrass) to improve livestock grazing can also negatively impact this habitat and result in lower native forb and grass cover in the understory.

In some areas, residential development can convert many acres of suitable habitat to an unsuitable condition, resulting in direct habitat loss.

Improving Condition

Primary strategies for management of mountain sagebrush habitat in Utah may include the following elements:

- Manage pinyon-juniper. Early treatment when pinyon-juniper seedlings are small is more cost effective, has less visual impact, and creates less woody debris.
- Continue to research methods to improve sagebrush habitat (Doherty et al. 2022).
- Continue to work with federal land managers to protect larger and healthier stands of mountain sagebrush habitat. This can include identifying the locations of these habitats

and driving potential impacts to less intact habitats (e.g., siting renewable or oil and gas projects away from more intact habitats).

- Work with local governments to identify larger and healthier stands of mountain sagebrush habitat to help avoid development in these habitats.
- Identify new noxious weed infestations and treatments.
- Use prescribed fire with caution. Although prescribed fire can be an effective tool for creating various age classes and helping to reinvigorate decadent stands, the risks of weed invasion and long-term loss of sagebrush cover must be carefully considered.

Threats

Table 17 summarizes the threats to mountain sagebrush habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including mountain sagebrush habitat. White rows indicate threats that are important to mountain sagebrush but do not impact as many species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 17. *Threat Prioritization Exercise Summary Results for Mountain Sagebrush Key Habitat*

MOUNTAIN SAGEBRUSH KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas			1			
Conversion of Cropland or Pasture				1		
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)		1				
Well Pad Development		1		1		
Mining and Quarrying				1		
Wind Power Facilities				1		
Roads – Transportation Network			1			
Utility and Service Lines				1		

MOUNTAIN SAGEBRUSH KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
OHV Motorized Recreation				1		
Camping/Campground Development (dispersed)				1		
Inappropriate Fire Frequency and Intensity			1			
Post-Fire Precipitation/Flooding (resulting water quality issues)				1		
Presence of Dams				1		
Brush Eradication/Vegetation Treatments			1			
Seeding Non-Native Plants				1		
Invasive Plant Species (non-native)			1			
Problematic Plant Species (native upland)		1				
Encroachment of Woody Vegetation/Shifting Tree Line		1				
Droughts			1			
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Plant Material Development			1			
Total	**0**	**4**	**11**	**10**	**0**	**25**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map and preserve highly intact habitats and reduce habitat fragmentation and perforation.

- Work with partners to determine a sound method by which to accurately assess habitat condition repeatedly through time.
- Continue to address pinyon-juniper encroachment.
- Support wildfire suppression, especially in larger and more intact communities.
- Continue noxious weed management.

Mountain Shrub

Mountain shrub habitat (Figure 21 and Figure 22) includes vegetation communities that occur on steep mountain slopes and foothills where shrubs or a mix of shrub and trees dominate the landscape at elevations generally between 1,524 and 2,438 m (5,000 and 8,000 feet) but can reach to 2,743 m (9,000 feet) in the Southern Rockies ecoregion. Additional factors such as soils, slope, aspect, and topography influence vegetation in this habitat. Throughout mountain shrub habitat, summers are generally warm and dry, and winters are cool and humid (BLM 2024b). In northern Utah, maple-oak stands are common, but pinyon and juniper can become more dominant in central and southern Utah.

Several different shrub species can dominate mountain shrub vegetation communities, but the most common species are Gambel oak and big tooth maple, with other associated shrubs that include chokecherry, wild rose species, Utah serviceberry, western serviceberry, mock orange, smooth sumac, skunkbush sumac, Rocky Mountain maple, mountain snowberry, western snowberry, ocean spray, mountain mahogany, birch leaf mountain mahogany, antelope bitterbrush, wax currant, and mallow bark ninebark (NatureServe 2018). In some areas, near monocultures of chokecherry, snowberry species or Gambel oak can occur. The oaks provide much-needed cover and food for many species of wildlife.

Understory grasses and forbs are often dominated by perennial species, including elk sedge, western wheatgrass, mountain brome, bluebunch wheatgrass, Sandberg bluegrass, longleaf phlox, penstemon, mule's ear, arrowleaf balsamroot, various milkvetch species, and western yarrow.

Wildfire plays an important role in this habitat and contributes to the unique composition and variety of species. In some cases, fires can cause a severe die-back of the existing shrub cover, or conversely, can enable aggressive resprouting of a specific species, such as Gambel oak (NatureServe 2018).

Insect communities in mountain shrublands are comparable in species richness and functional roles to those found in mountain sagebrush habitats; however, variation in dominant plant

species, annual precipitation and temperature patterns, and the frequency and intensity of disturbance regimes all influence the composition, abundance, and ecological interactions of these communities. Although the active growing season in mountain shrublands is shorter than in lower-elevation habitats, the spring emergence of vegetation creates a seasonal expansion of habitat resources. This phenological window allows many insect species already active at lower elevations to disperse into mountain shrublands, enabling them to exploit newly available resources and reduce interspecific competition. Furthermore, many shrub species serve as keystone species that support a wide range of specialist insects—particularly oak, willow, boxelder, chokecherry, sumac, wild rose, mountain mahogany, and conifer species—making them vital to supporting insectivorous wildlife.

Pollinator assemblages in these habitats include pollen generalist species—such as bumble bees, solitary bees, flies, and beetles—as well as herbivorous host plant specialists such as moths and butterflies that visit flowers for nectar. Additional floral visitors include ants, wasps, and various predators that may inadvertently transfer pollen between flowers. Beyond pollinators, a wide array of insect taxa—including flies, beetles, wasps, ants, hemipterans, grasshoppers, dragonflies, and others—contribute significantly to animal diversity and ecosystem processes. These insects function as herbivores, predators, parasites, and scavengers, as well as a key portion of the food resources for other wildlife, collectively enhancing the productivity, resilience, and ecological integrity in mountain shrub ecosystems.

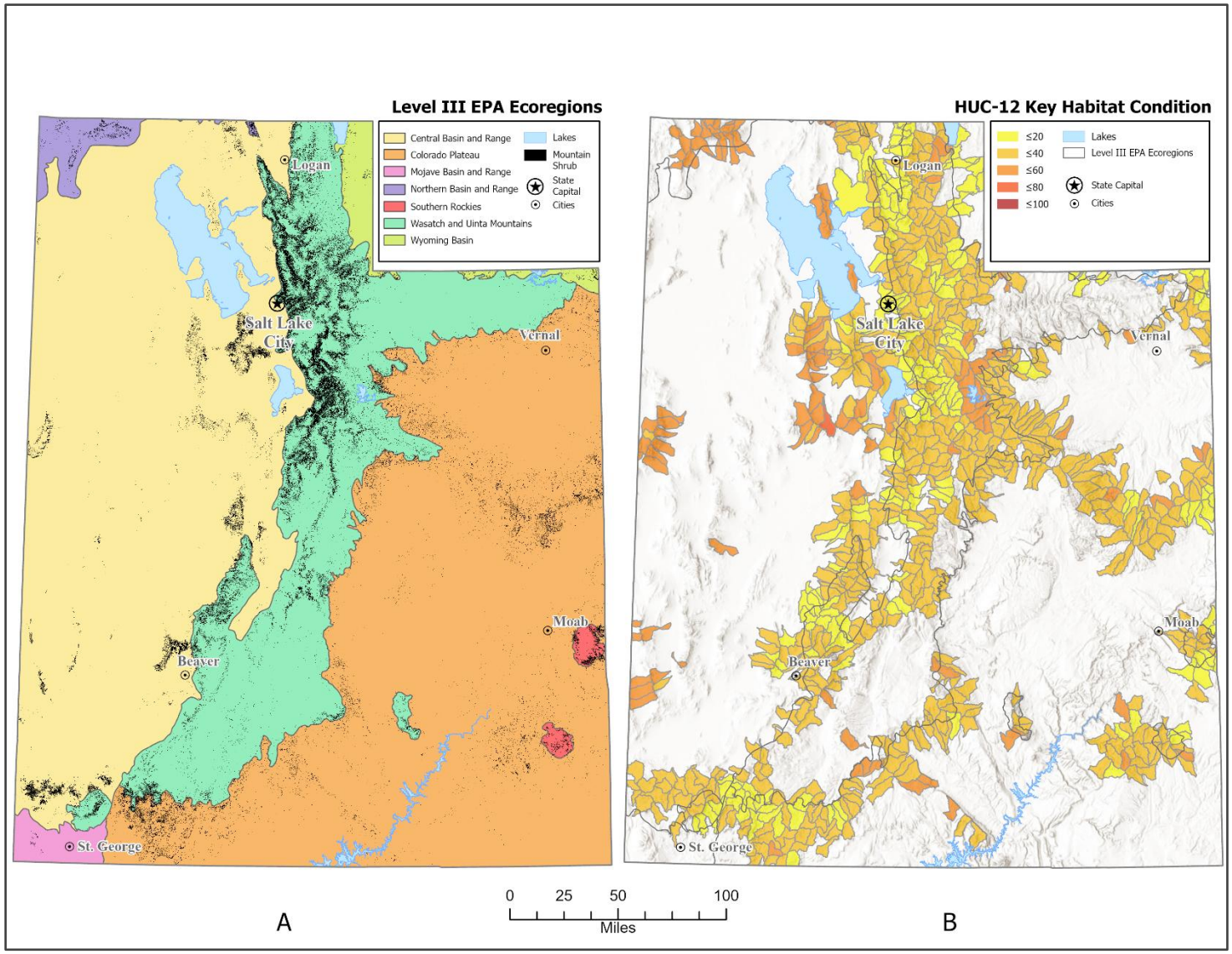


Figure 21. *(A) Mountain Shrub Key Habitat Statewide Distribution (B) Ecological Departure for Mountain Shrub Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 22. *Mountain Shrub Habitat; Salt Lake County*

Note: Photograph by Zach Coury, DWR, 2022.

Ecoregional Characteristics

Mountain Shrub Key Habitat occurs within five Utah ecoregions (making up more than 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, Northern Basin and Range, Southern Rockies, and Wasatch and Uinta Mountains. Descriptions of mountain shrub vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 16.1% of mountain shrub habitat in Utah occurs within this ecoregion. Mountain shrub habitats generally integrate with pinyon-juniper woodlands and sagebrush shrublands, with mountain shrub occurring at higher elevations and in moister habitats (such as on north-facing slopes). Mountain shrub habitats often grade into aspen habitats at their upper extents. Shrubs such as bitterbrush and western serviceberry serve as important browse for mule deer in this ecoregion (Woods et al. 2001).

Colorado Plateau

Approximately 20% of mountain shrub habitat in Utah occurs within this ecoregion. Landscape features such as the semiarid benchlands, canyonlands, and escarpments all contain portions of mountain shrub habitat. Gambel oak, Utah serviceberry, sagebrush species, snowberry species, and bitterbrush are relatively dominant in mountain shrub habitat in this ecoregion.

Northern Basin and Range

Approximately 1.3% of mountain shrub habitat in Utah occurs within the Northern Basin and Range ecoregion and is generally found on wetter or higher-elevation slopes of the Raft River and Grouse Creek Mountains. Mountain shrub habitat is bounded on lower elevations by sagebrush and juniper woodlands and at upper elevations by aspen.

Southern Rockies

Approximately 2% of mountain shrub habitat in Utah occurs in this ecoregion. Mountain shrub habitat within the Southern Rockies ecoregion occurs exclusively on lower montane slopes of the La Sal and Abajo Mountains and begins at higher elevations (2,286–2,743 m [7,500–9,000 feet]) compared to the other ecoregions containing this type of habitat. Mountain shrub vegetation communities within this ecoregion often includes individual Douglas-fir and ponderosa pine within larger stands of Gambel oak, with other mixed mountain shrub species in the understory. In 2021, a large fire burned a significant portion of the La Sal Mountains that impacted a large area of mountain shrub habitat. Because most species in this habitat are relatively fire tolerant, it is expected that burned areas are recovering and are moving through appropriate seral stages.

Wasatch and Uinta Mountains

Approximately 59.5% of mountain shrub habitat in Utah occurs within this ecoregion and supports a wide variety of shrub species (see the extensive list at the beginning of the Mountain

Shrub section). Maple-oak scrub is the most common mountain shrub habitat type at the northern extent of this ecoregion and is slowly replaced by pinyon-juniper woodlands farther south and downslope (Woods et al. 2001).

Extent

- LANDFIRE (2020a) was used to determine Mountain Shrub Key Habitat extent in Utah.
- Total current mapped area:
    - 1,868,990 acres
    - 3.44% of state surface area (see Figure 21)
    - 7,564 km^2 (2,920 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
    - Rocky Mountain Bigtooth Maple Ravine Woodland
    - Rocky Mountain Gambel Oak-Mixed Montane Shrubland
    - Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland
    - Rocky Mountain Lower Montane-Foothill Shrubland

Condition

Mountain shrub habitats are generally in good condition. Because they mostly occur on steeper slopes, residential development, conversion to agricultural lands, and other land uses are commonly precluded. Livestock grazing pressure is also generally light because of the steep slopes and the relatively high density of shrubs. Most species occurring in mountain shrub habitat are somewhat fire tolerant (with the exception of most sagebrush species, bitterbrush, and mountain mahogany species); impacts from wildfire are usually moderate and natural recovery is often rapid. In some areas with excessive fuel loading (such as in decadent oak brush stands or where Douglas-fir trees or dense pinyon-juniper woodlands have become established), higher burn severities may result in soil sterilization and excessive erosion due to soil hydrophobicity, which can prolong post-fire recovery.

Invasion by noxious weeds is generally limited; some areas are subject to problematic infestations from annual grasses (e.g., cheatgrass), white top, Canada thistle, musk thistle, and other problematic biennial weeds (e.g., houndstongue). Along roadsides, smooth brome can create monocultures and can spread into nearby habitats.

Wildfire during droughts or in areas of high fuel loading can cause excessive erosion and interfere with shrub re-establishment. Noxious weeds (most notably after wildfire and other disturbance events) can become established and, due to steep slopes, difficult to manage. Residential and recreational development is not common in these habitats but can be locally notable. Because many wildlife species use these habitats, including big game species (e.g., moose, elk, mule deer, black bear), habitat loss in some areas can have relatively large impacts to wildlife habitats and wildlife abundance.

Improving Condition

An effective strategy for management of mountain shrub habitat in Utah may include the following elements:

- Enforce a vegetation management plan aimed at protecting curl-leaf mountain mahogany with grazing-specific measures. Native ungulates highly favor curl-leaf mountain mahogany for winter range, which has ultimately led to excessive browsing and reduced regeneration as seedlings try to become established (NatureServe 2018).
- Promote policies and management that allow fire to return to a more natural regime. Fire, flooding, and erosion all impact mountain shrub habitat. A decrease in curl-leaf mountain mahogany occurred from 1954 through 1997 because of increased fire incidences linked to increased cheatgrass dominance; curl-leaf mountain mahogany is easily killed by fires and does not resprout (NatureServe 2018). Other species, such as birch leaf mountain mahogany, depend on fires to reproduce (via seeding). The open spaces created by shrub die-backs can allow for tree growth; however, the xeric characteristics and well-drained steep slopes of these lands have limited growth potential for trees.
- Continue funding and support for weed abatement programs, including EDRR programs.

Threats

Table 18 summarizes the threats to mountain shrub habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including mountain shrub habitat. White rows indicate threats that are important to mountain shrub habitat but do not impact as many species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 18. *Threat Prioritization Exercise Summary Results for Mountain Shrub Key Habitat*

MOUNTAIN SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas			1			
Trail, Trailhead, and Staging Area Development				1		
Ski Area Development				1		
Improper Grazing – Livestock (current)				1		
Improper Grazing – Livestock (historic)			1			
Well Pad Development				1		
Roads – Energy Development				1		
Utility and Service Lines				1		
Recreational Activities				1		
OHV Motorized Recreation				1		
Camping/Campground Development (dispersed)				1		
Hiking/Foot Travel				1		
Mountain Biking				1		
Inappropriate Fire Frequency and Intensity			1			
Fire Suppression Tactics				1		
Post-Fire Precipitation/Flooding (resulting water quality issues)				1		
Agricultural/Municipal/Industrial Water Usage				1		
Piping or Covering Streams				1		
Brush Eradication/Vegetation Treatments				1		
Invasive Plant Species (non-native)			1			
Feral Domesticated Animals				1		

MOUNTAIN SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Problematic Plant Species (native upland)				1		
Droughts				1		
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Total	**0**	**0**	**7**	**19**	**0**	**26**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map and preserve highly intact mountain shrub habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess mountain shrub habitat condition repeatedly through time.
- Produce a fine-scale, accurate map of remaining mountain mahogany stands in good condition to be able to collectively preserve good quality mountain shrub habitat.
- Implement fire policies that encourage a more natural fire regime to assist in the enhancement of mountain shrub habitat in Utah.
- Manage pinyon-juniper. Early treatment when pinyon-juniper seedlings are small is more cost effective, has less visual impact, and creates less woody debris.

Riparian

Riparian habitats (Figure 23 and Figure 24) are ecologically distinct in Utah, spanning from alpine environments above the tree line to the hottest lowland regions. These areas occur along streambanks, rivers, flood zones, lake margins, seeps, spring, alluvial terraces, hillslopes, canyons, and valleys. Despite the diversity in elevation, vegetation, and climate, the defining feature of riparian habitats is the consistent presence of water.

Vegetation varies greatly across this gradient, from alpine forbs and stunted willows to tall Fremont cottonwood trees in desert canyons. In more mesic, lowland areas, riparian vegetation includes netleaf hackberry, velvet ash, desert willow, coyote willow, and skunkbush sumac. Riparian shrubs also include dogwood, golden currant, silverleaf buffaloberry, and Wood's rose (Salt Lake County 2003). Common overstory species include Fremont cottonwood at lower elevations and narrow-leaf cottonwood between 1,829 and 2,438 m (6,000 and 8,000 feet), with associated species such as boxelder, water birch, willows, and hawthorns. Non-native tamarisk and Russian olive are also widespread, especially in mid- and low-elevation riparian systems (Wild About Utah 2009). Many grasses and flowering forb species are adapted to thrive in the moist soil adjacent to water, in sloughs (transitional elevations that flood periodically), and in the drier upland zones.

Riparian habitat is distinguished from wetland habitat in the UWAP by hydrology and vegetation origin. Riparian areas are typically only seasonally flooded (e.g., during spring runoff or high-water years), and are always located adjacent to rivers, streams, or lakes. In contrast, wetland habitat remains saturated for longer durations and may occur across the broader landscape, independent of surface waterbodies.

Riparian vegetation often originates in adjacent uplands and may tolerate dry conditions for part of the year, whereas wetland vegetation requires prolonged soil saturation and often includes obligate wetland species that cannot survive outside these conditions. For the purposes of habitat classification, riparian systems are categorized as terrestrial key habitats, with extent and condition evaluated using LANDFIRE data sets (LANDFIRE 2020a, 2020b) (see the Terrestrial Key Habitats section of this chapter and Appendix D).

Due to the critical importance of water for agriculture, a significant proportion of riparian habitat is privately owned. Water development and diversion projects for irrigation are common and can alter natural stream flows and ecological function. In some areas, however, these modifications may create expanded wetland-like conditions through flood irrigation and increased soil saturation.

Riparian zones are ecological hotspots that support a wide range of wildlife and plant diversity. In Utah's arid environment, lowland riparian areas are among the rarest and most biologically rich habitat types. These areas provide food, water, shelter, and connectivity for species movement.

Riparian habitat is essential to the majority of wildlife species in Utah, serving as critical habitat for both riparian obligate species and numerous upland species that rely extensively on these

areas for various life history needs. Bird diversity in riparian areas is notably high, with observed bird counts approximately twice those of neighboring uplands (Norvell et al. 2005). Additionally, many large mammals, fish, and amphibians make extensive use of riparian corridors. Streams bordered by well-developed riparian vegetation support higher populations of fish and amphibians, and many amphibian species rely on adjacent riparian zones such as those surrounding streams, sloughs, and other saturated areas for foraging.

Streamside vegetation contributes to lower water temperatures through shading, stabilizes banks, traps sediment and pollutants, and increases instream habitat complexity with coarse woody debris. These functions improve conditions for aquatic macroinvertebrates, which are essential prey for many vertebrate species.

Riparian systems support a remarkably diverse assemblage of insect and invertebrate species due to their cooler, moister microclimates and high plant diversity. Insect groups include herbivores such as grasshoppers, katydids, planthoppers, leafhoppers, aphids, crickets, beetles, gall-formers, thrips, and moths, many of which specialize in riparian vegetation. Pollinating insects include bumble bees, solitary bees, flies, beetles, moths, butterflies, and nectar-feeding ants and wasps. Aquatic insects—including non-biting midges, mosquitoes, crane flies, mayflies, stoneflies, salmonflies, snakeflies, dobsonflies, caddisflies, dragonflies, and damselflies—develop in benthic substrates and emerge as flying adults to mate and disperse. Detritivores and decomposers that process leaf litter and organic debris enhance soil fertility and contribute to water quality. Predators and parasitoids, including spiders, fireflies, tiger beetles, and wasps as well as amphibians, reptiles, birds, mammals, and fish rely on these abundant invertebrates for food.

The presence and diversity of aquatic macroinvertebrates are often used to assess stream health and water quality (Faulkner 1999). Moth diversity has also been suggested as a potential indicator of localized ecosystem health (Duran et al. 2022). The abundance of insect prey supports a high degree of the wildlife diversity associated with riparian habitats; this availability of prey resources permits niche partitioning among groups such as aerial insectivores (e.g., nocturnal birds and bats) (Bullington et al. 2021).

Beyond ecological importance, riparian habitats provide significant ecosystem services. These include flood mitigation, water purification, erosion control, and recreation opportunities such as fishing, birdwatching, kayaking, and hiking. The high biodiversity and ecological functions of riparian areas underscore their value for both conservation and sustainable land management.

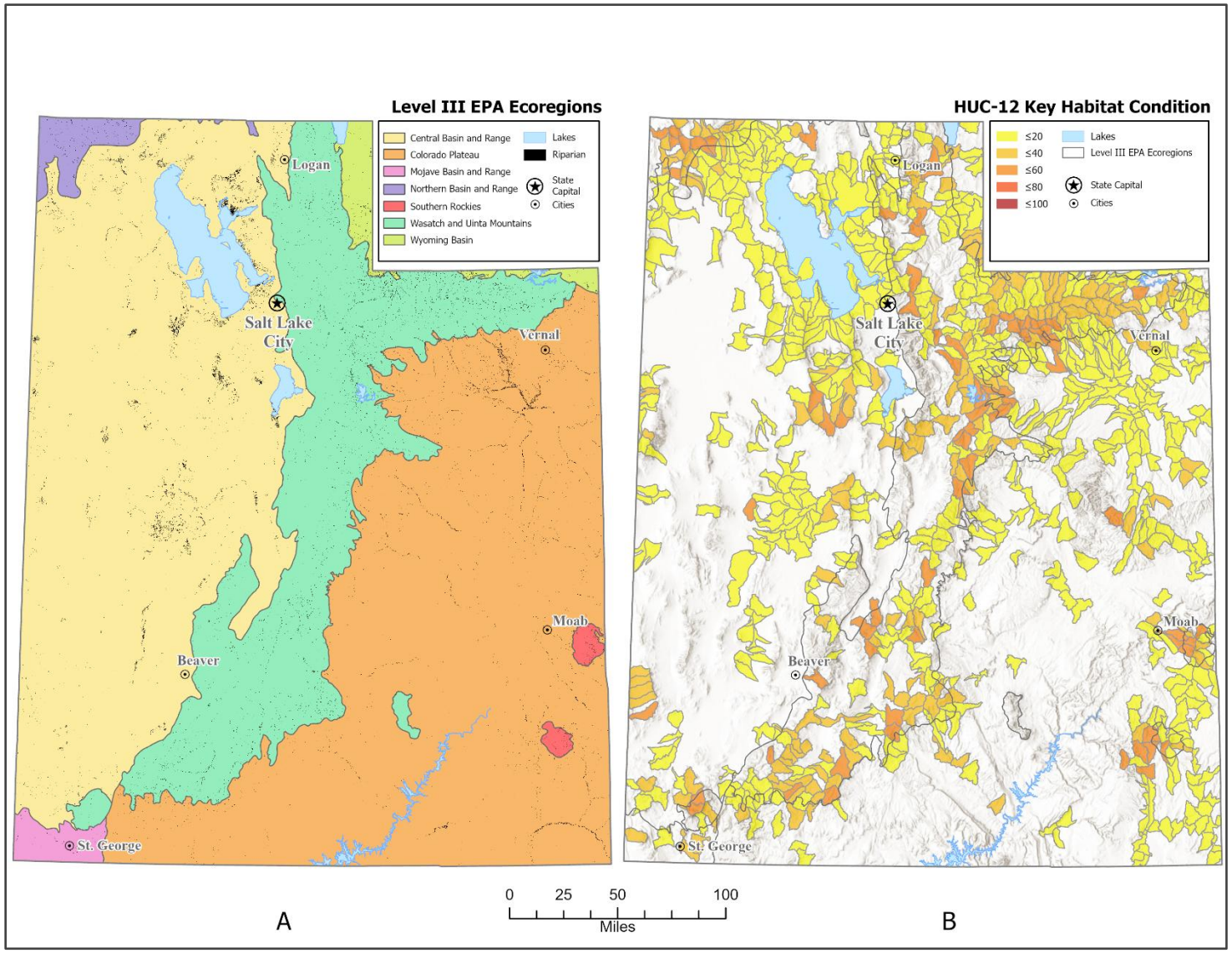


Figure 23. *(A) Riparian Key Habitat Statewide Distribution (B) Ecological Departure for Riparian Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 24. *Riparian Habitat; Wasatch County*

Note: Photograph by Zach Coury, DWR, 2023.

Ecoregional Characteristics

Riparian Key Habitat occurs in five Utah ecoregions (making up more than 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, Northern Basin and Range, Wyoming Basin, and Wasatch and Uinta Mountains. Descriptions of riparian habitat in these ecoregions are below.

Central Basin and Range

Approximately 45.2% of riparian habitat in Utah occurs within this ecoregion. Although riparian habitat is found scattered throughout the state, in this ecoregion specifically, it appears most prominent in the Moist Wasatch Front footslopes and the Malad and Cache Valley subregions. As noted above, the riparian habitat is found along streams, rivers, and lakes. Dominant riparian vegetation generally comprises a variety of species, including trees such as narrow-leaf and Fremont cottonwood, native boxelder, introduced Siberian elm, and native species such as speckled alder and water birch. Dominant shrubs include the noxious weeds Russian olive and tamarisk, as well as native silver sage, spearleaf rabbitbrush, dogwood, and several willow species, of which coyote willow is often the most common.

Herbaceous vegetation can include several agricultural cultivars that have become established in riparian areas, including smooth brome, orchard grass, yellow sweet clover, and alfalfa. Natives are dominated by arctic rush and a number of sedges. The noxious weed phragmites and the invasive reed canarygrass can be common in many areas. Wetlands in this ecoregion contain rushes, reedgrasses, and areas of open water, providing important habitat for migratory birds and wildlife refuges. Overall, lands within this ecoregion are heavily used for cropland and farming, which has affected stream quality and flow.

Colorado Plateau

Approximately 25.3% of riparian habitat in Utah occurs within this ecoregion. Riparian habitat vegetation within the Colorado Plateau ecoregion generally supports the same species compositions found at the higher and mid-level elevations discussed in the Central Basin and Range section above and the Wasatch and Uinta Mountains section below. In the lower elevations of this ecoregion, drier conditions exist. Dominant trees species include netleaf hackberry, velvet ash, and Fremont cottonwood. Shrub dominants include coyote willow, skunkbush sumac, spearleaf rabbitbrush, Russian olive, and tamarisk. Many sites in this ecoregion are sparsely vegetated, with either steep cut banks or larger sandbars. Some oil and gas fields are found in this ecoregion, but wells are mostly located outside riparian sites.

Northern Basin and Range

Approximately 1.4% of riparian habitat in Utah occurs within this ecoregion. Mountain-fed perennial streams surrounded by riparian vegetation contribute to irrigated agriculture found primarily in valleys. Vegetation within riparian habitat along streams is generally dominated by birch, boxelder, cottonwood species, willow, dogwood, Russian olive, and tamarisk. Other common vegetation includes golden currant, silverleaf buffaloberry, and Wood's rose (Salt Lake County 2003). Hawthorn may also be present as elevation increases.

Wasatch and Uinta Mountains

Approximately 24.2% of riparian habitat in Utah occurs within this ecoregion. The Wasatch and Uinta Mountains range in elevation from 1,524 to 3,353 m (5,000–11,000) feet into alpine habitat. Given the broad range in elevation, vegetation in the riparian habitat is very diverse. At higher elevations, most riparian systems are on USFS lands, as well as on some BLM-administered lands. Riparian sites on these lands are less disturbed and manipulated than on lower-elevation private lands. At higher-elevation riparian sites, vegetation is dominated by shrubs, including willows such as Booth's willow, Drummond's willow, coyote willow, and Bebb's willow. Other brushy species include water birch, resin birch, dogwood, wild rose, Nootka rose,

and twinberry honeysuckle. Herbaceous vegetation can be diverse but is generally dominated by arctic rush, water sedge, Nebraska sedge, beaked sedge, black sedge, and other sedge species. In montane areas, quaking aspen and river hawthorn are common overstory species along riparian areas. In lower-elevation sites, vegetation is similar to Central Basin and Range conditions.

Precipitation in upper elevations is strongly driven by snow, with the snowpack serving as a main source of summer water for lower elevations. Uinta Mountain subalpine forests occur from 3,048 to 3,353 m (10,000–11,000 feet) with mid-elevations ranging from 2,438 to 3,048 m (8,000–10,000 feet). They are characterized by deep canyons, reservoirs, and some natural lakes. Like the Alpine Key Habitat, snowmelt in these subregions provides water to the lower and more arid ecoregions via perennial streams. Much of the land use in this ecoregion is administered by federal land management agencies. Uses include seasonal livestock grazing, recreation (including big game hunting and fishing), timber production, mining (i.e., metal and non-metal), and (in lower elevations) irrigated croplands, feedlots, and some dairy operations.

Wyoming Basin

Approximately 2.6% of riparian habitat in Utah occurs within this ecoregion. Riparian habitat in the Wyoming Basin ecoregion is generally found in wet valleys on flat floodplains, low terraces, and alluvial fans along the Bear River. Riparian corridors in this ecoregion are mostly vegetated by an overstory of cottonwood species, especially narrow-leaf cottonwood, willow and alder thickets, and boxelder (NatureServe 2024a). Wetlands are dominated by sedges, rushes, bullrush, and cattails, which are also common in this ecoregion. Many of the broad valleys are supplementally irrigated for livestock pasturelands and hay production and are seasonally grazed.

Extent

- LANDFIRE (2020a) was used to determine Riparian Key Habitat extent in Utah.
- Total current mapped area:
    - 377,482 acres
    - 0.69% of state surface area (see Figure 23)
    - 1,528 km^2 (590 square miles)
- Distribution of riparian habitat: mapped in 2,347 of 2,885 HUC-12 subwatersheds that overlap Utah.

- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
    - North American Warm Desert Riparian Mesquite Bosque
    - North American Warm Desert Riparian Woodland and Shrubland
    - Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland
    - Rocky Mountain Subalpine-Montane Riparian Shrubland
    - Rocky Mountain Subalpine-Montane Riparian Woodland

Condition

In general, higher-elevation riparian habitats (i.e., alpine, subalpine, and montane habitats) are in good condition. Although some areas have seen localized impacts due to improper livestock grazing, past mining practices, and recent wildfire events, many riparian habitats are dominated by native trees, shrubs, and herbaceous species, with relatively low infestations of noxious weeds. Riparian habitat in these higher elevations also supports more natural cycles of ecosystem development and has good habitat structure. Some riparian habitats have been lost to water storage projects (i.e., reservoirs) where many miles of habitat are now inundated. It is also common for roads to follow rivers (and thus riparian habitat). Some road placement has led to increased sediment deposition into streams and riparian habitat and indirect pollution impacts from road runoff. Additionally, riparian areas have been impacted directly by large landscape-scale wildfires through the burning of vegetation and indirectly through post-fire flooding, which can scour vegetation and cause stream downcutting and sediment deposition and completely bury riparian habitats. Over time, most post-fire impacts will be resolved through re-establishment of more natural flow regimes, but aggressive weed management will need to occur to allow natural development of seral stages.

In montane and lower elevational zones, historical water developments have channelized rivers and streams and have reduced widths of historical floodplains and riparian habitat. Many of these developments have eroded and/or washed away, but many remain, thus simplifying the floodplain and narrowing potential riparian habitats. With less development occurring near streams and rivers, and diminished risks of flood events primarily due to large water storage projects, opportunities exist to identify old stream channelization structures and restore riparian habitat.

In mid- to lower elevational ranges, riparian habitat in Utah is subject to more indirect impacts through establishment of noxious weeds (primarily Russian olive and tamarisk, but also white top, Russian knapweed, Canada thistle, phragmites, and reed canarygrass). Tamarisk (and

Russian olive, to a lesser extent) creates soil conditions unsuitable for cottonwood seedling establishment. In some areas, riparian habitats have been completely changed from cottonwood stands to non-native systems. In mid-elevation zones, establishment of agricultural cultivars can also change habitat conditions, with smooth brome, orchard grass, Kentucky bluegrass, and crested wheatgrass often more dominant than local native plant species. These shifts in vegetation composition reduce the suitability of riparian habitats for big game species but have significant impacts to nongame species groups, including migratory birds, amphibians, and reptiles. In localized areas, primarily where irrigation flows return, where there is runoff from agricultural practices, and below older water treatment plants, elevated nutrient loading in return waters can create eutrophic conditions where species such as cattail can become extremely prolific and dominate riparian habitats.

Common stressors impacting riparian habitat include non-native and invasive plants, water diversions and irrigation return flows, hydrologic alteration, inappropriate grazing practices, and water quality stressors from urban and agricultural sources.

Improving Condition

An effective strategy for management of riparian habitat in Utah may include the following elements:

- Identify riparian habitat impacted by land use practices and continue to support funding for low-tech, process-based restoration (e.g., BDAs, one-rock dams). The use of these methods will restore Riparian Key Habitat by reconnecting floodplains, reducing soil erosion and controlling sediment, and increasing flood and wildfire resilience.
- Continue to support funding for weed treatment in riparian habitat, including Russian olive and tamarisk eradication. Use of mechanical treatment, herbicides, and prescribed fire are options to reduce non-native plant species; however, treatment must be followed up with management of other weeds, such as Russian knapweed and white top, which can quickly expand in disturbed areas and negate any benefits of initial treatments. Securing funding and follow-up treatments can ensure that initial efforts are successful.
- Identify old water control structures (including levees) that channeled rivers and separated floodplains from streams. Remove obsolete structures where possible to help reconnect floodplains and re-establish riparian zones.
- Assist in revegetation and restoration of burn scars.
- Promote zoning, policies, and laws that lead to responsible human intrusion and development.
- Promote development of BDAs and post-assisted log structures.

Threats

Table 19 summarizes the threats to riparian habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including riparian habitat. White rows indicate threats that are important to riparian habitat but do not impact as many species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 19. *Threat Prioritization Exercise Summary Results for Riparian Key Habitat*

RIPARIAN KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas			1			
Commercial and Industrial Areas				1		
Campground Development				1		
Conversion from Flood to Sprinkler Irrigation			1			
Improper Grazing – Livestock (current)		1				
Livestock Feedlot				1		
Water Developments for Livestock				1		
Improper Grazing – Livestock (historic)	1					
Oil and Gas Drilling				1		
Mining and Quarrying				1		
Roads – Transportation Network		1				
Roads – Energy Development				1		
Railroads				1		
Utility and Service Lines				1		
Excessive Harvest – Regulated/Legal		1				
OHV Motorized Recreation			1			

RIPARIAN KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Camping/Campground Development (dispersed)				1		
Hiking/Foot Travel				1		
River Rafting				1		
Inappropriate Fire Frequency and Intensity		1				
Canal Burning				1		
Post-Fire Precipitation/Flooding (resulting water quality issues)		1				
Presence of Dams		1				
Presence of Diversions		1				
Dam/Reservoir Operation		1				
Channelization/Bank Alteration (direct, intentional)		1				
Groundwater Pumping				1		
Spring Development/Capping				1		
Agricultural/Municipal/Industrial Water Usage	1					
Water Allocation Policies	1					
Salinity Alteration (of water)			1			
Sediment Transport Imbalance (sediment poor)		1				
Sediment Transport Imbalance (sediment rich)			1			
Brush Eradication/Vegetation Treatments			1			
Seeding Non-Native Plants				1		
Channel Downcutting (indirect, unintentional)		1				

RIPARIAN KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Invasive Plant Species (non-native)		1				
Feral Domesticated Animals				1		
Stormwater Runoff				1		
Wastewater Treatment Plant Effluent				1		
Agricultural and Forestry Effluents		1				
Encroachment of Woody Vegetation/Shifting Tree Line				1		
Droughts		1				
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Plant Material Development			1			
Total	**3**	**14**	**10**	**20**	**0**	**47**

Note: Yellow highlighting indicates priority threats.

In some agricultural areas, salinity control projects (e.g., U.S. Bureau of Reclamation and Natural Resources Conservation Service projects) are funding the conversion of open ditches to pipelines to reduce return flows of salts, total dissolved solids, and selenium, resulting in a net loss of riparian habitat. Ideally, this will keep salinity at a manageable and productive level, but the loss of those riparian areas could pose a threat to some SGCNs. For example, monarch butterflies would be negatively impacted because showy milkweed habitat would likely decrease.

Priority Needs

- Carry out systematic replacement of non-native riparian vegetation (e.g., tamarisk, non-native willows, Russian olive) with native riparian vegetation.
- Work with partners to determine key metrics to monitor the condition of Utah's riparian habitat.

- Develop functional flows for Utah's streams and rivers to provide appropriate flow regimes to sustain riparian habitat.

Salt Desert Shrub

Salt desert shrub habitats (Figure 25 and Figure 26) occur in highly saline and sometimes gypsiferous soil types primarily derived from decomposed shales and calcareous sandstones. Soil types play a strong role in the amount of vegetation cover and the types of vegetation found within this habitat. In some areas, salt desert shrublands have less than 5% vegetation cover. Due to the low vegetation cover, fires in this habitat do not occur as frequently as they do in other habitats throughout Utah. Fires can occur in conjunction with wet years, possibly once every 100 years on average (NatureServe 2018).

These habitats are typically found at elevations of 1,524 to 2,195 m (5,000–7,200 feet) and can occur either in the bottoms of enclosed basins or on alluvial and alkaline flats, mesas, plateaus, washes, bluffs, and badlands. In some areas, shrubs can have more extensive cover, but in other areas, annual grasses and forbs (invasive and native) can be more dominant than shrubs. Often, salt desert shrub communities can be interspersed within desert shrub and lowland sagebrush vegetation communities. These key habitats receive on average 12.7 to 33.0 cm (5.0–13.0 inches) of precipitation per year.

The soils in this habitat can be both alkaline and saline and experience high erosion rates when on slopes, such as in badlands. Plant communities are composed of species tolerant of these arid and saline environments, including a variety of saltbush species and greasewood. These landscapes can be dominated by dwarf shrublands composed of relatively pure stands of saltbush, especially mat saltbush and Gardner's saltbush. The herbaceous layer is typically sparse but can vary greatly in cover and species composition depending on precipitation trends and soil type.

Insect diversity in salt desert shrublands is generally lower than in other habitats due to sparse vegetation, high temperatures, and extreme environmental conditions; however, seasonal periods of increased precipitation and milder temperatures create windows of ecological opportunity during which rare and typically cryptic insect species become active. During these periods, ground-nesting solitary bees, wasps, ants, camel crickets, true bugs, and tiger beetles take advantage of emerging vegetation and flowering events to reproduce, construct nests, and provision their offspring. Pollinator communities—composed largely of flies, bees, butterflies, and moths—are present during these brief favorable conditions, and their diversity is largely shaped by the structure and composition of the local vegetation. The lack of humans,

environmental conditions, and land management patterns (most desert shrublands are managed by the federal government and Utah Trust Lands Administration) have resulted in many areas with little development, but mining, oil and gas development, military testing, and hazardous waste disposal do occur in limited areas. Scavengers, including ants, beetles, crickets, and flies, contribute to the decomposition of dead organisms and organic material, and serve as important food for other wildlife.

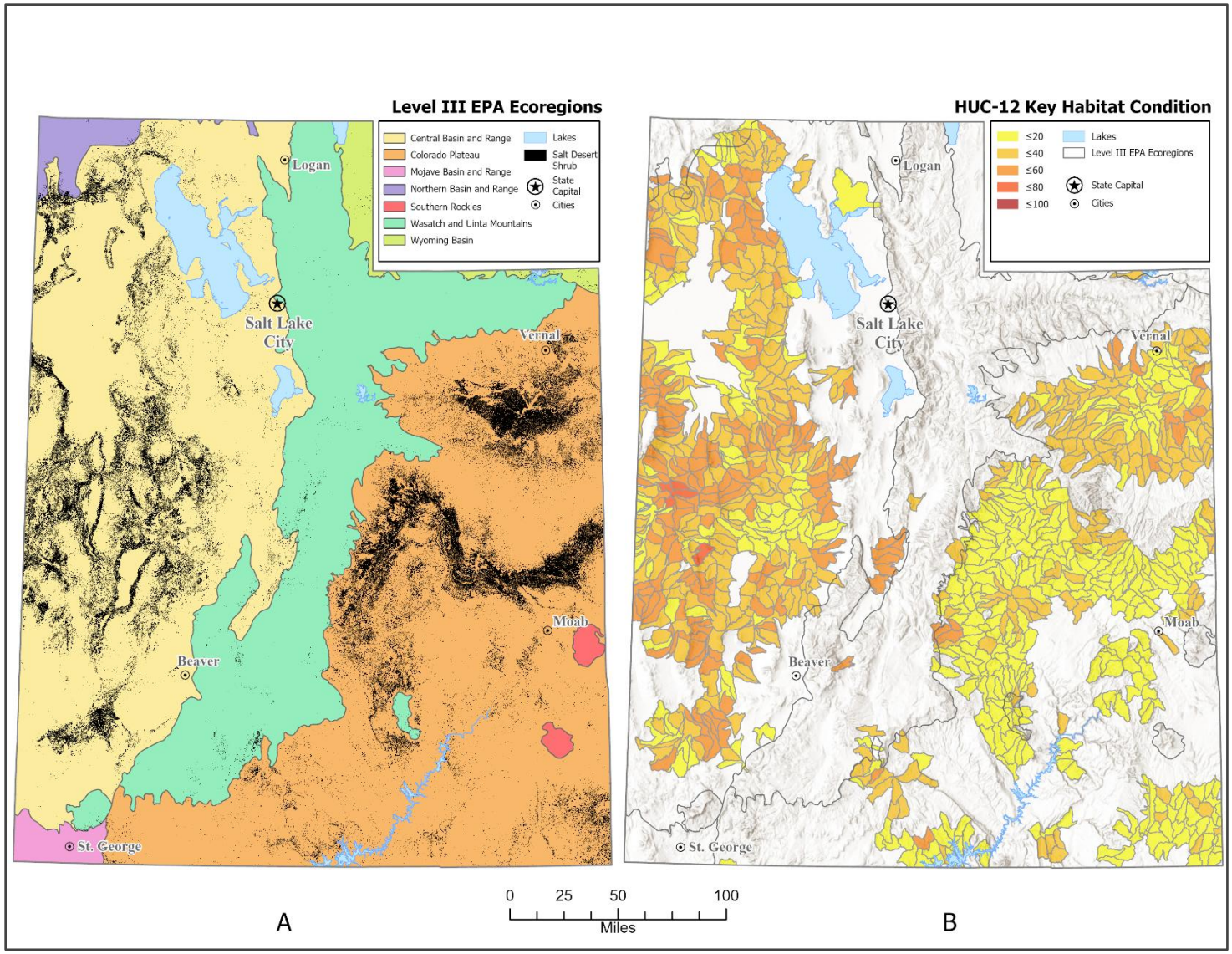


Figure 25. *(A) Salt Desert Shrub Key Habitat Statewide Distribution (B) Ecological Departure for Salt Desert Shrub Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 26. *Salt Desert Shrub Habitat; Millard County*

Note: Photograph by Zach Coury, DWR, 2022.

Ecoregional Characteristics

Salt Desert Shrub Key Habitat occurs in two ecoregions in Utah (making up more than 1% of the area of each ecoregion): Central Basin and Range and Colorado Plateau. Descriptions of the salt desert shrub vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 46.2% of salt desert shrub habitat in Utah occurs within this ecoregion. Salt desert shrub communities in this ecoregion are arid and occur mostly in saline basins, although some overlap does exist with this ecoregion's desert shrub habitats. Vegetation density within salt desert shrub communities of this ecoregion is often sparse but can be moderate, depending on topography and soil salinity levels. Common vegetation includes salt-tolerant plants such as shadscale, winterfat, and greasewood. More mesic and high-salt-tolerant plants, such as pickleweed and saltgrass, may occasionally occur along waterways and in ponded areas. Annual grasses and introduced perennials found in this ecoregion include cheatgrass, red brome, common Mediterranean grass (crested wheatgrass can also become well established within this habitat), and Russian thistle.

Colorado Plateau

Approximately 52.6% of salt desert shrub habitat in Utah occurs within this ecoregion. Salt desert shrub communities in this ecoregion are sparsely vegetated with large areas of dwarf shrublands. Dominant species include mat saltbush, bud sagebrush, James' galleta grass, shadscale, greasewood, winterfat, Indian ricegrass, horsebrush, various mallows, rabbitbrush, and Mormon tea. Depending on precipitation trends, a variety of forbs can be found in this habitat. The noxious weed halogeton is widespread and can often poison livestock. Tamarisk, another noxious weed, is common along waterways and occurs sporadically along dry washes.

Salt desert shrub soils in this ecoregion tend to be heavy in clay, often with significant amounts of salt and gypsum. The Colorado Plateau ecoregion is home to several national parks and large areas of BLM-administered lands, as well as major natural gas and oil developments.

Extent

- LANDFIRE (2020a) was used to determine Salt Desert Shrub Key Habitat extent in Utah.
- Total current mapped area:
    - 4,826,030 acres
    - 8.88% of state surface area (see Figure 25)
    - 19,530 km^2 (7,541 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Inter-Mountain Basins Greasewood Flat
    - Inter-Mountain Basins Mat Saltbush Shrubland
    - Inter-Mountain Basins Mixed Salt Desert Scrub

Condition

Salt desert shrub habitat varies in condition depending upon land use and disturbance history and can be in poor to good condition. This habitat naturally has very low plant cover, with perennial shrubs being most consistent. Perennial grasses and forbs can vary greatly from year to year in their size and coverage. Past livestock grazing, particularly winter range grazing for sheep, has negatively impacted more palatable plant cover and caused excessive erosion in some areas and expansion of less-palatable species; however, under good management, the negative effects can slowly be reversed. Past overgrazing has resulted in widespread erosion in many areas.

Halogeton and annual grasses (e.g., cheatgrass) have become established across large areas. Like native species in this habitat, these annual species can take advantage of wet years and increase in coverage, while having low cover in drought years.

Given the naturally low vegetation cover, intense precipitation events (i.e., thunderstorms) can produce excessive flooding and erosion events. Therefore, the ability of washes and gulches to support more well-developed riparian areas is naturally limited.

Because of the naturally open terrain, it is easy for OHVs to leave designated trails and cross open deserts, which can result in widespread soil and vegetation disturbance and weed dispersion and establishment. This results in even lower plant cover that can locally increase both wind- and precipitation-driven soil erosion.

Both plants and wildlife species occurring in this habitat exist in very harsh environments. Given this, periods of drought conditions or back-to-back dry years can result in a loss of perennial vegetation cover and a decrease in wildlife abundance. Even the hardiest of plants require some water, and longer periods of drought can quickly reduce plant abundance. Most of the annual species can persist through a drought (as seeds), but perennial species' (both plants and wildlife) recovery from droughts can take many years.

Locally, energy development (e.g., oil and gas and renewables) and associated infrastructure such as roads, pads, power lines, and pipelines can impact these habitats. Given the difficult growing conditions, revegetation of disturbed areas can take many years, and establishment of non-native species can be problematic.

Improving Condition

An effective strategy for management of salt desert shrub habitat in Utah may include the following elements:

- Create and maintain fuel breaks to prevent fire from reaching remaining unburned acres, particularly in Great Basin communities where plant cover is higher and annual grass cover is problematic. Prioritize the enhanced prevention and suppression of ignitions in unburned areas in habitats dominated by native plant communities.
- Continue the search for herbicidal agents and biological controls to use against invasive annual grasses.
- Work with larger federal land management agencies (e.g., the BLM and USFS) on OHV management; engage with user groups to help better manage OHV areas to reduce wind and precipitation erosion and habitat impacts.

- Continue research for effective plant restoration materials and methods that can be affordably translated from the research plot scale to the operational project scale.
- Continue the funding and support for weed abatement programs, including EDRR programs.
- Continue the development of new plant materials and restoration techniques suited to this habitat.
- Promote management that includes seeding a diversity of grasses, forbs, and shrubs that will lead to increased resiliency and resistance in the plant community.

Threats

Table 20 summarizes the threats to salt desert shrub habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including salt desert shrub habitat. White rows indicate threats that are important to salt desert shrub habitat but do not impact as many species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 20. *Threat Prioritization Exercise Summary Results for Salt Desert Shrub Key Habitat*

SALT DESERT SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Landfill Operation				1		
Trail, Trailhead, and Staging Area Development				1		
Improper Grazing – Livestock (current)				1		
Improper Grazing – Livestock (historic)		1				
Oil and Gas Drilling			1			
Mining and Quarrying				1		
Solar Power Facilities		1				
Wind Power Facilities				1		
Roads – Energy Development			1			

SALT DESERT SHRUB KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Utility and Service Lines				1		
OHV Motorized Recreation			1			
Military Testing and Training Activities				1		
Inappropriate Fire Frequency and Intensity		1				
Groundwater Pumping			1			
Invasive Plant Species (non-native)		1				
Feral Domesticated Animals				1		
Soil Movement/Deposition				1		
Droughts			1			
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Inadequate Restoration Tools or Methods			1			
Total	**0**	**4**	**9**	**9**	**0**	**22**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact salt desert shrub habitats at a fine resolution and work toward the preservation of those habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to assess salt desert shrub habitat condition to allow meaningful comparison through time.
- Work with federal land managers to identify high OHV disturbance areas and better manage OHV use to help reduce soil erosion and loss of sparse vegetation cover.

- Help designate energy corridors to help co-locate impacts from roads, power lines, and other infrastructure impacts.
- Develop policies that enforce grazing management strategies for salt desert shrub communities.
- Promote coordination between agencies and private landowners to install and maintain fire breaks that protect intact habitats.

Subalpine Grassland

Subalpine grassland habitat (Figure 27 and Figure 28) occurs at elevations between 2,195 and 3,353 m (7,200 and 11,000 feet), where finely textured soils, persistent snow accumulation, or windswept dry conditions limit the establishment of trees and shrubs. These grasslands often appear in small pockets across a range of elevations and vegetation types, where topographic and soil conditions favor increased moisture retention and soil deposition. Soils in subalpine grasslands are generally well drained, slightly acidic, and rich in organic material—similar in character to prairie soils.

Dominant grasses in this habitat include pine dropseed, timber oatgrass, Parry's oatgrass, Idaho fescue, Thurber's fescue, pullup muhly, and slender wheatgrass. Thurber's fescue is especially common at higher elevations, and Parry's oatgrass dominates on thinner, coarser soils. Forbs and low flowering shrubs also occur frequently in these habitats, including geranium, violet, buttercup, western blue flag, columbine, scarlet gilia, showy fleabane, cinquefoil species, larkspur, monkshood, mountain bluebell, harebell, biscuitroot, false hellebore, monument plant, Penstemon, elephant's-head lousewort, clover, arrowleaf balsamroot, and a variety of daisy-like composite flowers. Exotic species like Kentucky bluegrass and dandelion frequently occur near heavily grazed areas and along roadsides (NatureServe 2018).

Insect communities in subalpine grasslands share many traits with those of alpine ecosystems, due to overlapping plant species and similar environmental conditions above and below tree line. These grasslands, often interspersed with clusters of trees in a meadow mosaic, provide structural complexity and plant diversity that support a rich array of insect species—especially pollinators. The brief but intense growing season fosters a high level of insect activity among flowering forbs and shrubs, including numerous species of bumble bees and solitary native bees, flies, wasps, beetles, butterflies, and moths.

The presence of rocky soils and burrowing rodents create diverse nesting habitats for ground-nesting insects such as bumble bees. Several rare and declining bumble bee species appear to have found refugia in Utah's subalpine grasslands, where they persist despite broader declines

across their range due to habitat loss and fragmentation, drought, and rising summer temperatures (Janousek et al. 2023).

Throughout the season, plant-pollinator interactions shift rapidly due to overlapping species phenologies. These interactions influence floral traits, maintain genetic diversity in plant populations, and shape ecological processes such as herbivory, parasitism, and predation. Many pollinators occupy multiple ecological roles—not only as pollinators but also as herbivores contributing to nutrient cycling; prey for higher trophic levels; predators and parasitoids regulating invertebrate populations; and decomposers enhancing soil formation, carbon storage, and nutrient availability.

Other insects common to these habitats include many types of flies, ground beetles, grasshoppers, crickets, hemipterans, damselflies, ants, velvet ants, and many other taxa that occupy a multitude of ecological niches. Despite a relatively short growing season, the high species richness and productivity of subalpine grasslands are sustained in large part by the diversity and functional roles of their insect communities.

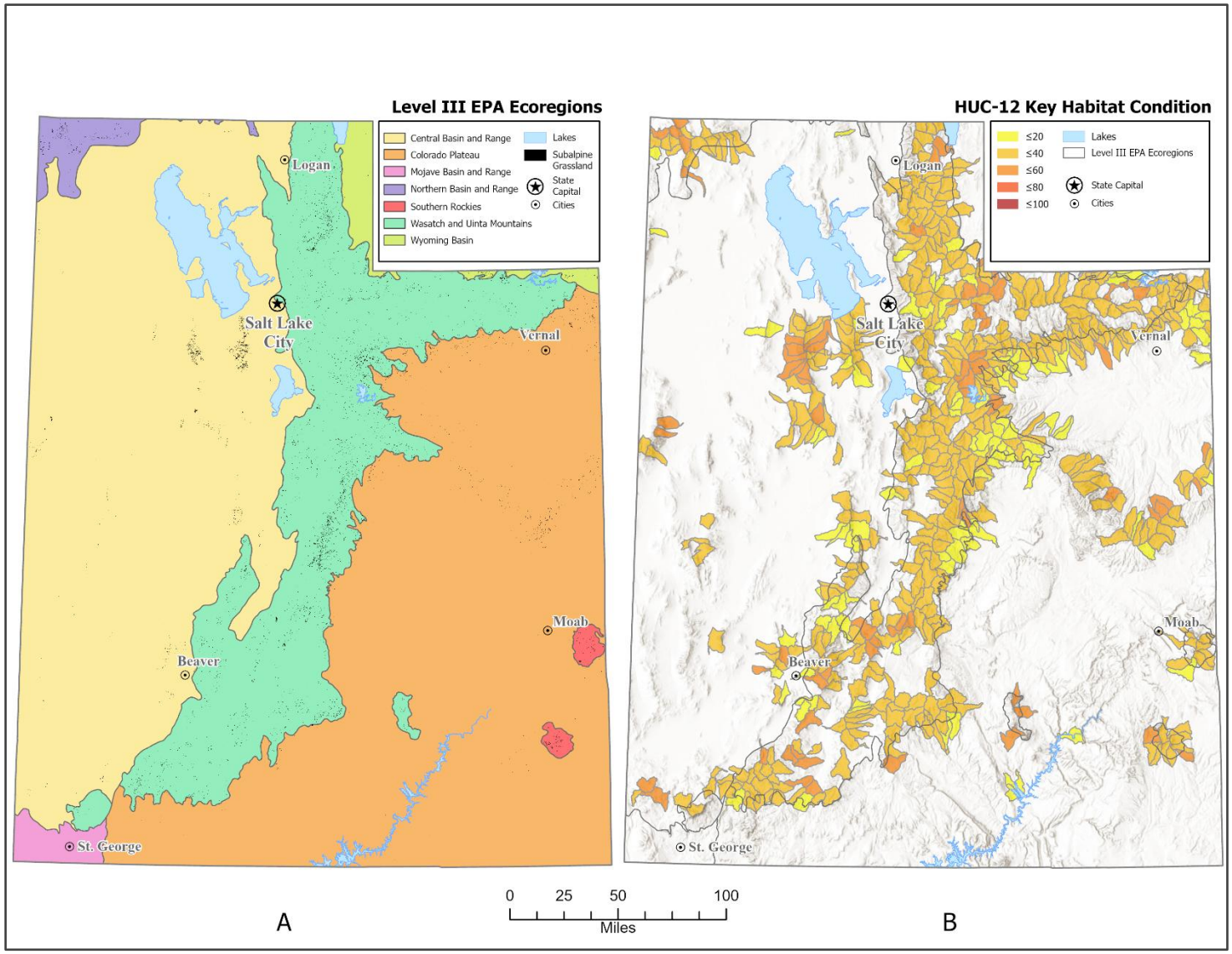


Figure 27. *(A) Subalpine Grassland Key Habitat Statewide Distribution (B) Ecological Departure for Subalpine Grassland Key Habitat*

Note: HUC-12 polygons containing a very small portion of the total key habitat are not displayed. Custom-weighted ecological departures are calculated for HUC-12 units, binned into five categories (0%–20%, 20%–40%, 40%–60%, 60%–80%, and 80%–100%), and shown as a percentage of the overall degree of departure from archetypal conditions.



Figure 28. *Subalpine Grassland Habitat; Sanpete County*

Note: Photograph by Zach Coury, DWR, 2022.

Ecoregional Characteristics

Subalpine Grassland Key Habitat occurs in six Utah ecoregions (making up more than 1% of the area of each ecoregion): Central Basin and Range, Colorado Plateau, Northern Basin and Range, Southern Rockies, Wasatch and Uinta Mountains, and Wyoming Basin. Descriptions of subalpine grassland vegetation communities in these ecoregions are below.

Central Basin and Range

Approximately 16.9% of subalpine grassland habitat in Utah occurs within this ecoregion. Subalpine grassland habitat can be found in valleys, on slopes, and on higher-elevation alluvial fans in the Oquirrh, Stansbury, Deep Creek, and Mineral Mountains. Vegetation in this ecoregion is typically a mosaic and varies in species composition depending on elevation and soils; for example, grasslands often intermix with stands of aspen and mixed conifers in the higher elevations, especially on north-facing slopes. Dominant species include spike fescue, bluebunch wheatgrass, and slender wheatgrass.

Colorado Plateau

Approximately 11.6% of subalpine grassland habitat in Utah occurs within this ecoregion, primarily on the Tavaputs Plateau. Precipitation in this habitat tends to be higher than other habitat types within the Colorado Plateau ecoregion, and increased moisture from thunderstorms provides favorable conditions for warm-season grasses. In this ecoregion, it is typical to see Wyoming big sagebrush co-occur with grasses. Dominant species can include Thurber's fescue, Sandberg bluegrass, muttongrass, and Kentucky bluegrass.

Southern Rockies

Approximately 2.4% of subalpine grassland habitat in Utah occurs within this ecoregion in the La Sal and Abajo Mountains. Subalpine grasslands in this ecoregion are often dominated by bunchgrasses such as timber oatgrass, Parry's oatgrass, fescues, slimstem muhly, Fendler's bluegrass, slender wheatgrass, or bluebunch wheatgrass.

Northern Basin and Range

Approximately 4.0% of subalpine grassland habitat in Utah occurs within this ecoregion, chiefly in the Raft River, Goose Creek, and Grouse Creek Mountains. This key habitat is commonly found on the ridgetops and side slopes of mountains with cold winters. In the Dissected High Lava Plateau area of this ecoregion, vegetation mostly consists of bluebunch wheatgrass, Idaho fescue, Wyoming big sagebrush, and low sagebrush. Crested wheatgrass can also be common.

Wasatch and Uinta Mountains

Approximately 63.6% of subalpine grassland habitat in Utah occurs within this ecoregion. The Wasatch and Uinta Mountains are characterized by high, glaciated mountains; dissected plateaus; foothills; and intervening valleys (Woods et al. 2001) that create many opportunities for subalpine grasslands to develop. Subalpine grasslands occur in mosaics with forest stands

of fir, aspen, and pine. Species often found in this habitat in this ecoregion include pine dropseed, spike fescue, and oatgrasses and less often, Thurber's fescue.

Wyoming Basin

Approximately 1.5% of subalpine grassland habitat in Utah occurs within this ecoregion. Subalpine grasslands are found close to the northeastern border of Utah near Flaming Gorge Reservoir and to the northwest near the town of Randolph, where several waterbodies bisect these habitats (e.g., Little Creek and Big Creek). Subalpine grassland habitat in this ecoregion tends to dominate high hills and low mountains and can also be drier and less continuous than typical subalpine grasslands. Typical species in this habitat include bluebunch wheatgrass, Sandberg bluegrass, and Fendler's bluegrass mixed with mountain big sagebrush. Exotic annual grasses can also be common because of repeated fires and grazing in this part of Utah.

Extent

- LANDFIRE (2020a) was used to determine Subalpine Grassland Key Habitat extent in Utah.
- Total current mapped area:
    - 149,545 acres
    - 0.28% of state surface area (see Figure 27)
    - 605 km^2 (234 square miles)
- LANDFIRE EVTs (NatureServe 2018) included in this key habitat are as follows:
    - Southern Rocky Mountain Montane-Subalpine Grassland

Condition

Subalpine grasslands are generally in good condition; these habitats are often high enough in elevation and receive enough precipitation to limit the invasion of annual grasses. Past overgrazing in some areas has likely favored coarser grasses that are less palatable to wildlife, such as Thurber's fescue; therefore, some areas likely have limited species diversity. In mesic depressions, some noxious weeds may be of issue (primarily Canada thistle).

Impacts from wildfires are fairly limited except during the most extreme droughts; most grasses only burn at the top, preserving the root crown, and can resprout relatively quickly. During extreme drought, however, root crowns can become very dry, and fires can burn down into the roots and kill the grass completely.

In some areas, concentrated livestock grazing and feral horse grazing can negatively impact community health and, as mentioned, favor coarser and less-palatable grass species (e.g., Thurber's fescue).

Near roadsides and previously disturbed areas, the establishment of smooth brome (which can form near monocultures) has displaced native grasses and forbs.

Improving Condition

An effective strategy for management of subalpine grassland habitat in Utah may include the following elements:

- Monitor impacts from feral horses and other species (introduced or native) more closely, especially how those impacts are compounded when combined with livestock grazing (which federal managers have generally better supervised in terms of duration and timing).
- Assess natural perennial grass re-establishment after extreme fire events. If perennial grass mortality has occurred, reseeding with local native grasses should occur to prevent excessive erosion and to help reduce the risk of non-native species establishment (e.g., smooth brome, annual grasses).
- Continue the development of new plant materials and restoration techniques suited to this habitat.

Threats

Table 21 summarizes the threats to subalpine grassland habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including subalpine grassland habitat. White rows indicate threats that are important to subalpine grassland habitat but do not impact as many species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 21. *Threat Prioritization Exercise Summary Results for Subalpine Grassland Key Habitat*

SUBALPINE GRASSLAND KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Cabin Communities/Development				1		

SUBALPINE GRASSLAND KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Campground Development				1		
Ski Area Development				1		
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)		1				
Oil and Gas Drilling				1		
Mining and Quarrying				1		
Wind Power Facilities				1		
Roads – Transportation Network				1		
Roads – Energy Development				1		
OHV Motorized Recreation				1		
Camping/Campground Development (dispersed)			1			
Inappropriate Fire Frequency and Intensity			1			
Post-Fire Precipitation/Flooding (resulting water quality issues)				1		
Seeding Non-Native Plants			1			
Feral Domesticated Animals				1		
Problematic Plant Species (native upland)				1		
Encroachment of Woody Vegetation/Shifting Tree Line			1			
Droughts			1			
No Standardized Condition Assessment Method			1			
Future Effects of Greater Temperature Variability under Climate Change			1			

SUBALPINE GRASSLAND KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Future Effects of Greater Precipitation Variability under Climate Change			1			
Total	**0**	**1**	**9**	**12**	**0**	**22**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners and land managers to map highly intact subalpine grassland habitats at a fine resolution and work toward the preservation of those mapped habitats to reduce habitat fragmentation and perforation.
- Work with partners to determine a sound method by which to accurately assess subalpine grassland habitat condition to allow meaningful comparison through time.
- Support grazing management to promote a variety of grass species to occupy the different niches within this habitat type.
- Promote any prescribed wildfire management protocols to enhance diversity across the community versus allowing greater occupancy of introduced grasses.

Other Habitats

Badlands

In Utah, the term *badlands* generally refers to areas with sparse or absent vegetation, primarily due to inhospitable soil conditions. These soils are typically derived from marine shale, mudstone, or other highly erodible, clay-rich parent materials that exhibit slow water infiltration and high surface runoff. As a result, vegetation is limited and often composed of locally endemic species that have evolved specialized adaptations to persist under such extreme environmental conditions over millennia.

Badlands—or "sparsely vegetated habitats" as classified by the LANDFIRE EVT model (LANDFIRE 2020a; NatureServe 2018)—are widespread across Utah, largely due to the prevalence of saline-affected geological substrates in many of the state's desert regions. Notable examples of plant species adapted to these conditions include the three milkvetch species under the Milkvetch Conservation Agreement: Cisco milkvetch, Isely's milkvetch, and Stage Station milkvetch (USFWS et al. 2022). Additional characteristic species include dwarf

bear-poppy, numerous saltbush species, and other wildflowers whose seeds remain viable for several years until adequate precipitation prompts their germination, rapid growth and flowering, and return to the soil seed bank.

Despite their harsh conditions, Utah's badlands support an exceptional diversity of insect life. Many beetles, moths, butterflies, grasshoppers, camel crickets, gnats, and flies have adapted to the unique challenges of this environment. Particularly notable is the richness of ground-nesting, solitary, pollen-specialist bees, which have evolved brief flight periods that coincide with the flowering of specific host plants (Carril et al. 2018). These highly specialized bees are often closely associated with equally elusive kleptoparasitic species, such as cuckoo bees, wasps, velvet ants, and certain beetles. Their life cycles are tightly linked to seasonal precipitation, which triggers the sequential emergence of host plants and their pollinators.

These complex ecological interactions are further supported by a suite of cryptic predators—such as spiders, scorpions, solfugids, centipedes, and other arthropods—that are rarely encountered but play integral roles in badland food webs. Together, these communities illustrate the remarkable biodiversity and ecological specialization present in Utah's badland ecosystems.



Figure 29. *Badlands Habitat; Uintah County*

Note: Photograph by Tory Mathis, DWR, 2025.

Cliffs and Canyons

Cliffs and canyons occur throughout Utah due to the state's complex geology and erosional features. These areas are generally sparsely vegetated and consist of steep cliff faces or narrow canyons. Cliffs and canyons can provide refugia for many plants and animals to escape the heat and/or predators. They also provide water through runoff from rock surfaces into streams, creeks, or other water features below. Water also seeps through porous rock layers within cliffs to create hanging gardens. The combination of the parent materials of these features and geological time often dictates the specialized species that can thrive in these habitats. The composition of these escarpments, cliffs, and canyons vary from limestones to sandstones to shales that have experienced many geological processes, all while developing associations with flora and fauna. Animal species that often use cliffs and canyons include mountain lion, bighorn sheep, and many species of birds. Examples of plants that often live on cliffs or canyons or in hanging gardens include Barneby's reed-mustard, Jones cycladenia, Frank Smith's violet, Navajo sedge, alcove rock-daisy, and Desolation Canyon columbine.

Insect taxa associated with canyons are generally similar to those found in other riparian habitats. However, several canyons in southern Utah are home to rare and endemic species of dragonflies, damselflies, and tiger beetles (Myrup and Baumann 2016; Pearson et al. 2015). Sandstone cliff faces offer a distinctive substrate for the burrows of a recently described xeric bee species—the sandstone digger bee—which is known only from a handful of records in sandstone formations throughout the Colorado Plateau (Orr et al. 2016). Because canyons and cliff sides vary in geological composition, depth, water availability, climate, and vegetation, they support unique assemblages of invertebrates that may further distinguish individual habitats through their contribution to ecological function and productivity.

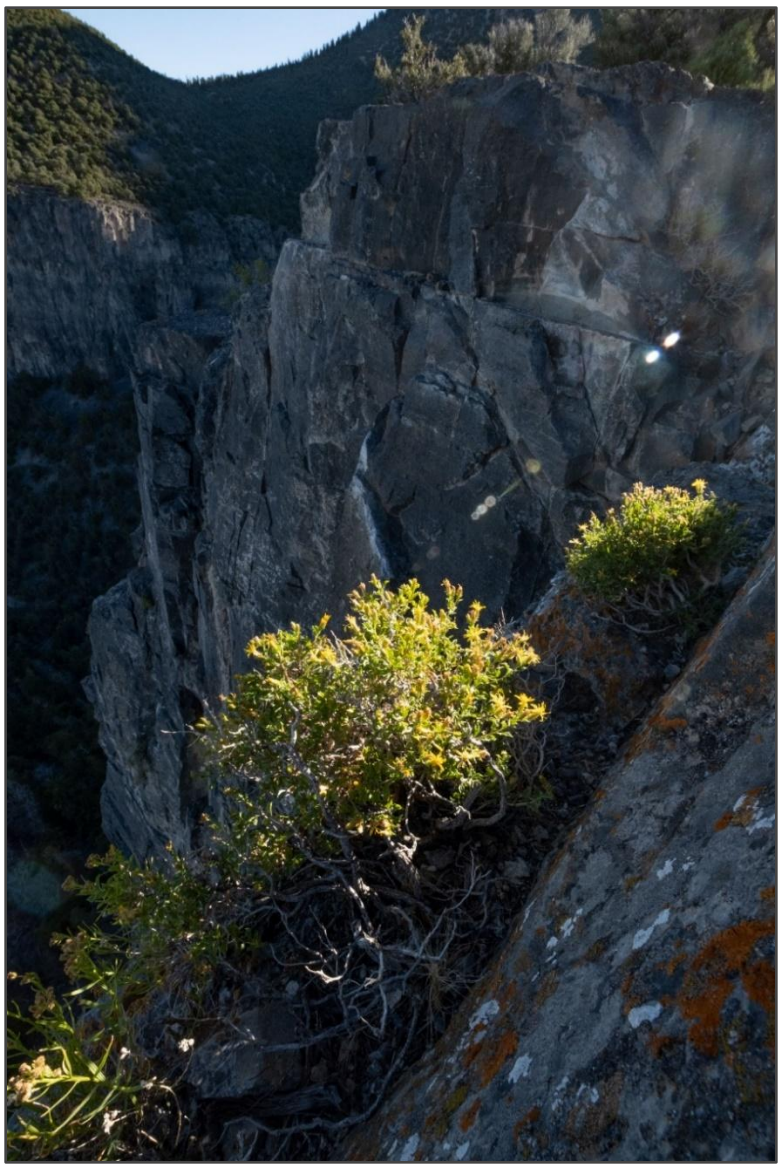


Figure 30. *Cliffs and Canyons Habitat; Millard County*

Note: Photograph by Zach Coury, DWR, 2023.

Mesic Meadows

Mesic meadows most commonly contain some sagebrush, lower montane, and subalpine habitats where finely textured soils, snow deposition, highly moist soils, or windswept conditions limit tree establishment. Many occurrences are small patches that are often found in mosaics within woodlands, dense shrublands, or just below alpine communities. Mesic meadows occur on gentle to moderate-gradient slopes and in relatively moist habitats. Soils are typically seasonally moist to saturated in the spring but dry out later in the growing season. At montane elevations, soils are usually clays or silt loams, and some occurrences may have inclusions of hydric soils in low depressional areas. At subalpine elevations, soils are derived

from a variety of parent materials and are usually rocky or gravelly, with good aeration and drainage and a well-developed organic layer. Some occurrences are more heavily dominated by grasses, whereas others are more dominated by forbs and occasional shrubs. Mesic meadows differ from wet meadows in that their soils dry out by midsummer. Many SGCN, including the greater sage-grouse, rely upon mesic meadows for water as well as food because these areas provide abundant insect life for critical life stages of young birds.



Figure 31. *Mesic Meadows Habitat; Carbon County*

Note: Photograph by Danny Summers, DWR, 2023.

Microbialites

Microbialites are a key feature of the Saline Lakes/Great Salt Lake Ecosystem Key Habitat and occur specifically within the GSL ecosystem. These organo-sedimentary structures can take several forms: thinly layered stromatolites, clotted thrombolites, and spherical oncolites. Microbialites are formed through precipitation from mineral-rich springs and form reef-like structures that cover an estimated 20% of the GSL bottom, thus representing the most extensive assemblage of living microbialites on Earth.

GSL microbialites are colonized by complex photosynthetic microbial mats, consisting of both cyanobacteria and algae (diatoms) that contribute fixed carbon supporting a diversity of heterotrophic microorganisms also living within these mats. These diverse microbial communities are also thought to be involved in the formation of carbonate minerals, which can

lithify and preserve the microbialite structure. Biomass produced by these complex microbial communities supports a variety of more complex organisms, including brine flies, brine shrimp, and recently discovered nematode worms, though the lake's hypersaline environment precludes most aquatic organisms that would browse on stromatolites. The relative lack of aquatic animals in GSL minimizes stirring of sediments from the lakebed that would otherwise blanket stromatolites from sunlight, and the absence of plants and the scarcity of other algae on the lake floor reduce competition for nutrients and space.

The microbialites of GSL's benthic community contribute to the greater lake ecosystem as an essential support system for brine fly offspring. Brine flies lay eggs on the rough texture of submerged microbialite substrates, where larvae attach and graze on the mat of photosynthetic microorganisms until they can safely pupate and detach into the water column. Brine flies represent key food sources for birds, including an estimated 10 million birds that visit GSL annually (Wurtsbaugh 2009). This number includes both shorebirds and waterbirds that dive and feed on brine flies and brine shrimp. Brine flies are considered a keystone species of GSL because of their outsized role as a vital food source for many bird species and other insectivorous predators that depend on the lake ecosystem as an important feeding ground.

Changes in the water level, salinity, and biology of GSL have been shown to impact the aquatic community, particularly with respect to microbialite communities and effects on brine flies. Increases in lake elevation have historically been accompanied by decrease in salinity, shifting phytoplankton communities dominated by halophilic microorganisms to those dominated by phototrophic microorganisms. Decreases in lake elevation accompany increased salinity levels, which result in a decreased abundance of phytoplankton, increased metabolic stress to brine fly larvae due to higher osmoregulation, and potential exposure and desiccation of microbialite communities.

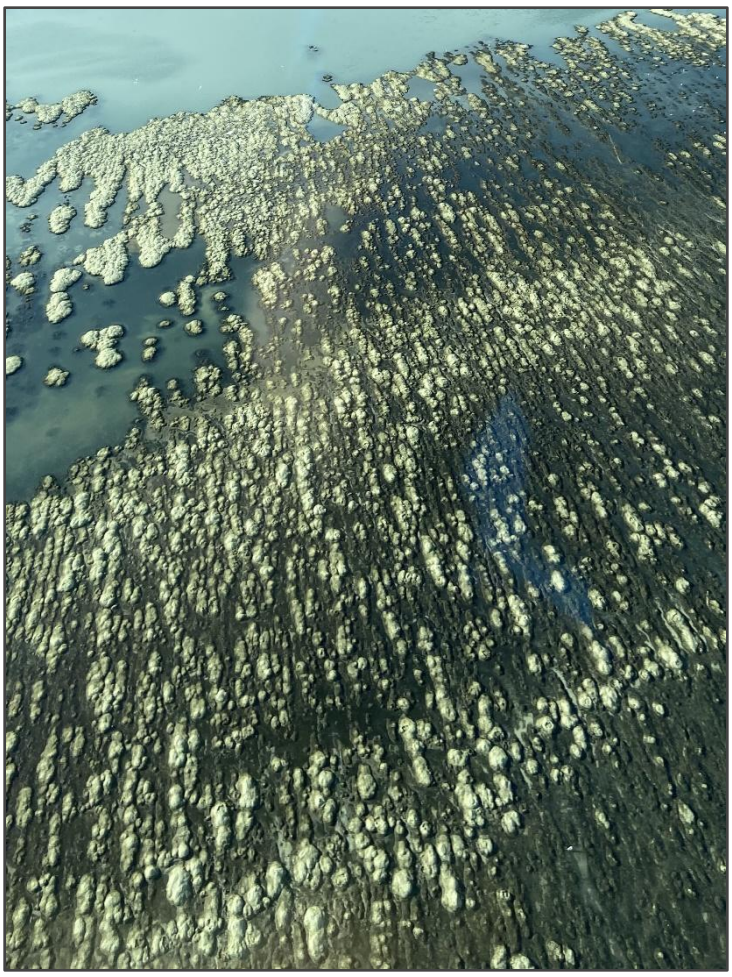


Figure 32. *Microbialites on Great Salt Lake; Salt Lake County*

Note: Photograph by John Luft, DWR, 2022.

Sand Dunes

Sand dunes are typically small, localized landforms where both stabilized and actively shifting sand dominate the substrate. These environments are characterized by intense heat, aridity, and persistent winds and generally support little to no vegetation due to these harsh conditions. Localized pockets of higher soil moisture may occur, however, influenced by underlying geology and the presence of springs.

Despite the arid setting, the rapid infiltration of precipitation into dune sands reduces surface evaporation, creating relatively mesic microenvironments. This retained soil moisture contributes to the stability of dune systems and supports a surprising array of biodiversity, particularly below the surface. Ground-nesting insects, burrowing rodents, and reptiles are commonly found in these habitats, benefiting from the moisture and shelter the dunes provide.

Vegetation in sand dune habitats is typically sparse but specialized. Plant species are adapted to survive extreme conditions such as high temperatures, prolonged drought, and the physical challenges of sand burial. Adaptations include rapid stem elongation, radical growth, and, in the case of the federally listed Welsh's milkweed, extensive rhizome networks that both anchor the plant and help stabilize the dune itself. Characteristic vegetation includes drought-tolerant grasses, forbs, and low shrubs.

Variations in sand grain size and texture, along with fluctuating moisture availability, create microhabitat heterogeneity across dune landscapes. Differences in vegetation between dune crests and swales reflect these underlying physical and hydrological gradients, contributing to a mosaic of ecological niches.

Dune systems are often isolated from each other, forming ecological "habitat islands" that support distinct and endemic species (Epps et al. 2002; Ricketts et al. 1999). Due to this isolation, many organisms within dunes—particularly insects—have limited dispersal capabilities and are highly adapted to the unique conditions of their local environment. Consequently, they are vulnerable to disturbances that alter dune dynamics or ecological function.

Sand dunes harbor a wide variety of sand-obligate insects, including darkling beetles, tiger beetles, camel crickets, flies, velvet ants, and diverse pollinator assemblages—moths, wasps, butterflies, and bees—often closely associated with the available plant species. These invertebrate communities fluctuate with the seasons, forming ephemeral biological communities during periods of moderate temperatures and increased moisture availability, particularly in spring and autumn. These seasonal peaks in productivity correspond with heightened activity among both invertebrate and vertebrate wildlife.

An example of a dune-restricted and conservation-dependent species is the endemic Coral Pink Sand Dunes tiger beetle in southern Utah, which relies on a combination of vegetated swales with sufficient soil stability and shifting, unvegetated dune areas for different stages of its life cycle. The species' survival depends on the continued availability of invertebrate prey and the maintenance of its specialized habitat (Knisley and Hill 2001).



Figure 33. *Sand Dune Habitat; Wayne County*

Note: Photograph by Amanda Barth, Utah State University, 2023.

Aquatic Key Habitat Descriptions

Lakes and Reservoirs

Lakes and reservoirs habitat (Figure 34 and Figure 35) includes perennial bodies of standing freshwater such as natural lakes and reservoirs. For the purpose of the 2025 UWAP, small ponds less than 20 acres in size were categorized as Wetlands Key Habitat because they are more effectively mapped in the NWI source data set. Most lakes and reservoirs are permanently or semipermanently inundated and have wave-formed or bedrock shorelines. Emergent vegetation often occupies the littoral zones, but vegetative cover of the surface area is generally less than 30% (U.S. Environmental Protection Agency 2024a). Clear lakes and reservoirs often support submerged or floating aquatic vegetation. Lakes and reservoirs vary in depth from Lake Powell at 178 m (583 feet) and Bear Lake at 63 m (208 feet) to Utah Lake at approximately 5.5 m (18 feet) (Abbott et al. 2022). Larger and deeper reservoirs share many features of lakes, including thermal stratification; in contrast, smaller waterbodies have relatively uniform water temperatures.

Larger natural lakes occupy topographic depressions, such as waterbodies in subalpine cirques, montane lakes, larger oxbow waterbodies, and some spring-fed waterbodies. Reservoirs are typically human-made impoundments and can occur in river and stream channels or on natural lakes impounded by dams; however, off-channel reservoirs have also been created. Reservoir size and shape are determined by topography and range from expansive reservoirs on rivers (e.g., Lake Powell, which has a storage capacity of more than 24,322,000 acre-feet) to larger livestock waterbodies or urban stormwater basins (e.g., those with a storage capacity of less than 5,000 acre-feet). Smaller reservoirs typically serve local communities, providing water for irrigation, recreation, and wildlife habitat, whereas large reservoirs can store substantial amounts of water for purposes such as agriculture, municipal supply, and hydropower generation. Larger human-made impoundments in waterfowl management areas outside saline lakes habitat are also included in this key habitat, however, the NHDPlus and NWI data sets may classify these as either lakes or waterbodies.

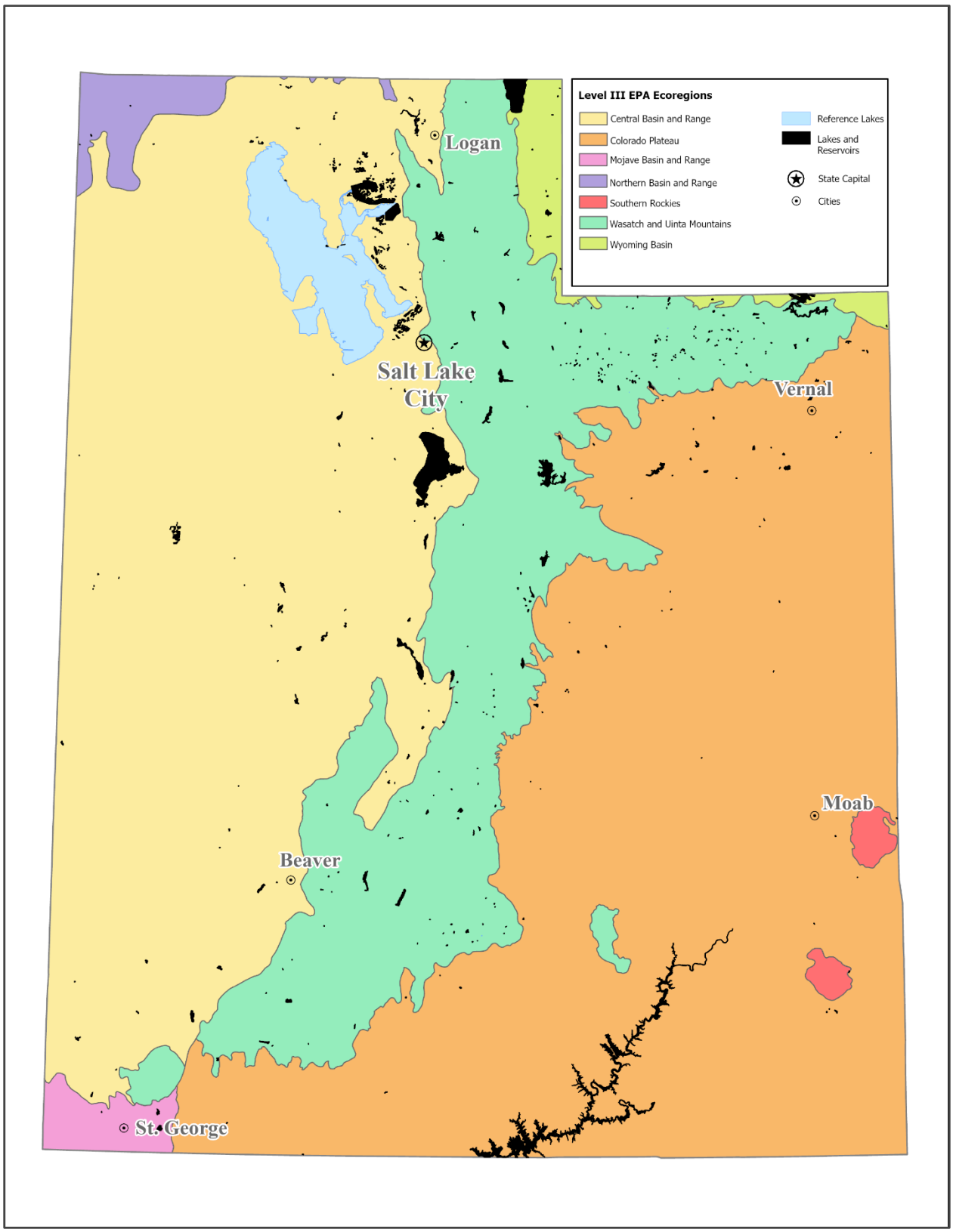


Figure 34. *Lakes and Reservoirs Key Habitat Statewide Distribution*



Figure 35. *Deer Creek Reservoir, Wasatch County*
Note: Photograph by Arianna Mason, SWCA Environmental Consultants, 2023.

Ecoregion Characteristics

Lakes and Reservoirs Key Habitat occurs across Utah in all seven ecoregions. Lakes and reservoirs are important because they provide habitat and water for SGCN in dry landscapes across Utah. The Central Basin and Range ecoregion contains two of Utah's largest natural lakes, both of which are the remnants of prehistoric Lake Bonneville: Utah Lake (freshwater) and GSL (saline). The Colorado Plateau ecoregion contains Lake Powell, the largest reservoir in Utah.

Extent

- Lakes and reservoirs were classified as Open Water Key Habitat in the 2015 UWAP.
- The NHDPlus layer was used to determine habitat extent for lakes and reservoirs habitat in Utah.
- Lakes and reservoirs include perennial bodies of standing water, including natural lakes, reservoirs, and waterbodies greater than 20 acres. In general, waterbodies less than 20 acres in size are classified as wetlands because the NWI captures these habitats better than NHDPlus; however, there is some overlap between these two habitats.
- In general, the extent of reservoirs fluctuates seasonally between wet and dry precipitation cycles and depending on water management, whereas these have less of an impact to the extent of natural lakes (e.g., Bear Lake).

Condition

Most remote subalpine lakes and waterbodies are minimally altered by human activities.

Lower-elevation lakes, waterbodies, and reservoirs vary in condition. Of the lakes, waterbodies, and reservoirs monitored by the Utah Department of Environmental Quality, 47% do not support one or more beneficial uses (e.g., the desired uses that the waterbody should support), primarily due to metal pollutants, dissolved oxygen, and nutrient levels that lead to eutrophication and sedimentation. Lakes and reservoirs also can experience harmful algal blooms, with 11 lakes and reservoirs currently listed as impaired due to harmful algal blooms or eutrophication (DWQ 2022).

In general, water quality in lakes and reservoirs is impacted by upstream human land use and water quantity.

The relative condition of most of Utah's smaller lakes is currently unknown; however, some habitat metrics are collected by agencies (see Table 7 in the Aquatic Key Habitats section of this chapter).

Improving Condition

An effective strategy for management of lakes and reservoirs habitat in Utah may include the following elements:

- Promote policies that maintain conservation pools in lakes and reservoirs.
- Promote policies that limit nutrient input into lakes and reservoirs.
- Promote policies that reduce grazing practices by domestic livestock, feral horses, and wildlife that negatively impact lakes and reservoirs.
- Promote policies that minimize or eliminate the placement of roads in riparian zones.

The condition metrics above are mainly measures of water quality or physical lake conditions, but invasive species can impact lake condition as well. Important strategies to manage invasive species may include the following:

- Continue the use of methods for reducing the spread and dominance of invasive weeds and aquatic vegetation, including EDRR programs.
- Promote policies that eliminate illegal fish introductions.

Threats

Table 22 summarizes the threats to Utah's lakes and reservoirs identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including lakes and reservoirs. White rows indicate threats that are important to lakes and reservoirs but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 22. *Threat Prioritization Exercise Summary Results for Lakes and Reservoirs Key Habitat*

LAKES AND RESERVOIRS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas			1			
Commercial and Industrial Areas				1		
Tourism and Recreational Areas			1			
Improper Grazing – Livestock (current)				1		
Improper Grazing – Livestock (historic)				1		
Spills and Production Water				1		
Mining and Quarrying				1		
Hydropower Facilities				1		
Roads and Railroads				1		
Pipelines/Powerlines - Energy Development				1		
OHV Motorized Recreation				1		
Camping/Campground Development (dispersed)				1		
Unauthorized Species Introductions			1			
Presence of Diversions		1				
Dam/Reservoir Operation		1				
Spring Development/Capping				1		
Agricultural/Municipal/Industrial Water Usage	1					
Water Allocation Policies	1					

LAKES AND RESERVOIRS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Salinity Alteration (of water)				1		
Sediment Transport Imbalance (sediment rich)			1			
Invasive Wildlife Species (non-native)			1			
Invasive Plant Species (non-native)			1			
Stormwater Runoff				1		
Wastewater Treatment Plant Effluent				1		
Agricultural Pollution				1		
Droughts	1					
Data Gaps						
Atmospheric Deposition and Snowmelt Chemistry			1			
Relationship between Groundwater and Surface Water			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Total	**3**	**2**	**10**	**15**	**0**	**30**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Expand water quality monitoring on lakes and reservoirs.
- Continue expanding continuous temperature monitoring and uploading all temperature information into the Utah DWQ Continuous Water Quality Monitoring Dashboard (2025).
- Survey lakes and reservoirs for SGCN and SGIN.
- Develop reservoir and lake level seasonal targets that benefit SGCN (e.g., Bear Lake spring levels that maximize Bear Lake sculpin spawning access to nearshore cobble).

Rivers and Streams

Rivers and streams (Figure 36 and Figure 37) represent flowing water in natural stream channels as identified by the NHDPlus data layer that defines the extent of this key habitat (see Figure 36). Streamflow conditions can be broadly categorized based on flow duration and groundwater exchange processes. Perennial streams flow year-round, mainly sustained by base flow during low runoff periods. Intermittent streams flow when groundwater discharge or precipitation is sufficient, with occasional dry periods when the water table drops. Ephemeral streams only flow during runoff events, because the water table typically remains below the channel bottom. Rivers and streams transport water, sediment, and nutrients from springs and snowmelt at higher elevations or elevated areas. Geologically speaking, sediment transport has shaped river channels, altered landscapes, and influenced aquatic habitat (Wampler 2012). Rivers and streams have carved through rock layers, creating canyon reaches (Utah State University Extension 2020), especially in the Colorado River system. Nutrient transport is essential for forming the base of the food web (e.g., aquatic plants, algae), which provides important habitats for many different life stages of aquatic and terrestrial SGCNs.

Rivers and streams vary greatly in size, from small streams (i.e., intermittent and first to second order; see Strahler [1957] for stream order definition) to very large rivers (i.e., fifth order and larger). Small streams often originate in the headwaters of watersheds or subwatersheds. They can flow seasonally (intermittently) or perennially (year-round), with the greatest streamflow often supported by snowmelt and base summer flows supported by groundwater. The gradient for small streams tends to be moderate to high with boulder and cobble substrates. When water is present, temperature varies by elevation and source (e.g., precipitation or groundwater). Some small streams originate in semiarid regions or smaller watersheds, where they provide ribbons of aquatic and riparian habitats and there are no larger streams. Small streams, particularly in southern Utah, can carry large volumes of water during summer monsoon rains.

Large streams (i.e., third to fourth order) form as small streams coalesce in wide montane and foothill valleys. They tend to have wider channels and a lower gradient than small streams. Snowmelt-driven flood pulses can be of high volume, moving sediment and large woody debris. Summer base flows can be low and are typically sustained by groundwater, with occasional large monsoonal flood events that deliver sediment. Larger streams have greater meandering potential than small streams, which allows floodplain features such as alluvial bars, side channels, and overhanging banks to develop. Riparian habitats along large streams can be diverse and productive and can include forests, shrublands, and meadows. Large woody debris is more abundant in large streams; further diversifies stream habitat; and is an important labile

substrate for periphyton, microbes, and macroinvertebrates. Water temperatures are generally cool to cold, although temperatures rise during the summer.

Rivers (fifth order and larger) include all mainstem rivers and their major tributaries. Streamflow is characterized by high-volume spring and summer flooding from snowmelt and summer base flows that are sustained by groundwater and larger perennial tributaries. Foothill and lower montane rivers have moderate gradients with boulder and cobble rapids and riffles; cobble and gravel runs; and large pools with sand, gravel, and silt. The Colorado and Green Rivers have wide, dynamic floodplains with complex aquatic habitats, although tamarisk and reduced spring flow due to reservoirs and diversions (i.e., human water demand) reduce the connection with the floodplain. High flows move sediment and woody debris that form side and braided channels, backwaters, oxbow waterbodies, and wetlands. Canyon reaches tend to have rapids created by large boulder inputs from side canyon fans and cliffs, followed by large and deep pools and sandy beaches in eddies.

Larger rivers and streams with higher volumes and velocities also have greater stream capacity (i.e., ability to transport sediment) and stream competence (i.e., movement of larger sediment particles). Rivers with greater stream competence have the ability to shape aquatic habitat by undercutting banks, establishing side channel habitat, and moving boulders and large woody debris. Streamflow, sedimentation, and geology collaboratively shape aquatic habitats through various mechanisms. Streamflow dynamics, including velocity variations, give rise to distinct habitat types such as pools, riffles, and runs, each supporting different aquatic species and ecological functions. Sedimentation processes contribute to habitat formation by depositing sediments to create features such as sandbars and gravel beds, whereas erosion can undercut banks and deepen pools. Additionally, sediment transport introduces large woody debris into streams, enhancing habitat complexity. Geology influences substrate composition, channel morphology, and the formation of features like undercut banks, collectively shaping habitat structure and providing essential niches for aquatic organisms (McCabe 2011).

Aquatic macroinvertebrates in Utah's rivers and streams are small organisms—mostly insect larvae, worms, and snails—that play a crucial role in the health of these ecosystems. These diverse communities fulfill many ecological functions. They are primary consumers of algae and aquatic vegetation; detritivores that break down organic material; predators that prey on other invertebrates and small fish; and, importantly, a major food source for fish, amphibians, reptiles, birds, and mammals. Insects comprise the majority of these macroinvertebrates, including mayflies, stoneflies, caddisflies, beetles, midges, crane flies, dragonflies, and damselflies. Other invertebrates include snails, clams, aquatic worms, and crayfish. These

communities can also serve as important indicators of water and habitat quality and are routinely sampled as part of stream health bioassessments.

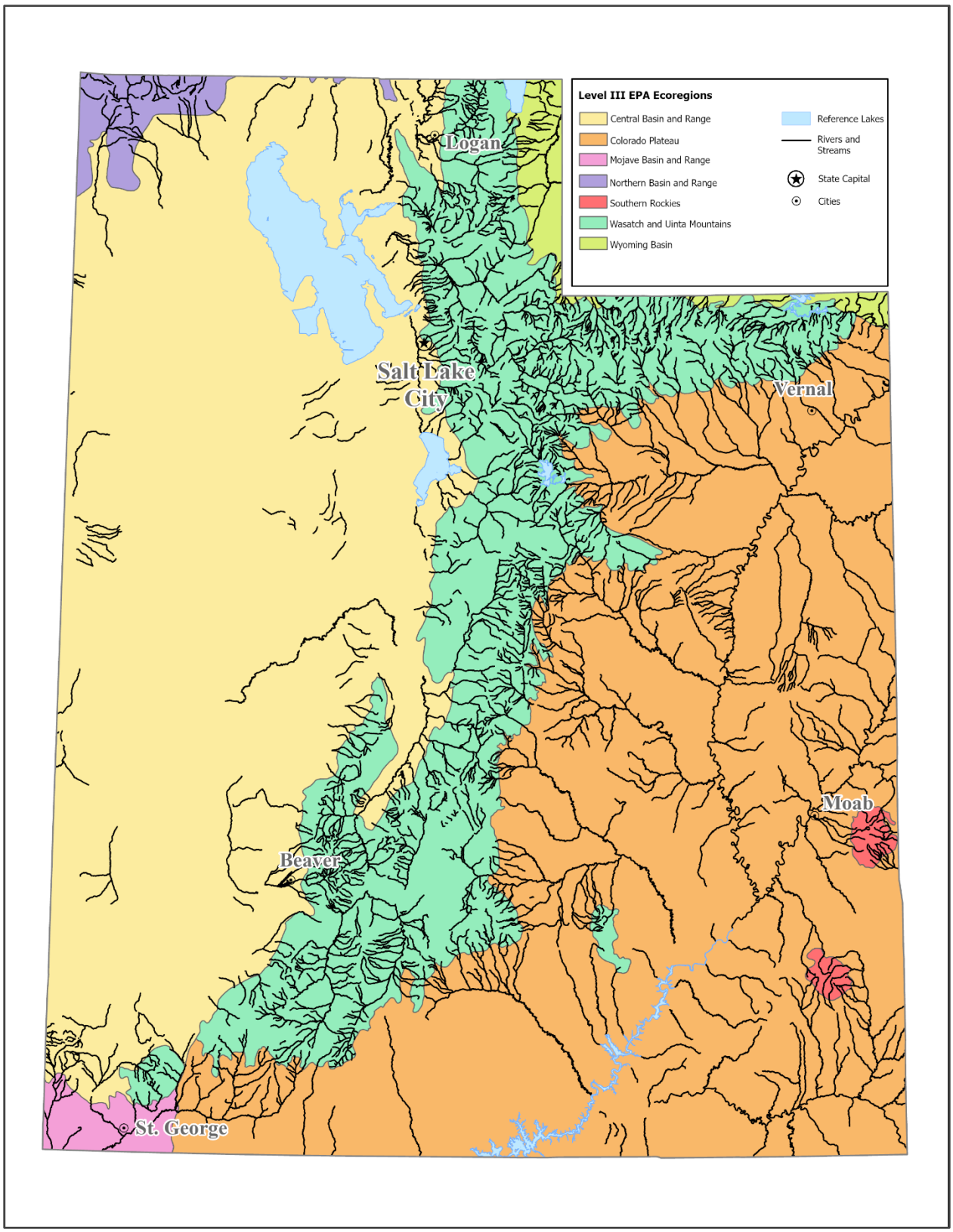


Figure 36. *Rivers and Streams Key Habitat Statewide Distribution*



Figure 37. *West Fork Blacks Fork River, Summit County*

Note: Photograph by Steve Fuller, SWCA Environmental Consultants, 2023.

Ecoregion Characteristics

Rivers and Streams Key Habitat occurs across Utah in all seven ecoregions. Rivers and streams provide habitat and water for SGCN, which are critical in dry landscapes such as Utah. The Wasatch and Uinta Mountains ecoregion encompasses the watersheds of large rivers and streams, such as the Weber, Provo, and Jordan Rivers, which terminate at GSL in the Great Basin. The Colorado Plateau ecoregion contains both the Green and Colorado Rivers, which are Utah's largest rivers; their headwaters are in Wyoming and Colorado, respectively.

Extent

- The NHDPlus layer (U.S. Geological Survey 2025a) was used to determine habitat extent for rivers and streams habitat in Utah.
- Rivers and streams represent flowing water in natural stream channels that are categorized as perennial, intermittent, or ephemeral based on flow duration and groundwater exchange processes.

Condition

Intact small stream habitat occurs across the state but is increasingly affected by warming temperatures, drought, livestock grazing, and human land uses that alter streamflow, water

temperature, sediment transport, and nutrient cycling. Similarly, intact large stream habitat is present but often is impacted by historical or current human land uses, constrained and simplified floodplains, reduced habitat diversity and function, altered river flows, and impaired water quality. Human activities include water development and livestock grazing. Additionally, many Utah rivers, particularly in the Great Basin, face challenges from minimally buffered developments that alter river flows, constrain and simplify floodplains, reduce riparian habitat, and diminish habitat complexity and function, as well as impact the abundance and distribution of large woody debris.

Diversions and dams fragment habitat and limit movement opportunities for some SGCN to access habitats for life history needs such as spawning.

DWQ's *2024 Integrated Report on Water Quality* found that 42% of perennial stream miles (out of 15,820 perennial miles reported) in Utah did not meet water quality standards (DWQ 2024). This is down from 52% reported in 2022 (DWQ 2022). Out of those perennial stream miles evaluated, a total of 31% supported their designated beneficial use. Designated beneficial uses protect water quality for different uses, including drinking water, recreation, aquatic life, and agriculture (DWQ 2024).

The relative condition of most of Utah's rivers and streams is currently unknown; however, some habitat metrics are collected by agencies and other organizations (see Table 8 in the Aquatic Key Habitats section of this chapter).

Improving Condition

An effective strategy for management of rivers and streams habitat in Utah may include the following elements:

- Promote policies that maintain or restore natural flow and sediment regimes.
- Promote policies that reduce inappropriate grazing by domestic livestock, feral horses, and wildlife.
- Promote policies that minimize or eliminate the placement of roads in riparian zones.
- Promote policies that reduce inappropriate residential and commercial development in floodplains.
- Continue the use of appropriate methods for reducing the spread and dominance of invasive weeds and aquatic vegetation, including EDRR programs.
- Use proven stream restoration techniques to aggrade the channels of highly degraded streams, especially those that are so channelized and/or incised that they are no longer

connected to the floodplain, (e.g., incorporation of low-tech, process-based restoration techniques such as BDAs) to restore natural stream conditions (Anderson, Goeking, et al. 2024; Utah State University 2024).

Threats

Table 23 summarizes the threats to rivers and streams habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including rivers and streams. White rows indicate threats that are important to rivers and streams but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 23. *Threat Prioritization Exercise Summary Results for Rivers and Streams Key Habitat*

RIVERS AND STREAMS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas		1				
Commercial and Industrial Areas				1		
Tourism and Recreational Areas				1		
Conversion from Flood to Sprinkler Irrigation			1			
Improper Grazing – Livestock (current)		1				
Livestock Feedlot				1		
Water Developments for Livestock				1		
Improper Grazing – Livestock (historic)		1				
Well Pad Development			1			
Spills and Production Water			1			
Mining and Quarrying				1		
Hydropower Facilities			1			
Nuclear Power Facilities				1		

RIVERS AND STREAMS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Roads – Transportation Network			1			
Roads – Energy Development				1		
Railroads				1		
Pipelines/Powerlines – Energy Development				1		
Excessive Harvest – Regulated/Legal		1				
OHV Motorized Recreation			1			
Camping/Campground Development (dispersed)				1		
Hiking/Foot Travel				1		
Mountain Biking				1		
River Rafting				1		
Inappropriate Fire Frequency and Intensity		1				
Post-Fire Precipitation/Flooding (resulting water quality issues)		1				
Presence of Dams		1				
Presence of Diversions	1					
Dam/Reservoir Operation		1				
Channelization/Bank Alteration (direct, intentional)		1				
Groundwater Pumping				1		
Spring Development/Capping				1		
Agricultural/Municipal/Industrial Water Usage	1					
Water Allocation Policies	1					
Salinity Alteration (of water)			1			

RIVERS AND STREAMS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Sediment Transport Imbalance (sediment poor)		1				
Sediment Transport Imbalance (sediment rich)			1			
Brush Eradication/Vegetation Treatments			1			
Channel Downcutting (indirect, unintentional)		1				
Invasive Plant Species (non-native)		1				
Feral Domesticated Animals				1		
Stormwater Runoff				1		
Wastewater Treatment Plant Effluent				1		
Acid Mine Drainage				1		
Agricultural and Forestry Effluents			1			
Increasing Stream Temperatures		1				
Droughts		1				
Severe/Extreme Weather Events			1			
Data Gap Threats						
Inadequate Understanding of Distribution or Range			1			
No Standardized Condition Assessment Method			1			
Relationship between Groundwater and Surface Water			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Total	**3**	**14**	**16**	**19**	**0**	**52**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners to determine key metrics for monitoring the condition of Utah's rivers and streams.
- Expand continuous temperature monitoring and upload all temperature information into the Utah Continuous Water Quality Monitoring Dashboard (Utah Department of Environmental Quality 2025).
- Standardize stream barrier assessments by using the DWR's BAIT (DWR 2024c).
- Survey rivers and streams for SGCN and SGIN and establish population baselines.
- Identify functional flows for Utah's rivers and streams (see the California example in Grantham et al. 2022).

Saline Lakes/Great Salt Lake Ecosystem

The Saline Lakes/Great Salt Lake Ecosystem Key Habitat (Figure 38 and Figure 39) is ecologically distinct from freshwater lakes and reservoirs due to its elevated salinity, endorheic nature (i.e., lacking an outlet to the ocean or other drainage systems), and specialized communities of halophilic organisms. Despite these differences, saline lakes similarly influence regional temperature and precipitation patterns and play a critical role in regulating local climates. Typically found in arid regions with high evaporation rates, saline lakes are vital ecological components in Utah's desert landscape.

This habitat type has been newly defined in the 2025 UWAP (it was previously grouped with the Open Water Key Habitat in the 2015 UWAP [UWAP Joint Team 2015]). In Utah, prominent saline systems include Sevier Lake and GSL, with the latter serving as the primary focus of this key habitat due to its high conservation value for SGCNs.

GSL is the largest saline lake in the Western Hemisphere and the eighth largest globally. Its ecosystem encompasses the lake and adjacent habitats—such as wetlands and marshes—extending up to approximately 1,286 m (4,218 feet) above sea level. There is considerable overlap between the Wetlands and the Saline Lakes/Great Salt Lake Ecosystem Key Habitats, particularly along the GSL's extensive shoreline wetland systems, which comprises hundreds of thousands of acres of playas, marshes, meadows, and waterbodies that support high species diversity. These habitats are influenced by the hydrological inputs from the Jordan, Weber, and Bear Rivers, with lake elevation and wetland extent largely dependent on water management, snowfall, and spring runoff.

Currently, GSL is approximately 121 kilometers (km) (75 miles) long and 56 km (35 miles) wide. It is a shallow terminal lake, with an average depth of approximately 4 m (14 feet) and a maximum depth near 11 m (35 feet). The lake is a remnant of ancient Lake Bonneville and once covered approximately 4,403 km^2 (1,700 square miles) (DWR 2023). Since 1875, the lake's elevation has declined by approximately 2.6 m (8.5 feet), resulting in a 44% reduction in surface area—approximately 2,460 km^2 (950 square miles) (DWR 2023). The tectonic activity that characterizes Utah's Basin and Range Province—specifically, faulting and crustal extension—has shaped the topography and structural basin that holds the lake.

A notable anthropogenic feature of the lake is the Lucin Cutoff, a railroad line crossing GSL from east to west near the south end of Promontory Point. Constructed on a mostly solid causeway, the Lucin Cutoff divides the lake into the North Arm and South Arm, allowing only limited water flow between the two. With no major freshwater inflows, the North Arm has become a hypersaline environment, reaching salinities up to 28% (330 grams per liter). In contrast, the South Arm receives riverine inputs and exhibits lower salinity levels, which are actively managed by the FFSL. Target salinity levels for the South Arm range from 120 to 160 grams per liter (12%–16%), a range that supports ecological functions, recreation, and mineral extraction.

Although the hypersaline conditions of GSL limit invertebrate biodiversity, the lake supports immense populations of specialized species such brine shrimp, brine flies, alkali flies, and newly discovered nematodes (Jung et al. 2024). These organisms thrive on abundant phytoplankton and experience little interspecific competition, leading to population sizes in the billions. Salinity and lake temperature are key drivers of primary productivity, population dynamics, and individual development rates for these invertebrates. As a result, they form a critical prey base for millions of migratory and resident birds that rely on the lake throughout the year (Barrett and Belovsky 2020).

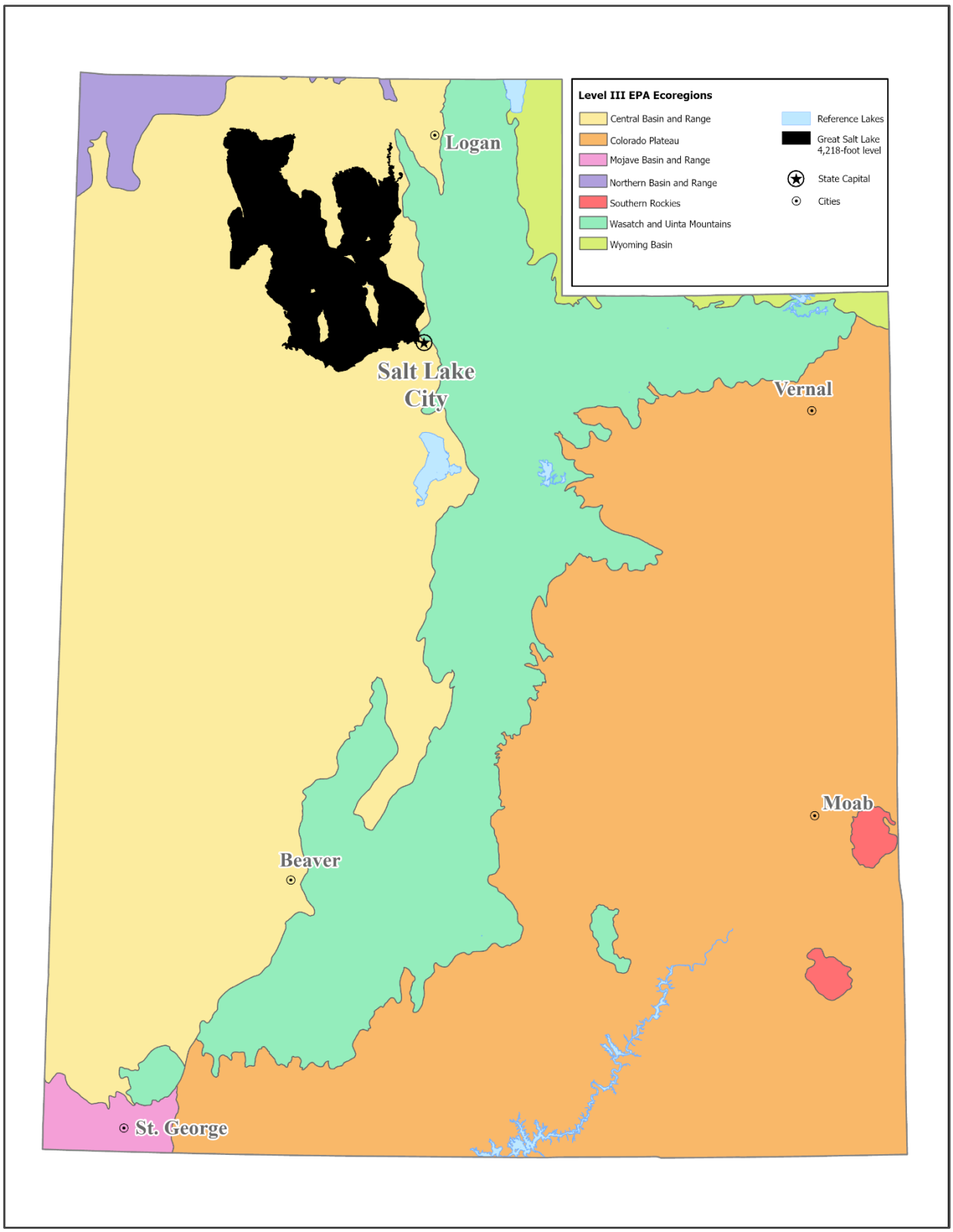


Figure 38. *Saline Lakes/Great Salt Lake Ecosystem Key Habitat Statewide Distribution*



Figure 39. *Great Salt Lake, Davis County*

Note: Photograph by Cara Emery, SWCA Environmental Consultants, 2022.

Ecoregion Characteristics

Saline Lakes/Great Salt Lake Ecosystem Key Habitat occurs within the Central Basin and Range ecoregion in Utah. This ecosystem provides a critical link for birds in the Pacific Flyway between North and South America. Every year, 10 million birds from 338 different species visit the ecosystem to breed, rest, and eat during migrations of approximately 1,609 km (1,000 miles) or more. With the decline of other saline lakes in the flyway, the Saline Lakes/Great Salt Lake Ecosystem Key Habitat is increasingly important to these bird species.

Extent

- The extent of the Saline Lakes/Great Salt Lake Ecosystem Key Habitat depends on tributary inputs and water management, but for the UWAP, this habitat includes associated wetlands and marshes below approximately 1,286 m (4,218 feet) above sea level.
- Wetlands surrounding GSL that are within this elevation line overlap with wetlands identified in the Wetlands Key Habitat.

Condition

Drought, human demand for water, changes to hydrology from development, forest management, and invasive species (e.g., phragmites) have reduced the amount of habitat available for migratory birds. GSL fell to a record low water level in October 2021 and again in

November 2022. See the target elevation set in the *Final Great Salt Lake Comprehensive Management Plan and Record of Decision* for the severity levels of possible drought (FFSL 2013).

GSL's salinity varies with the lake's water volume. Increased salinity observed during the historic low lake levels in the South Arm in November 2022 threatened an ecosystem collapse. With the increased frequency of droughts and increased demand for water due to human population growth in the areas surrounding the GSL ecosystem, increased salinity levels and a future ecosystem collapse will remain a threat (Steed 2024).

Non-native, invasive phragmites covers much of GSL's wetlands. Phragmites is an aggressive noxious weed that can quickly colonize ecosystems by seeds, stolons, and rhizomes. This dense species can alter the habitat, resulting in negative effects on birds and other species (Hazelton et al. 2018). Phragmites disrupts hydrology and sediment transport and increases evapotranspiration rates (Alminagorta 2017), which reduces water availability for wetlands. In addition, phragmites converts diverse native habitats of sparse, patchy, low vegetation and open water (i.e., good migratory bird habitat) to impenetrable, dense, homogenous, fire-prone, 3.7-m-tall (12.0-foot-tall) vegetation stands with no open water, which eliminates migratory bird habitat. The State of Utah has been aggressively treating and removing phragmites (FFSL 2024).

Data sets collected by agencies to evaluate GSL habitat condition are presented in Table 8 in the Aquatic Key Habitats section of this chapter.

Improving Condition

An effective strategy for management of Saline Lakes/Great Salt Lake Ecosystem Key Habitat in Utah may include the following elements:

- Promote policies that maintain or restore natural sediment regimes and streamflow into saline lakes.
- Improve water delivery inputs (quality and quantity) by promoting and observing water conservation.
- Establish GSL water rights to maintain healthy lake elevations.
- Promote policies that minimize or eliminate the placement of roads in wetlands and riparian zones.
- Promote policies that reduce residential and commercial development in wetlands, riparian zones, and floodplains that impact GSL.

- Continuing the use of methods for reducing the spread and dominance of invasive weeds and aquatic vegetation (especially phragmites), including EDRR programs.

Threats

Table 24 summarizes the threats to the Saline Lakes/Great Salt Lake Ecosystem Key Habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including the Saline Lakes/Great Salt Lake Ecosystem Key Habitat. White rows indicate threats that are important to the Saline Lakes/Great Salt Lake Ecosystem Key Habitat but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 24. *Threat Prioritization Exercise Summary Results for Saline Lakes/Great Salt Lake Ecosystem Key Habitat*

SALINE LAKES/GREAT SALT LAKE ECOSYSTEM KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Expansion of Urban Footprint		1				
Commercial and Industrial Areas		1				
Landfill Operation				1		
Trail, Trailhead, and Staging Area Development			1			
Annual and Perennial Non-Timber Crops			1			
Improper Grazing – Livestock (current)			1			
Improper Grazing – Livestock (historic)		1				
Spills and Production Water				1		
Mining and Quarrying	1					
Solar Power Facilities				1		
Roads – Transportation Network		1				
Roads – Energy Development				1		

SALINE LAKES/GREAT SALT LAKE ECOSYSTEM KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Railroads	1					
Utility and Service Lines		1				
Excessive Harvest – Regulated/Legal					1	
OHV Motorized Recreation		1				
Camping/Campground Development (dispersed)				1		
Hiking/Foot Travel				1		
Military Testing and Training Activities				1		
Work and Other Activities			1			
Inappropriate Fire Frequency and Intensity		1				
Dams and Water Management/Use	1					
Presence of Dams	1					
Presence of Diversions	1					
Groundwater Pumping	1					
Agricultural/Municipal/Industrial Water Usage	1					
Water Allocation Policies	1					
Salinity Alteration (of water)	1					
Brush Eradication/Vegetation Treatments				1		
Intentional Poisoning of “Nuisance” Wildlife				1		
Invasive Wildlife Species (non-native)		1				
Invasive Plant Species (non-native)		1				
Stormwater Runoff			1			
Wastewater Treatment Plant Effluent			1			

SALINE LAKES/GREAT SALT LAKE ECOSYSTEM KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Heavy Metal Deposition			1			
Agricultural Pollution		1				
Pesticides (insecticides/herbicides/fungicides)			1			
Garbage and Solid Waste			1			
Atmospheric Deposition			1			
Soil Movement/Deposition		1				
Noise Pollution			1			
Light Pollution			1			
Droughts	1					
Temperature Extremes	1					
Severe/Extreme Weather Events		1				
Data Gap Threats						
Unknown Population Status		1				
No Standardized Condition Assessment Method		1				
Relationship between Groundwater and Surface Water		1				
Future Effects of Greater Precipitation Variability under Climate Change	1					
Plant Material Development			1			
Total	**12**	**15**	**13**	**9**	**1**	**50**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Develop and maintain GSL water level conservation targets.
- Continue water conservation measures and ensure that water savings reach GSL.
- Continue phragmites vegetation control and replacement.

- Complete NWI mapping of Utah to provide improved habitat extent data for saline lakes.
- Expand streamflow monitoring in the GSL watershed to better manage water deliveries to GSL.
- Expand water quality monitoring in the GSL watershed to better manage water quality.
- Survey Saline Lakes/Great Salt Lake Ecosystem Key Habitat for SGCN and SGIN.

Springs

Springs are groundwater-dependent ecosystems that occur when water emerges at the surface from an underground aquifer or water table. These systems are sustained by groundwater recharge from precipitation and surface water. Deeper aquifers often contain ancient water, with some dated to thousands of years old. There are 12 recognized types of springs: cave, exposure, fountain, geyser, gushet, hanging garden, helocrene, hillslope, hypocrene, limnocrene, mound form, and rheocrene (SSI 2024a).

Springs are typically formed where water discharges along slopes at geological faults or rock fractures, or where it is forced to the surface by impermeable layers or pressure or thermal gradients, such as in artesian and geothermal springs. These features are distributed throughout Utah's landscape, from low-elevation deserts to high-elevation forests (Figure 40). Their size, physical and chemical properties, and condition vary considerably.

Although many springs in Utah are small and locally significant, some are large and high volume. Springs may be perennial or ephemeral and can emerge in a wide range of environments, including desert basins, forests, and lake beds, and river channels. Spring-fed aquatic habitats are notable for their relatively stable water temperatures and chemical composition, both of which reflect the geological formations through which the groundwater passes. These temperatures may be cooler or substantially warmer than ambient air temperature. Warm and hot (geothermal) springs often exhibit unique chemistry and support specialized aquatic biota adapted to those conditions.

Springs frequently support unique biological communities of aquatic biota, particularly aquatic plants, mollusks, and invertebrates. Due to the often isolated nature of springs in Utah's arid climate, they provide disproportionately valuable and productive riparian and wetland habitats. Despite some overlap with other aquatic ecosystems, Springs Key Habitat is defined as including isolated springheads, spring-fed creeks, and the associated habitats. Springs that connect with larger flowing systems are categorized under Rivers and Streams Key Habitat, and adjacent vegetated wetlands—such as wet meadows and marshes—are covered under

Wetlands Key Habitat. Some larger springheads are mapped within the wetlands spatial layer, but these are still considered part of the Springs Key Habitat (see Figure 40; Figure 41).

Springs support diverse and often specialized insect communities that are shaped by factors such as water chemistry, temperature, and flow dynamics. These include numerous aquatic and terrestrial insects, such as crane flies, non-biting midges, mosquitoes, hover flies, tachinids, and picture-wing flies, which occupy a variety of ecological niches. Beetles are also well represented, from aquatic diving beetles to predaceous fireflies and tiger beetles in moist soils, and various herbivorous and saproxylic ground beetles.

Pollinators—including bees, flies, butterflies, moths, and wasps—are frequently associated with springs and may consist of rare, endemic, or migratory species (as with monarch butterflies) seeking floral resources. Additionally, aquatic macroinvertebrates are a prominent component of spring ecosystems, with taxa such as mayflies, caddisflies, dragonflies, damselflies, water striders, and occasionally stoneflies, alongside mollusks and crustaceans. These organisms fulfill critical ecological functions, including sediment processing, decomposition, water quality enhancement, and serving as prey for a wide range of wildlife such as fish, amphibians, birds, and mammals.

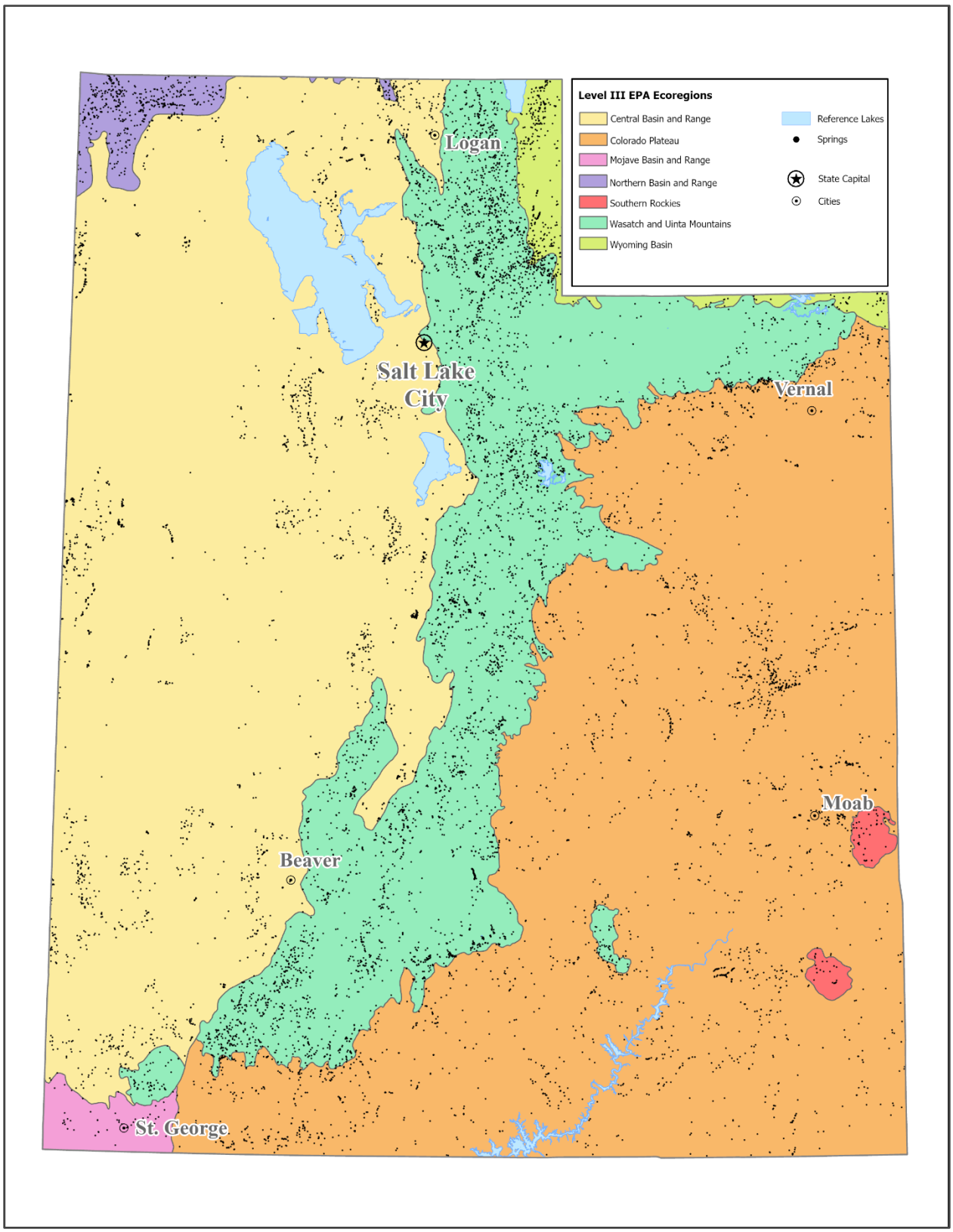


Figure 40. *Springs Key Habitat Statewide Distribution*



Figure 41. *Cascade Springs, Utah County*

Note: Photograph by Diane Menuz, UGS, 2023.

Ecoregion Characteristics

Springs Key Habitat occurs in all seven ecoregions. Springs are crucial in providing water for SGCN in dry landscapes and have, in places, created unique ecosystems that contain species endemic to Utah. Springs, especially in the Central Basin and Range, Wasatch and Uinta Mountains, and Wyoming Basin ecoregions, can feature unique springsnail populations.

Extent

- The extent of springs habitat in Utah is incomplete. The SSI manages the Springs Online database, which contains thousands of spring points and some associated data for springs in Utah and other parts of the United States (SSI 2024b). The DWR has downloaded the spring points from the SSI database into the DWR Springs database, and UWAP partners are using the Springs App to continue mapping the extent of this key habitat. The UGS has recently started mapping spring points and wetland features while conducting wetland mapping (Menuz and Goodwin 2024).
- More than 11,000 springs are mapped within Utah (see Figure 40).

Condition

The condition of many of Utah's springs is currently unknown. The condition of springs habitat in some areas has been diminished due to stressors, including changes in precipitation and hydrologic regimes, surface and groundwater availability, disturbance, and human land use and extraction.

Some habitat condition information exists for springs in the DWR Springs Database (DWR 2024b) and for springs that contain SGCN springsnails that are managed under a conservation agreement and strategy.

The BLM also has condition information for some springs on BLM-administered lands through Proper Functioning Condition assessments and the Riparian and Wetland Assessment, Inventory, and Monitoring (AIM) program.

A priority of the Statewide Mollusk Conservation Strategy Working Group (Springsnail Conservation Team 2020) is to develop protocols for monitoring spring habitat condition through time. The Springs App allows users to record spring habitat condition data.

Improving Condition

An effective strategy for management of springs habitat in Utah may include the following elements:

- Promote policies that maintain or restore natural flow and sediment regimes within springs.
- Promote policies that reduce grazing by domestic livestock, feral horses, and wildlife that negatively impacts springs.
- Promote policies that minimize or eliminate the placement of roads in riparian zones.
- Promote policies that reduce development that impacts springs.
- Promote policies that reduce dewatering of springs.
- Continue the use of methods for reducing the spread and dominance of invasive weeds and aquatic vegetation, including EDRR programs.
- Follow SSI's restoration and rehabilitation recommendations for heavily degraded springs and springs that contain rare species of springsnails and other mollusks, including removal of exotic weeds and protection from grazing.

Threats

Table 25 summarizes the threats to springs habitat identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including springs habitat. White rows indicate threats that are important to springs but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 25. *Threat Prioritization Exercise Summary Results for Springs Key Habitat*

SPRINGS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Housing and Urban Areas			1			
Conversion from Flood to Sprinkler Irrigation			1			
Improper Grazing – Livestock (current)		1				
Water Developments for Livestock		1				
Improper Grazing – Livestock (historic)		1				
Unintentional Spread of Non-Native Species				1		
Roads – Transportation Network				1		
Railroads				1		
Logging and Wood Harvesting				1		
OHV Motorized Recreation				1		
Inappropriate Fire Frequency and Intensity				1		
Post-Fire Precipitation/Flooding (resulting water quality issues)				1		
Groundwater Pumping		1				
Spring Development/Capping		1				

SPRINGS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Agricultural/Municipal/Industrial Water Usage				1		
Water Allocation Policies	1					
Salinity Alteration (of water)				1		
Invasive Plant Species (non-native)			1			
Feral Domesticated Animals		1				
Droughts		1				
Temperature Extremes			1			
Data Gap Threats						
Impacts to Migrating Birds			1			
Future Effects of Greater Temperature Variability under Climate Change			1			
Future Effects of Greater Precipitation Variability under Climate Change			1			
Renewable Energy Impacts				1		
Inadequate Understanding of Distribution or Range		1				
No Standardized Condition Assessment Method			1			
Total	**1**	**8**	**8**	**10**	**0**	**27**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Work with partners to use the Springs App to determine and standardize the extent and condition of Utah's springs.
- Survey springs for SGCN and SGIN.
- Protect springs where needed.
- Conduct one or more case studies on proper springs management or restoration.

Wetlands

Wetlands encompass a broad range of habitats, including marshes, wet meadows, fens, backwater sloughs, oxbows, and mudflat fringes. These ecosystems are characterized by a high water table and frequent soil saturation at or near the surface. Wetlands may be permanently inundated, intermittently flooded, or seasonally saturated and are classified based on the duration and depth of flooding. Flooding regimes range from deep, permanent inundation to brief, shallow saturation during parts of the growing season (Downard et al. 2017).

The USFWS defines wetlands as transitional areas between terrestrial and aquatic systems that are inundated or saturated with water often enough to support hydric soils and hydrophytic vegetation (Federal Geographic Data Committee 2013). For the purposes of the 2025 UWAP, small ponds less than 20 acres in size were categorized as wetlands. This distinction aligns with data layers used to identify aquatic key habitats; many features mapped in the NWI either dry out seasonally or have transitioned into vegetated wetlands over time. There is an overlap between the Wetlands Key Habitat and the Saline Lakes/Great Salt Lake Ecosystem Key Habitat with wetlands adjacent to GSL.

Utah wetlands are hydrologically diverse systems receiving water from multiple sources, including groundwater discharge, surface runoff, direct precipitation, snowmelt, and overbank flooding from rivers and lakes. Many wetlands receive input from a combination of these sources (Figure 42 and Figure 43).

There is often overlap between wetland and riparian habitats; however, they differ in spatial occurrence and hydrologic regimes. Wetlands can occur across the landscape and typically experience longer and more frequent periods of soil saturation than riparian zones. In contrast, riparian habitats are confined to areas adjacent to rivers, streams, and lakes, and are typically flooded only briefly, often during seasonal high-water events such as spring runoff.

Wetland vegetation is dominated by hydrophytes (plant species adapted to saturated soils) and tends to be primarily herbaceous. Riparian vegetation, by contrast, may include both herbaceous and woody species. Wetlands provide habitat for a wide array of plant and animal species and perform critical ecosystem services, such as flood control, drought mitigation, fire buffering, and water quality regulation through nutrient filtration and sediment retention (Endter-Wada et al. 2020; Gage and Cooper 2013).

The regular presence of moisture combined with plant diversity and structural complexity enables wetland systems to support a wide variety of insects and other invertebrates. Herbivorous insect groups include grasshoppers, katydids, planthoppers, leafhoppers, aphids,

beetles, gall-formers, thrips, butterflies and moths, many of which are specialized to use wetland and riparian vegetation. Pollinators such as bumble bees, solitary bees, butterflies, moths, nectar-feeding ants and wasps, flies, and beetles are also abundant and essential to ecosystem function. Aquatic insects—such as non-biting midges, mosquitoes, crane flies, mayflies, stoneflies, salmonflies, snakeflies, dobsonflies, caddisflies, dragonflies, and damselflies—develop in submerged or saturated substrates and emerge as aerial adults. These insects contribute to nutrient cycling, decomposition, and food web dynamics. Detritivores and decomposers further enrich wetland soil and water quality by breaking down organic debris and recycling nutrients. Wetlands also support a wide range of predatory and parasitic species, including spiders, tiger beetles, fireflies, and wasps, as well as amphibians, reptiles, birds, mammals, and fish that feed on invertebrates. This abundance of insect prey contributes to the overall biological richness and ecological productivity of wetland ecosystems.

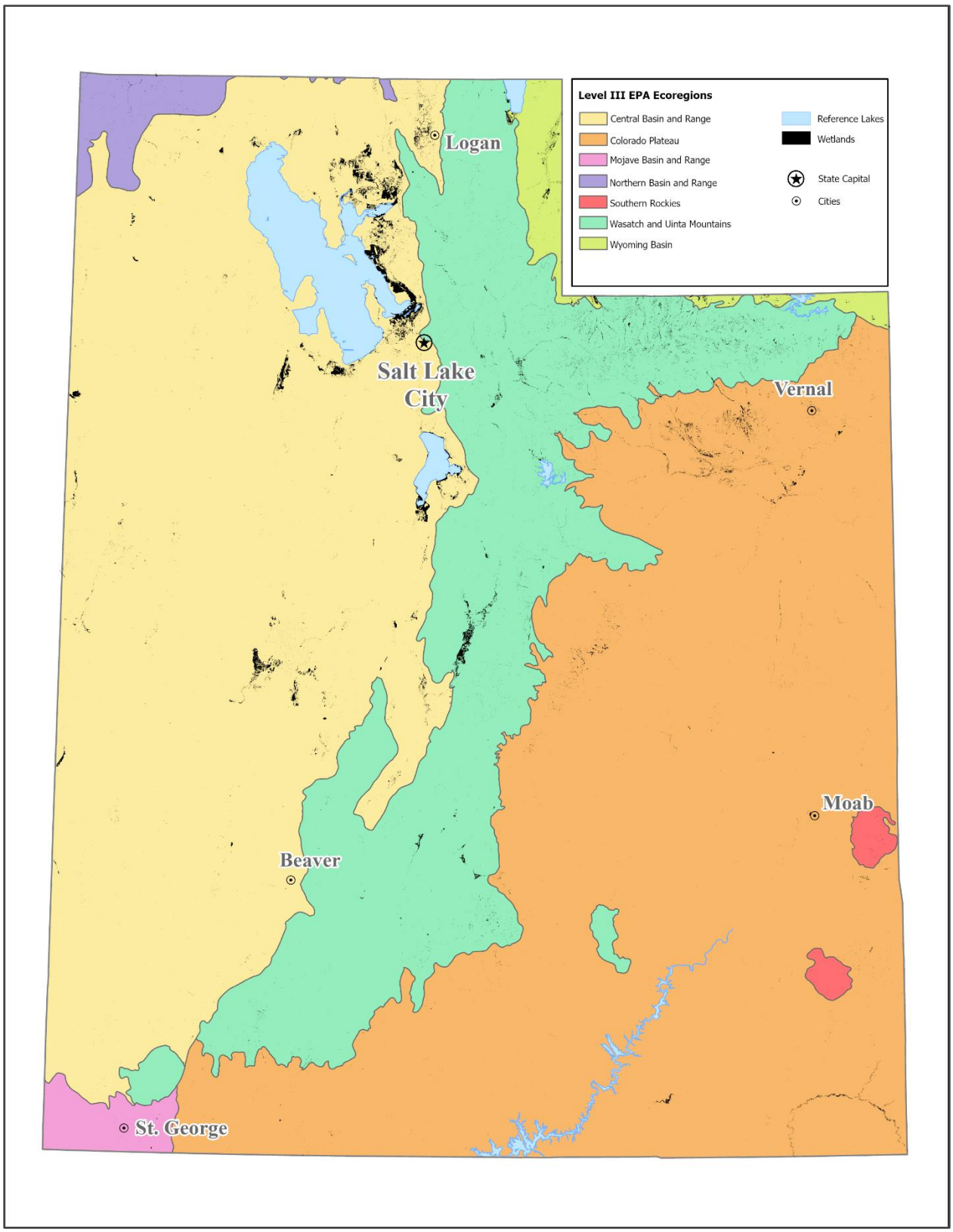


Figure 42. *Wetlands Key Habitat Statewide Distribution*



Figure 43. *Wetlands in Wasatch County*

Note: Photograph by Steve Fuller, SWCA Environmental Consultants, 2023.

Ecoregion Characteristics

Wetlands Key Habitat occurs across Utah in all seven ecoregions. Wetlands filter pollutants and excess nutrients, provide water for SGCN and SGIN in dry climates, and have unique ecosystems that contain species found nowhere else. Depending on where wetlands occur in Utah, they provide different benefits for SGCNs. For example, in the Central Basin and Range ecoregion, some wetlands provide year-round habitat for birds, fish, amphibians, and mollusks, whereas wetlands around GSL (included as part of the Saline Lakes/Great Salt Lake Ecosystem Key Habitat) provide important habitat for migrating and breeding shorebirds, waterbirds, waterfowl, and landbirds. In the Colorado Plateau ecoregion, wetlands along the Green and Colorado Rivers provide critical early life stage habitat for SGCN fish and year-round habitat for many SGCN birds.

Extent

- The extent of wetlands in Utah is mapped within the NWI (USFWS 2024a). Although NWI coverage of some areas of Utah is outdated, the overall NWI wetland layer for the state has become more accurate over the past 10 years (Menuz and Goodwin 2024).

- Historical data suggest that approximately 30% of the state's wetlands were destroyed prior to the 1980s (Dahl 1990); however, no comprehensive assessment has occurred since then.
- Since the 1980s, in some areas the extent of wetland habitat has diminished due to stressors such as groundwater and surface water diversions, changes in precipitation and temperature, disturbance, and human development and use (McCoy-Sulentic et al. 2021; Menuz and Sempler 2018). In some areas, wetlands have been created as part of mitigation and restoration projects, and some of those projects have been more successful than others (e.g., the Provo River Delta Restoration Project [Utah Reclamation, Mitigation, and Conservation Commission et al. 2024]).
- Some wetlands are protected under the Clean Water Act, but precisely which wetlands are protected changes over time based on federal rulemaking and court cases (Menuz and Downard 2023). The U.S. Supreme Court 2023 ruling in the *Sackett et ux. V. Environmental Protection Agency et al.* ruling and subsequent rulemaking are expected to reduce the collective wetlands area protected by the Clean Water Act, particularly for wetlands that lack surface water connection to adjacent waterbodies.
- Total current mapped area within Utah totals 532,240.09 acres, which is 0.98% of the state's surface area (see Figure 42).
- Wetlands are mapped in 2,433 of 2,885 HUC-12 units that overlap Utah.

Condition

The UGS has conducted wetland condition studies in the Central Basin and Range and Wasatch and Uinta Mountains ecoregions of Utah (McCoy-Sulentic et al. 2021) and in the major watersheds feeding GSL (the Bear, Weber, and Jordan River systems) (McCoy-Sulentic et al. 2021; Menuz and McCoy-Sulentic 2019; Menuz and Sempler 2018; Menuz et al. 2016). These studies indicate that the condition of a given wetland typically corresponds to its elevational location within its respective watershed; the higher the wetland location, the better the wetland condition. This is likely due to several factors. In general, higher elevations receive more precipitation and fewer land use impacts, whereas lower elevations receive less precipitation and have more land use impacts.

Non-native and invasive plant species are the most widespread stressor and are particularly common in wetlands impacted by other disturbances; around GSL, phragmites is the most problematic (Kettenring et al. 2020). Also common are stressors to hydrology, including unnatural flow regimes due to water management, decreased flows from water diversion and

pumping, and extended periods of drought. Other common stressors are hydrologic alteration, habitat loss and encroachment of land conversion to hardscaped uses, inappropriate livestock grazing, and urban and agricultural sources that affect water quality.

Some habitat condition metrics for wetlands are tracked through the development of conservation agreements and strategies for some SGCN (e.g., Bailey et al. 2006; Least Chub Conservation Team 2014).

The BLM maintains condition information on some wetlands on BLM-administered lands gathered through the agency's riparian and wetland AIM protocol. Data collected since 2022 are publicly available through the BLM National AIM Riparian and Wetland Indicators Hub (BLM 2023).

The UGS and DWQ combined their wetland programs in 2021, with the program now housed at the UGS. The UGS intends to create one comprehensive monitoring tool that refines and combines survey methods from past UGS (Menuz and McCoy-Sulentic 2019) and DWQ (Downard 2021) efforts. The UGS and DWQ combined their wetland programs and strategies to create one comprehensive tool that refines and prioritizes the most effective survey methods for measuring wetland condition.

Improving Condition

An effective strategy for management of wetlands habitat in Utah may include the following elements:

- Promote policies that maintain or restore natural flow and sediment regimes.
- Promote policies that reduce inappropriate grazing by domestic livestock, feral horses, and wildlife.
- Promote policies that protect wetlands from development and provide a buffer between development and adjacent aquatic resources.
- Continue the use of appropriate methods for reducing the spread and dominance of invasive weeds and aquatic vegetation, including EDRR programs.
- Work to improve wetland mitigation by providing comments on public notices and suggestions for potential mitigation sites and exploring a possible state-run mitigation program.
- Support and expand existing wetland restoration programs (e.g., Zeedyk structures, phragmites removal, Utah Lake shore restoration) and develop additional restoration capacity.

Data sets collected by agencies to evaluate wetlands habitat condition are presented in Table **7** in the Aquatic Key Habitats section in this chapter.

Threats

Table 26 summarizes the threats to Utah's wetlands identified in a statewide assessment (described in more detail in Chapter 4, Threats, Data Gaps, and Conservation Actions). Yellow rows indicate UWAP priority threats that negatively impact many species and habitats, including wetlands. White rows indicate threats that are important to wetlands but do not impact as many other species and habitats as the priority threats. Chapter 4 focuses exclusively on UWAP priority threats.

Table 26. *Threat Prioritization Exercise Summary Results for Wetlands Key Habitat*

WETLANDS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Cabin Communities/Development			1			
Expansion of Urban Footprint			1			
Commercial and Industrial Areas			1			
Tourism and Recreational Areas				1		
Conversion from Flood to Sprinkler Irrigation		1				
Conversion of Cropland or Pasture			1			
Improper Grazing – Livestock (current)			1			
Water Developments for Livestock				1		
Improper Grazing – Livestock (historic)			1			
Oil and Gas Drilling				1		
Mining and Quarrying				1		
Roads – Transportation Network			1			
Roads – Energy Development				1		
Railroads				1		
Utility and Service Lines				1		

WETLANDS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
OHV Motorized Recreation			1			
Hiking/Foot Travel				1		
Inappropriate Fire Frequency and Intensity				1		
Post-Fire Precipitation/Flooding (resulting water quality issues)				1		
Presence of Dams				1		
Presence of Diversions			1			
Dam/Reservoir Operation				1		
Channelization/Bank Alteration (direct, intentional)				1		
Groundwater Pumping		1				
Spring Development/Capping				1		
Agricultural/Municipal/Industrial Water Usage		1				
Water Allocation Policies		1				
Sediment Transport Imbalance (sediment rich)				1		
Seeding Non-Native Plants				1		
Channel Downcutting (indirect, unintentional)			1			
Invasive Wildlife Species (non-native)				1		
Invasive Plant Species (non-native)			1			
Feral Domesticated Animals				1		
Household Sewage and Urban Wastewater				1		
Agricultural Pollution			1			
Soil Erosion/Loss				1		

WETLANDS KEY HABITAT THREATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
Ecosystem Encroachment					1	
Droughts		1				
Temperature Extremes			1			
Data Gap Threats						
Inadequate Understanding of Distribution or Range				1		
No Standardized Condition Assessment Method			1			
Relationship between Groundwater and Surface Water			1			
Climate Change			1			
Inadequate Restoration Tool or Methods		1				
Plant Material Development		1				
Total	**0**	**7**	**16**	**21**	**1**	**45**

Note: Yellow highlighting indicates priority threats.

Priority Needs

- Continue updating NWI coverage of Utah wetlands.
- Support efforts by UWAP partners such as the BLM and UGS to continue collecting wetland condition data and work with partners to determine key metrics that could be collected more broadly and to test applicability of methods for targeted decision making.
- Better quantify hydrologic stress to wetlands using information such as climate and remotely sensed groundwater and streamflow data.
- Identify important wetlands that lack existing protections (due to landownership, lack of federal protections, etc.).
- Work to implement protections for high-priority wetlands that lack protection or are experiencing extreme hydrologic stress.
- Survey wetlands for SGCN and SGIN.

Chapter 3. Climate Adaptation

Introduction

The Intergovernmental Panel on Climate Change (IPCC) defines climate as the average weather over a period of time, or "the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization" (IPCC 2018). Climate change is projected to have profound effects in Utah, characterized by a reduced snowpack due to more precipitation falling as rain than snow, more snow melting during the winter, and earlier snowmelt each spring; more frequent heat waves; and a decrease in the flows of Utah's rivers (U.S. Environmental Protection Agency 2016). Changes in these climatic indicators have the potential to impact Utah's habitats, altering the distribution and composition of fish, wildlife, plants, and invertebrates. Changes to the composition of Utah's ecosystems will then have consequences for resource-driven economic sectors and associated stakeholders.

The impacts of climate change extend beyond environmental shifts; these impacts are crucially affecting resources essential for Utah's communities and health, including food production, water availability, and biodiversity (IPCC 2023). Additionally, climate change influences the spread of infectious diseases, exacerbates extreme weather events, alters species' ranges and seasonal timing, and disrupts ecosystem structures (IPCC 2023). Notably, global surface temperatures have increased faster since 1970 than in any other 50-year period over the last 2,000 years, underscoring the urgency of addressing these interconnected challenges (IPCC 2023). Given this, understanding and mitigating these impacts is vital for preserving Utah's natural heritage and ensuring the well-being of its residents.

The Association of Fish and Wildlife Agencies (2022) outlines the foundational issues that fish and wildlife face because of climate change and provides resources to implement adaptive responses to this threat. This guidance is broken into seven principles for incorporating climate change into state wildlife action plans: 1) fully integrate climate change into state wildlife action plans; 2) adopt forward-looking goals; 3) explicitly link actions to climate vulnerabilities; 4) manage for change, not just persistence; 5) consider broader landscapes and longer time frames; 6) address uncertainty by considering future scenarios and use of adaptive management; and 7) engage diverse partners with climate experience and expertise.

The Utah Wildlife Action Plan (UWAP) Climate Adaptation Subcommittee has undertaken tasks to begin incorporating climate considerations throughout the plan, particularly engaging diverse partners to identify short- and long-term goals for making progress on addressing climate. The group decided that identifying climate refugia in Utah would be the first step in addressing climate for the 2025 UWAP. This work was completed by Dr. Edward Hammill from Utah State University and is summarized later in this chapter. The subcommittee also identified long-term goals for addressing climate change that could not be accomplished for the 2025 UWAP but will be incorporated in future amendments or revisions.

Current Weather and Climate Across Utah

Various resources were reviewed to capture the current weather and climate across Utah, including the following:

- Utah Center for Climate and Weather (2015)
- Utah Geological Survey (UGS) (2024e)
- Weather Atlas (2024)
- National Oceanic and Atmospheric Administration National Centers for Environmental Information (Palecki et al. 2021)

This chapter provides a snapshot of current weather in Utah, recent changes to weather, and how climate may change in the future. Utah is one of the most arid states in the United States, with approximately 33% of the state considered a desert (Utah Center for Climate and Weather 2015). Vegetated wetlands account for approximately 1% of Utah's total land cover (UGS 2024e). Utah's climate generally consists of long, dry summers and cold, short winters (Weather Atlas 2024). During the summer months, monsoons and thunderstorms with lightning and flash flooding are common.

Weather varies throughout the state of Utah. Northern Utah is the coldest region of the state. Precipitation in northern Utah falls primarily in the form of snowfall and is dependent on location, with an average of 12 meters (m) (500 inches) falling at the mountain resorts within the Wasatch Range. In contrast, southern Utah experiences some of the driest and warmest weather in the state, and precipitation falls primarily in the form of rain. Table 27 summarizes the average maximum and minimum temperatures, precipitation, and snowfall throughout the year for three locations in Utah: Randolph, Utah, in the north (one of the coldest places in Utah); St. George, Utah, in the south (one of the warmest places in Utah); and Ephraim, Utah, in center of the state.

Table 27. *Regional Average Maximum and Minimum Temperatures, Precipitation, and Snowfall in Randolph, Ephraim, and St. George, Utah, during Winter, Spring, Summer, and Fall Seasons*

SEASON	RANDOLPH NORTHERN UTAH, ELEVATION APPROXIMATELY 6,280 FEET	EPHRAIM CENTRAL UTAH, ELEVATION APPROXIMATELY 5,540 FEET	ST. GEORGE SOUTHERN UTAH, ELEVATION APPROXIMATELY 2,860 FEET
Winter			
Average maximum temperature (°F)	29.4	38.3	55.4
Average minimum temperature (°F)	5.6	13.1	29.6
Average precipitation (inches)	3.2	3.01	3.5
Average snowfall (inches)	39.0	14.9	1.0
Spring			
Average maximum temperature (°F)	52.1	61.9	76.0
Average minimum temperature (°F)	25.4	30.6	46.8
Average precipitation (inches)	4.3	3.4	2.0
Average snowfall (inches)	18.2	3.4	0.2
Summer			
Average maximum temperature (°F)	78.2	87.6	99.4
Average minimum temperature (°F)	42.8	48.5	68.8
Average precipitation (inches)	3.2	2.2	1.7
Average snowfall (inches)	0.1	0.0	0.0
Autumn			
Average maximum temperature (°F)	56.8	65.1	78.8
Average minimum temperature (°F)	24.7	30.4	47.3
Average precipitation (inches)	3.7	3.04	0.8
Average snowfall (inches)	13.5	1.5	0.0

Source: Palecki et al. (2021).

Note: °F = degrees Fahrenheit.

Climate Change in Utah

Information in this section is from the *Recent Climate Change in Utah, 1870–2023* fact sheet (Hotaling and Becker 2024). Climate change is impacting Utah. Temperature data collected over 45 years show that Utah is steadily warming which, in turn, is driving declines in winter snowpack, shifting the timing and amount of available water, increasing fire risk, and causing ecological change. This link between warming and natural resources stems from the fundamental connection in mountain regions between temperature, precipitation, and water supply. In winter, Utah receives precipitation, primarily as snow. High-elevation mountain stations like Alta, Utah, in the Wasatch Mountains regularly record an average of 12 m (500 inches) of snowfall, which contributes to the area's average of 147 centimeters (58 inches) of precipitation annually (Gillies and Ramsey 2009). Utah's snowpack seasonally accumulates at higher elevations in winter (Figure 44) then melts in spring and summer. By acting as a natural water reservoir that is seasonally replenished, snowpack buffers the landscape against dry conditions. Snow cover also acts as a large-scale control on plant growth and animal movement, influencing local ecology. Thus, current and projected shifts in Utah's temperature and precipitation regimes due to climate change will continue to impact its water supply, wildfire risk, and ecosystems.



Figure 44. *Utah's High-Elevation Snowpack*

Temperature

Ambient temperatures strongly influence many aspects of modern life, natural resources, and ecosystems. In a dry state like Utah, annual and seasonal temperatures are closely tied to water demand and availability. Warmer summers increase demand for water. Warmer winters cause more precipitation to fall as rain instead of snow, resulting in a shallower snowpack that contains less water and melts out earlier. Together, warmer summers and winters exacerbate water supply issues, particularly in late summer when water is most needed. Over the past four decades, the annual mean temperature in Utah has increased by approximately 0.4 degree Fahrenheit (°F) per decade (Figure 45). This trend is driven by rising summer temperatures and is projected to continue; winter temperatures are also projected to increase (Hegewisch and Abatzoglou 2024a, 2024b).

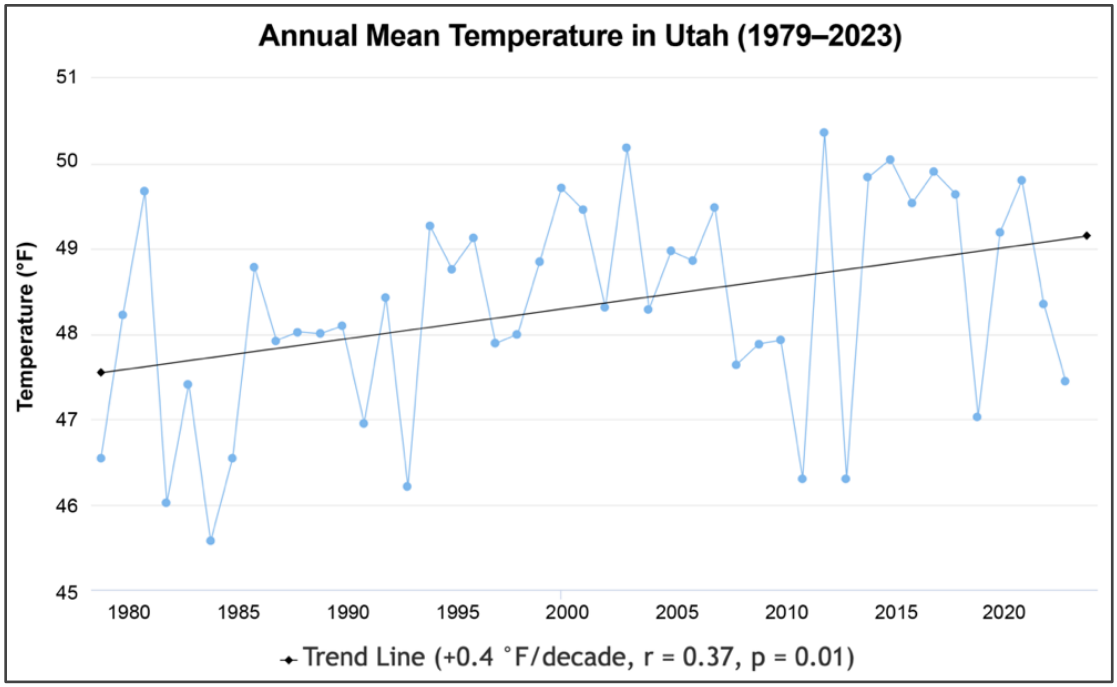


Figure 45. *Increasing Annual Mean Temperature in Utah (1979–2023)*

Source: Hegewisch and Abatzoglou (2024a) (Image licensed under CC BY 4.0: https://creativecommons.org/licenses/by/4.0/).

Summer Temperatures

In Utah, July temperatures are rising faster than any other month, increasing by nearly 1°F per decade since 1979 (Figure 46). This rate of warming parallels global patterns of increasing temperatures caused by anthropogenic greenhouse gas emissions, particularly carbon dioxide (Crowley 2000). Because future greenhouse gas emissions depend on policies and actions, scientists consider a range of future greenhouse gas concentration scenarios to predict future climates. These climate change scenarios are known as Representative Concentration

Pathways (RCPs). The original four RCPs are RCP 2.6, 4.5, 6, and 8.5. The higher the RCP value, the higher the greenhouse gas concentration. Two commonly used scenarios are RCP 4.5 and RCP 8.5. RCP 4.5 is a lower emissions scenario based on a future where the concentration of greenhouse gases in the atmosphere stabilizes before the year 2100; RCP 8.5 is a higher emissions scenario where greenhouse gas concentrations continually increase (RCP Database 2009). Looking ahead to 2100, under RCP 4.5 and RCP 8.5, summer temperatures in Utah are expected to rise by 3.4°F and 9.0°F, respectively (Figure 47).

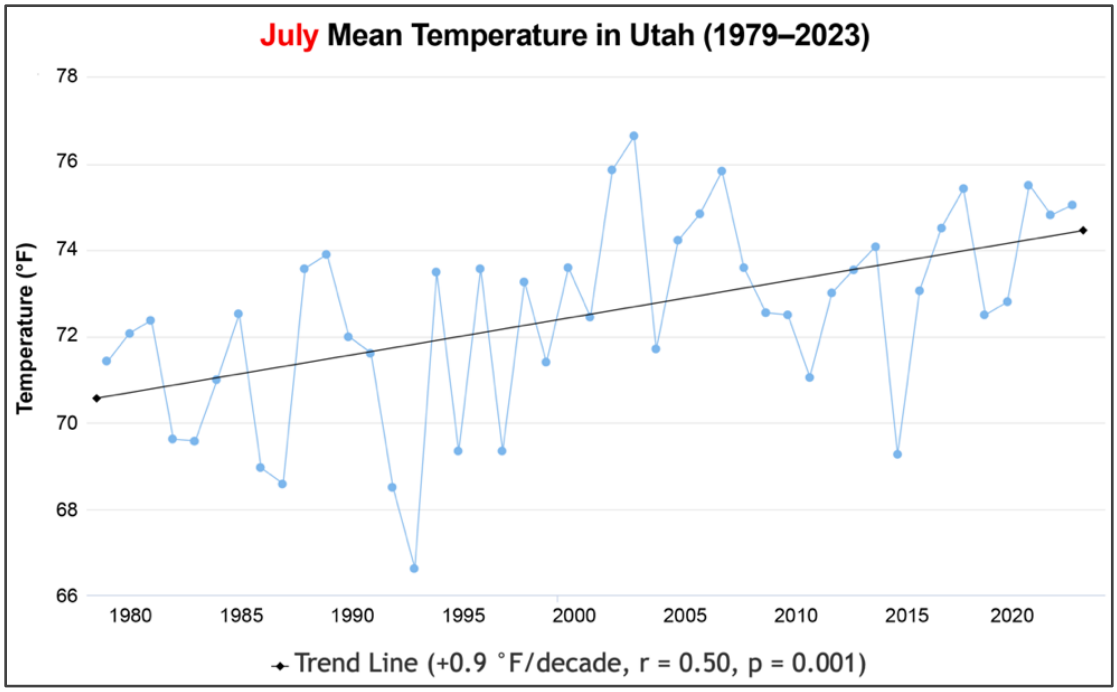


Figure 46. *Increasing July Mean Temperature in Utah (1979–2023)*

Source: Hegewisch and Abatzoglou (2024a) (Image licensed under CC BY 4.0: https://creativecommons.org/licenses/by/4.0/).

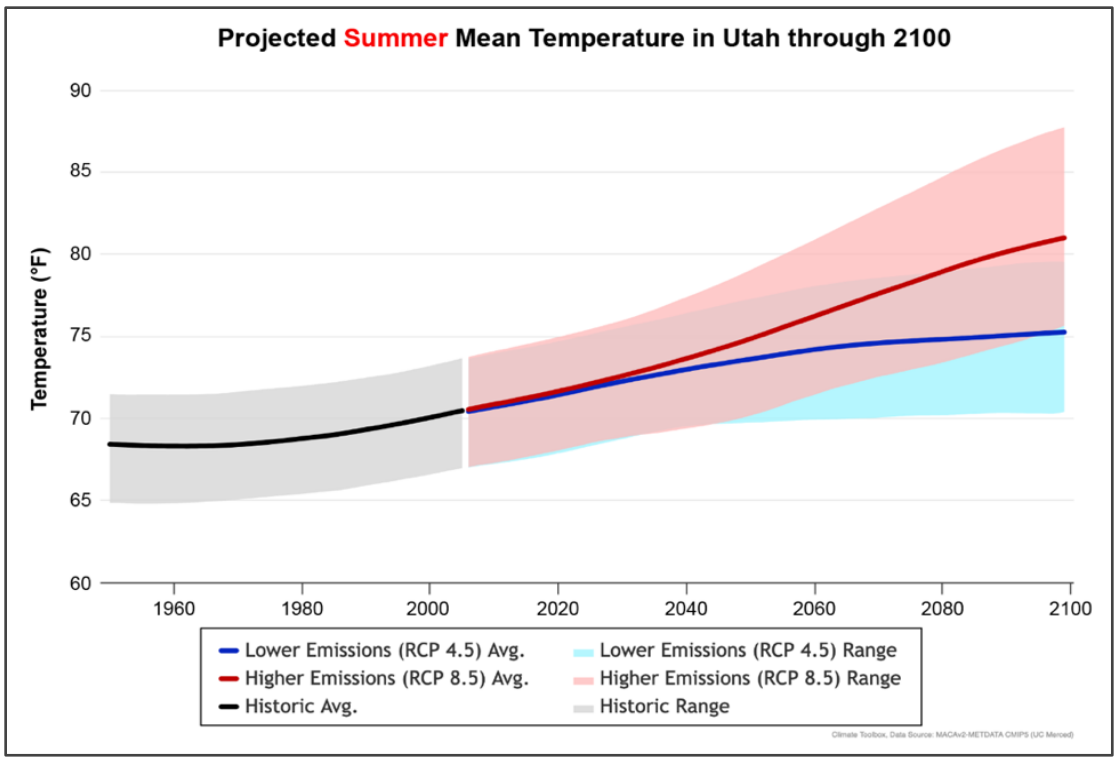


Figure 47. *Projected Rise in Summer Mean Temperature in Utah through 2100 under Representative Concentration Pathways 4.5 and 8.5 Emissions Scenarios*

Note: 4.5 and 8.5 refer to the warming influence expected in 2100 from the projected greenhouse gas concentrations.

Source: Hegewisch and Abatzoglou (2024b) (Image licensed under CC BY 4.0: https://creativecommons.org/licenses/by/4.0/).

Winter Temperatures

Temperatures in winter also appear to be rising, though not as rapidly as summer temperatures. The trend for January mean temperature in Utah indicates an increase of approximately 0.7°F per decade since 1979, but these data are more variable, and the trend is not statistically significant (*P* = 0.12). More warming, however, is anticipated. By 2100, under the RCP 4.5 and RCP 8.5 emissions scenarios, winter temperatures in Utah are expected to rise by 3.8°F and 8.2°F, respectively (Figure 48).

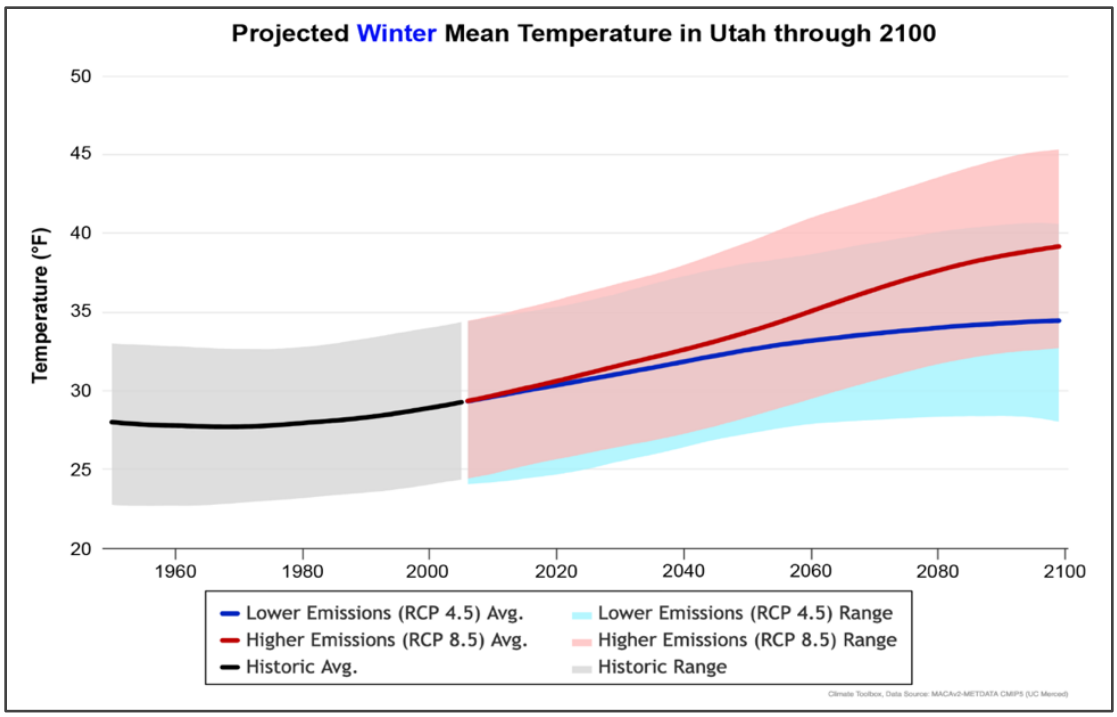


Figure 48. *Projected Rise in Winter Mean Temperature in Utah through 2100 under Representative Concentration Pathways 4.5 and 8.5 Emissions Scenarios*

Source: Hegewisch and Abatzoglou (2024b) (Image licensed under CC BY 4.0: https://creativecommons.org/licenses/by/4.0/).

Precipitation and Snowpack

The amount of winter precipitation falling in Utah has not meaningfully changed in the last 40 years, nor is it projected to (Figure 49) (Hegewisch and Abatzoglou 2024b); however, rising temperatures are impacting Utah's water supply by increasing the percentage of winter precipitation falling as rain rather than snow. Between 1960 and 2010, the proportion of winter precipitation falling as snow declined by approximately 9% (Gillies et al. 2012), contributing to a 16% decline in peak snowpack statewide from 1979 to 2023 (Figure 50, top). In this context, *snowpack* refers to snow water equivalent, a standard measure that corresponds to the amount of liquid water the snow would yield when melted.

> Projections indicate that by 2062, Utah will start seeing years where seasonal snowpack does not accumulate.

The timing of snowpack accumulation is also changing. Since 1979, the date of peak snowpack in Utah has advanced by approximately 9 days (Figure 50, bottom). Projections indicate that by 2062, the Upper Colorado Basin, which includes much of eastern Utah, will begin seeing years where seasonal snowpack does not accumulate. This equates to less than 10% of the current typical spring snow water equivalent (Siirila-Woodburn et al. 2021). This lack of snowpack will remove the massive natural, frozen reservoir that steadily melts, filling lakes and keeping streams flowing in late summer.

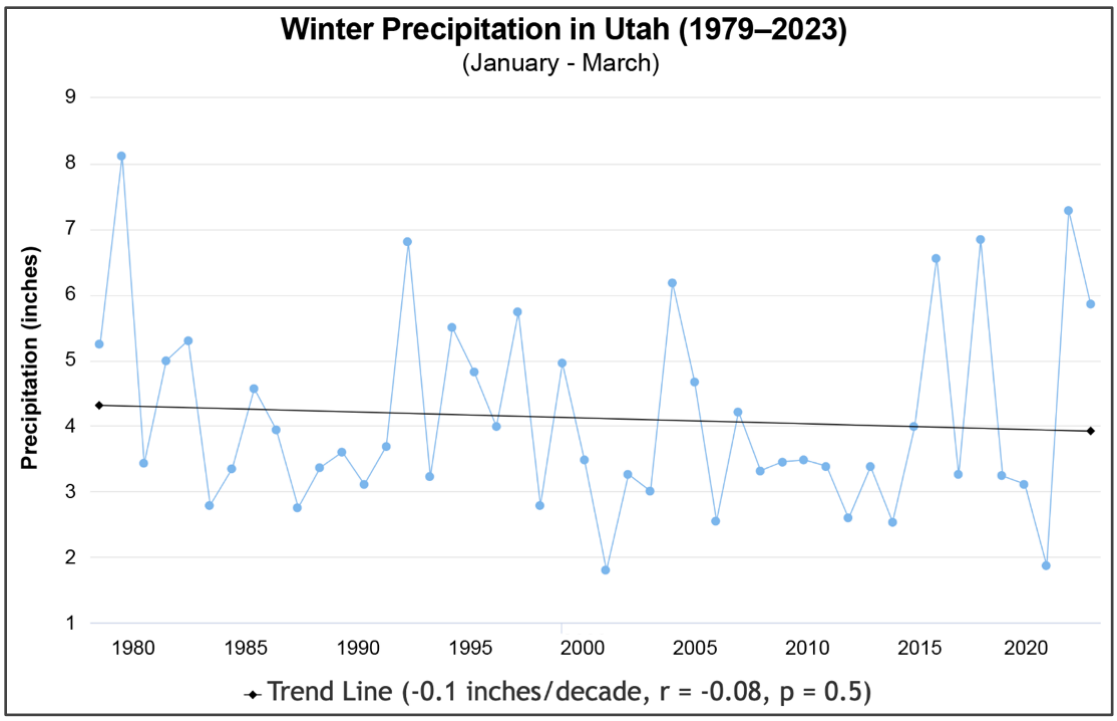


Figure 49. *No Significant Increase or Decrease in Winter Precipitation in Utah (1979–2023)*

Source: Hegewisch and Abatzoglou (2024a) (Image licensed under CC BY 4.0: https://creativecommons.org/licenses/by/4.0/).

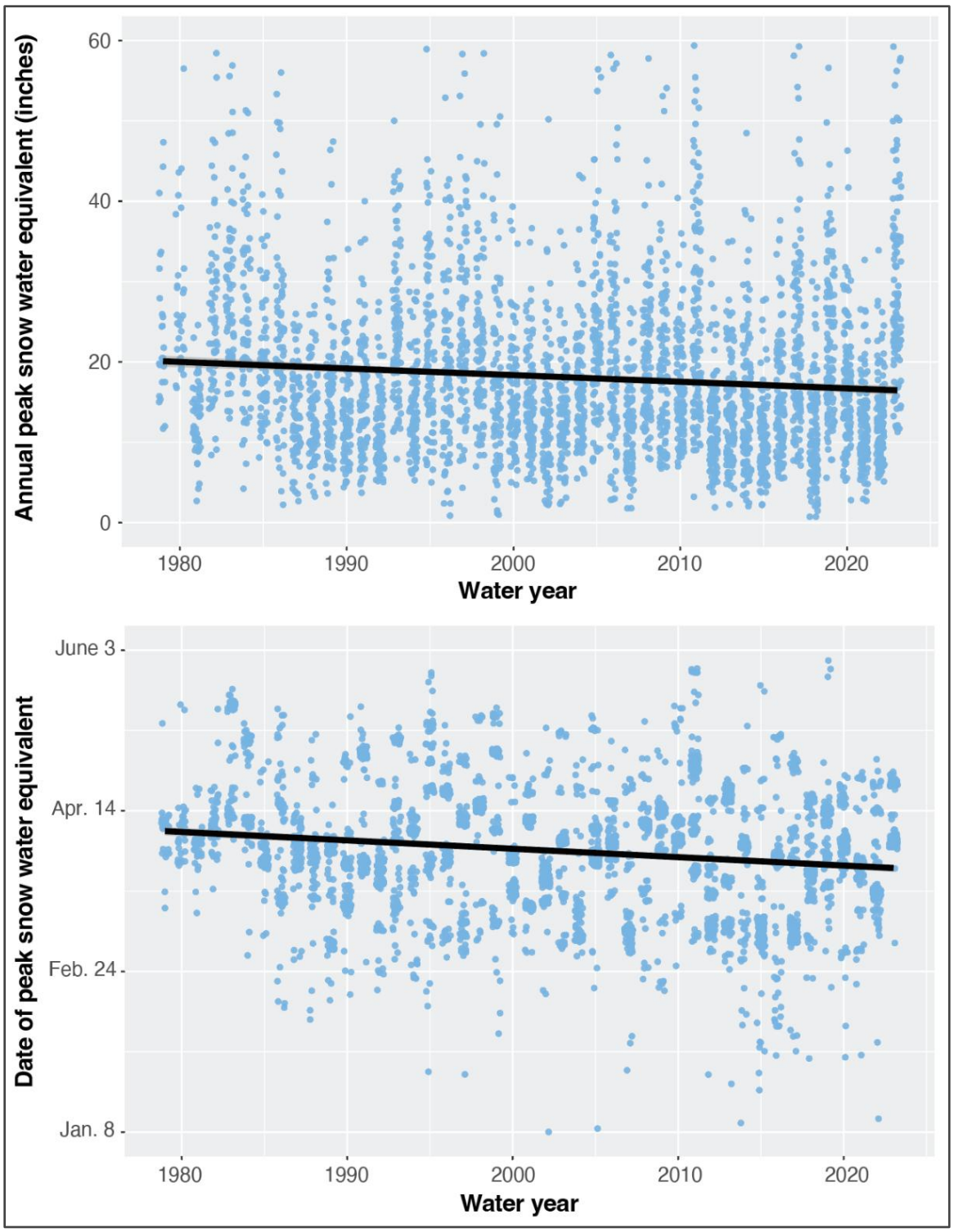


Figure 50. *(Top) Decline in Utah Peak Snowpack (1979–2023) (Bottom) Advancing Date of Utah Peak Snowpack (1979–2023)*

Note: A water year begins on October 1 of the previous year and ends on September 30 of the named year. Each circle represents 1 water year of data for a snow telemetry (SNOTEL) station in Utah.

Source: Natural Resources Conservation Service National Water and Climate Center (2024).

Stream Flow

In mountain regions, summer stream flow is linked to the amount of snowpack that accumulated during the preceding winter and the timing of snowmelt. Thus, reduced peak snowpack and shifts toward an earlier peak—a response to warmer temperatures—can change stream baseflows. For example, August discharge in northern Utah's Logan River has declined since 1979 (Figure 51). Although this decline has not been directly attributed to climate change, it parallels expectations that consider regional temperature increases and snowpack declines during this period (see Figure 46 and Figure 50).

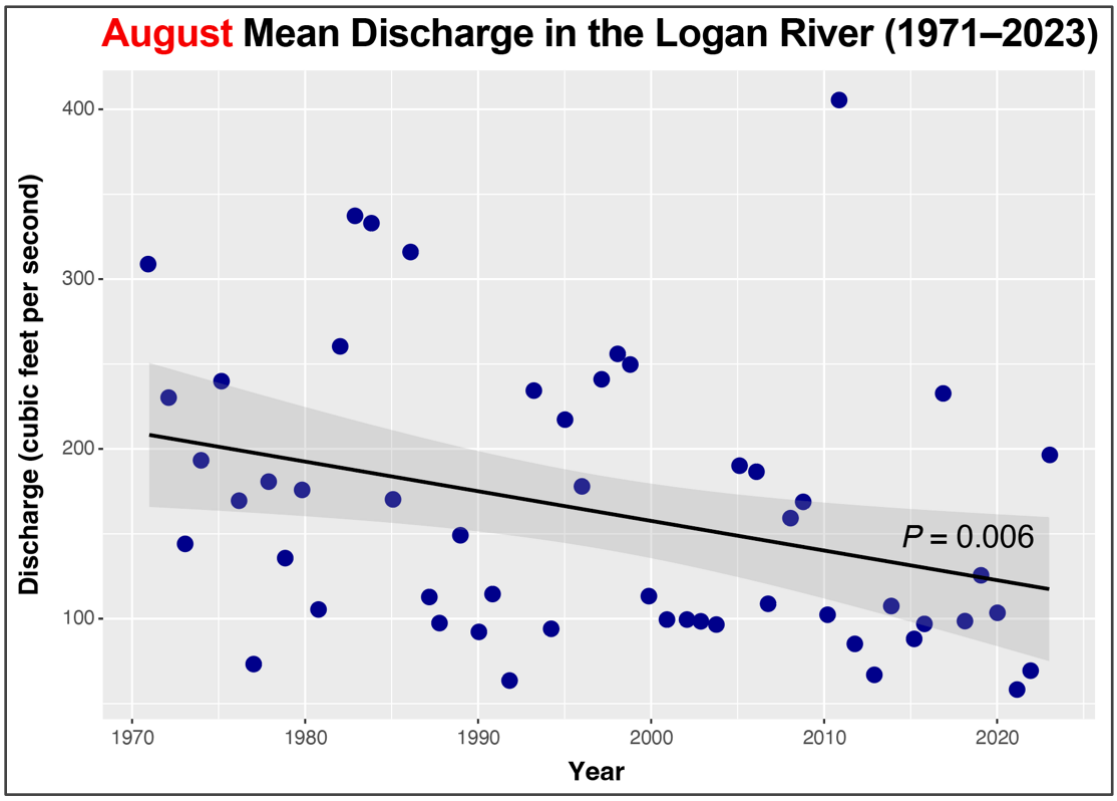


Figure 51. *Declining August Mean Discharge in Utah's Logan River (1971–2023)*

Source: U.S. Geological Survey (2024b).

The Colorado River (Figure 52)—one of the most iconic and influential rivers in the American West—is also impacted by climate change. From 1916 to 2014, stream flow in the Upper Colorado River Basin, which includes eastern Utah, declined by over 16%, despite a slight increase in precipitation over the same period (McCabe et al. 2017; Milly and Dunne 2020; Xiao et al. 2018). Over half of the decline (approximately 9%) was directly attributed to warming in the region.



Figure 52. *The Colorado River Flowing through Glen Canyon*

Source: Adrille (2007) (Image licensed under CC BY-SA 3.0: https://creativecommons.org/licenses/by-sa/3.0/).

In the central Rocky Mountains, an analysis of August discharge for 153 streams from 1950 to 2008 found that 89% of all nonregulated streams are experiencing declines in stream flow. Furthermore, "pristine" sites—those without diversions or land use change during the study period—are experiencing the most rapid decline, with an average 23% decline in August discharge (Leppi et al. 2012). Reduced stream flow can transform streams from perennial, where they flow all year, to ephemeral, where they only flow intermittently, thereby altering the communities of plants, animals, and other organisms the streams can support.

Wildfire

In addition to reducing water availability, higher temperatures affect fire risk by increasing vapor pressure deficit, which draws moisture out of fuel, making it more flammable (Figure 53). Across the western United States, contemporary climate change accounted for approximately 55% of the observed increase in fuel aridity from 1979 to 2015 (Abatzoglou and Williams 2016). In July 2007, the largest wildfire in Utah's recent history occurred: the Milford Flat Fire. The fire was ignited by lightning and, in less than 2 weeks, burned approximately 363,000 acres. As temperatures continue to rise and fuel becomes drier, the frequency and severity of large fires in Utah will likely increase. Changes in fire regime affect habitat by altering the structure and type of vegetation (Agee 1993).

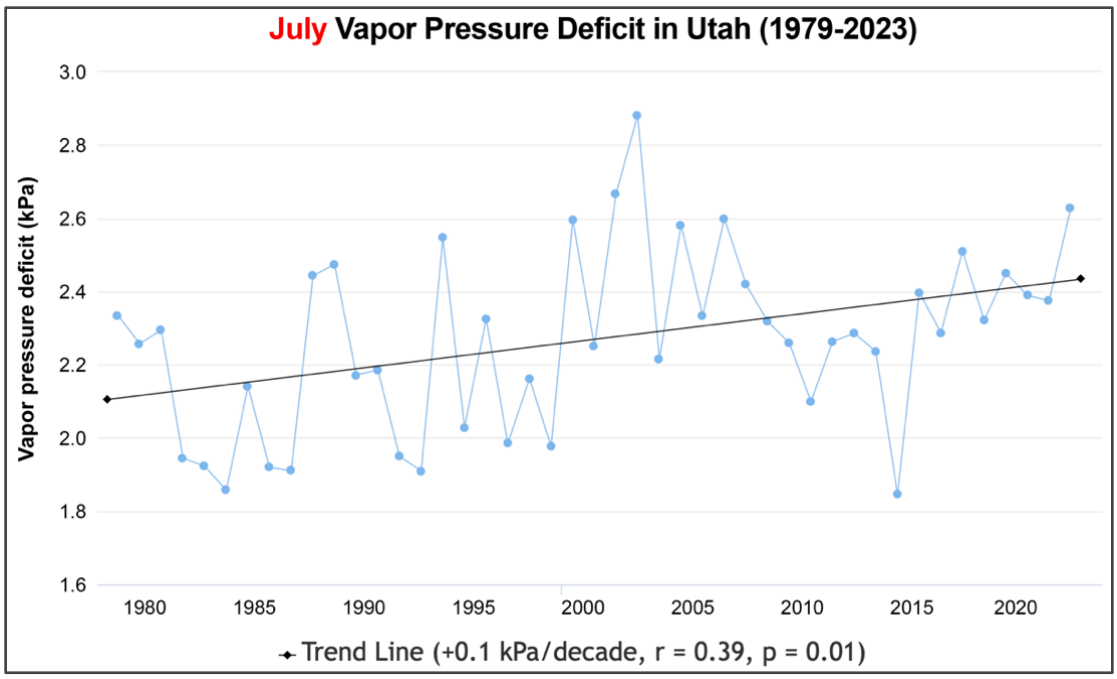


Figure 53. *Increasing July Vapor Pressure Deficit in Utah (1979–2023)*

Source: Hegewisch and Abatzoglou (2024a) (Image licensed under CC BY 4.0: https://creativecommons.org/licenses/by/4.0/).

Ecological Change

Climate change is also driving ecological changes in Utah; however, given the long time scale of the change and the difficulty of collecting long-term data, specific examples for Utah are rare. Using repeat photographs spanning 131 years (1870–2001), Munroe (2003) documented an approximately 100-m (328-foot) uphill shift of tree line in the Uinta Mountains (Figure 54 top and bottom). When tree lines shift uphill, which can occur in response to climate warming, alpine habitats shrink. Warmer temperatures can also threaten species diversity. In northwestern Montana, warming mountain streams are driving a rise in hybridization between non-native rainbow trout and native westslope cutthroat trout (Muhlfeld et al. 2014). Given the similar dynamics between non-native rainbow trout and Bonneville cutthroat trout in Utah (e.g., Meyer et al. 2022), climate change may also contribute to hybridization of these species in local fisheries.

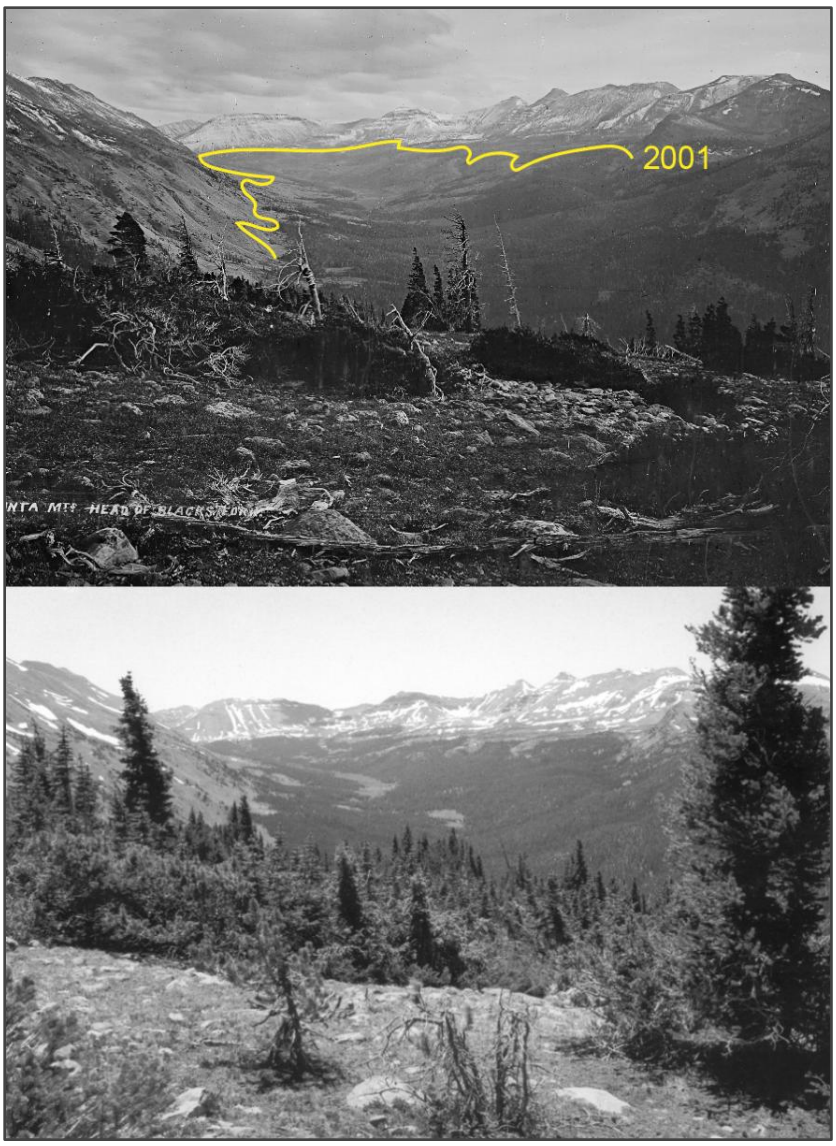


Figure 54. *(Top) Historical (1870) and (Bottom) Modern (2001) Repeat Photographs of the Little East Fork Blacks Fork, Uinta Mountains*

Note: The yellow line on the 1870 photograph shows that tree line moved 100 m (328 feet) uphill by 2001, reducing alpine habitat.

Photograph credits: (top) Jackson, W. H., 1870, and (bottom) Munroe, J. S., 2003, used with permission.

Generally, higher temperatures, declining snowpack, and reduced late-summer stream flow in Utah will alter the mosaic of existing habitats. For instance, these conditions will likely extend the Great Basin Desert to higher elevations and expand its geographic range. At the same time, habitats above tree line will contract as downslope tree species shift uphill. Long-term data sets are needed to track these changes and their effects.

Future

It is projected that greenhouse gas emissions will continue to affect several climatic factors within the state of Utah. As mentioned above, these factors may include changes in temperature, timing and amount of precipitation, accumulation and timing of snowpack, snow water equivalent, stream flow, and the likelihood of wildfires (U.S. Environmental Protection Agency 2024b; Khatri and Strong 2020).

Overall, it is important to note that research into extreme weather events within the state of Utah is limited and highly uncertain, but it is expected that with increasing average temperatures, drought conditions will increase in severity. Changes in seasonal precipitation may also increase the severity of winter storms. Projections show more precipitation will occur as rainfall during the winter season instead of snow, and this in turn may lead to an increase in flood risks (Garfin et al. 2013).

Identifying Climate Refugia

The Climate Adaptation Subcommittee worked with Dr. Edward Hammill of Utah State University to identify climate refugia in Utah (Figure 55). An analysis using the program Marxan was completed to identify Hydrologic Unit Code (HUC) 12 subwatersheds within Utah that were projected to be the least exposed to temperature increases at RCP 4.5 and also included at least 50% of the distribution of 2025 UWAP species of greatest conservation need (SGCN) and 50% of the UWAP key habitats (see Hammill et al. 2024 for more details on the Marxan analysis). Figure 55 presents the analysis results for all SGCNs, as well as for aquatic and terrestrial SGCNs separately. The figure compares outcomes when only SGCNs were evaluated versus when both SGCNs and key habitats were considered. The identified HUC-12s highlight areas in the state that support SGCNs and key habitats while being less exposed to the impacts of climate change. Therefore, focusing landscape restoration projects in these areas should retain the highest benefits over time.

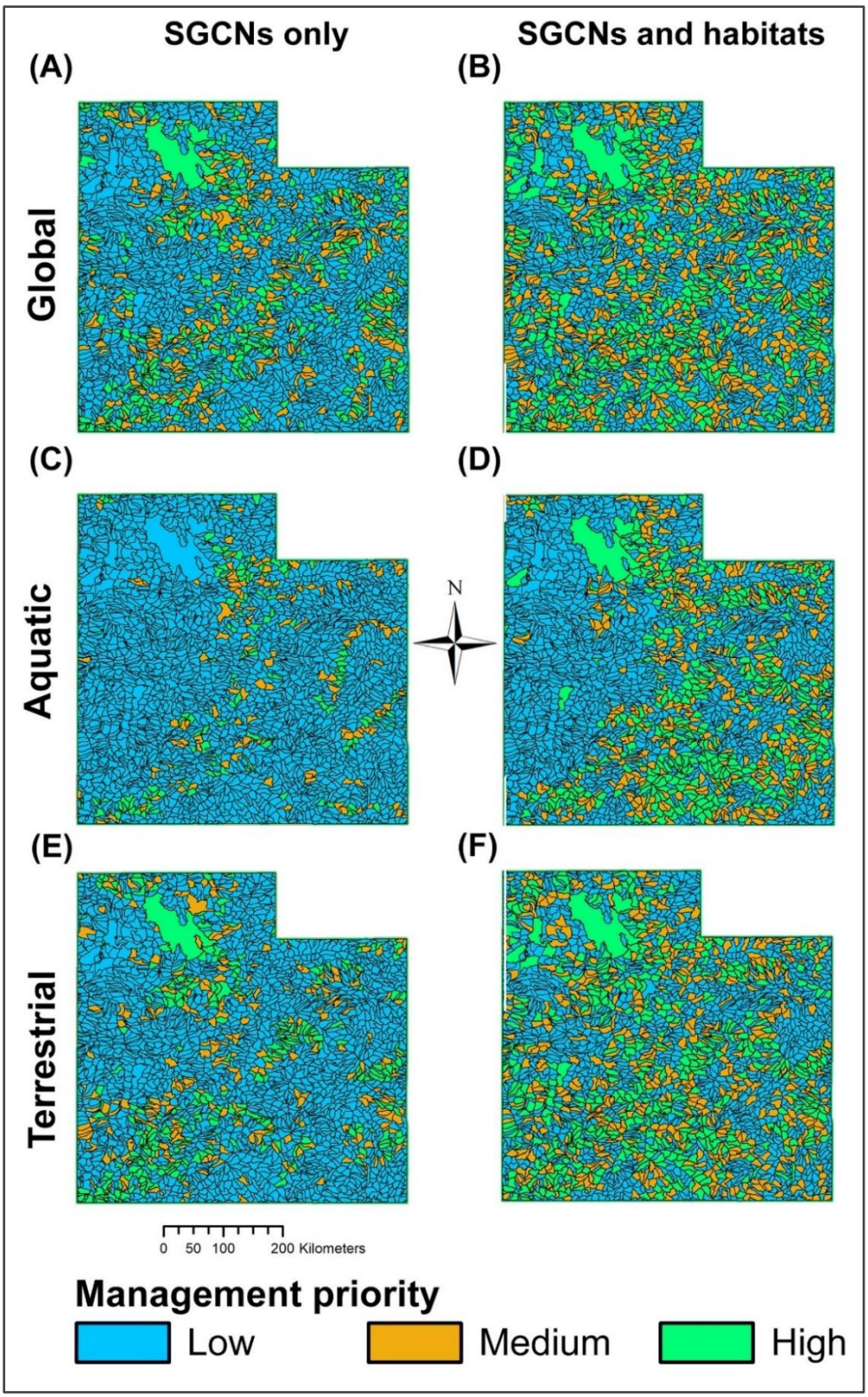


Figure 55. *Spatial Distribution of Low, Medium, and High Priority Hydrologic Unit Code 12 Subwatersheds under Different Analyses*

Source: Hammill et al. (2024).

Long-Term Climate Goals

The Climate Adaptation Subcommittee identified several long-term goals for incorporating climate adaptation that could not be achieved for the 2025 UWAP. This group will continue to work toward prioritizing and accomplishing some of these goals. Goals that were not achieved are as follows:

- Expand the climate refugia analysis to include other risk layers (e.g., fire, industry, development) and SGCN habitat connectivity and movement needs to better identify true Conservation Opportunity Areas to help focus limited funding into the most important conservation areas identified in the UWAP.
- Evaluate climate vulnerability of SGCNs using the Climate Change Vulnerability Index (NatureServe 2024c).
- Complete climate predictive modeling for key habitats.
- Model the impacts of increased water temperature to aquatic SGCNs and prioritize mitigation through methods such as purchasing or leasing additional water, riparian restoration, and increasing streambank vegetation.
- Align climate threats in Utah Division of Wildlife's Watershed Restoration Initiative (WRI) with solutions (e.g., incorporate climate resilience into best management practices and/or develop an adaptive climate resilience checklist for restoration projects).

Threats

The Conservation Measures Partnership Direct Threats Classification identifies climate change as a Level-1 threat and further identifies five Level-2 climate-related threats (Conservation Measures Partnership 2016). The UWAP Core Team further identified three Level-3 climate-related threats (see Chapter 4, Threats, Data Gaps, and Conservation Actions for details on threat levels and a breakdown of the classification numbering system [i.e., 11, 11.1, 11.1.1]):

11. Climate Change

- 11.1 Ecosystem Encroachment – Large-scale effects of ecosystems shifting and impinging on other species and ecosystems
    - 11.1.1 Increasing Stream Temperatures
    - 11.1.2 Encroachment of Woody Vegetation/Shifting Tree Line
    - 11.1.3 Shifting Phenology

- 11.2 Changes in Geochemical Regimes – Broad-scale changes in the geochemical conditions of ecosystems
- 11.3 Changes in Temperature – Broad-scale changes in temperature mean, variability, seasonality and extremes, including changes in temperature extremes, increased average summer temperature, and decreased minimum winter and spring temperatures
- 11.4 Changes in Precipitation and Hydrological Regimes – Broad-scale changes in precipitation mean, variability, seasonality, and extremes, including decreased or increased precipitation, changes in timing of precipitation, changes in form of precipitation (e.g., snow vs. rain; snow cover and snowpack where applicable), changes in evapotranspiration rates and hydrological cycles, and droughts and floods
- 11.5 Severe/Extreme Weather Events – Changes in frequency, timing and/or intensity of storms as well as severe weather events that threaten targets that have lost resilience

Climate change also exacerbates other UWAP priority threats (e.g., many of the Level-2 and Utah's Level-3 threats under Level-1 threat 7: Natural System Modifications). The UWAP also includes a Utah-specific Level-1 threat of 12. Data Gaps, which includes a Level-2 threat of 12.6 Climate Change, and two associated Level-3 threats:

12. Data Gaps

- 12.6 Climate Change
    - 12.6.1 Future Effects of Greater Temperature Variability Under Climate Change
    - 12.6.2 Future Effects of Greater Precipitation Variability Under Climate Change

See the explanation of threat tiers in Chapter 4, Threats, Data Gaps, and Conservation Actions and Appendix E for a full list of threats. These climate-specific threats were used in SGCN and key habitat threat assessments for the 2025 UWAP. Climate change and severe weather directly affect fish and wildlife within Utah by shifting and altering their habitats at many trophic levels. Climate change affects seasonal temperatures and precipitation (timing, amount, duration, and severity), which in turn shifts the habitats that may be suitable for certain species. This includes rising water temperatures, which threaten sensitive aquatic species, and shifting terrestrial habitats, which are being affected by habitat encroachment due to increased woody vegetation.

Fire is a major climate-related threat with the potential to generate large landscape-level effects on ecosystems throughout Utah. It is linked to climate change, past forest management, and invasive annual grasses. Gaps in available data for Utah are a major concern because they reduce managers' ability to make informed, forward-looking decisions. Climate-specific

concerns include the future effects of increasing temperature, precipitation variability, a decreasing snowpack, and timing and availability of snowmelt.

Conservation Actions

Conservation actions can be taken to better prepare and be more proactive at managing resources and reducing negative impacts from projected changes to climate. Some current actions implemented by Utah Division of Wildlife and partners, including resources, are summarized below.

Making Climate Actionable Through Utah Division of Wildlife Resources' Watershed Restoration Initiative

The WRI is the primary vehicle for implementing the UWAP and provides the framework for all Utah partners to submit and implement Utah wildlife conservation projects, from big game habitat restoration and wildfire rehabilitation to UWAP project implementation. There have been over 700 partners (2006–2022) that have provided funding to and submitted projects through the WRI. Including all funding sources, the annual budget of the WRI is over $30 million (Eddington 2024). UWAP project planning and implementation have been effectively integrated into the WRI project scoring system, which ensures that all projects consider UWAP implementation along with their other project objectives. Receiving funding through the WRI is highly competitive, which encourages project proponents to maximize their funding chances by ensuring their projects are mitigating priority threats, including climate threats, to SGCNs and their key habitats. For example, the Level-2 threats of 11.1 Ecosystem Encroachment and 11.4 Changes in Precipitation and Hydrological Regimes are identified as UWAP priority threats (a list of all priority threats is provided in Chapter 4, Threats, Data Gaps, and Conservation Actions), and WRI projects that address these threats will receive additional points. The diverse funding portfolio of the WRI provides a unique opportunity to stretch limited UWAP funding dollars, fund UWAP projects through nontraditional funding sources, and address UWAP priority threats like climate change.

U.S. Forest Service Climate Strategies

The U.S. Forest Service continues to develop climate change vulnerability assessments and engage in climate adaptation efforts, furthering the incorporation of climate science and climate adaptation principles, strategies, and tactics into project designs and management decisions.

The Intermountain Region of the U.S. Forest Service partnered with the research branch of the agency, along with many other partners, and successfully collaborated in a region-wide climate assessment effort from 2015 to 2018. This was published as a general technical report through the Rocky Mountain Research Station in 2018 and provides a comprehensive foundation for the agency and partners to continue to build on. The general technical report is titled *Climate Change Vulnerability and Adaptation in the Intermountain Region* and consists of 15 chapters, including chapters on climate science, hydrology, vegetation, terrestrial species, recreation, and ecosystem services. The successful effort took an all-hands, all-lands approach and welcomed the input of partners (Halofsky et al. 2018a, 2018b). The region and agency continue to build on this work though climate scorecards, research, reports, and workshops.

The Nature Conservancy Strategies: Resilient Sites and Connected Landscapes

In 2016, The Nature Conservancy (TNC) released the first version of the resilient and connected network (RCN) analysis tool for terrestrial ecosystems (Anderson et al. 2023; TNC 2025a). The RCN is a spatial tool that provides an analysis at reasonable resolution (30–180 m [approximately 98–590 feet]) and identifies areas on the landscape that provide landscape resilience to climate change, areas with connectivity and flow, areas with recognized biodiversity, and a compilation of all three as the RCN for the purposes of planning and conservation. This mapping tool has been periodically updated and increased in spatial extent. In 2024, a freshwater version of the RCN tool was released that focused on freshwater ecosystems of the United States (Anderson, Olivero, et al. 2024; TNC 2025b). The landscape resilience analysis shows a gradient (e.g., from low to high) of landscape resilience to climate change. Landscape resilience is partially based on topographic diversity and landscape connectivity. For example, a conical-shaped mountain without disturbance would have high resilience because species that are able to move can shift their range to the appropriate slope and aspect. Connectivity and flow identify areas with high landscape connectivity (e.g., no development, interstates, natural boundaries, etc.) and are split categorically into gradients of diffuse flow and concentrated flow. Areas with recognized biodiversity were identified in TNC's ecoregional planning efforts from the 2000s but rely heavily on state-level data sets from natural heritage programs. The RCNs are areas with high values of landscape resilience, flow, and recognized biodiversity. The analysis was generally biophysical and not species oriented but was developed to identify areas with high conservation value based on their climate resilience, biodiversity, and connectivity.

General Strategies

- Obtain continuous water temperature data from streams important to SGCNs and upload data to the Utah Division of Water Quality continuous water quality monitoring dashboard (Utah Division of Water Quality 2025).
- Keep water temperature from rising beyond thresholds in which aquatic life may survive through streambank and riparian restoration; maintain water quantity and healthy riparian corridors.
- Maintain biodiversity and healthy landscapes to reduce the impact from noxious weeds and lower fuel moisture, which could lead to increased fire activity.
- Conserve and enhance environmental water to benefit SGCNs and their key habitats (see multiple Essential Conservation Actions to Address this Threat sections under water-related threats in Chapter 4, Threats, Data Gaps, and Conservation Actions).

Chapter 4. Threats, Data Gaps, and Conservation Actions

Introduction

Utah's diverse habitats are subject to a wide range of ecological threats. As one of the most arid states in the nation, and with over 3,048 meters (m) (10,000 feet) of elevational variation, Utah encompasses seven U.S. Environmental Protection Agency Level III ecoregions and 37 Level IV ecoregions, each characterized by distinct environmental conditions and unique biological communities. For resource managers, overseeing these ecoregions and understanding the pressures they face is essential. These threats vary by ecoregion and include shifting climatic patterns, invasive species encroachment, and development pressures.

A comprehensive understanding of these threats is the foundation for assessing their impacts, evaluating ecological resilience, and identifying effective mitigation strategies. Effective conservation efforts prioritize minimizing the impact of large-scale threats: preventing ecosystem degradation is more efficient than attempting to restore ecosystems already damaged. Furthermore, restoration efforts are unlikely to succeed if the root causes of degradation remain unaddressed. Given the ecological diversity of Utah's ecoregions and potential severity of the threats they face, a thorough understanding of these challenges is critical to preserving the state's biodiversity for future generations.

Developing a comprehensive list of the threats to species and habitats is a significant challenge due to Utah's vast and varied landscapes as well as the complexity of the threats themselves. Many early state wildlife action plans lacked consistency in the terminology used to describe threats, data gaps, and essential conservation actions. This inconsistency hindered conservation across state borders and complicated collaboration, coordination, and joint fundraising initiatives. Standardizing the terminology used in conservation strategies fosters more effective and consistent approaches at state and regional levels.

Utah and other states adopted a standardized terminology (at the recommendation of the Association of Fish and Wildlife Agencies) (Table E-1 in Appendix E) (Conservation Measures Partnership [CMP] 2016; Salafsky et al. 2008) to describe threats faced by species and habitats, as well as a standardized list of recommended conservation actions (Table E-2 in Appendix E) that can be taken to avoid, reduce, or mitigate threats identified in state wildlife action plans. Using standardized language to describe and refer to threats and conservation actions during

the planning process allows state wildlife action plans to more easily identify which threats impact multiple species and habitats—collectively referred to as *conservation targets*. The standardized threats and conservation actions continue to be updated (Conservation Standards 2025), and future Utah Wildlife Action Plans (UWAPs) will use the updated threats and conservation actions.

Standardized Threats System

The standardized terminology adopted by numerous states and territories (CMP 2016) categorizes threats into two hierarchical levels. At the first level (Level-1), a limited number of broad categories encompasses all possible threats, clarified based on their origin (e.g., human disturbance, development, invasive species). These general Level-1 categories are further divided into more specific Level-2 categories. Within this structured system, users can define even more detailed threat categories.

In Utah, an additional level of standardized threats, Level-3, was developed by UWAP partners for the 2015 UWAP (UWAP Joint Team [Joint Team] 2015) to preserve critical local information that might otherwise be lost within the broader Level-2 classifications. For example, presence of diversions and dam/reservoir operation represent distinct Level-3 threats, each requiring different mitigation strategies and involving different stakeholders. Both are categorized under the Level-2 threat, dams and water management/use, which, in turn, falls under the broader Level-1 threat of natural system modification. This standardized terminology significantly enhances the ability to assess threats and conservation actions across multiple conservation targets within Utah, while also facilitating collaboration among states.

The standardized threat classification outlined by Salafsky et al. (2008) and its subsequent revisions (CMP 2016; Salafsky et al. 2025) do not address data gaps. The UWAP treats data gaps as a distinct Level-1 threat, with specific gaps categorized under Level-2 threats. In preparation for the 2025 UWAP revision, the Species of Greatest Conservation Need (SGCN) Subcommittee reviewed all Utah-specific Level-3 threats to ensure their continued relevance. Some Level-3 threats were updated, and additional ones were introduced to incorporate threats affecting native plants and invertebrates, which were newly included in the UWAP.

Each standardized threat at every level is assigned a numeric code and label. Throughout this chapter, threat labels are used more frequently than numeric codes. Where codes do appear, they follow the format: #.#.#, where the first digit represents the Level-1 category, the second denotes Level-2, and the third indicates Level-3.

Statewide Threat Assessment

The threat assessment was conducted with a focus on key habitats, wildlife, plants, and invertebrates. Some identified threats also represent essential public services and land uses. For instance, water development, residential expansion, renewable energy production, mining, and agriculture are critical public interests that provide societal benefits. Although activities such as water diversion for municipal or agricultural purposes may negatively impact certain SGCNs and their habitats, they remain legitimate and necessary uses of natural resources. Identifying these threats is essential to assess their relative impact and to determine where remedial or preventive actions would be most effective.

UWAP-prioritized threats have been effectively integrated into the Watershed Restoration Initiative (WRI) project scoring system, ensuring that all projects align with UWAP implementation while addressing other project objectives. Because WRI funding is highly competitive, project proponents are incentivized to strengthen their proposals by demonstrating how their projects mitigate threats to SGCNs and their key habitats. Additionally, WRI's diverse funding portfolio provides an opportunity to extend limited UWAP funds and secure financial support through nontraditional sources. For further details on the WRI, refer to the case study in Chapter 6, Partnerships, Implementation, and Regional Collaboration.

A summary of the threat assessment process is provided below, with additional details on the methods used to identify, evaluate, and prioritize threats and data gaps available in Appendix E.

Threats were scored based on their **scope** and **severity** for each target:

- **Threat Scope**: The proportion of the population or species distribution (or key habitat) currently affected or projected to be affected within the next 10 years.
- **Threat Severity**: The extent to which the threat is likely to eliminate populations (or key habitats) or significantly reduce distribution within the next 10 years.

Using a numerical formula (NatureServe 2020), severity and scope scores were combined into a single **threat impact** measure.

After evaluating all threats to all targets, the data were analyzed to determine the following:

- The number of targets affected by each threat.
- The overall degree of impact (low, medium, high, very high).

A total of 6,594 threat-by-target instances were identified (Table 28).

Table 28 presents the statewide assessment results, summarizing threats at the broadest classification level (Level-1). If threat 12 (Data Gaps) is the primary reason for a species' designation as an SGCN, that species is now classified as a species of greatest information need (SGIN) (see Table 28). This new classification approach is an addition for the 2025 UWAP (see Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance, for further details).

Table 28. *Results of Statewide Assessment of Level-1 Threats to Utah Wildlife Action Plan Conservation Targets*

LEVEL-1 THREATS TO SGCNS AND KEY HABITATS	THREAT IMPACT (SCOPE × SEVERITY)					
	VERY HIGH	HIGH	MEDIUM	LOW	UNKNOWN	TOTAL
1. Residential and Commercial Development	63	61	63	320	5	512
2. Agriculture and Aquaculture	101	168	124	201	39	633
3. Energy Production and Mining	85	143	80	247	13	568
4. Transportation and Service Corridors	55	92	58	325	16	546
5. Biological Resource Use	25	18	36	148	15	242
6. Human Intrusions and Disturbance	69	141	95	363	23	691
7. Natural System Modifications	99	207	195	356	6	863
8. Invasive and Problematic Species, Pathogens, and Genes	145	230	175	206	18	774
9. Pollution	8	45	89	222	11	375
10. Geological Events	2	0	0	11	1	14
11. Climate Change	125	250	212	92	39	718
12. Data Gaps	53	96	290	188	31	658
Total	**830**	**1,451**	**1,417**	**2,679**	**217**	**6,594**

Note: The numbers in columns relate to how many targets are impacted by the threat and at which threat level. The information in this table was compiled for the June 2024 SGCN list, which was largely complete; however, changes made to the SGCN list after that time may not be represented in the threats analysis.

Ranking the Threats

The Joint Team developed a threat ranking system for the 2015 UWAP (Joint Team 2015) and applied it to the full threats data set. The goal was to conduct a transparent, repeatable, and objective process for ranking priority threats across the state, rather than focusing on specific threats. This approach also aimed to improve efficiency and provide clear direction for UWAP implementation.

Threats that pose broader, more significant challenges by severely impacting multiple conservation targets over large areas are ranked higher and are considered **priority UWAP threats**. In contrast, threats that affect fewer targets or cause less severe impacts in more limited areas are ranked lower and are addressed outside the scope of the UWAP.

For the 2025 UWAP, the SGCN, Terrestrial Key Habitats, and Aquatic Key Habitats Subcommittees reviewed and updated threat assessments for new SGCNs, SGCNs that had updated NatureServe subnational conservation status ranks (i.e., S-ranks), and each key habitat. The Water, Climate Adaptation, and Habitat Connectivity Subcommittees also evaluated and updated threats for their respective resources. After the updates, the Utah Division of Wildlife Resources (DWR) Wildlife Action Plan Implementation Team and UWAP Core Team reviewed the threats and provided feedback to ensure agreement and add relevant insights.

This chapter presents a summary of Utah's priority threats. Additional details on the methods used to identify and assess threats and data gaps, along with a table listing all threats from the full data set, can be found in Appendix E. Below is a description of the threat ranking process:

- Starting with the complete data set (6,594 records), all Level-2 threats relevant to Utah targets (48) had data relating to data gaps (Level-1 threat 12. Data Gaps) removed, eliminating seven Level-2 threats.
- The remaining data (4,557 records for the 41 remaining Level-2 threats) were further filtered by removing instances of low-impact threats (2,183 records), which resulted in the elimination of one Level-2 threat.
- From the remaining data set (2,374 records across 40 Level-2 threats), records with unknown impact levels (117 records) were removed, eliminating three additional Level-2 threats.
- For the remaining data set (2,257 records across 37 Level-2 threats), a count was made of how many targets each threat impacted (a range of 1 to 223 targets). The average was calculated to be 61.

- Twelve Level-2 threats that impacted more than the average number of targets (>61), were selected as priority Level-2 threats (Table 29).

These 12 priority Level-2 threats account for over 27% of the total data set (1,784 of 6,594 records). Only these priority threats were considered for further assessment, and non-priority threats were removed from subsequent tables. For a complete list of all threats, see Appendix E.

Table 29. *Summary of the Results of the Level-2 Threat Prioritization Process*

PRIORITY LEVEL-2 THREATS TO SGCNS AND KEY HABITATS	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
1. Residential and Commercial Development				
1.1 Housing and Urban Areas	28	25	37	90
2. Agriculture and Aquaculture				
2.3 Livestock Farming and Ranching	47	89	71	207
3. Energy Production and Mining				
3.2 Mining and Quarrying	26	41	15	82
3.3 Renewable Energy	12	28	27	67
4. Transportation and Service Corridors				
4.1 Roads and Railroads	26	43	35	104
6. Human Intrusions and Disturbance				
6.1 Recreational Activities	37	81	62	180
7. Natural System Modifications				
7.1 Fire and Fire Suppression	25	64	52	141
7.2 Dams and Water Management/Use	51	88	84	223
8. Invasive and Other Problematic Species, Pathogens, and Genes				
8.1 Invasive Non-Native/Alien Plants and Animals	56	85	69	210
8.2 Problematic Native Plants and Animals	40	73	62	175
11. Climate Change				
11.1 Ecosystem Encroachment	15	31	42	88
11.4 Changes in Precipitation and Hydrological Regimes	50	96	71	217
Total	**413**	**744**	**627**	**1,784**

Note: Priority Level-2 threats are highlighted in orange. Numerical threat codes are part of the hierarchy and standardization.

Following the Level-2 threats prioritization exercise, 70 Level-3 threats remained nested within the 12 priority Level-2 threats. Because Level-3 represents the most actionable level for conservation efforts, the UWAP Core Team determined that addressing all 70 threats would be inefficient and impractical for targeted action and monitoring. As a result, a further prioritization process was conducted (Table 30) using the same methodology applied to Level-2 threats:

- Within the 12 priority Level-2 threats, 70 Level-3 threats were identified, encompassing 1,784 records.
- To refine the focus, the number of conservation targets impacted by each threat was analyzed (range 1–217), and the average number of impacted targets was calculated at 25.7.
- All Level-3 threats affecting more than the average number of targets (>25.7) were designated priority Level-3 threats.
- The final set of 20 priority Level-3 threats (including the three Level-2 threats in Table 30) accounts for 13.2% of the full data set (872 of 6,594 records).

Only these priority threats were included in subsequent assessments, and non-priority threats were excluded from the following tables. For a complete list of all identified threats, refer to Appendix E.

The number of conservation targets affected by Level-2 priority threats will differ between Table 29 and Table 30. Table 29 shows the number of all conservation targets impacted in the medium, high, or very high categories. However, if the Level-3 threats nested within the Level-2 threats did not impact an above-average level of conservation targets on their own, they did not rise to a Level-3 priority threat. In addition, when ranking Level-3 threats, all records for Level-3 threats with low or unknown impacts were removed, and the sum of the remaining conservation targets are presented in Table 30. The number of conservation targets presented in Table 29 for these particular Level-2 threats will be greater than the number of conservation targets presented for the same Level-2 threat in Table 30.

Table 30. *Summary of the Results of the Level-3 Threat Prioritization Process*

PRIORITY LEVEL-3 THREATS TO SGCNS AND KEY HABITATS	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
1.1 Housing and Urban Areas				

PRIORITY LEVEL-3 THREATS TO SGCNS AND KEY HABITATS	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
1.1.2 Expansion of Urban Footprint	7	9	13	29
2.3 Livestock Farming and Ranching				
2.3.1 Improper Grazing – Livestock (current)	4	14	24	42
2.3.4 Improper Grazing – Livestock (historic)	4	18	10	32
3.2 Mining and Quarrying*	23	30	13	66
3.3 Renewable Energy†	5	16	11	32
4.1 Roads and Railroads				
4.1.1 Roads – Transportation Network	1	13	13	27
6.1 Recreational Activities				
6.1.1 OHV Motorized Recreation	4	11	17	32
7.1 Fire and Fire Suppression				
7.1.1 Inappropriate Fire Frequency and Intensity	16	31	23	70
7.2 Dams and Water Management/Use				
7.2.2 Presence of Diversions	7	6	7	20
7.2.3 Dam/Reservoir Operation	6	11	–	17
7.2.5 Channelization/Bank Alteration (direct, intentional)	–	5	10	15
7.2.6 Groundwater Pumping	1	10	6	17
7.2.8 Agricultural/Municipal/Industrial Water Usage	10	10	12	32
7.2.9 Water Allocation Policies	12	10	6	28
8.1 Invasive Non-Native/Alien Plants and Animals				
8.1.1 Invasive Wildlife Species (non-native)	12	10	18	40
8.1.2 Invasive Plant Species (non-native)	12	23	23	58
8.2 Problematic Native Plants and Animals				
8.2.7 Natural Rarity	12	12	17	41
8.2.8 Small Isolated Populations	5	16	10	31
11.1 Ecosystem Encroachment				

PRIORITY LEVEL-3 THREATS TO SGCNS AND KEY HABITATS	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
11.1.1 Increasing Stream Temperatures	2	9	15	26
11.4 Changes in Precipitation and Hydrological Regimes‡	50	96	71	217
Total	**193**	**360**	**319**	**872**

Note: Priority Level-3 threats are highlighted in yellow, and priority Level-2 threats are highlighted in orange. Numerical threat codes are part of the hierarchy and standardization.

* Level-2 priority threat 3.2 Mining and Quarrying has no associated Level-3 threats. The four Level-3 threats under 3.2 did not impact an above-average number of conservation targets, so no individual threat rose to a Level-3 priority status. Threat 3.2 is included because it ranks as a Level-2 priority threat and will be addressed at this level.

† Level-2 priority threat 3.3 Renewable Energy has no associated Level-3 threats. The five Level-3 threats under 3.3 did not impact an above-average number of conservation targets, so no individual threat rose to a Level-3 priority status. Threat 3.3 is included because it ranks as a Level-2 priority threat and will be addressed at this level.

‡ Level-2 priority threat 11.4 Changes in Precipitation and Hydrological Regimes has no associated Level-3 threats. Accordingly, this threat is addressed at Level-2.

This ranking process aimed to identify the threats with the highest impact to the greatest number of SGCNs and key habitats so that conservation resources can be focused more efficiently. The UWAP Core Team found these results satisfactory because they eliminated nearly 78% of the data while preserving all key statewide threats for further review.

Ideally, the wildlife conservation community needs to move toward steady and holistic management for the benefit of many species and habitats at once. By prioritizing threats to focus on those with the largest statewide impact, the UWAP implements a consistent approach with collective benefit. This approach was implemented in the 2015 UWAP (Joint Team 2015) and carried forward in this revision, because it is efficient and proactive in accomplishing the following:

- Reducing the number of species warranting a listing under the Endangered Species Act (ESA)
- Reducing the number of divisive, expensive conflicts among stakeholders and authorities
- Improving broad ecosystem health and function (i.e., cleaner air and water, more carbon in the soil, more water in the streams and lakes, less soil erosion, and more native wildlife)
- Increasing recreational and economic opportunities and intangible amenities for all Utahns

Although lower-priority threats will not be further addressed in the UWAP, they may still pose significant risks to certain SGCN or key habitats. Lead poisoning serves as a notable example: although it affects relatively few SGCN, it represents the most severe threat to at least one—the California condor. Although such threats must be mitigated to ensure the conservation of specific SGCN or key habitats, they fall outside the scope of the UWAP and will not be considered further in this document. This chapter presents information on the threats that were prioritized following the ranking process. These threats to SGCNs and key habitats are most likely to cause significant issues for Utah if not properly managed. In the pages that follow, there is a brief narrative account for every priority threat in Table 30.

The Standardized Conservation Actions System

Similar to standardized threats, standardized conservation actions (see Table E-2 in Appendix E) are organized into three hierarchical levels (Level-1, Level-2, and Level-3) based on established literature (conservation actions classification version 1.0 [Salafsky et al. 2008]). These conservation actions were updated in 2016 to version 2.0 (CMP 2016), incorporating Level-3 actions for greater specificity. They were updated again within the past year to version 4 (Salafsky et al. 2024). The 2025 UWAP adopts the 2016 conservation actions classification version 2.0 (CMP 2016):

- Level-1 actions: Broad, landscape-scale strategies that address multiple SGCN or key habitats. These actions focus on general intervention types, such as water protection, land conservation, or policy changes.
- Level-2 actions: More specific measures that fall within the most relevant Level-1 category.
- Level-3 actions: Highly targeted efforts nested within the appropriate Level-2 category.

Each standardized action, like the standardized threats, is assigned a numeric code and label. Throughout this chapter, action codes and labels are used consistently, and are presented in Potential Conservation Actions tables to address each priority threat. The coding format mirrors that of threats, structured as #.#.#, where the first digit represents the Level-1 category, the second corresponds to Level-2, and the third indicates Level-3. (It is important to note that the coding and classification of priority threats and conservation actions are not directly correlated.)

Essential Conservation Actions

Conservation professionals must understand the biological and human social systems in which they work. The core strategy of conservation is to influence these biological and social systems

for the good of SGCNs and their habitats. Actions are essential to bring this strategy to life to improve the conservation status of SGCN and key habitats. For instance, actionable items may include the following:

- Restore and/or improve declining wildlife populations and degraded habitat conditions or functions
- Respond to emergencies
- Take advantage of valuable opportunities

Effective conservation actions must be selected or developed in collaboration with administrators and stakeholders involved in activities identified as priority threats—many of which serve legitimate economic, cultural, or recreational purposes.

Collaborative Development of Realistic and Acceptable Conservation Actions

A strategic first step in developing conservation actions is to anticipate potential implementation challenges. Some threats can be mitigated through actions that DWR and its partners have full authority to undertake. Others require dialogue and compromise, and DWR and partners will continue to pursue such approaches individually and collectively.

Certain threats, however, present greater challenges. In some cases, no existing UWAP partners have the legal authority to address them. In others, competing resource demands create conflicts with conservation objectives, or the appropriate course of action remains unclear. Addressing these threats will require working collaboratively with relevant authorities, stakeholders, and partners to identify shared interests and develop mutually acceptable solutions.

The actions outlined in this plan serve as starting points for discussion rather than rigid mandates. Progress will depend on considering a wide range of ideas that can lead to broadly acceptable strategies for meeting the needs of SGCNs, their habitats, and the people of Utah. Inclusivity is essential in determining the scope, method, location, and timing of conservation efforts. Many key partners and allies have yet to be fully engaged in shaping the final UWAP actions.

Because most SGCNs and key habitats are affected by multiple threats, DWR recognizes the importance of collaboration with agencies and partners beyond its direct authority. When multiple threats impact a conservation target, actions will be implemented strategically to ensure a balanced and diversified approach, allocating funding and resources appropriately to address each threat. Conservation actions will be continuously evaluated to measure their

effectiveness in mitigating threats and ensuring an equitable contribution to long-term species and habitat security.

This chapter presents a detailed analysis for each priority threat, including a comprehensive description and assessment. At the core of each priority threat analysis is a set of essential conservation actions, structured around four key components:

- Objective(s) for each priority Level-3 threat.
- Potential indicators of success reaching each objective.
- Potential conservation actions to mitigate the threat.
- Likely authorities, stakeholders, and/or partners involved in addressing the threat.

Although some priority threats present complex and formidable challenges requiring extensive stakeholder collaboration, successful precedents demonstrate that such challenges can be effectively managed. To illustrate this, several case studies are included as examples to guide and inspire those working to address these issues. Additionally, Chapter 6, Partners, Implementation, and Regional Collaboration, offers resources and recommendations for initiating and structuring crucial stakeholder discussions.

Within the analyses for each priority threat below, a table is provided that shows the SGCN species affected by this threat at the very high, high, and medium levels. In some cases, more than one priority Level-3 threat is associated with the Level-2 threat. Consequently, some threat impacts in these tables may have a score larger than one.

Residential and Commercial Development

Threats from human settlements or other nonagricultural land uses with a substantial footprint.

Within this broad category, housing and urban areas was identified as the sole Level-2 priority threat.

Housing and Urban Areas

Table 31 summarizes the numbers of species and habitats affected by this Level-2 priority threat, detailing its impact across all associated Level-3 threats and categorizing the severity of impacts as very high, high, or medium.

This Level-2 threat is further subdivided into several Level-3 threats, with expansion of urban footprint designated as a priority.

Table 31. *Results of Threat Assessment of Priority Level-2 Threat, Housing and Urban Areas*

LEVEL-3 THREAT: EXPANSION OF URBAN FOOTPRINT	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**2**
Arizona toad	–	–	1	
Northern leopard frog	–	1	–	
Aquatic Key Habitats				**2**
Saline Lakes/Great Salt Lake Ecosystem	–	1	–	
Wetlands	–	–	1	
Birds				**6**
Greater sage-grouse	–	–	1	
Long-eared owl	–	–	1	
Sharp-tailed grouse	–	1	–	
Short-eared owl	–	–	1	
White-faced ibis	–	–	1	
Wilson's phalarope	–	1	–	
Insects				**9**
American bumble bee	1	–	–	
Brine fly	1	–	–	
Giant salmonfly	–	–	1	
Large marble butterfly	–	1	–	
Mojave poppy bee	1	–	–	
Monarch butterfly	–	1	–	
Morrison's bumble bee	–	1	–	
Utah wood-nymph	1	–	–	
West Coast lady butterfly	1	–	–	
Fishes				**2**
Virgin River chub	1	–	–	

LEVEL-3 THREAT: EXPANSION OF URBAN FOOTPRINT	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Woundfin	1	–	–	
Mollusks				**5**
Bear Lake springsnail	–	1	–	
Mountain marshsnail	–	–	1	
Western pearlshell	–	–	1	
Winged floater	–	–	1	
Wrinkled marshsnail	–	–	1	
Plants				**16**
Ann Kelsey’s milkvetch	1	–	–	
Arapien stickleaf	1	–	–	
Barneby's aromatic scurf-pea	–	1	–	
Deseret milkvetch	–	1	–	
Dwarf bear-poppy	1	–	–	
Goodrich’s Penstemon	–	1	–	
Hamilton's milkvetch	–	1	–	
Marcus Jones' penstemon	1	–	–	
Paradox milkvetch	1	–	–	
Purple-spined hedgehog cactus	1	–	–	
Rollin's sweetvetch	–	1	–	
Shivwits milkvetch	1	–	–	
Sunnyside green-gentian	–	1	–	
Utah ivesia	–	1	–	
Ute ladies'-tresses	1	–	–	
Wasatch fitweed	–	1	–	

LEVEL-3 THREAT: EXPANSION OF URBAN FOOTPRINT	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Reptiles				**2**
Common chuckwalla	–	1	–	
Gila monster	–	–	1	
Total	**15**	**17**	**12**	**44**

Threat: Expansion of Urban Footprint. Utah is one of the fastest-growing states in the nation. Utah's population reached 3 million in 2015 and is expected to double by 2065 (Kem C. Gardner Policy Institute 2017). That growth will necessitate more places for people to live, work, shop, and recreate (often at the expense of SGCNs and their habitats). For every new resident, open space is lost due to the construction of housing, roads, schools, commercial buildings, and other infrastructure. In 2020, Utah's 25 urban areas were home to 2.94 million people, containing 1 million housing units with an average population density of approximately 2,340 people per square mile, an increase of 434,000 more people from 2010, as well as thousands more housing units and denser population centers. In comparison, approximately 74,000 more people lived in rural areas in 2020 than in 2010. Additionally, urban growth requires the development and use of limited water resources.

A frequently overlooked aspect of urban expansion is the widespread introduction of artificial light in environments where it would not naturally occur, both in terms of timing and intensity. Artificial light at night is particularly challenging to quantify because its effects extend far beyond the physical boundaries of urban infrastructure. Atmospheric scattering and cloud cover contribute to skyglow, which can spread light pollution hundreds of miles farther than its direct source. Unlike natural light from the sun, moon, and stars, artificial light at night has a distinct spectral composition, with modern lighting technologies—such as light-emitting diodes (LEDs)—trending toward whiter light that emits a strong component in the blue spectrum.

The biological effects of artificial light at night vary substantially across species, life stages, habitats, and exposure conditions. However, extensive research consistently demonstrates the harmful impacts of light pollution to gene expression, physiology, foraging, daily movements, migration, reproduction, and overall survival (Gaston et al. 2015), as well as ecological functions such as pollination (Knop et al. 2017), and even nighttime cleansing of the atmosphere (Stark et al. 2011). Although light pollution is identified as a separate Level-3 threat from expansion of

urban footprint, it remains deeply interconnected with urban development, exacerbating the broader ecological consequences of urbanization for wildlife and biodiversity.

The impacts of urbanization to SGCNs are most significant where growth overlaps with rare habitats and range-restricted species. Species like the endangered Virgin River chub and woundfin have a narrow habitat range in Utah in the Virgin River and have been impacted by the growth of St. George and surrounding suburbs.

Because more than 70% of Utah is in public ownership, there is political opposition to reductions in the private land base. Therefore, voluntary agreements and incentives to preserve land in open space are generally preferred actions. Land use planning decisions occur at a high level, with wildlife concerns often taking a back seat to economic and other quality-of-life factors such as transportation, clean air, and education. Rather than driving the conversation, wildlife concerns need to be incorporated into planning efforts to achieve the greatest impact.

Although the primary aim of the UWAP is to propose actions that directly benefit SGCNs, there are many benefits of preserving wildlife habitat in and around urban areas. Experiencing nature in an urban context can foster support for ecological preservation and has the potential to improve the quality of life and health of urban and suburban residents.

Case Study: Balancing Urban Development and Ecological Preservation in Eagle Mountain, Utah

Although mule deer are not designated as SGCN, they are a priority species for DWR. Eagle Mountain, Utah, provides a case study for balancing urban development while preserving a critical migration corridor for mule deer and demonstrates how partnerships can positively protect wildlife habitat. Eagle Mountain is one of the fastest-growing cities in the state of Utah, and its population is expected to double by 2040. This rapid growth presents significant challenges, especially in maintaining a migration corridor for approximately 2,000 mule deer between the Lake Mountains and the Oquirrh Mountains.

Identifying the Challenges

- **Mitigating wildlife-vehicle collisions while preserving a migration corridor:** One threat identified to the mule deer migration corridor was wildlife-vehicle collisions, with over 100 collisions occurring yearly on State Route 73.
- **Secretarial Order 3362:** Rapid population growth, development, and expansion of highways and infrastructure to accommodate the human population within crucial mule deer habitat have resulted in Eagle Mountain being identified as a priority in the Utah

Action Plan (Association of Fish and Wildlife Agencies 2018). Preserving the mule deer's migration corridor may be accomplished by creating protected passage routes across roadways and through master planning to maintain green space, identify opportunities for easements, and prioritize targeted habitat improvements. This Secretarial Order underscored the urgency of effective measures to safeguard the mule deer throughout its migration corridor.

- **Balancing preservation and development:** The task was further complicated by the delicate balance between ecological preservation, urban growth, and property rights, especially given the mule deer's navigation through vested properties with approved high-density master development plans.

Mule Deer GPS Tracking Used for Preservation Efforts

- Between 2018 and 2019, DWR fitted 46 mule deer with GPS tracking collars. Analysis of these data revealed two major migratory pathways from summer to winter range where 35 of the 46 mule deer consistently passed through the Eagle Mountain area. An additional 10 deer were collared in winter 2023 to further understand movements in the area.
- DWR identified an area to provide a high-use migration corridor through the city with minimal impact to landowners. The corridor was strategically designed to follow ridgelines and ephemeral streams, using existing city ordinances and vested open spaces.

The Power of Communication and Diverse Collaborative Partnerships

- **Communication:** When DWR presented Eagle Mountain City (EMC) with the mule deer tracking data, the first partnership began to preserve this mule deer migration corridor.
- **Community Outreach:** The initial joint effort between DWR and EMC was to educate the community about the mule deer migration corridor. Their community outreach resulted in a strong collaborative partnership with several organizations.
- **Common Goal:** This diverse partnership united around the common goal of minimizing human-wildlife conflict while preserving the mule deer migration corridor.

Roles of Nonprofit Organizations and Government Entities

- Nonprofit organizations have played a crucial role in advancing the mule deer migration corridor. They bring diverse interests and perspectives, actively engage the community, raise awareness, offer innovative solutions, and leverage local knowledge and resources.

- Government expertise brings professional knowledge, diverse resources, and the ability to implement policy and management strategies, enhancing the impact and importance of the mule deer migration corridor through collaboration and community outreach.

Partnerships in Action

Diverse partnerships are essential for safeguarding the deer migration corridor from urban development through a multifaceted approach. The commitment from each partner is also exemplified through the following actions:

- Bureau of Land Management (BLM): The BLM follows the Secretarial Order 3362 directive to apply site-specific management activities identified in the UWAP (BLM 2018).
- DWR: DWR has integrated the mule deer migration corridor in the UWAP and have applied for funding for corridor improvements (Utah Department of Natural Resources [DNR] 2025a; DWR and Wildlife Migration Initiative 2024).
- Utah National Guard Camp Williams and West Traverse Community Partnership: These entities actively contribute by assisting and funding conservation easements, restoration projects, and wildlife-impregnable fencing within their authorized priority zones (Conservation Fund 2025).
- Great Salt Lake (GSL) Sentinel Landscape Committee: The mule deer migration corridor holds integral importance within the GSL Sentinel Landscape because it enhances the potential for federal protection of the corridor (GSL Sentinel Landscape Committee 2024).
- Utah Department of Transportation (UDOT): UDOT continues to collect deer-vehicle collision data and participate in scientific research on the effectiveness of wildlife crossing structures and speed reduction measures to determine driver response (Wildlife Connectivity Institute 2025).
- EMC: EMC has taken proactive steps by passing a wildlife corridor overlay zone and incorporating the corridor into update master plans (EMC 2020, 2022, 2025).
- Eagle Mountain Nature and Wildlife Alliance: The Eagle Mountain Nature and Wildlife Alliance's educational community outreach efforts have garnered numerous letters of support for grant funding from multiple stakeholders. Their research and recommendations contribute to effective policy and planning for the corridor, and they assist with ongoing scientific research and various migration corridor projects.

- Mule Deer Foundation: The Mule Deer Foundation is dedicated to advocating for mule deer and preserving and restoring habitat. They are among the largest financial supporters of wildlife-impregnable fencing along the migration corridor.

The Eagle Mountain, Utah, case study provides a compelling example of successful collaboration among diverse partners. Their efforts to manage urban development while preserving a crucial mule deer migration corridor are achieved through scientific research, community outreach, strategic design, planning, and policy implementation.

Essential Conservation Actions to Address this Threat

Objective #1 for Housing and Urban Areas

Identify and protect open lands critical to native wildlife, plants, and invertebrates from being developed for housing and urban growth.

Potential Indicators of Success Reaching this Objective

- Sufficient acreage of land tracts in key areas are in ownership, easement, or zoning status that precludes housing and urban development and designates conservation to safeguard crucial habitats.
- Monitored populations of indicator species, SGCNs, or other key species demonstrate stable or increasing trends, suggesting that habitat protection efforts are effectively supporting biodiversity.

Potential Conservation Actions

CODE	ACTION
2.1.1	Manage game species to support sustainable populations that contribute to economic activity and the maintenance of natural resources.
3.1.2	Raise awareness through social media outreach about the importance of insect diversity to ecosystem health, including as an important food source for other wildlife, pollination services, natural pest control, water quality, decomposition, and nutrient cycling.
3.1.2	Share social media posts highlighting natural landscapes and the unique and interesting species that use those habitats, especially SGCNs in key habitats.
3.1.7	Contact counties, municipalities, and property owners to raise awareness of priority habitats and solutions to conserve these habitats and gauge their willingness to help protect these habitats.
3.1.7	Provide counties and municipalities with examples or references of other government bodies using planning and legislative codes to protect critical wildlife areas.

CODE	ACTION
3.1.8	Encourage community participation in conservation activities through volunteer restoration, species surveys, nature walks, and other outdoor educational opportunities.
5.4.1	Use programs, tools, and opportunities to preserve important wildlife habitat from development. Examples include bargain sale of land; purchase or transfer of development rights; wildlife property tax valuation or other tax incentives; and partnerships for funding leverage, stewardship, and purchasing of land.
5.4.2	Institute a process where actions that result in adverse impacts to native wildlife, plants, and invertebrates or their habitats can be offset by funding conservation and management on other lands through mechanisms such as conservation banks.
5.5.4	Use programs, tools, and opportunities to preserve important wildlife habitats from development.
6.1.1	Donate land by bequest.
6.1.1	Continue DWR's Cooperative Wildlife Management Unit program (DWR 2024e).
6.1.2	Enroll private lands in temporary voluntary agreements (e.g., Safe Harbor Agreements, Candidate Conservation Agreements).
6.1.2	Encourage the use of reserved life estate.
6.1.3	Encourage multiple land uses that maintain diverse wildlife habitats by promoting the presence of healthy soils and diverse native plants for forage, shelter, spring and summer breeding, and overwintering needs.
6.2.1	Work with partners (e.g., The Nature Conservancy [TNC], Utah Department of Agriculture and Food [UDAF], Natural Resources Conservation Service [NRCS]) to establish conservation easements and use deed restrictions.
6.3.1	Identify and designate key areas where a sustained reduction of light pollution and planning for dark skies can benefit wildlife, communities, and cultural heritage (International Dark-Sky Association 2018).
6.3.1	Apply proactive zoning designations to identified critical wildlife areas.
6.4.2	Identify and/or curate a database of important wildlife lands.
6.4.2	Identify and maintain wildlife migration corridors and protected buffers around populations of SGCN/SGIN that may need to move across the landscape or up or down in elevation.
6.4.2	Develop a list of priority locations for resource and habitat protection.
6.4.3	Encourage pollinator-friendly landscapes (e.g., award native plant kits through the Utah Pollinator Habitat Program, reward through official recognition, demonstration gardens) that promote biological connectivity between fragmented habitats.
6.4.4	Continue DWR's walk-in access program (DWR 2024f) and expand it to nonconsumptive uses.

CODE	ACTION
7.1.3	Work with state and local government to incorporate dark sky ordinances into energy efficiency policies, design standards for lighting in new development, and retrofit existing infrastructure with dark sky–friendly lighting.
7.1.4	Explore legislative measures that support the preservation of priority habitats within developable regions. For instance, the local land authority could permit developers to relocate vested density to another area, provide variances for setback requirements to allow more housing in other areas of the development, and grant credit or amenity points toward required open space on buildable land designated as important wildlife habitat.
7.2.3	Engage with statewide and local efforts to ensure wildlife values are incorporated into visioning and planning efforts. Encourage the use of the DWR Wildlife Habitat Analysis Tool (WHAT) (DWR 2024a).
7.2.4	Encourage counties and municipalities to incorporate vital habitat areas and corridors in their master plans and city ordinances. See the *Salt Lake City Open Space Acquisition Strategy* as an example (Salt Lake City 2010).

Likely Authorities, Stakeholders, and/or Partners

- Accredited Utah Land Trusts
    - Utah Open Lands, TNC, others
- DNR
- Public Lands Policy Coordinating Office (e.g., state initiatives and resource plans)
- DWR
- Utah Division of Forestry, Fire and State Lands (FFSL)
- Envision Utah
- Utah Trust Lands Administration (TLA)
- Utah Lake Authority
- Virgin River Program
- County and city planning and land use authorities
- UDOT
- U.S. Fish and Wildlife Service (USFWS)
- BLM
- NRCS
- Private landowners
- Private developers

- Federal and state sentinel landscapes
- U.S. Department of Defense Readiness and Environmental Protection Integration Program
- Municipalities holding conservation easements
- 501(c)(3) nonprofits
- Tribal nations
- Mountainland Association of Governments
- Other vested and/or interested parties

Objective #2 for Housing and Urban Areas

Reduce or manage future physical and environmental footprints of housing and urban development so that SGCNs and their habitats are maintained.

Potential Indicators of Success Reaching this Objective

- Decrease in per capita water consumption.
- Future development follows smart growth principles to reduce urban sprawl.
- Ambient lighting is used appropriately, with dark sky–friendly approaches such as lower lighting levels, warmer light temperatures, and strategic lighting fixtures and sensors that direct light only when and where needed.
- SGCN/SGIN populations in and around existing urban areas expand or remain stable.

Potential Conservation Actions

CODE	ACTION
2.1.1	Maintain the integrity of important habitat areas by providing spatial and noise buffers to adjacent housing and urban growth.
2.1.2	Provide nesting features and overwintering shelter and materials in landscaping (e.g., brush piles, leaf piles, nest boxes, rock walls, dead snag trees, native shrubs and wildflowers) to mimic natural nesting site densities and reduce disease and parasite issues for wildlife and invertebrates.
2.1.3	Identify and maintain wildlife migration corridors and protected buffers around populations of SGCN/SGINs that may need to move across the landscape or up or down in elevation.
2.1.3	Develop wildlife crossing structures to provide safe passages of roads or other movement barriers.

CODE	ACTION
3.1.2	Communicate the potential harms of pesticide use in urban landscaping, especially insecticides, to native insect pollinators and beneficial insect species in priority habitats near urban areas.
3.1.1-8 and 9.2.1-3	Manage human-wildlife conflicts by means that minimize property and human safety risks while preserving intact wildlife, native plants, and invertebrate populations.
3.1.3	Develop and promote public information and educational programs to encourage positive attitudes and behaviors for wildlife, native plants, and invertebrate conservation.
3.1.4	Conduct environmental education in urban parks to foster appreciation for conservation and connect growing urban populations with nature, potentially broadening support for natural resource conservation.
5.2.5	Encourage landscaping with native plants to provide pollinator and wildlife habitat and water conservation. Encourage municipalities to amend their codes to remove real or perceived barriers or provide preference to the use of native plants in place of turf grass.
5.2.5	Encourage efforts to curb urban light pollution through dark sky best practices, such as replacing or retrofitting existing lighting, promoting a dark sky community culture, and sharing information about the impacts of artificial light to the environment.
5.2.5	Support programs, landscape planning, and local nursery operations that advocate converting lawns and urban landscaping to diverse, water-wise, native (and local ecotype) plants that provide a variety of habitat resources to native invertebrates and wildlife.
5.2.5	Provide rebates or other incentives for activities that reduce residential water use.
5.5.1	Highlight the economic benefits of open spaces and outdoor recreation, such as increased property values, jobs, travel and tourism, and enhanced life and health.
5.5.1	Demonstrate potential energy cost savings and payback for upgrade conversions to adaptive and energy-efficient lighting.
6.3.1	Proactively preserve dark skies through community design standards to enhance property values and overall attractiveness to potential buyers.
6.3.1	Enable and promote redevelopment and compact development to minimize open space conversion.
7.1.1	Engage with statewide and local efforts to ensure native wildlife, plants, and invertebrate values are incorporated into visioning and planning efforts.

Likely Authorities, Stakeholders, and/or Partners

- DWR
- UDOT
- Slow the Flow

- Water conservancy districts
- Envision Utah
- County and city planning and zoning commissions
- NRCS
- County and local municipalities
- State, county, and local initiatives
- Private landowners
- Private developers
- Utah League of Cities and Towns
- Utah Association of Counties
- Utah Community Development Office

Agriculture and Aquaculture

Threats from improper farming and ranching practices due to agricultural expansion and intensification of practices; includes silviculture, mariculture, and aquaculture.

Within this broad category, one Level-2 threat was ranked as a priority: livestock farming and ranching.

Livestock Farming and Ranching

Table 32 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into several Level-3 threats, four of which have impacts above the low level. Two of these, improper grazing – livestock (current) and improper grazing – livestock (historic), were ranked as a priority. These threats occur when a site does not have the capacity to accommodate the duration, intensity, and/or timing of grazing that occurs by livestock, wildlife, feral animals, or some combination thereof.

Table 32. *Results of Threat Assessment of Priority Level-2 Threat, Livestock Farming and Ranching*

LEVEL-3 THREAT: IMPROPER GRAZING – LIVESTOCK (CURRENT), IMPROPER GRAZING – LIVESTOCK (HISTORIC)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**4**
Columbia spotted frog	–	1	1	
Northern leopard frog	–	–	1	
Western toad	–	–	1	
Aquatic Key Habitats				**8**
Saline Lakes/Great Salt Lake Ecosystem	–	1	1	
Springs	–	2	–	
Streams and rivers	–	2	–	
Wetlands	–	–	2	
Birds				**14**
Band-tailed pigeon	–	1	1	
Black-throated gray warbler	–	–	1	
Gray vireo	–	1	–	
Greater sage-grouse	2	–	–	
Loggerhead shrike	–	1	–	
Long-eared owl	–	2	–	
Pinyon jay	–	1	–	
Sharp-tailed grouse	2	–	–	
Short-eared owl	–	–	2	
Insects				**7**
American bumble bee	–	–	1	
Large marble butterfly	–	1	–	
Mojave poppy bee	1	–	–	
Morrison's bumble bee	–	1	–	
Suckley's cuckoo bumble bee	1	–	–	

LEVEL-3 THREAT: IMPROPER GRAZING – LIVESTOCK (CURRENT), IMPROPER GRAZING – LIVESTOCK (HISTORIC)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Western bumble bee	–	1	–	
West Coast lady butterfly	–	1	–	
Fishes				**5**
Bluehead sucker	–	1	–	
Colorado River cutthroat trout	–	2	–	
Flannelmouth sucker	–	1	–	
Least chub	–	–	1	
Mammals				**3**
Little brown bat	–	–	1	
Pygmy rabbit	–	–	1	
Townsend's big-eared bat	–	–	1	
Mollusks				**4**
Bear Lake springsnail	–	–	1	
Mountain marshsnail	–	–	1	
Nuwuvi pyrg	–	1	–	
Wrinkled marshsnail	–	–	1	
Plants				**182**
Ackerman green gentian	–	2	–	
Angell cinquefoil	–	2	–	
Aquarius Indian paintbrush	–	2	–	
Arapien stickleaf	2	–	–	
Argyle Canyon phacelia	2	–	–	
Atwood's camissonia	–	2	–	
Atwood's pretty	–	2	–	
Autumn buttercup	2	–	–	

LEVEL-3 THREAT: IMPROPER GRAZING – LIVESTOCK (CURRENT), IMPROPER GRAZING – LIVESTOCK (HISTORIC)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Avon milkvetch	–	–	1	
Barneby ridgecress	–	2	–	
Barneby's aromatic scurf-pea	–	2	–	
Barneby's reed-mustard	–	2	–	
Bear River Range beardtongue	–	2	–	
Ben's beardtongue	2	–	–	
Canaan Mountain beardtongue	–	–	2	
Canyonlands lomatium	–	–	2	
Cisco milkvetch	1	–	–	
Clay phacelia	1	–	–	
Clay reed-mustard	2	–	–	
Comb Wash wild buckwheat	2	–	–	
Cottonwood Springs suncup	2	–	–	
Creeping draba	–	2	–	
Cronquist daisy	–	–	2	
Cronquist milkvetch	–	1	–	
Cronquist's phacelia	–	2	–	
Deep Creek stickseed	–	–	2	
Deseret milkvetch	–	2	–	
Despain pincushion cactus	2	–	–	
Entrada skeletonplant	–	2	–	
Frisco Mountains mustard	–	2	–	
Gate Canyon buckwheat	–	2	–	
Gibben's beardtongue	–	–	2	
Gierisch's globemallow	2	–	–	

LEVEL-3 THREAT: IMPROPER GRAZING – LIVESTOCK (CURRENT), IMPROPER GRAZING – LIVESTOCK (HISTORIC)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Goodrich's blazingstar	–	2	–	
Goodrich’s cleomella	–	2	–	
Goodrich's columbine	2	–	–	
Goodrich’s penstemon	–	2	–	
Goose Creek milkvetch	–	2	–	
Graham's beardtongue	2	–	–	
Grouse Creek rockcress	–	2	–	
Gumbo milkvetch	–	2	–	
Hamilton's milkvetch	–	2	–	
Heliotrope milkvetch	–	–	2	
Holmgren cinquefoil	–	–	1	
Horse Canyon stickleaf	–	2	–	
Horseshoe milkvetch	–	2	–	
Huber's pepperplant	–	2	–	
Hughes' phacelia	–	2	–	
Ibex buckwheat	–	2	–	
Idaho penstemon	–	2	–	
Isely's milkvetch	2	–	–	
Johnston catseye	–	2	–	
Jones cycladenia	–	–	2	
Jones’ globemallow	–	2	–	
La Sal Mountains’ groundsel	–	2	–	
Last Chance townsendia	2	–	–	
Lost Creek buckwheat	2	–	–	
Maguire’s whitlow-grass	–	2	–	

LEVEL-3 THREAT: IMPROPER GRAZING – LIVESTOCK (CURRENT), IMPROPER GRAZING – LIVESTOCK (HISTORIC)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Marcus Jones' penstemon	2	–	–	
Mesic milkvetch	2	–	–	
Murdock's evening primrose	–	–	2	
Narrow-leaf evening primrose	–	2	–	
Navajo sedge	2	–	–	
Paradox milkvetch	2	–	–	
Pariette cactus	2	–	–	
Pinyon penstemon	–	2	–	
Pohl's milkvetch	2	–	–	
Purple-spined hedgehog cactus	2	–	–	
Rollin's sweetvetch	–	2	–	
September 11 stickleaf	–	–	2	
Shivwits milkvetch	2	–	–	
Shrubby reed-mustard	2	–	–	
Sigurd Easter daisy	–	2	–	
Siler pincushion cactus	–	2	–	
Smith's buckwheat	–	2	–	
Snowbasin rockcress	–	2	–	
Stage Station milkvetch	1	–	–	
Stemless beardtongue	–	2	–	
Sunnyside green-gentian	–	2	–	
Sweet penstemon	–	2	–	
Thompson’s flameflower	–	2	–	
Tuhy aromatic scurf-pea	2	–	–	
Tushar paintbrush	2	–	–	

LEVEL-3 THREAT: IMPROPER GRAZING – LIVESTOCK (CURRENT), IMPROPER GRAZING – LIVESTOCK (HISTORIC)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Uinta Basin hookless cactus	2	–	–	
Untermann's daisy	–	2	–	
Utah ivesia	–	2	–	
Utah phacelia	–	2	–	
Ute ladies'-tresses	2	–	–	
Welsh's milkweed	–	2	–	
Western townsend-daisy	1	–	–	
Wheeler's angelica	1	–	–	
White River beardtongue	2	–	–	
Winkler's pincushion cactus	2	–	–	
Wright fishhook cactus	2	–	–	
Zion buckwheat	–	–	2	
Terrestrial Key Habitats				**24**
Alpine	–	1	1	
Aspen-Conifer	1	1	–	
Desert Grassland	–	–	2	
Desert Shrub	–	1	1	
Lower Montane Mixed Conifer	–	1	1	
Lowland Sagebrush	–	1	1	
Mojave Desert Shrub	–	2	–	
Montane and Subalpine Conifer	–	–	2	
Mountain Sagebrush	–	1	1	
Mountain Shrub	–	–	1	
Riparian	1	1	–	
Salt Desert Shrub	–	1	–	

LEVEL-3 THREAT: IMPROPER GRAZING – LIVESTOCK (CURRENT), IMPROPER GRAZING – LIVESTOCK (HISTORIC)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Subalpine Grassland	–	1	1	
Total	**73**	**127**	**51**	**251**

Note: This Level-2 threat has more than one priority Level-3 threat; consequently, some threat impacts have a score larger than one.

Threat: Improper Grazing – Livestock (current). Livestock grazing on both private and public lands plays a significant role in Utah's economy and the livelihoods of rural communities. In 2022, agricultural cash receipts totaled $2.8 billion, largely driven by livestock and dairy production, contributing approximately 2.6% of Utah's total gross domestic product (GDP) (English et al. 2025). This economic impact is particularly pronounced in rural areas, where livestock production supports local businesses and employment. As the predominant land management practice in the western United States, grazing influences nearly three-quarters of the region's land, including wilderness areas, wildlife refuges, national forests, and national parks. Consequently, it has a substantial impact to native ecosystems.

The ecological effects of livestock grazing can be profound, altering ecosystem composition, function, and structure (Franklin et al. 1981; Jones 2000; Li et al. 2021). Across western ecosystems, grazing can have direct and indirect negative consequences for vertebrates, plant communities, and invertebrate populations. Studies examining impacts to pollinators, particularly wild bees, butterflies, and flower flies, indicate that intensive grazing reduces pollinator abundance, richness, and diversity (Glenny et al. 2022). Although grazing can be managed sustainably, the historical variability of range management practices since the introduction of livestock to the West complicates efforts to assess long-term ecological costs (Fleischner 1994).

In landscapes and vegetation communities that evolved with natural grazing disturbance regimes, livestock grazing can be ecologically sustainable. Native herbivores such as bison, elk, deer, bighorn sheep, and pronghorn historically sustained large populations by migrating in great herds, preventing overgrazing in any single area. With the exception of bison, these native grazers continue to roam public lands and compete for resources with managed livestock, wild or feral horses, and burros. Adaptive land management strategies can be used to mitigate this type of population overlap that leads to overgrazing. Holistic grazing practices that imitate native wildlife resource use and account for population overlap include livestock rotation, periods of land rest, and duration or intensity adjustments that consider individual ecosystem needs (McKnight et al. 2018). Additionally, small mammals such as rodents contribute to

ecosystem health through burrowing activities that promote seed dispersal, soil aeration, and plant diversity.

The Utah-Wyoming Mountain Ecoregion, for example, was historically shaped by migrating bison herds, which fed intensively in one area before moving on, allowing vegetation to regenerate. Their hoof action disturbed the soil surface, creating microhabitats and facilitating seed establishment. If properly managed through rotational grazing—characterized by frequent rotation and controlled grazing intensity—cattle can serve as a functional replacement for bison grazing in this ecoregion. Such approaches can mitigate overgrazing, enhance soil health, support diverse plant communities, and promote the return of native species. Additionally, grazing at low to intermediate intensities in ecosystems adapted to herbivory can restore historic disturbance regimes, maintain ecosystem structure, and support pollinator populations (Lazaro et al. 2016; Shapira et al. 2020; Tonietto and Larkin 2018; Vulliamy et al. 2006).

Conversely, improper grazing has the potential to negatively affect key habitats and SGCNs. Grazing may have a neutral impact to rapidly regenerating ecosystems (such as grasslands), but many of Utah's xeric habitats are characterized by slow growing vegetation that is negatively impacted by herbivory and soil disturbance. These disturbances risk destruction of insect nesting sites and water resources, a decrease in native plant reproduction, and the spread of invasive plant species (Glenny et al. 2022). These ecological consequences can, in turn, affect the economic stability of ranching operations. Therefore, it is essential to implement grazing practices that balance economic viability with ecological sustainability.

Fortunately, modern livestock practices in Utah have substantially improved over the past century, and a range of stewardship practices exists that promote both economic and ecological sustainability. Many of these practices are eligible for technical and financial assistance, enabling ranchers to minimize environmental impacts while maintaining or even enhancing productivity. In some cases, sustainable practices can offer direct economic benefits; for instance, one study suggests that simply providing cattle with access to clean water can promote greater weight gain (Willms et al. 2002). By integrating responsible grazing strategies and prioritizing landscape health, it is possible to sustain both healthy ecosystems and resilient agricultural economies.

Case Study: Three Creeks Grazing Management Changes – Envisioning Sustainable Grazing

The Three Creeks Grazing project was implemented in 2022 through a collaborative effort with the BLM, U.S. Forest Service (USFS), Utah Grazing Improvement Program, TLA, NRCS, Three Creeks Grazing LLC, and Working Lands Conservation. This project was an effort to change

grazing management on 138,000 acres of public and private rangelands in Rich County, Utah, in a way that would benefit wildlife species and habitat as well as maintain livestock grazing and the local communities and economies that it supports.

Implementation occurred after years of planning, environmental assessments, and construction of needed infrastructure. Some of the goals of this project were to improve riparian habitat, water quality, and greater sage-grouse habitat and reduce erosion while increasing or maintaining available forage for livestock and continuing to permit livestock grazing at current levels. The project took 10 allotments with 22 pastures managed by the BLM and USFS and consolidated that area into one allotment with 33 pastures. Grazing management changed from a season-long, continuous turnout with 70 to 100 days per pasture or deferred rotation with 30 to 60 days per pasture to a time-controlled rotation with every pasture being rested at least once every 5 years. Annual monitoring determined changes to length of time livestock spent in each allotment. Livestock were consolidated into two cattle herds with greater densities in these pastures but for shorter duration. Four pastures on USFS lands were designated for grazing by both cattle and sheep, and another six USFS pastures were designated for grazing by sheep only. The development of off-channel water troughs was a critical component of this project.

By 2024, after 2 years of implementation, positive changes in the landscape were apparent. Monitoring in riparian areas displayed greater stubble and forb heights, and water quality monitoring showed a reduction in *Escherichia coli* (*E. coli*) levels. Future improvements are anticipated in riparian habitat as well as increased bank stability and cover and decreased fine sediment in streams, which will benefit aquatic SGCNs and Bonneville cutthroat trout (BCT). In addition, greater sage-grouse lek counts are being tracked through time to monitor what should be a positive response to the Three Creeks project.

This project is an excellent example of how collaboration with partners can lead to the development and implementation of creative solutions for a multi-use framework on public lands. Livestock grazing has the capacity to simultaneously be maintained and aid in the improvement of habitats that support fish and wildlife.

Case Study: Cattle Grazing Can Be Used to Improve Habitat for Species of Greatest Conservation Need



Cows Grazing Phragmites. Photograph by Rich Hansen, DWR, Weber County, 2024.

Phragmites is an invasive grass that has taken over wetlands and disturbed, moist areas in the Saline Lakes/Great Salt Lake Ecosystem Key Habitat. Once established, phragmites expands aggressively to form dense patches, up to 4.5 m (15.0 feet) tall. Because of its negative impacts to wildlife, including SGCN birds, land managers around GSL seek to manage or contain phragmites. Past approaches to manage phragmites included herbicide applications, mowing, burning, water management, and revegetation. More recently, targeted cattle grazing has been used as an effective tool for phragmites control. Grazing is inexpensive and generally requires minimal labor beyond fence installation. Cattle grazers pay for the grazing with in-kind services, including heavy equipment work to clean channels, tractor work, grading roads and dikes, and fixing all fences in state-owned wildlife management areas. Some grazers even purchase equipment and materials for these areas, which allows funding to be used elsewhere.

The areas that cattle graze have been converted from monotypic stands of phragmites to multi-functional pastures. These areas were previously unavailable to nearly all birds and are now heavily used by white-faced ibis, American avocet, and black-necked stilts. Long-billed curlew, Wilson's phalarope, and snowy plover occasionally use these areas as well. American bittern are also thriving with the return to cattail and other native emergent vegetation types. Intensive phragmites grazing has opened many channels that were previously so overgrown that American white pelicans could not take off or land in them. There are now exponentially more opportunities for piscivorous birds to use these areas.

Grazing not only removes plant biomass but also provides other benefits, including breaking up dead plant material through trampling, stressing phragmites through grazing, and increasing biodiversity. Proper water management in combination with grazing can drought stress the areas, which allow salts to come to the surface. These salty conditions further stress the phragmites and allow native vegetation like saltgrass to come back and outcompete phragmites. Using this mutually beneficial method, state agencies around GSL have been able to manage almost 20,000 acres that are being grazed each year with minimal effort beyond managing grazing contracts.

Essential Conservation Actions to Address this Threat

Objective #1 for Improper Grazing – Livestock (current)

Grazing is managed such that ecological conditions in key habitats show measurable improvement in various indicators of rangeland health.

Potential Indicators of Success Reaching this Objective

- At the site, allotment, and larger landscape scales, indicators of soil stability, ecological integrity, and hydrological integrity (see BLM Technical Reference 1734-6 [BLM 2020] for more information) are at, or are moving toward, levels that represent proper functioning for the various habitats in which grazing occurs.
- At a Hydrologic Unit Code (HUC) 12 or comparable landscape scale, measurable vegetative characteristics (e.g., species composition [LANDFIRE 2020a Existing Vegetation Type (EVT)] and habitat age structure) are comparable to, or are on a trend toward the reference condition for all key habitats' constituent Biophysical Settings (BpS) as described in the LANDFIRE vegetation model for the corresponding map zone (LANDFIRE 2020b).

Potential Conservation Actions

CODE	ACTION
1.1.5	Rotate livestock through allotments with the aid of moveable borders, fences, salt blocks, nutritional supplements, or geographic barriers such as water features or impassable topography.
2.1.1	Strategize the duration, timing, and intensity of livestock grazing in areas with large populations of native, wild or feral ungulates (i.e., elk, deer, burros and horses) to limit competition and rapid depletion of resources.
2.1.2	Adjust grazing practices (per the grazing principles of timing, duration, and intensity) to improve conditions of habitat, water, and wildlife.
2.1.6	Graze over the fall and winter months when flowering plants are dormant and pollinators are less active.
2.1.6	Use high-density, short-duration grazing alongside rest periods.
2.1.6	Carry out low-density grazing in season-long use areas or rotations that are longer than 45 days.
2.1.6	Implement rotational grazing methods to ensure sufficient land rest periods and habitat diversity. Rotate sheep on a designated route in 3 to 5–year intervals, minimizing sheep forage to 1 to 2 days for a single site.

CODE	ACTION
2.1.6	Monitor utilization rates of pasture annually for livestock and aim for less than 40% utilization in xeric landscapes.
2.1.6	Apply adaptation strategies during times of drought, such as adjusting seasonal land use timing, implementing drought-tolerant feed, and reducing stocking rates.
2.1.6	A post-fire grazing management plan should include a site-specific rest period (2–3 year minimum) to allow for ecological recovery. Regrowth of perennial grasses, forbs, biological soil crusts, and bioaccumulation are essential for soil stability.
5.4.2	On public lands, encourage collaborative problem solving and monitoring among agency staff, permittees, and interested parties.
6.4.1	Use cost-share and technical assistance programs administered by NRCS, Utah Farm Bureau Federation (UFBF), UDAF, Utah State University (USU) Extension, and other organizations to improve natural resource management.
6.5.2	Encourage landowner, permittee, and (on public lands) conservation nongovernmental organizations (NGOs) and community science involvement in monitoring efforts.
6.5.2	Develop locally and (on public lands) broadly acceptable strategies for managing grazing in key areas.
6.5.2	Provide technical assistance to grazing permittees to increase buy-in for management changes.
8.1.1	Incorporate assessments of floral and pollinator presence/abundance into existing rangeland utilization monitoring with the help of resources such as the *Xerces Society's Native Bee Conservation Pollinator Habitat Assessment Form and Guide: Natural Areas and Rangeland* (Jordan et al. 2014).

Likely Authorities, Stakeholders, and/or Partners

- USFS
- BLM
- NRCS
- Grazing permittees
- TLA
- UFBF
- Working Lands Conservation
- Utah Cattlemen's Association
- Utah Woolgrowers' Association
- UDAF

- Utah Grazing Improvement Program
- Conservation NGOs
- Academic specialists in rangeland science and related disciplines

Threat: Improper Grazing – Livestock (historic). Early grazing practices often prioritized maximizing the number of animals on the land without considering long-term ecological impacts. As a result, historic overgrazing has caused lasting environmental effects that continue to affect key habitats and SGCNs today. Over time, grazing management has evolved to incorporate more precise methods for regulating livestock density such as the Animal Unit Month. This system standardizes grazing practices by considering factors such as animal size, land health, and water availability. Animal Unit Months can be adjusted to accommodate varying management needs, ensuring more sustainable grazing practices and providing guidance on appropriate livestock levels to maintain ecosystem balance.

Case Study: The Invasion of Cheatgrass

After years of grazing in the 1800s and early 1900s with little to no management, most Utah rangelands were overgrazed. Historic overgrazing and other factors such as altered fire regimes and climate change have contributed to current habitat challenges. Cheatgrass was introduced to Utah in the mid-1800s by European settlers and was able to fill the void left by overgrazing. Since its introduction, cheatgrass has spread to most of Utah's rangelands. Similar issues have occurred in Utah's sagebrush key habitats. Historic grazing degraded the sagebrush ecosystem by removing the native bunchgrass and forb understory, which allowed the invasion of cheatgrass. Most range management projects in Utah address some of the effects of historic overgrazing and need to consider how the project could increase the potential for an invasion of annuals such as cheatgrass.

A recent successful project completed by the BLM, DWR, and others was to reseed approximately 12,000 acres of rangeland that burned in the 2020 Turkey Farm Road Fire in the Mojave Basin and Range ecoregion. A variety of reseeding efforts were needed to ensure success of the project. Rangeland in this ecoregion supports several SGCN species, including the Mojave desert tortoise and Gila monster, and soils are highly susceptible to wind and water erosion, invasion of noxious weeds, and the spread of cheatgrass after a fire. The primary objective of the seeding effort was to reintroduce perennial grasses, forbs, and shrubs after the fire that would establish and compete with invasive annual grasses. Aerial seeding was the primary method of treatment for the project burned area. The seed mix was prepared by the Great Basin Research Center and comprised seeds that were ecoregion specific and beneficial

to the Mojave desert tortoise. In addition to aerial seeding, hand planting of seeds and seedlings were used to ensure successful coverage. Following the seeding, chaining was implemented, where the terrain allowed, on 420 acres. In addition, state-owned lands in the treatment area received an herbicide treatment of Plateau to prevent cheatgrass invasion. Herbicide was sprayed via helicopter on 2,439 acres. Rehabilitation is a slow process in Utah's dry climate, but early monitoring results have been promising with the establishment of native vegetation over non-native vegetation. The project will be monitored for multiple years (for more information, see the 2020 Turkey Farm Road ESR, Project No. 5499 in the WRI database [DNR 2024b]).

Essential Conservation Actions to Address this Threat

Objective #1 for Improper Grazing – Livestock (historic)

Collaborate with partners to restore landscapes degraded by historic grazing, particularly in areas where natural processes alone cannot achieve recovery or restore the landscape to a desired state. Restoration efforts should be prioritized in areas where ongoing degradation continues to negatively impact SGCNs and their key habitats.

Potential Indicators of Success Reaching this Objective

At the site, allotment, and broader landscape scales:

- Indicators of soil stability, ecological integrity, and hydrological integrity (as outlined in BLM 2020) either meet or are progressing toward levels that represent proper ecological function for habitats affected by historic grazing.

At a HUC-12 or comparable landscape scale:

- Measurable vegetative characteristics—including species composition (LANDFIRE EVTs [2020a]) and habitat age structure—are either aligned with or trending toward the reference condition for each key habitat's constituent BpS as defined in the LANDFIRE (2020b) vegetation model for the relevant map zone.

Potential Conservation Actions

CODE	ACTION
5.4.2	On public lands, encourage collaborative problem solving and monitoring among agency staff, permittees, and interested parties.
6.4.1	Use cost-share and technical assistance programs administered by NRCS, UFBF, UDAF, USU Extension, and other organizations to improve landscapes that are still impacted by historic improper grazing practices.

CODE	ACTION
6.5.2	Encourage landowner, permittee, and (on public lands) conservation NGO and community science involvement in monitoring efforts.
6.5.2	Develop locally and, on public lands, broadly acceptable strategies for managing grazing in areas that are still impacted by historic improper grazing practices.
6.5.2	Provide technical assistance to grazing permittees to increase buy-in for management changes.

Likely Authorities, Stakeholders, and/or Partners

- USFS
- BLM
- NRCS
- Grazing permittees
- TLA
- UFBF
- Working Lands Conservation
- Utah Cattlemen's Association
- Utah Wool Growers Association
- UDAF
- Utah Grazing Improvement Program
- Conservation NGOs
- Academic specialists in rangeland science and related disciplines

Energy Production and Mining

Threats from production of non-biological resources.

Within this broad category, two Level-2 threats were ranked as a priority: mining and quarrying and renewable energy.

Mining and Quarrying

Table 33 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into four Level-3 threats; however, these threats were evaluated collectively, which resulted in the Level-2 threat of mining and quarrying being ranked as a priority.

Table 33. *Results of Threat Assessment of Priority Level-2 Threat, Mining and Quarrying*

LEVEL-2 THREAT: MINING AND QUARRYING	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Aquatic Key Habitats				**2**
Saline Lakes/Great Salt Lake Ecosystem	1	–	–	
Streams and Rivers	–	1	–	
Birds				**3**
Sharp-tailed grouse	–	1	–	
Snowy plover	–	–	1	
Wilson's phalarope	–	1	–	
Fishes				**1**
Bluehead sucker	–	–	1	
Insects				**2**
Mojave poppy bee	–	–	1	
Morrison's bumble bee	–	–	1	
Plants				**49**
Ackerman green gentian	–	1	–	
Arapien stickleaf	1	–	–	
Atwood's camissonia	–	1	–	
Atwood's pretty	–	1	–	
Avon milkvetch	–	–	1	
Barneby's reed-mustard	–	1	–	
Canyonlands lomatium	–	–	1	
Cisco milkvetch	1	–	–	
Clay reed-mustard	1	–	–	

LEVEL-2 THREAT: MINING AND QUARRYING	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Comb Wash wild buckwheat	1	–	–	
Cronquist milkvetch	–	1	–	
Deep Creek stickseed	–	–	1	
Despain pincushion cactus	1	–	–	
Dwarf bear-poppy	1	–	–	
Entrada skeletonplant	–	1	–	
Frisco buckwheat	1	–	–	
Frisco Mountains mustard	–	1	–	
Gate Canyon buckwheat	–	1	–	
Gierisch's globemallow	1	–	–	
Goodrich's columbine	1	–	–	
Goodrich’s penstemon	–	1	–	
Graham's beardtongue	1	–	–	
Graham's columbine	–	–	1	
Gumbo milkvetch	–	1	–	
Horse Canyon stickleaf	–	1	–	
Huber's pepperplant	–	1	–	
Isely's milkvetch	1	–	–	
Johnston catseye	–	1	–	
Jones cycladenia	–	–	1	
Last Chance townsendia	1	–	–	
Lost Creek buckwheat	1	–	–	
Marcus Jones' penstemon	1	–	–	
Ostler peppergrass	1	–	–	
Ostler's ivesia	1	–	–	

LEVEL-2 THREAT: MINING AND QUARRYING	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Paradox milkvetch	1	–	–	
Pinyon penstemon	–	1	–	
Shrubby reed-mustard	1	–	–	
Siler pincushion cactus	–	1	–	
Smith's buckwheat	–	1	–	
Sweet penstemon	–	1	–	
Tushar paintbrush	1	–	–	
Uinta Basin hookless cactus	1	–	–	
Untermann's daisy	–	1	–	
Utah phacelia	–	1	–	
Western Townsend-daisy	–	1	–	
White River beardtongue	1	–	–	
Winkler's pincushion cactus	1	–	–	
Wright fishhook cactus	1	–	–	
Zion buckwheat	–	–	1	
Terrestrial Key Habitats				**1**
Desert Shrub	–	–	1	
Total	**24**	**23**	**11**	**58**

Threat: Mining and Quarrying. There are four Level-3 threats identified under mining and quarrying: hardrock minerals, sand and gravel, oil shale, and tar sands. In general, the scope of these Level-3 impacts to individual SGCNs and specific key habitats was small, but collectively they elevated this Level-2 threat to a priority. Mining operations introduce bright artificial light into environments adapted to dark nighttime conditions, altering the sky brightness and, consequently, the physiological and behavioral responses of many wildlife species. Furthermore, effluents from mineral extraction can contain high concentrations of heavy metals that are toxic to aquatic communities—particularly to the macroinvertebrates that comprise a significant prey base for other wildlife (Frakes et al. 2021). Although ongoing research is needed

to better understand the full extent of environmental consequences, UWAP partners believe that these impacts will increase over the next 10 years as Utah continues to expand its energy portfolio.

Case Study: Developing a Conservation Agreement for Two Species of Penstemons

Two of Utah's SGCN plants, the White River beardtongue and the Graham's beardtongue, are herbaceous perennials found growing in the Uinta Basin on white shale ledges and talus slopes of the Green River Formation. Among and under those white shale ledges and other areas within the Green River Formation lie large deposits of both oil shale and tar sands—two resources often sought for extraction for energy needs. Due to the rarity of these plants and the threat of widespread oil shale and tar sands extraction, these two plants were proposed to be listed under the ESA. In 2013, representatives from federal, state, and local entities (USFWS, Uintah County [Utah], DWR, Rio Blanco County [Colorado], Utah Public Lands Policy Coordinating Office, BLM, and TLA) formed the Penstemon Conservation Team. The purpose of the Penstemon Conservation Team is to identify, avoid, minimize, and mitigate potential threats to these two penstemons and their habitats and to promote the species' long-term persistence to prevent the need to list either species under the ESA.



Graham's Beardtongue. Photograph by Zach Coury, USU, Utah Rare Plant Program, Uintah County, 2022.

Hundreds of person hours of meetings with the above stated partners were conducted to address plant mortality and habitat fragmentation due to energy development as well as indirect disturbance, population vulnerability, climate change, and lack of range-wide protection as well as the cumulative effects on these plants due to these stated factors. The resulting penstemon conservation agreement and strategy (Penstemon Conservation Team 2014) details the information and the process with which the Penstemon Conservation Team initiated disturbance limits on 47,732.9 acres of conservation areas (areas with high concentrations of these species and quality habitat) across six units of mixed land ownership. The conservation agreement and strategy also outline monitoring and research needs for these two species to better understand population dynamics and trends.

Since its inception, the Penstemon Conservation Team has completed a mitigation plan, population monitoring plan, weed management plan, livestock management plan, and a

document that outlines the criteria for calculation of baseline and new surface disturbance. The entirety of the penstemon conservation agreement and strategy is scheduled to be in place until 2034. Additionally, annual reports have been completed each year since 2015. All reports are posted on TLA's Penstemon Conservation Agreement website (TLA 2015).

As of 2024, the 6,802 in-kind hours and $364,256 spent on penstemon work (does not include hours and funding prior to 2017) has been an enlightening learning experience for all partners. Agency lawyers travel into the field to assist with survey and monitoring efforts, and field biologists learn the rules, regulations, and mandates of each agency. Largely because of this wide-ranging partnership and its accomplishments, the USFWS announced that the two penstemons were not warranted for listing under the ESA in 2022.

Essential Conservation Actions to Address this Threat

Objective #1 for Mining and Quarrying

Mining and quarrying are managed such that DWR is a stakeholder that is able to provide recommendations on new projects or expanding projects to help minimize potential conflict and/or impact to game species, SGCNs, and their habitats.

Potential Indicators of Success Reaching this Objective

- When planning new projects or project expansions, industry stakeholders use the WHAT (DWR 2024a) to understand the wildlife and SGCNs that use the project area.
- When planning new projects or project expansions, industry stakeholders consult land management partners and DWR to help minimize project impacts to wildlife and SGCNs.

CODE	ACTION
1.2.2	Manage rivers downstream of mineral extraction sites to maintain non-harmful heavy metal levels and promote responsible land use practices to reduce sedimentation.
2.1.1	Maintain the integrity of important habitat and culturally significant areas by providing spatial and timing buffers to adjacent resource development.
2.1.3	Identify and maintain wildlife migration corridors and protected buffers around populations of SGCN/SGINs that may need to move across the landscape or up or down in elevation.
5.4.2	Encourage collaborative problem solving and monitoring among agency staff, industry, and interested parties.
5.4.3	Encourage offset conservation and mitigation.

CODE	ACTION
6.3.1	Define lighting zones (via land use zoning and/or relationship or proximity approaches) "where general conditions related to lighting uses are sufficiently different to merit some differences in lighting standards within an overlay zone" (Illuminating Engineering Society and International Dark-Sky Association 2011).
6.3.1	Identify and designate key areas where a sustained reduction of light pollution and planning for dark skies can benefit wildlife, communities, and cultural heritage (International Dark-Sky Association 2018).
6.4.1	Use cost-share and technical assistance programs to improve landscapes that may be impacted by resource development.
6.5.2	Provide technical assistance to industry partners regarding opportunities to minimize impacts to game species, SGCNs and their habitats, including minimizing light pollution.
7.1.3	Engage with statewide, local, and tribal efforts to ensure wildlife values are incorporated into visioning and planning efforts for new and existing projects. Encourage the use of the DWR WHAT (DWR 2024a).

Likely Authorities, Stakeholders, and/or Partners

- Utah Petroleum Association
- Utah Mining Association
- Utah Office of Energy Development
- Utah Division of Oil, Gas and Mining
- USFWS
- USFS
- BLM
- TLA
- Ute Mountain Ute Tribe
- Navajo Nation
- Ute Indian Tribe
- Paiute Indian Tribe of Utah

Renewable Energy

Table 34 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into five Level-3 threats; however, these threats were evaluated collectively, which resulted in the Level-2 threat of renewable energy being ranked as a priority.

Table 34. *Results of Threat Assessment of Priority Level-2 Threat, Renewable Energy*

LEVEL-2 THREAT: RENEWABLE ENERGY	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Birds				**9**
Bendire's thrasher	–	1	–	
Black-throated gray warbler	–	–	1	
Gray vireo	–	–	1	
Greater sage-grouse	–	–	1	
Loggerhead shrike	–	–	1	
Long-eared owl	–	1	–	
Pinyon jay	–	–	1	
Sharp-tailed grouse	–	1	–	
Short-eared owl	–	1	–	
Fishes				**1**
Bluehead sucker	–	1	–	
Insects				**2**
American bumble bee	–	–	1	
Morrison's bumble bee	–	–	1	
Mammals				**4**
Gunnison's prairie dog	–	–	1	
Hoary bat	–	1	–	
Little brown bat	–		1	
Pygmy rabbit	–	–	1	
Mollusks				**1**
Fat-whorled pondsnail	–	1	–	

LEVEL-2 THREAT: RENEWABLE ENERGY	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Plants				**9**
Atwood's pretty	–	1	–	
Ben's beardtongue	1	–	–	
Cisco milkvetch	1	–	–	
Gumbo milkvetch	–	1	–	
Ibex buckwheat	–	1	–	
Marcus Jones' penstemon	1	–	–	
Pohl's milkvetch	1	–	–	
Stage Station milkvetch	1	–	–	
Western Townsend-daisy	–	1	–	
Terrestrial Key Habitats				**4**
Desert Shrub	–	1	–	
Lowland Sagebrush	–	–	1	
Mojave Desert Shrub	–	–	1	
Salt Desert Shrub	–	1	–	
Total	**5**	**13**	**12**	**30**

Threat: Renewable Energy. There are five Level-3 threats identified under renewable energy: geothermal power facilities, solar power facilities, wind power facilities, hydropower facilities, and nuclear power facilities. In general, the scope of these Level-3 impacts to individual SGCNs and specific key habitats was small, but collectively they elevated this Level-2 threat to a priority. In addition, UWAP partners believe that these impacts will increase over the next 10 years as Utah continues to expand its energy portfolio.

Case Study: The Wildlife Habitat Analysis Tool

Renewable energy is growing at an accelerated pace (Olano 2024). As with all industry, renewable energy can impact SGCNs and their habitats, especially if they are not considered in the project scope and design. Many of these conflicts can be avoided if project managers have information indicating where species occur and have resources on how to minimize the

conflicts. The DWR WHAT was developed in 2024 to provide resources to environmental professionals (e.g., private consultants, developers, energy sector members), conservation partners (e.g., NGOs, federal and state agencies), educators, and the public (DWR 2024a).

This geographic analysis tool promotes improved wildlife planning efforts and environmental review through better access to data earlier in the decision-making process. Informed management actions in turn aid efforts such as optimal site selection, habitat restoration, land conservation, species listing prevention under the ESA, sustainable trail design, and improved wildlife connectivity.

The tool has an intuitive user interface and leverages holistic data sources to provide a one-stop shop for authoritative Utah wildlife and plant species information. The tool provides comprehensive reporting that goes beyond wildlife information to provide mitigation recommendations and important site and landscape context. It has the potential to serve as a portal for data ingestion allowing for analysis of private species survey data and user reference layers. Data can be tailored to individual user roles allowing for various levels of data sharing and custom uses. The WHAT can be found on the DWR website (DWR 2024a).

Essential Conservation Actions to Address this Threat

Objective #1 for Renewable Energy

Renewable energy is managed such that DWR is a stakeholder that is able to provide recommendations on new projects or expanding projects to help minimize potential conflict and/or impact to game species, SGCNs, and their habitats.

Potential Indicators of Success Reaching this Objective

- When planning new projects or project expansions, industry stakeholders use the WHAT (DWR 2024a) to understand the wildlife and SGCNs that use the project area.
- When planning new projects or project expansions, industry stakeholders consult land management partners and DWR to help minimize project impacts to wildlife and SGCNs.

CODE	ACTION
2.1.1	Maintain the integrity of important habitat areas by providing spatial and timing buffers to adjacent resource development.
2.1.3	Identify and maintain wildlife migration corridors and protected buffers around populations of SGCN/SGINs that may need to move across the landscape or up or down in elevation.
5.4.2	Encourage collaborative problem solving and monitoring among agency staff, industry, and interested parties.

CODE	ACTION
6.4.1	Use cost-share and technical assistance programs to improve landscapes that may be impacted by resource development.
6.5.2	Provide technical assistance to industry partners regarding opportunities to minimize impacts to game species, SGCNs, and their habitats.
7.1.3	Engage with statewide, local, and tribal efforts to ensure wildlife values are incorporated into mapping and planning efforts for new and existing projects. Encourage the use of the DWR WHAT (DWR 2024a).
7.2.3	Encourage policy development for off-site mitigation to account for unavoidable impacts and to minimize on-site impacts.
8.2.1	Support research and implement actions to reduce mortality from wind turbine strikes.

Likely Authorities, Stakeholders, and/or Partners

- Power and transmission companies
- American Clean Power Association
- Office of Nuclear Energy
- American Wind Energy Association
- Geothermal industry
- Utah Office of Energy Development
- USFWS
- USFS
- BLM
- DWR
- TLA
- Conservation NGOs

Transportation and Service Corridors

Threats from long, narrow transport corridors and the vehicles that use them, including associated wildlife mortality.

Within this broad category, one Level-2 threat was ranked as a priority: roads and railroads.

Roads and Railroads

Table 35 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into several Level-3 threats, four of which have impacts above the low level. One of these, roads – transportation network, was ranked as a priority.

Table 35. *Results of Threat Assessment of Priority Level-2 Threat, Roads and Railroads*

LEVEL-3 THREAT: ROADS – TRANSPORTATION NETWORK	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Aquatic Key Habitats				**3**
Saline Lakes/Great Salt Lake Ecosystem	–	1	–	
Streams and Rivers	–	–	1	
Wetlands	–	–	1	
Fishes				**2**
Green sucker	–	–	1	
June sucker	–	–	1	
Insects				**2**
Brine fly	–	1	–	
Coral Pink Sand Dunes tiger beetle	–	–	1	
Mammals				**1**
Wolverine	–	–	1	
Mollusks				**2**
Nuwuvi pyrg	–	1	–	
Pine Grove pyrg	–	1	–	
Plants				**41**
Aquarius Indian paintbrush	–	1	–	
Arapien stickleaf	1	–	–	
Argyle Canyon phacelia	1	–	–	

LEVEL-3 THREAT: ROADS – TRANSPORTATION NETWORK	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Atwood's camissonia	–	1	–	
Barneby ridgecress	–	1	–	
Bear River Range beardtongue	–	1	–	
Ben's beardtongue	1	–	–	
Canyonlands lomatium	–	–	1	
Cisco milkvetch	1	–	–	
Clay phacelia	1	–	–	
Cottonwood Springs suncup	1	–	–	
Cronquist milkvetch	–	1	–	
Deseret milkvetch	–	1	–	
Dwarf bear-poppy	1	–	–	
Entrada skeletonplant	–	1	–	
Gate Canyon buckwheat	–	1	–	
Goodrich's blazingstar	–	1	–	
Goose Creek milkvetch	–	1	–	
Guard milkvetch	–	1	–	
Gumbo milkvetch	–	1	–	
Horse Canyon stickleaf	–	1	–	
Horseshoe milkvetch	–	1	–	
Isely's milkvetch	1	–	–	
Jones' false goldenaster	–	–	1	
Last Chance townsendia	1	–	–	
Lost Creek buckwheat	1	–	–	
Maguire's primrose	–	1	–	
Narrow-leaf evening primrose	–	1	–	

LEVEL-3 THREAT: ROADS – TRANSPORTATION NETWORK	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Paradox milkvetch	1	–	–	
Pinyon penstemon	–	1	–	
Pohl's milkvetch	1	–	–	
Shrubby reed-mustard	1	–	–	
Stage Station milkvetch	1	–	–	
Stemless beardtongue	–	1	–	
Sunnyside green-gentian	–	1	–	
Sweet penstemon	–	1	–	
Thompson’s flameflower	–	1	–	
Untermann's daisy	–	1	–	
Utah ivesia	–	1	–	
Ute ladies'-tresses	1	–	–	
Wasatch fitweed	–	1	–	
Reptiles				**4**
Arizona mountain kingsnake (formerly pyro mountain kingsnake)	–	–	1	
Gila monster	–	1	–	
Midget faded rattlesnake	–	–	1	
Mojave desert tortoise	1	–	–	
Terrestrial Key Habitats				**3**
Desert Shrub	–	–	1	
Mountain Sagebrush	–	–	1	
Riparian	–	1	–	
Total	**16**	**30**	**12**	**58**

Threat: Roads – Transportation Network. The road and transportation system in Utah plays a crucial role in the daily lives of its residents. Utah encompasses over 1,574 kilometers (km) (978

miles) of interstate highways and approximately 3,318 km (2,062 miles) of U.S. highways, along with 5,887 km (3,658 miles) of Utah state highways. These major roadways serve as the primary means for transporting goods and people throughout the state. Additionally, Utah's transportation network includes thousands of miles of lighter-duty roads, ranging from paved two-lane county roads to dirt or gravel backways that are maintained periodically.

Roads significantly impact wildlife in various ways. Historically, roads were constructed in locations that offered the most cost-effective and straightforward development, often in canyon bottoms or along creeks and rivers. This approach necessitated bridges and culverts to cross waterbodies, inadvertently creating barriers to fish passage. Furthermore, the stabilization of meandering waterways to prevent lateral movement has hindered natural flood events, which are essential for maintaining riparian vegetation. Such vegetation provides critical habitat for numerous aquatic and terrestrial wildlife species, native plants, and invertebrates.

Roadways can also fragment natural habitats, isolating wildlife populations and restricting their access to essential resources such as food and breeding grounds. Collisions with vehicles pose a major threat to wildlife, resulting in significant mortality rates for mammals, reptiles, birds, amphibians, and invertebrates. These fatalities impact population dynamics and gene flow. Many animals experience elevated stress because of traffic noise and the presence of vehicles. Avoidance of roads can influence community composition and dynamics, alter wildlife movement patterns, and result in reduced productivity in roadway-adjacent habitat.

The development and expansion of road networks facilitate the spread of non-native plants and animals, primarily due to disturbances and removal of native vegetation. Areas adjacent to roadways often experience altered vegetation, microclimate shifts, and other edge effects that disrupt species reliant on specific habitat conditions. Pollutants from roads directly degrade the habitat that supports wildlife. Chemical pollutants associated with high traffic volumes and de-icing treatments can accumulate in the soils and vegetation of roadside habitats; these degraded resources in turn expose invertebrate wildlife to potentially toxic levels of these pollutants (Mitchell et al. 2020). Wildflowers near dirt roads exhibit reduced pollen loads as a result of dust deposition, reducing their ability to serve as a food resource for native pollinators (Waser et al. 2017). Traffic noise further interferes with wildlife behavior, communication, foraging, breeding, and migration patterns. Reduced landscape connectivity and restricted movements caused by roads contribute to increased mortality, lower reproduction rates, disrupted migratory routes, and ultimately, smaller and less viable wildlife populations.

Roadways are also significant contributors to light pollution—also known as skyglow—a form of habitat degradation that has cascading effects on entire ecosystems, particularly where natural

darkness is essential (Cieraad et al. 2022; Gaston et al. 2021). Artificial lighting along roads and highways can both attract and repel wildlife, altering critical nocturnal behaviors such as migration, foraging, hunting, and courtship (Burt et al. 2023; Cao et al. 2024; Hillón-Salas et al. 2024; Horton et al. 2023; Van Doren et al. 2017). These disruptions extend to physiological processes, because artificial light interferes with circadian rhythms, navigation, reproduction, metabolic activity, and overall health across many species across both terrestrial and aquatic systems (Emmer et al. 2018; Stanton and Cowart 2024; Touzot et al. 2020).

Insects and migratory birds are particularly vulnerable. They are disoriented by bright lights, and millions are harmed or killed each year, making light pollution of key driver of both insect and avian declines (Adams et al. 2021; Avalon et al. 2019). Moths, fireflies, beetles, katydids, stoneflies, mayflies, caddisflies, midges, and many other nocturnal insects may suffer from exhaustion, heat exposure, increased predation risk, and disrupted courtship behaviors. Likewise, bats and other small mammals tend to avoid artificially lit areas or may be drawn to certain light wavelengths, resulting in functional habitat loss or alteration and a subsequent reduction in food availability and other critical resources (Beier 2006; Hermans et al. 2024; Rydell 2006).

Despite these impacts, light pollution can be effectively mitigated without compromising human needs. Organizations such as DarkSky International provide comprehensive guidelines for reducing environmental harm. Recommended strategies include minimizing the number and duration of active lights, employing adaptive lighting technologies that respond to real-time traffic and weather conditions, and using directional fixtures that concentrate light only where needed (International Dark-Sky Association 2018). Additionally, lower-intensity, warmer-colored lights are encouraged over broad-spectrum white lights, which are more disruptive to wildlife (Justice and Justice 2021).

Utah's human population reached 3 million in 2015 and is projected to double by 2065 (Kem C. Gardner Policy Institute 2017). This growth will likely result in significant modifications to existing roadways as well as the construction of new roads. As infrastructure expands, collaborative efforts can help avoid, minimize, or mitigate habitat fragmentation to the benefit of both wildlife and human populations. Potential strategies include the implementation of wildlife crossings, roadside fencing to guide wildlife to designated crossing points, habitat restoration in degraded areas, and reduced speed limits in wildlife-prone zones to decrease the risk of collisions.

Case Study: Wildlife Crossings Create Opportunities for Safe Passage for all Wildlife While Bringing Partners Together to Provide Connectivity for People

Southern Utah is home to spectacular scenery that attracts thousands of visitors annually. Although these landscapes attract tourists for their natural beauty, the area is also home to many wildlife species, including the premier Paunsaugunt interstate migratory deer herd that moves between Utah and Arizona. U.S. Highway 89 bisects the spring and fall migration routes, and hundreds of wildlife-vehicle collisions were occurring annually along that route.

In 2009, multiple state, federal, local, and private entities came together to develop a solution to improve motorist safety and reduce wildlife-vehicle collisions while maintaining habitat connectivity for mule deer. DWR and UDOT worked together with multiple partners, including Arizona Game and Fish Department, the Federal Highway Administration, Kane County, the BLM, Grand Staircase-Escalante National Monument, Sportsmen for Fish and Wildlife, the Mule Deer Foundation, and others to fund and implement the U.S. Highway 89 Kanab-Paunsaugunt Wildlife Crossing Project. Wildlife exclusionary fencing and associated infrastructure such as cattleguards, gates, and escape ramps were installed along 20.1 km (12.5 miles) of roadway to guide mule deer to four existing structures and three newly constructed wildlife underpasses completed in 2013. DWR, UDOT, and Arizona Game and Fish Department initiated a 5-year postconstruction monitoring study with USU. During monitoring, various other wildlife species were observed using the crossings, such as jackrabbit, badger, black bear, bobcat, coyote, and mountain lion, which indicates that SGCNs are benefiting from the project. The study found the crash rate had decreased by 53%, and overall success rate at all seven structures during the entire study was 77%. Six of the structures had mule deer success rates over 90% by year five of the study. Phase I of the U.S. Highway 89 Kanab-Paunsaugunt Wildlife Crossing Project was reported as “one of the most successful mule deer mitigation projects in all of North America” (Cramer and Hamlin 2019). The project is a great example of what partners can accomplish when they come together to collaborate to find solutions.

The Wildlife Crossing Pilot Program was established in 2021 under the Bipartisan Infrastructure Law. Under this program, the Federal Highway Administration allocated funding for grants to reduce wildlife-vehicle collisions while improving habitat connectivity for terrestrial and aquatic species. To help match this federal grant opportunity, the Utah State Legislature provided UDOT $20 million, with support from many different organizations. The partnership saw this as an opportunity to continue with Phase II of the U.S. Highway 89 Kanab-Paunsaugunt Wildlife Crossing Project. The partnership collaboratively applied for the Wildlife Crossing Pilot Program grant to construct more wildlife exclusionary fencing and crossing along U.S. Highway 89. Phase II was awarded $5 million from the Wildlife Crossing Pilot Program grant by leveraging $5

million of matching funds provided by the Utah State Legislature. It is anticipated that Phase II will begin in 2025/2026 and will include an additional 11.6 km (7.2 miles) of exclusionary fencing, and the upgrading of two existing culverts for wildlife passage, and the construction of a new wildlife underpass. Additional funding contributions include $300,000 from DWR's successful National Fish and Wildlife Foundation grant and $100,000 from conservation organizations.

Essential Conservation Actions to Address this Threat

Objective #1 for Roads – Transportation Network

New roads are planned and sited in areas where there is limited impact to native wildlife, plants, and invertebrates. When existing roads are maintained, barriers to wildlife movement are removed to allow for movement, and roadside habitats are carefully managed to minimize further degradation.

Potential Indicators of Success Reaching this Objective

- UDOT works with DWR and other wildlife stakeholders to site and design new highways to avoid, minimize, and/or mitigate wildlife-vehicle collisions.
- UDOT works with DWR and other wildlife stakeholders to improve and maintain existing highways to avoid, minimize, and/or mitigate wildlife-vehicle collisions.
- UDOT, counties, and private landowners work with DWR and other wildlife stakeholders to allow and improve fish passage at road/stream crossings to avoid or minimize barriers to aquatic SGCN movement.
- UDOT works with municipalities, tribal nations, and other stakeholders to create an action plan to limit and reduce light pollution and build support for protecting dark skies.

Potential Conservation Actions

CODE	ACTION
1.1.1	Maintain a zone (1.5–3.0 m [4.9–9.8 feet] wide) of closely mowed vegetation bordering road pavement to reduce plant and invertebrate exposure to roadway toxins; vegetation removal should ideally be limited to this zone (except for selective removal of invasive weeds).
1.1.1	Limit the frequency of roadside vegetation removal to no more than twice a year; mowing and similar vegetation removal should be conducted only in early spring or late fall.
1.1.1	Use arthropod-friendly mowing techniques (e.g., mow during the warmest time of the day, use flushing bars, use a minimum mow height of 30 to 40 centimeters (12–16 inches) in areas further from the road).

CODE	ACTION
1.1.1	Install (or retrofit) shielded streetlights with long-wavelength bulbs (i.e., warmer colors) in order to reduce light pollution and impacts to wildlife.
1.1.2	Use selective spot-treatments of pesticide to remove invasive species rather than blanket application; limit pesticide use to early in the growing season before plants have flowered.
1.2.3	Plant seed mixes along roadways that use local ecotype native seeds with a diversity of flowering plants. Prioritize planting after construction projects and at the periphery of existing habitat; limit creation of new habitat to areas where planting will be highly effective (i.e., sites that experience low pressure from invasive weeds, are situated on low-traffic roads, and connect areas of existing wildlife habitat).
2.1.3	Identify and maintain wildlife migration corridors and protected buffers around populations of SGCN/SGINs that may need to move across the landscape or up or down in elevation. Consolidate information through the Wildlife Migration Initiative.
2.1.3	Include native milkweed and forbs or shrubs that provide floral nectar in seed mixes for roadside planting to provide monarch butterfly and native pollinator habitat; consider conservation measures consistent with the *Nationwide Candidate Conservation Agreement for Monarch Butterfly on Energy and Transportation Lands: An integrated Candidate Conservation Agreement with Assurances (CCAA) and Candidate Conservation Agreement (CCA)* (Cardno 2020).
2.1.3	Create selective fish passage structures at priority barriers.
2.1.6	Remove undesired instream barriers or consolidate multiple barriers where feasible.
2.1.6	Build wildlife crossings.
2.1.7	Remove invasive weeds and replace them with local ecotype native plants that benefit native pollinators.
3.1.3	Develop informational materials to help design (e.g., gradient, stream velocity) road and stream crossings for aquatic SGCN movements.
4.3.2	Enforce existing regulations on stream alteration.
6.1.1	Develop a list of priority locations for site or area protective designations.
6.1.1	Establish protected areas of roadside with remnant native plant communities that provide habitat for pollinator SGCN species.
6.3.1	Apply protective zoning designations to identified critical wildlife areas.
6.4.2	Develop a list of priority locations for restoration of habitats and natural processes.
6.5.1	Design and locate recreational infrastructure and facilities in appropriate locations that avoid or minimize adverse impacts to SGCNs and key habitats.

CODE	ACTION
8.1.1	Conduct roadside surveys to identify occurrences of remnant habitat to target for conservation, invasive weeds for removal, and sites that are suitable for the creation of new roadside habitat.
9.2.3	Provide training to mowing and herbicide crews on native plant and insect identification to reduce accidental elimination of desired taxa.
10.1.6	Expand and maintain noxious weed reporting capacity along transportation corridors (in accordance with Utah Noxious Weed Control Act).

Likely Authorities, Stakeholders, and/or Partners

- UDOT
- USFS
- BLM
- DWR
- TLA
- Conservation NGOs
- County and city planning and zoning commissions
- Tribal nations

Human Intrusions and Disturbance

Threats from human activities that alter, destroy, and disturb habitats and species associated with nonconsumptive uses of biological resources.

Within this broad category, one Level-2 threat was ranked as a priority: recreational activities.

Recreational Activities

Table 36 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into numerous Level-3 threats, seven of which have impacts above the low level. One of these, Off-Highway Vehicle (OHV) Motorized Recreation, was ranked as a priority.

Table 36. *Results of Threat Assessment of Priority Level-2 Threat, Recreational Activities*

LEVEL-3 THREAT: OHV MOTORIZED RECREATION	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**1**
Western toad	–	–	1	
Aquatic Key Habitats				**3**
Saline Lakes/Great Salt Lake Ecosystem	–	1	–	
Streams and Rivers	–	–	1	
Wetlands	–	–	1	
Birds				**4**
Band-tailed pigeon	1	–	–	
Bendire's thrasher	–	–	1	
Greater sage-grouse	–	–	1	
Sharp-tailed grouse	–	–	1	
Fishes				**3**
Bluehead sucker	–	–	1	
Colorado River cutthroat trout	–	–	1	
Flannelmouth sucker	–	–	1	
Insects				**4**
American bumble bee	–	–	1	
Mojave poppy bee	–	1	–	
Tanner's black camel cricket/Sand treader	–	–	1	
West Coast lady butterfly	–	1	–	
Mammals				**2**
Dark kangaroo mouse	–	1	–	
Kit fox	–	–	1	
Plants				**66**
Angell cinquefoil	–	1	–	

LEVEL-3 THREAT: OHV MOTORIZED RECREATION	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Aquarius Indian paintbrush	–	1	–	
Arapien stickleaf	1	–	–	
Atwood's camissonia	–	1	–	
Atwood's pretty	–	1	–	
Avon milkvetch	–	–	1	
Barneby ridgecress	–	1	–	
Barneby's aromatic scurf-pea	–	1	–	
Bear River Range beardtongue	–	1	–	
Canaan Mountain beardtongue	–	–	1	
Canyonlands lomatium	–	–	1	
Cisco milkvetch	1	–	–	
Clay reed-mustard	1	–	–	
Cottonwood Springs suncup	1	–	–	
Creeping draba	–	1	–	
Cronquist milkvetch	–	1	–	
Cronquist's phacelia	–	1	–	
Despain pincushion cactus	1	–	–	
Dwarf bear-poppy	1	–	–	
Entrada skeletonplant	–	1	–	
Frisco Mountains mustard	–	1	–	
Gate Canyon buckwheat	–	1	–	
Giant four-wing saltbush	–	–	1	
Gierisch's globemallow	1	–	–	
Goodrich’s cleomella	–	1	–	
Goose Creek milkvetch	–	1	–	

LEVEL-3 THREAT: OHV MOTORIZED RECREATION	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Graham's beardtongue	1	–	–	
Guard milkvetch	–	1	–	
Gumbo milkvetch	–	1	–	
Hamilton's milkvetch	–	1	–	
Heliotrope milkvetch	–	–	1	
Horse Canyon stickleaf	–	1	–	
Huber's pepperplant	–	1	–	
Ibex buckwheat	–	1	–	
Isely's milkvetch	1	–	–	
Johnston catseye	–	1	–	
Jones cycladenia	–	–	1	
Jones' false goldenaster	–	–	1	
Last Chance townsendia	1	–	–	
Lost Creek buckwheat	1	–	–	
Murdock's evening primrose	–	–	1	
Narrow-leaf evening primrose	–	1	–	
Navajo sedge	1	–	–	
Paradox milkvetch	1	–	–	
Pariette cactus	1	–	–	
Pavement phacelia	1	–	–	
Pinyon penstemon	–	1	–	
Pohl's milkvetch	1	–	–	
Purple-spined hedgehog cactus	1	–	–	
Rollin's sweetvetch	–	1	–	
Shrubby reed-mustard	1	–	–	

LEVEL-3 THREAT: OHV MOTORIZED RECREATION	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Sigurd Easter daisy	–	1	–	
Siler pincushion cactus	–	1	–	
Smith's buckwheat	–	1	–	
Stage Station milkvetch	1	–	–	
Stone rubberweed	–	–	1	
Sunnyside green-gentian	–	1	–	
Sweet penstemon	–	1	–	
Thompson’s flameflower	–	1	–	
Tuhy aromatic scurf-pea	1	–	–	
Tushar paintbrush	1	–	–	
Uinta Basin hookless cactus	1	–	–	
Utah phacelia	–	1	–	
Welsh's milkweed	–	1	–	
White River beardtongue	1	–	–	
Winkler's pincushion cactus	1	–	–	
Reptiles				**1**
Mojave desert tortoise	–	1	–	
Terrestrial Key Habitats				**6**
Aspen-Conifer	–	–	1	
Desert Grassland	–	–	1	
Desert Shrub	–	–	1	
Mojave Desert Shrub	–	1	–	
Riparian	–	–	1	
Salt Desert Shrub	–	–	1	
Total	**25**	**39**	**26**	**90**

Threat: OHV Motorized Recreation. With its beautiful and diverse landscapes featuring dramatic alpine mountains, iconic red rock deserts, shimmering salt flats, and stunning rivers and lakes, Utah is a virtual mecca for outdoor recreation enthusiasts. From birdwatching and nature photography to skiing and snowmobiling, in 2022, outdoor recreation contributed more than $11.98 billion in direct visitor spending, employed more than 98,600 direct jobs, and led to $23.38 billion in total output for Utah's economy (Leaver 2024).

When enjoyed responsibly, OHV motorized recreation can have minimal impacts to wildlife populations and their habitats and can provide opportunities for people to observe and appreciate wildlife. OHV use without adequate consideration for its negative potential, however, can have severe impacts to wildlife, including changes to wildlife abundance and community composition, degraded habitats, and conflicts between wildlife stakeholders. The effects of recreation activities on wildlife can be roughly categorized as impacts to individuals and impacts to habitats.

Recreation impacts to individuals are direct effects from activities that may harm, kill, or displace an individual plant or animal, such as striking them with a vehicle. This also includes activities that unintentionally or intentionally harass individuals. Obvious behavioral responses to disturbance (such as a bird flushing from a nest) are often accompanied by invisible physiological responses (such as elevated levels of stress hormones). Although a single incident may not harm an individual, repeated disturbance can negatively impact survival or reproduction. Chronic exposure to recreation-imposed disturbance can be particularly harmful when critical life stage habitats such as dens, nests, maternity colonies, and hibernacula are disturbed, leading to reduced reproductive fitness, abandoned offspring, and increased mortality. Recreation activities can also directly impact individuals through the introduction of problematic plants, pathogens, and predators, and by creating artificial conditions that subsidize native predator populations.

OHV use can be a significant source of noise pollution, particularly from vehicles with two-stroke engines and modified exhaust systems, which produce noise levels in high (>90) decibel ranges. Prolonged exposure to loud noise from OHVs directly impacts animal behavior, stress levels and heart rates, breeding and migratory patterns, and predator-prey interactions—leading to shifts in biological communities in popular OHV use areas. OHVs also contribute to air pollution by stirring up dust and particulate matter, and gas-powered vehicles tend to produce excessive exhaust. Leaking fluids from OHVs can be toxic to wildlife and persist in soil and waterways. Recreation impacts to habitats include changes to structural features and ecosystem function that in turn affect the behavior, survival, reproduction, and distribution of

individuals. Common impacts are trampling plants, exposing roots, soil compaction, erosion (which introduces sediments that pollute water and reduce oxygen availability), sparking accidental wildfires, and creating faux microhabitats that could potentially lure animals into harm's way. Illegal trails created by OHV ruts fragment habitat and facilitate the dispersal of invasive species in sensitive areas. The impacts can be more significant in rare and or vulnerable habitats that are important to wildlife, such as wetlands, riparian areas, dune systems, desert soils, and alpine meadows, which are highly sensitive to disturbance and may have limited natural recovery processes.

For both forms of impact, the significance and magnitude of effect are related to the scope, intensity, and timing of the recreational activity. Individual responses, even for organisms within the same species, may vary greatly due to factors such as habitat condition, habituation, and life stage.

In general, recreation was not ranked as a high-impact threat to many individual species or habitats. Recreational activities rose to a priority threat because they are pervasive on the landscape and have myriad impacts to many species. In most instances, recreation alone is unlikely to drive a species to an ESA listing or extinction but can compound or exacerbate the effects of other threats to imperiled populations. OHV motorized recreation commonly serves as a vector for other priority threats, including invasive species and diseases, and is also a frequent source of fire ignitions.

As recreation continues to increase with the growth in both population and tourism, finding ways to manage it while providing for the needs of wildlife will be a large and growing challenge for the foreseeable future. In 2022, the Utah State Legislature recognized the growing importance of the outdoors to Utah's economic prosperity and quality of life and created the Utah Division of Outdoor Recreation. The conversion to electric-powered OHVs can mitigate many types of pollution (noise, air, soil), and educating OHV users about negative environmental impacts and responsible riding practices can greatly minimize harms to habitats and sensitive species. DWR has been coordinating closely with the new Division of Outdoor Recreation to minimize OHV and other outdoor-related conflicts with wildlife.

Case Study: Managing Off-Highway Vehicles to Conserve the Coral Pink Sand Dunes Tiger Beetle



Coral Pink Sand Dunes Tiger Beetle. Photograph by Fin Keleher, Naturalist, Kane County, 2016.

The Coral Pink Sand Dunes tiger beetle occurs only in the Coral Pink Sand Dunes, a 3,500-acre geological feature named for the deep pink color of its sand dunes. A section of the dune system is leased from the BLM and managed by the Utah Division of State Parks. The tiger beetle occurs sporadically throughout the dunes, but two populations have consistently occurred at two separate locations, occupying a total space of approximately 500 acres where dune movement, soil moisture, vegetation and prey availability provide suitable larval and adult habitat. OHV use significantly impacts the tiger beetle's habitat by damaging vegetation that supports prey, directly killing prey, and reducing soil stability and moisture. It is also responsible for directly killing adult beetles and larvae. The combined impacts of OHVs and drought were identified as threats in a 2012 proposal by the USFWS to list the tiger beetle as threatened under the ESA.

Outdoor recreation in southern Utah attracts visitors year-round, and local economies depend heavily on tourism. The prospect of limiting or closing OHV access to the Coral Pink Sand Dunes State Park represented a potentially significant economic impact to Kanab and surrounding towns in Kane County.

Following the listing proposal, a conservation committee formed to balance the protection of crucial tiger beetle habitat with the interests of stakeholders. Through a 2009 conservation agreement and strategy—reassessed and amended in 2013—partners made a series of conservation commitments, which led to the USFWS withdrawing the listing proposal. Signatories on the 2013 amended agreement consisted of USFWS, BLM, DNR, Utah State Parks, and Kane County (Coral Pink Sand Dunes Tiger Beetle Conservation Committee 2013). Conservation measures outlined in the original and amended strategy and agreement included two protected areas that exclude OHV access, an expansion of the protected area in Coral Pink Sand Dunes State Park, and visitor outreach and education activities that comprehensively addressed the known threats and challenges to the species. These actions by partners ultimately prevented the need to list the Coral Pink Sand Dunes tiger beetle under the ESA. The conservation strategy and agreement was updated again in 2024 to ensure that the outlined conservation measures reasonably address all threats to the core beetle population. As a result

of partner commitments and rigorous annual population monitoring, the endemic Coral Pink Sand Dunes tiger beetle and its habitat are protected, allowing OHV access to safely continue in most other areas of the park.

Essential Conservation Actions to Address this Threat

Objective #1 for Recreational Activities

Recreational opportunities are designed and presented in ways that encourage and promote responsible participation while also ensuring that wildlife and habitat impacts are kept at acceptably low levels.

Potential Indicators of Success Reaching this Objective

- New trails and recreation facilities are designed to minimize wildlife impacts.
- New trails and recreation facilities are located in areas of existing disturbance and avoid areas of unfragmented wildlife habitat.
- SGCN populations remain stable in areas of high recreation interest, despite growth in the recreation sector of Utah's economy.
- Consumer preferences for electric OHVs and equipment conversions to electric powertrains reduce noise and emissions, reflecting the growing demand for sustainability, peaceful outdoor experiences, and reduced long-term operating costs.

Potential Conservation Actions

CODE	ACTION
1.1.8	Install and/or maintain signage, fencing, or other aids to guide recreational use.
1.1.8	Monitor and manage recreational activities to avoid or minimize adverse impacts to SGCNs and key habitats.
1.1.8	Close areas, roads, or trails during times of severe fire danger.
1.1.8	Close areas, roads, or trails following severe wildfire to allow for successful rehabilitation following reseeding efforts.
1.1.8	When appropriate, implement seasonal closures of areas, roads, or trails to reduce impacts to wildlife migration, breeding, and vulnerable life stages.
1.1.8	Where possible, reduce OHV track density (i.e., eliminate redundant access routes, consolidate parallel routes into single trails).
1.1.8	Rehabilitate illegal roads and vehicle routes.
2.1.7	Determine wildlife response to disturbance.

CODE	ACTION
4.1.2	Increase law enforcement capacity to discourage new user-created OHV trails and travel in unauthorized areas.
5.2.1	Continue to require mufflers with approved spark arresters on all OHVs.
5.5.3	Emphasize the importance of open spaces and outdoor recreation to enhance the lives and health of the public.
6.4.4	Promote Utah as an ecotourism and wildlife watching destination.
6.4.4	Emphasize the importance of responsible outdoor recreation to Utah's economy.
6.5.1	Design and locate recreational infrastructure and facilities in appropriate locations that avoid or minimize adverse impacts to SGCNs and key habitats. Avoid locating recreational infrastructure such as OHV routes in floodplains, wetlands, near bodies of water, or in areas with unstable soils prone to erosion or compaction.
7.2.3	Ensure wildlife review of special recreation permits.
7.2.3	Coordinate with the Utah Division of Outdoor Recreation to minimize outdoor recreation impacts to SGCNs and their habitats.
7.2.3	Engage with statewide and local efforts to ensure wildlife values are incorporated into recreation planning efforts.
7.2.4	Support the establishment of multiagency OHV travel plans developed on a county or planning unit level.

Likely Authorities, Stakeholders, and/or Partners

- National Park Service (NPS)
- USFS
- BLM
- Utah Division of State Parks
- Utah Division of Outdoor Recreation
- USFWS
- TLA
- Utah Outdoor Industry Association
- Governor’s Council on Balanced Resources
- County and city parks, recreation, and trails committees
- OHV user groups

Objective #2 for Recreational Activities

Responsible recreation is promoted and encouraged via effective education and enforcement.

Potential Indicators of Success Reaching this Objective

- Decrease in the mileage of user-created illegal trails.
- Decrease in law enforcement citations issued to outdoor recreationists.

Potential Conservation Actions

CODE	ACTION
1.1.8	Monitor and manage recreational activities to avoid or minimize adverse impacts to SGCNs and key habitats.
3.1.3	Include materials covering responsible outdoor recreation and OHV use in shed antler and hunter education courses.
3.1.2	Develop and distribute brochures, web materials, and social media to positively encourage behavior.
3.1.1	Develop public information and educational programs aimed at encouraging attitudes and behaviors that are positive for wildlife conservation.
5.2.4	Continue to require youth to complete an education program, including responsible and ethical riding, to obtain an OHV permit.
4.1.2	Support ongoing efforts to reduce illegal OHV use to prevent resource damage and the spread of invasive or problematic plant species.
4.2.1	Enforce existing hunting, fishing, and recreation laws and regulations.
4.2.3	Use citations and restitution charges to mitigate damage to public resources.
7.2.3	Explore a more robust state-federal partnership to provide adequate resources for recreation administration on federal lands.
7.2.6	Form public/private partnerships (e.g., with OHV dealers and outdoor retailers) to disseminate outdoor recreation information and education.
7.2.7	Use public/private partnerships to educate outdoor recreationists on the need and methods to decontaminate recreational gear (e.g., waders, boats, caving gear, OHVs) to prevent the spread of invasive or problematic species and/or pathogens.

Likely Authorities, Stakeholders, and/or Partners

- NPS
- USFS
- BLM

- Utah Division of State Parks
- Utah Division of Outdoor Recreation
- USFWS
- TLA
- Utah Outdoor Industry Association
- Outdoor businesses
- Tread Lightly
- Leave No Trace
- County and city parks, recreation, and trails committees
- OHV user groups
- Governor's Council of Balanced Resources

Natural System Modifications

Threats from actions that convert or degrade habitat in service of managing natural or semi-natural systems, often to improve human welfare.

Within this very broad category, two Level-2 threats were ranked as priorities: fire and fire suppression and dams and water management/use. Each has been given its own table and associated threat and action descriptions.

Fire and Fire Suppression

Table 37 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into several Level-3 threats, five of which have impacts above the low level. One of these, inappropriate fire frequency and intensity, was ranked as a priority.

Table 37. *Results of Threat Assessment of Priority Level-2 Threat, Fire and Fire Suppression*

LEVEL-3 THREAT: INAPPROPRIATE FIRE FREQUENCY AND INTENSITY	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**1**
Columbia spotted frog	–	–	1	

LEVEL-3 THREAT: INAPPROPRIATE FIRE FREQUENCY AND INTENSITY	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Aquatic Key Habitats				**2**
Saline Lakes/Great Salt Lake Ecosystem	–	1	–	
Streams and Rivers	–	1	–	
Birds				**19**
Band-tailed pigeon	1	–	–	
Bendire's thrasher	–	1	–	
Black-throated gray warbler	–	–	1	
Boreal owl	–	–	1	
Cassin's finch	–	1	–	
Evening grosbeak	–	1	–	
Flammulated owl	–	–	1	
Gray vireo	–	1	–	
Greater sage-grouse	1	–	–	
Lewis's woodpecker	–	1	–	
Loggerhead shrike	–	1	–	
Long-eared owl	–	–	1	
Olive-sided flycatcher	–	1	–	
Pine grosbeak	–	1	–	
Pinyon jay	–	1	–	
Red crossbill	–	1	–	
Sharp-tailed grouse	1	–	–	
Short-eared owl	–	–	1	
Williamson's sapsucker	–	–	1	
Fishes				**4**
Bluehead sucker	–	–	1	

LEVEL-3 THREAT: INAPPROPRIATE FIRE FREQUENCY AND INTENSITY	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Colorado River cutthroat trout	–	–	1	
Flannelmouth sucker	–	–	1	
Least chub	–	–	1	
Insects				**4**
Giant salmonfly	1	–	–	
Large marble butterfly	1	–	–	
Ruddy copper	–	1	–	
West Coast lady butterfly	1	–	–	
Mammals				**6**
Dark kangaroo mouse	–	1	–	
Hoary bat	–	–	1	
Kit fox	–	1	–	
Little brown bat	–	–	1	
Pygmy rabbit	–	1	–	
Townsend's big-eared bat	–	–	1	
Mollusks				**3**
Nuwuvi pyrg	–	–	1	
Pine Grove pyrg	–	1	–	
Santa Clara pyrg	–	–	1	
Plants				**8**
Arapien stickleaf	1	–	–	
Giant four-wing saltbush	–	–	1	
Gierisch's globemallow	1	–	–	
Goose Creek milkvetch	–	1	–	
Grouse Creek rockcress	–	1	–	

LEVEL-3 THREAT: INAPPROPRIATE FIRE FREQUENCY AND INTENSITY	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Guard milkvetch	–	1	–	
Paradox milkvetch	1	–	–	
Shivwits milkvetch	1	–	–	
Reptiles				**4**
Arizona mountain kingsnake (formerly pyro mountain kingsnake)	–	1	–	
Common chuckwalla	–	1	–	
Gila monster	1	–	–	
Midget faded rattlesnake	–	–	1	
Terrestrial Key Habitats				**11**
Aspen-Conifer	1	–	–	
Desert Grassland	–	1	–	
Lower Montane Mixed Conifer	–	1	–	
Lowland Sagebrush	1	–	–	
Mojave Desert Shrub	1	–	–	
Montane and Subalpine Conifer	–	1	–	
Mountain Sagebrush	–	–	1	
Mountain Shrub	–	–	1	
Riparian	–	1	–	
Salt Desert Shrub	–	1	–	
Subalpine Grassland	–	–	1	
Total	**14**	**27**	**21**	**62**

Threat: Inappropriate Fire Frequency and Intensity. This includes all cases of fire regimes that have been disrupted from their historical range of natural variation. Some habitats are now burning with greatly increased frequency. These tend to be lower-elevation deserts and shrublands, and the cause is most commonly the presence of a continuous bed of fine fuels, which readily ignites and carries fire across vast distances. Continuous fine-fuel beds leave no

unburned mosaics (as burned, native bunchgrasses would have) and allow fire to jump significant obstacles such as rivers and interstate highways. These unnatural fire patterns often burn with a sterilizing thermal intensity, generating heat sufficient to kill all native seed stored in the soil bed, and potentially impacting soil microbes and mycorrhizae, which are important for native soil and plant ecology. Siltation and other water quality issues pertaining to fire pose a significant threat to aquatic invertebrates, particularly freshwater mussel populations, which have been documented to suffer potential extirpation due to wildfire runoff (Lawrence et al. 2022).

Invasive, non-native annual grasses such as cheatgrass and red brome create these fine, continuous fuels. The most apparent landscape effects of increased lower-elevation fire frequency are a reduction in shrub and forb cover and an increase in the extent of areas dominated by annual grasses. These areas will remain at an ecological dead end until active restoration is conducted to restore habitat functions. Many wildlife and invertebrate species are negatively impacted by these landscape changes due to reductions in food and cover, while very few tolerate or benefit from the changes.

Other habitats are now burning with greatly decreased frequency. These tend to be mid- and high-elevation forests. The principal cause of less-frequent fire in upper-elevation landscapes was the suppression of almost every ignition under the "10 a.m. Policy" (in effect from 1935–1978), which decreed that every fire should be suppressed by 10 a.m. on the day after it was first spotted (Loveridge 1944). Another cause is policy requirements created or imposed upon local, state, and federal land fire management agencies. These policies have been implemented nationally through a highly effective interagency wildfire response system. This system has tremendous logistical and tactical capacities and is enabled by massive public expenditures; however, before 2002, when the Wildland Fire Leadership Council was created (USFS 2025), there was no coherent, national strategy for allowing some natural fire progression and no recognition of the risk, unsustainability, and unnaturalness of the degree of fuel accumulation that the wholesale use of this response and suppression system had caused. *The National Strategy: The Final Phase in the Development of the National Cohesive Wildland Fire Management Strategy* described its "vision for the next century: To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire" (Wildland Fire Leadership Council 2014).

A secondary cause of reduced fire frequency is land cover fragmentation caused by human developments such as reservoirs, subdivisions, and highways. Fragmentation facilitates fire suppression by preventing fires from burning as far as they once would have. Fragmentation

complicates and impedes use of prescribed fire by introducing numerous risks and complications to fire management.

The most apparent vegetative effect of decreased mid- and high-elevation fire frequency is a reduction in the area occupied by young stands of deciduous tree species and by shade-intolerant conifers, shrubs, and herbaceous plants. Concurrently, there has been an increase in the density and acreage of shade-tolerant and/or fire-intolerant conifer forests and an aging and eventual replacement of deciduous forests. As with excess low-elevation fire, many wildlife species are negatively impacted by the extensive landscape changes resulting from too infrequent mid- and high-elevation fire.

Another negative consequence of less-frequent fire at higher, more productive elevations is excessive fuel buildup, which can result in larger and hotter fires. When a fire ignites and suppression is not successful, it can be catastrophically damaging to various values and interests. Of particular concern are effects on aquatic ecosystems and developed water supplies, both of which can be destroyed by catastrophic floods and debris flows triggered by heavy rains following severe fire events.

Fire suppression is necessary in some circumstances to protect property and human life. The unmet need is to operationalize, at a multi-decadal and continental scale, a recognition that not every fire needs to be suppressed. Excessive fuel buildup prohibits simple reversion to a let-it-burn policy. The growing problem of catastrophic megafires can be solved by a systematic campaign of active restoration via mechanical fuel-reduction treatments and prescribed fire to safely return wildfire as a viable, natural, cost-effective means of maintaining necessary patterns of ecological succession across the landscape. The fire and land management policy environment will require significant change to enable this solution to occur.

Case Study: Prioritizing Fuels Treatments with Landscape Conservation Forecasting

In 2007, TNC, in collaboration with federal agencies and technology contractors, expanded the national LANDFIRE program's state-and-transition simulation models of reference vegetation to develop a planning tool known as Landscape Conservation Forecasting (LCF) (Low et al. 2010; Provencher et al. 2013; Provencher et al. 2021). LCF enhances the ecological health of large landscapes by assisting managers of national forests, national parks, BLM field offices, and private entities such as mining companies to identify cost-effective land management strategies. These strategies are designed to achieve the lowest ecological departure from reference condition, maximize ecological returns on investments, and optimize other stakeholders' priorities, such as wildlife habitat suitability and carbon stock-and-flow metrics.

The foundation of LCF consists of two primary maps: 1) the distribution of ecological systems (i.e., dominant vegetation types expected based on the physical environment); and 2) the current vegetation classes within each ecological system, categorized by succession, structure, and whether they align with or deviate from reference (pre-settlement) conditions.

Ecological integrity is assessed with various metrics, and the primary indicator is *ecological departure*. Ecological departure measures the differences between: 1) expected distribution of vegetation classes under reference conditions, and 2) the actual distribution of vegetation classes in the current landscape (Blankenship et al. 2015; Blankenship et al. 2021; Hann and Strom 2003; Provencher et al. 2024; Swaty et al. 2022). Although the goal is to guide management toward reducing this dissimilarity, achieving a perfect match with reference conditions may not be financially feasible.

LCF operates using computerized ecological state-and-transition simulation models (Daniel et al. 2016) that depict how each ecological system functions naturally and in response to human management. These models simulate the effects of natural disturbance (e.g., fire) and human activities (e.g., cattle grazing) on vegetation dynamics over time. Each management action is associated with a known cost per unit area and success/failure rates derived from experts' knowledge and literature (Provencher et al. 2021). The complexity of these simulations can be enhanced by incorporating spatial climate time series, and factors such as topography, wind direction lightning strike data, land management constraints, and equipment availability (Daniel et al. 2016; Provencher et al. 2021).

Once maps, models, and metrics are established, TNC collaborates with agency staff and stakeholders to evaluate outcomes of various management strategies over medium- to long-range periods (typically 20 or 50 years). The principal focus is on reducing vegetation classes with excessive acreages, such as overabundant native or uncharacteristic classes, while increasing those that are underrepresented with the goal of aligning more closely with the refence conditions.

Model outputs are primarily expressed in terms of predicted ecological departure and can be compared to scenarios in which no active management occurs. This comparison quantifies the improvements in ecological integrity resulting from active management versus minimal management approaches. Additionally, vegetation dynamics over time can be analyzed to deepen the understanding of ecological responses to different treatments.

The benefits of active management, as predicted by simulations, include healthier vegetation conditions and reduced risks of large, high-severity wildfires, which threaten wildlife and

infrastructure. The cost of achieving these benefits is also reported, allowing for an evaluation of the cost effectiveness of management actions over 10- or 50-year periods. The Ecological Return on Investment (E-ROI) metric, developed by TNC, quantifies this cost effectiveness by calculating the difference in ecological departure between active and custodial (control) scenarios multiplied by the size of the ecological system and divided by the total cost of management (Low et al. 2010; Provencher et al. 2013). Comparing E-ROI values across different management scenarios provides a standardized measure to guide decision making. Although selecting actions with the highest E-ROI is generally recommended, other considerations, such as public safety through hazardous fuel reduction, may influence final management decisions.

To date, approximately 20 large-scale LCF applications have been completed or are underway, primarily in Nevada, eastern California, and Utah. Each new LCF project builds on previous implementations and incorporates scientific advancements and innovations. As LCF projects are completed across the Intermountain West, they collectively contribute to large-scale planning efforts aimed at improving ecological health across the region.

Essential Conservation Actions to Address this Threat

Objective #1 for Inappropriate Fire Frequency and Intensity

Fire is suppressed in habitats that are now prone to large and destructive fires that impact native vegetation; habitats are being actively managed (i.e., treated) to reduce components or factors that promote risk of catastrophic fire, such as cheatgrass, excessive conifer encroachment, or unnaturally large stands of mature Gambel oak.

Potential Indicators of Success Reaching this Objective

- Many land and resource management agencies are conducting long-range planning to identify where and when to implement fuel-reduction treatments aimed at invasive annual grasses and pervasive conifer encroachment, among other treatments.
- The distribution of vegetation classes in susceptible habitats is becoming more similar to (less departed from) their natural reference distribution, especially due to reduction of uncharacteristic, annual-grass-dominated classes.
- Annual acreage treated for fuels reduction is adequate and appropriate.
- Treatment unit sizes are appropriate for the habitat type and its natural disturbance regime.

Potential Conservation Actions

CODE	ACTION
1.1.1	Conduct mechanical control of invasive or problematic species.
1.1.2	Conduct chemical control of invasive or problematic species.
1.1.3	Conduct biological control of invasive or problematic species.
1.1.3	Conduct fuels reduction through targeted grazing.
1.1.6	Address fire ignition points to minimize the risk of unintended fire starts.
1.1.6	Establish or enhance fuel breaks in locations that are susceptible to large or intense fires.
1.1.6	Conduct upland vegetation treatments to restore characteristic upland vegetation and reduce uncharacteristic fuel types and loadings.
1.1.6	Conduct riparian vegetation treatments to restore characteristic riparian vegetation and reduce uncharacteristic fuel types and loadings.
1.1.6	Conduct better fire suppression in habitats and locations that are susceptible to damage from fire that now would be too frequent or intense.
1.1.6	Conduct post-fire rehabilitation.
1.1.8	Close areas, roads, or trails during times of severe fire danger.
1.2.2	Mimic natural burn disturbance regimes with prescribed fires that promote diverse native vegetation and nesting availability for ground-nesting bees, rodents, and reptiles (i.e., burn only small sections at a time, mow firebreaks and leave fire skips, and avoid high-intensity fires).
1.2.2	Rotate applications of prescribed fires in a specific area every 3 to 6 years, review location and timing of recent fires, and conduct burns between October and December to minimize impacts to native and sensitive pollinator communities.
2.2.1	Increase cover and extent of native riparian vegetation by restoring beavers to the landscape where social and environmental factors permit (see USU's Beaver Restoration Assessment Tool [USU 2025b]).
3.1.1	Develop and implement mass-media communication and outreach messages.
5.2.1	Increase the volume and diversity of native seed and plant stock available for rehabilitation or restoration.
5.2.1	Continue to require mufflers with approved spark arresters on all OHVs.
6.4.2	Use grass banking to promote forage supply reliability in anticipation of more vegetation treatments and wildlife.
7.2.3	Support the WRI.

CODE	ACTION
8.1.1	Conduct pre-burn surveys for vegetation and pollinator communities, especially SGCN bumble bees, butterflies, their host plants, and floral resources.
9.1.2	Include fire ecology in all levels of school curricula.
9.2.2	Provide training opportunities to professional staff, partners, and stakeholders.

Likely Authorities, Stakeholders, and/or Partners

- USFS
- BLM
- NPS
- FFSL
- WRI
- Utah Division of Water Resources (DWRe)
- Conservation NGOs

Objective #2 for Inappropriate Fire Frequency and Intensity

Fire is returned to habitats from which it had been unnaturally suppressed; the fire regime (frequency and intensity) in these habitats generally approximates a natural, pre-settlement regime.

Potential Indicators of Success Reaching this Objective

- Policies mandating immediate suppression of all natural ignitions are modified to enable and promote managed wildland fire where it would be beneficial to habitats.
- Public attitudes toward the use of managed and prescribed fire are shifting from concern and opposition to tolerance and acceptance.
- Many land and resource management agencies are conducting long-range planning to identify where and when to implement fire and fire-surrogate treatments.
- The distribution of age and structure classes in affected habitats is becoming more similar to (less departed from) their natural reference distribution; generally, acres of older and/or denser classes are being converted back to more open younger classes or being assisted in succession to more open older classes.
- Annual acreage treated for fuels reduction is adequate and appropriate.

- Treatment unit sizes are appropriate for the habitat type and its natural disturbance regime.

Potential Conservation Actions

CODE	ACTION
1.1.6	Conduct upland vegetation treatments to restore characteristic upland vegetation and reduce uncharacteristic fuel types and loadings.
1.1.6	Conduct riparian vegetation treatments to restore characteristic riparian vegetation and reduce uncharacteristic fuel types and loadings.
1.1.6	Apply or allow more fire in habitats and locations where fire was historically more frequent or intense.
3.1.1	Develop and implement mass-media communication and outreach messages.
6.4.2	Use grass banking to promote forage supply reliability in anticipation of more vegetation treatments and wildfire.
7.2.2	Increase the use of stewardship contracting on BLM-administered and USFS lands.
9.1.2	Include fire ecology in all levels of school curricula.
9.2.2	Provide training opportunities to professional staff, partners, and stakeholders.

Likely Authorities, Stakeholders, and/or Partners

- USFS
- BLM
- NPS
- FFSL
- WRI
- DWRe
- Conservation NGOs

Dams and Water Management/Use

Table 38 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into numerous Level-3 threats, 12 of which have impacts above the low level. Six of these were ranked as priorities: presence of diversions,

dam/reservoir operation, channelization/bank alteration (direct, intentional), groundwater pumping, agricultural/municipal/industrial water usage, and water allocation policies.

Table 38. *Results of Threat Assessment of Priority Level-2 Threat, Dams and Water Management/Use*

LEVEL-3 THREAT: PRESENCE OF DIVERSIONS, DAM/RESERVOIR OPERATION, CHANNELIZATION/ BANK ALTERATION (DIRECT, INTENTIONAL), GROUNDWATER PUMPING, AGRICULTURAL/ MUNICIPAL/INDUSTRIAL WATER USAGE, AND WATER ALLOCATION POLICIES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**9**
Arizona toad	1	–	–	
Columbia spotted frog	–	1	1	
Northern leopard frog	–	3	–	
Western toad	–	–	3	
Aquatic Key Habitats				**19**
Lakes and Reservoirs	2	2	–	
Saline Lakes/Great Salt Lake Ecosystem	4	–	–	
Springs	1	1	–	
Streams and Rivers	3	2	–	
Wetlands	–	3	1	
Birds				**6**
Snowy plover	–	1	1	
White-faced ibis	–	1	1	
Wilson's phalarope	–	1	1	
Fishes				**29**
Bluehead sucker	3	2	–	
Desert sucker	1	–	–	
Flannelmouth sucker	2	3	–	
Green sucker	–	3	1	
June sucker	–	1	3	

LEVEL-3 THREAT: PRESENCE OF DIVERSIONS, DAM/RESERVOIR OPERATION, CHANNELIZATION/ BANK ALTERATION (DIRECT, INTENTIONAL), GROUNDWATER PUMPING, AGRICULTURAL/ MUNICIPAL/INDUSTRIAL WATER USAGE, AND WATER ALLOCATION POLICIES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Least chub	–	3	–	
Virgin River chub	3	–	–	
Virgin spinedace	1	–	–	
Woundfin	3	–	–	
Insects				**6**
Brine fly	3	–	–	
Giant salmonfly	–	1	–	
Nokomis/Silverspot butterfly	1	–	–	
Utah wood-nymph	–	–	1	
Mollusks				**14**
Bear Lake springsnail	–	–	3	
Creeping ancylid	–	–	1	
Desert tryonia	–	–	3	
Fat-whorled pondsnail	–	2	–	
Lindahl's pyrg	–	–	1	
Santa Clara pyrg	–	–	1	
Western pearlshell	–	–	1	
Winged floater	–	–	1	
Wrinkled marshsnail	–	1	–	
Plants				**7**
Autumn buttercup	3	–	–	–
Mesic milkvetch	1	–	–	–
Sunnyside green-gentian	–	1	–	–
Ute ladies'-tresses	1	–	–	–

LEVEL-3 THREAT: PRESENCE OF DIVERSIONS, DAM/RESERVOIR OPERATION, CHANNELIZATION/ BANK ALTERATION (DIRECT, INTENTIONAL), GROUNDWATER PUMPING, AGRICULTURAL/ MUNICIPAL/INDUSTRIAL WATER USAGE, AND WATER ALLOCATION POLICIES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Wheeler's angelica	1	–	–	–
Terrestrial Key Habitats				**7**
Desert Shrub	–	–	1	–
Riparian	2	3	–	–
Salt Desert Shrub	–	–	1	–
Total	**36**	**35**	**26**	**97**

Note: This Level-2 threat has more than one priority Level-3 threat; consequently, some threat impacts have a score larger than one.

The threat of dams and water management/use includes diversions and withdrawal of both surface and groundwater from natural systems. This is a broad-scale threat that encompasses multiple methods of water use and means of extraction. Utah receives an average of 33 centimeters (13 inches) of rain per year, making it one of the most arid states in the nation (Sowby 2024). Statewide, residential water use averages approximately 242 gallons of water per person, per day (O'Donoghue 2018), making Utah one of the highest water users in the country.

To provide sufficient water supply to Utah's human population, a complex network of dams, diversions, canals, wells, and pipelines has been built to store and supply water to meet agricultural, municipal, and industrial needs. As Utah's population grows, conservation of water will become increasingly important to ensure sufficient water for human use as well as for healthy wildlife and habitats.

DWR's stake in water conservation is that water is essential for all wildlife. This is most obviously a need for fish and rivers, but all wildlife and all habitats rely on water. DWR has worked with many partners on water-related issues. This has been accomplished through endangered species recovery programs, conservation agreements, water rights regulations, stream alteration permits, water acquisition, and many other processes.

Many of the priority UWAP threats are not clearly bounded, simple, or linear with respect to cause and effect. The threat of dams and water management/use exemplifies this challenge. To present and address the water-related problems facing species and habitats as cleanly and simply as possible, actions have been organized in the following way:

- Actions related to dams and diversions will focus on correcting barriers to fish movement and other mechanisms of habitat and population fragmentation.
- Actions related to water use will focus on retaining or acquiring water to sustain the habitat at critical times.
- Actions related to dam and reservoir operation and sediment transport imbalance will focus on maintaining or restoring appropriate temperature and sediment regimes and timing of flows.

To minimize repeating the same objectives and actions multiple times, actions are mostly listed under just one threat (though it would not be incorrect to list them under multiple threat categories). For example, the action of removing a diversion (listed under Level-3 threat 7.2.2 Presence of Diversions), would affect fish movement, but it could also affect the amount, and thus temperature, of water in the system; therefore, it could also qualify as an action under dam/reservoir operation. Changing the amount of water in a stream affects a stream's capacity to transport sediment; therefore, removing a diversion could also qualify as an action under dam/reservoir operation.

Managers who are planning projects in streams or rivers to address one specific threat should examine the actions under all dams and water management/use Level-3 threat categories to determine if actions identified under other threats could help address their threat and improve their project.

The case studies and objectives for more specific Level-3 threats discussed below provide examples of cases where DWR and partners have worked together to address specific threats. This collaboration has allowed for the development of more comprehensive approaches to identify and prioritize threats and actions on a broader scale. Comprehensive, watershed-scale management and restoration plans were first developed for the Weber River (USU 2014) and San Rafael River (Laub et. al. 2013), and community watershed groups have been established in many other locations. The Weber and San Rafael Rivers are examples of two very different rivers and watersheds (with different outlets, levels of development, degree and kind of fishing interest and pressure, native species communities, etc.); however, these two plans were both developed in close consultation with local stakeholders to identify native species' needs and broadly acceptable, yet still specific, goals and objectives. These plans discuss all the Level-3 threats discussed below as well as additional watershed-specific threats that are not statewide priorities but are very important locally. They also pull together information known about the watershed and species needs, fishing pressure, agricultural and municipal water needs, and other information specific to each watershed. With this information and buy-in from the local

stakeholders, the working groups can prioritize efficient work areas where threats can be addressed most effectively. These watershed-scale plans were the model upon which additional plans have been developed.

Threat: Presence of Diversions. Dams and water diversions are a broad category of structures that can remove water from a stream and/or create a physical impediment to the movement and passage (upstream or downstream) of fish, sediment, and coarse woody debris. Even small water diversions can completely fragment a previously intact natural system that depends on migratory movement of fishes. Some diversions also have design features that may entrain or entrap fish in canals, or otherwise remove them from the natural channel, so that a potentially significant portion of the breeding population is lost through annual water management actions. Some diversions have been abandoned and are falling into disrepair. Although these diversions are no longer actively used to remove water from a stream, they often still present a bidirectional impediment to fish passage and may also restrict the downstream movement of sediment or coarse woody debris, both of which are fundamentally important in aquatic ecology.

This threat, like all the threats nested within dams and water management/use, disproportionately impacts aquatic species and their habitats. Aquatic species represent 70% of the SGCN targets with medium, high, or very high impacts from this threat.

Effective conservation of water for both humans and wildlife demands careful monitoring of the subsequent effects of water control, including thermal, hydrologic, and sedimentary alteration of waterways downstream of dams and diversion structures. Aquatic invertebrate SGCNs are particularly vulnerable to alterations in waterways from diversion and dam presence. One such species is the giant salmonfly, a keystone species that provides a vital prey and nutrient base for native aquatic and terrestrial species across multiple trophic levels (Lecerf and Richardson 2011; Walters et al. 2018) such as native fish, migratory birds, and other insectivores. Changes in host fish migration and general presence of host fish due to water diversions and dams are also significant threats for freshwater mussel SGCNs (Vaughn and Taylor 1999) such as western pearlshell and winged floater.

Water diversion structures are much smaller than dams and are typically more widely distributed throughout a watershed. Although a single dam may have a greater negative impact to wildlife than a single diversion, diversions are vastly more numerous and widely distributed and have the potential to cause a greater scope of impact for many species. Diversions tend to be less permanent structures than dams, and there are frequent opportunities across the landscape to influence how and when they are built, removed, or renovated.

Although DWRe records both dams and diversions, they have not been fully mapped in relation to their impact to fish passage. UWAP partners are beginning to do this in some watersheds. For example, diversions and other fish barriers have been mapped in the Weber River watershed (Thompson and Burnett 2019) (Figure 56).

This map highlights the diversity, abundance, and extent of diversions in this watershed and was created for prioritizing which diversions most urgently need to be altered to permit fish passage. This type of mapping still needs to occur for many other Utah watersheds. All new diversions on fish-bearing streams should be made passable to the desirable aquatic species that are present or planned for reintroduction; however, water diversion structures are already abundant in the landscape and retrofitting them for fish passage is generally very costly. Therefore, assessment and prioritization of existing diversions for fish passage retrofitting—whether diversions are abandoned or still in operation—needs to occur. Recently, the Barrier Assessment and Implementation Tool (BAIT) has been developed to standardize the process to evaluate instream structures to determine their level of impact to fish passage. BAIT will allow UWAP partners to address this threat in a consistent manner.

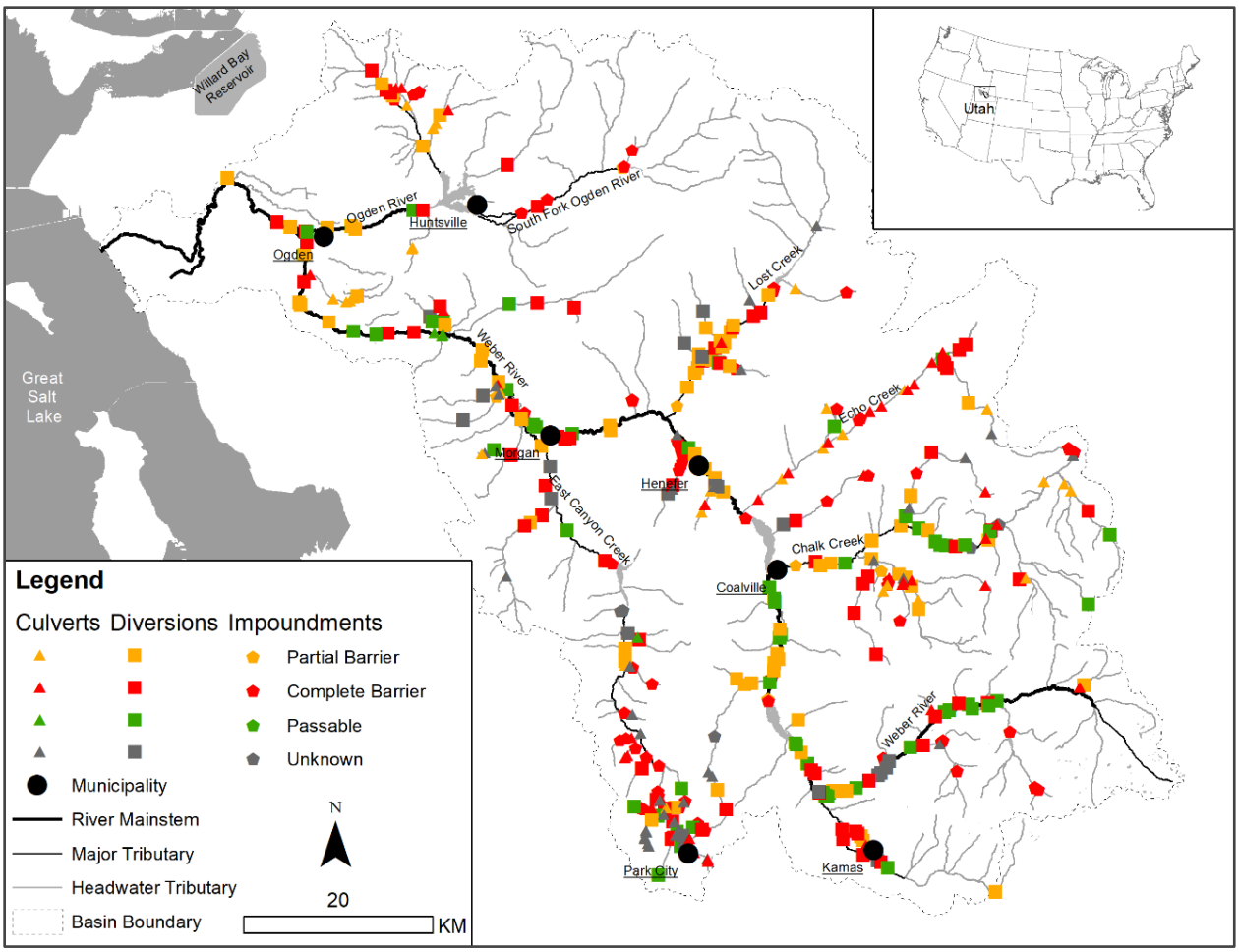


Figure 56. *Presence of Diversions and Other Barriers to Fish Passage, Weber River Basin, Utah*

Case Study: Fish Management in the Weber River

Much of the Weber River in northern Utah is a Blue Ribbon fishery (DWR 2025b) because this river contains healthy populations of large brown trout. Other fish of interest in the Weber River are native BCT and green sucker, which is an SGCN. At least one population of BCT in the Weber River provides an important and popular local fishery and expresses a fluvial life history during which mainstem individuals grow large and migrate into small tributaries for spawning; the fluvial life history strategy has been lost to all but a few BCT populations. Green suckers occur in the mainstem of the Weber River, where they travel 20 kilometers (12.4 miles) between spawning and overwintering habitats. Water and water management has been identified in the UWAP as the most pervasive threat to aquatic SGCNs and their habitats, and this is especially true in the Weber River. The habitat for BCT and green suckers has been fragmented by more than 300 barriers; most of these barriers are from irrigation diversions, but some are from road and utility crossings (Thompson and Burnett 2019) (see Figure 56).

In 2010, DWR and Trout Unlimited began undertaking barrier removal in the Weber River for native fish as a priority conservation action. Initially, the effort to reconnect habitat was slow and the lack of relationships with stakeholders such as water users, government agencies, private landowners, and utility companies was hampering progress with habitat reconnection. New barriers were being built at a faster rate than barriers were being removed. To build these relationships, a steering committee, composed of Utah agencies working in the Weber River watershed, was formed to secure a small grant, hire a consulting firm, organize stakeholder meetings to identify broad stakeholder priorities, and write a watershed plan (USU 2014) that ultimately identified BCT and green sucker as priority conservation targets. The watershed plan and subsequent stakeholder meetings developed a framework for the Weber River Partnership. This partnership holds an annual symposium where larger watershed issues are discussed. The symposium has provided a platform where fisheries managers have been able to tell the story of these two SGCN and the importance of habitat connectivity (Thompson and Burnett 2019).

Through collaborative relationships with nontraditional partners, the relevance of fisheries in the Weber River has been realized. Further relevance to the watershed is evidenced by the development of a wide range of on-the-ground actions. Fish passage has been re-established at multiple mainstem Weber River diversions and with most fluvial BCT spawning tributaries. Largely due to good data and a newly formed partnership with PacifiCorp, a large, multimillion-dollar fish ladder is scheduled to be built in 2026 as part of a Federal Energy Regulatory Commission relicensing project at a small hydroelectric dam in Weber Canyon. Additional projects are in various stages of development, and water users continue to contact fishery managers to discuss irrigation diversion reconstruction projects that incorporate fish passage (Thompson and Burnett 2019).

Essential Conservation Actions to Address this Threat

Objective #1 for Presence of Diversions

Native fish can move past water diversion barriers where needed or desired to allow fulfillment of necessary life cycles.

Potential Indicators of Success Reaching this Objective

- Water districts and irrigation companies work with DWR and other wildlife stakeholders to design, construct, or reconstruct irrigation diversion to allow upstream and downstream SGCN movement at priority barriers and minimize entrainment in irrigation ditches.
- Number of diversions removed or made passable for fish.

- Increased miles of connected or accessible habitat.
- Number of diversion intakes having screens or other technology to prevent or reduce fish entrainment.
- Repeated, site-specific monitoring of aquatic macroinvertebrate communities that demonstrates improved ecosystem health (e.g., clean and oxygenated water, sufficient shelter substrates, adequate food sources, cold water temperatures), and stable populations of keystone species (e.g., stoneflies, caddisflies, mayflies).

Potential Conservation Actions

CODE	ACTION
1.2.1-3	Establish nurseries, refuge populations, and hatcheries to support management.
1.2.2	Identify priority abiotic habitat restoration sites for stream flow, stream temperature, and sediment buildup.
2.1.1	Develop a list of priority reintroduction species and locations in diverted, segmented, or otherwise ecologically impaired reaches of rivers and streams.
2.1.6	Create selective fish passage structures at priority barriers.
2.1.6	Remove undesired instream barriers or consolidate multiple barriers where feasible.
2.1.3	Restore natural water flows where possible to promote abundance and diversity of aquatic macroinvertebrates as important food sources for fish, aerial insectivores, and amphibians.
7.2.3	Prioritize fish passage and/or screening at existing diversions in coordination with priorities of water users and other partners.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including Utah Division of Water Rights (DWRi), DWRe, and DWR)
- NRCS
- USFS
- BLM
- Utah Department of Environmental Quality and Utah Division of Water Quality
- NPS
- U.S. Army Corp of Engineers
- U.S. Bureau of Reclamation
- NRCS
- USFWS

- Conservation NGOs
- Local conservation districts (private landowners: ranchers, farmers, diverters, working lands)
- Utah watershed councils
- Developers
- Water conservancy districts and irrigation companies
- City and county stakeholders
- Universities

Threat: Dam/Reservoir Operation. One significant and ongoing impact of dams is the alteration of the timing and magnitude of the natural hydrograph. Many fish species rely on natural flow patterns for key life history events. For example, the rising limb of the hydrograph caused by snowmelt runoff often triggers spawning movements and leads to seasonal flooding of floodplains and backwaters, which provide essential rearing habitats for juvenile fish species.

Dams also substantially affect water temperature and downstream sediment transport. By trapping the majority of stream sediment, dams contribute to the degradation and downcutting of downstream channels, often causing more extensive habitat loss than the upstream impoundment itself. These changes can severely limit native species' ability to grow and survive in these altered conditions and simultaneously create favorable conditions for non-native cold water predatory fish, which can severely impact juvenile native fish densities. Deposition of fine sediment downstream of dams and diversions can cause significant reproductive and recruitment failure in freshwater mussels (Williams and Searles Mazzacano 2022).

Water storage for agriculture and municipal use remains a critical need for communities that depend on these resources. In some cases, DWR and partners have successfully collaborated with water users and dam managers to purchase or lease water and adjust water release schedules to better mimic a more natural hydrograph while still fulfilling essential water supply needs. With GSL reaching a record low level of 1,276.7 m (4,188.5 feet) in November 2022, the State of Utah has enacted additional water conservation measures and purchased or leased water rights for the lake. As water continues to be allocated throughout the GSL watershed, new opportunities may emerge to time water releases in ways that benefit stream ecosystems.

Case Study: Identifying Functional Flows for the Great Salt Lake Basin

California has developed functional flows for many of their river basins (California Environmental Flows Technical Team 2021). This approach characterizes and quantifies stream

flow targets that are ecologically critical to the support and maintenance of habitat, water quality, and aquatic life. Functional flows are essentially the stream flow needed by stream reach to maintain functional river processes that maintain water quality and healthy fisheries. The development of functional flows for the GSL basin was funded through the *Great Salt Lake Basin Integrated Plan* (DWRe 2024).

There are many competing interests for water in the GSL basin. Ideally, the timing and magnitude of water deliveries to GSL also would maximize water quality, habitat, and aquatic life in upstream tributaries. The appropriate magnitude, timing, and rate of change of flow to maintain or restore these benefits, however, has yet to be determined. Functional flows represent distinct aspects of the annual stream flow hydrograph that sustain ecological, geomorphic, or biogeochemical functions and that support the life history and habitat needs of aquatic biota. The functional flow metrics are not directly linked to individual or specific organisms or groups but are associated with specific biological and ecosystem processes (Yarnell et al. 2020). Functional flows are characterized using a suite of flow metrics calculated at reference stream flow gages. These flow metrics can be used to help establish flow-based conservation objectives for GSL basin streams and wetlands. Delivering water to GSL can also support upstream water quality and aquatic life uses for multiple ecosystem benefits. Generating reach-scale estimates of natural functional flows for all streams in the GSL basin will quantify ecosystem water demands and enable deliveries and tradeoffs with human water uses to be modeled. This provides needed information to develop more efficient and effective restoration strategies in degraded waterbodies. Understanding the ecological functions of stream flow along a longitudinal gradient from streams to rivers to wetlands to the lake will help identify locations throughout the basin where altering the timing or quantity of water delivery can improve ecological conditions. Finally, functional flows will be evaluated for wet, moderate, and dry year conditions so that water and other natural resource managers can take advantage of wet years or mitigate adverse effects in dry years (Anderegg et al. 2023). Functional flow metrics will provide critical input about how limited water supplies can be more effectively managed to be ecologically protective (Null et al. 2022).

The Functional Flow Project will support stakeholders by developing functional flows for Utah's GSL basin. To support the *Great Salt Lake Basin Integrated Plan* (DWRe 2024), the Functional Flow Project will provide tools and data sets to 1) identify key functional flows and associated ecological indicators, 2) develop a geodatabase of reach-scale natural functional flow metric predictions, and 3) provide a library of regional flow-ecology relationships. Future applications of the Functional Flow Project include evaluating hydromodification from functional flows and evaluating water management alternatives for delivering functional flows. Applying a functional

flows framework will enable stakeholders to estimate the nature and extent of ecological modifications resulting from hydrologic alterations and make recommendations about flows that would most benefit GSL basin rivers, streams, wetlands, and the lake itself.

Essential Conservation Actions to Address this Threat

Objective #1 for Dam/Reservoir Operation

Natural hydrographs (e.g., timing, duration, temperature) are restored or mimicked in priority stream reaches below dams and reservoirs.

Potential Indicators of Success Reaching this Objective

- Water temperatures are appropriate.
- Sediment transport regime is sufficient to maintain essential downstream habitats.
- The downstream hydrograph is sufficient to promote suitable habitat conditions and characteristics that allow for the complete life cycle of the target SGCNs.
- Demographically adequate fish reproduction and recruitment are occurring.
- Decreased frequency of dewatered systems.
- Stable or increasing water levels in GSL.

Objective #2 for Dam/Reservoir Operation

Opportunities are found and taken to modify or remove reservoir infrastructure or modify outflow management to simulate or return natural sediment transport.

Potential Indicators of Success Reaching this Objective

- Working to restore a more natural hydrograph (spring peak) is part of reaching sediment balance.
- Sediment transport supports natural ecology or sufficiently promotes native species reproduction.
- Rewetting drained wetlands creates a supply of permanent artificial lentic pools, that support diverse and abundant aquatic macroinvertebrate communities and contribute to habitat value of these restored ecosystems.
- Build new or retrofit old dams with proven features designed to pass sediment.
- Work with water users and reservoir operators to shepherd water in larger pulses to mobilize sediment and transport.

- Work with water users and reservoir operators to remove (and pass) sediment from reservoirs where loss of storage due to sediment input is a concern.

Objective #3 for Dam/Reservoir Operation

Aquatic invasive species are restricted in distribution to the locations they occupy in 2025.

Potential Indicators of Success Reaching this Objective

- Avoid unintentional promotion or spread of existing invasive and problematic species through unrelated actions.
- Avoid the spread of existing diseases and pathogens or establishment of new diseases and pathogens through education, planning, management, and/or regulation.
- Conduct targeted predator management and/or screen outflows to prevent escapement from fisheries.
- Allocate more enforcement resources to illegal species introductions.

Potential Conservation Actions

CODE	ACTION
1.2.2	Mimic or restore the natural hydrograph to promote natural channel and aquatic characteristics and site-appropriate riparian vegetation.
1.2.2	Work with water users and reservoir operators to remove (and pass) sediment from reservoirs.
1.2.2	Identify priority abiotic habitat restoration sites for stream flow, stream temperature, and sedimentation.
1.2.3	Find opportunities through water purchase or lease or flexibility within water delivery to meet functional flow needs that will maintain healthy fisheries and water quality.
1.2.3	Modify dam operations where feasible to mimic or restore processes and conditions favorable to relevant SGCNs and aquatic habitats.
2.1.1	Screen reservoirs to prevent or limit predator escapement from fisheries.
3.1.3	Reduce the spread of aquatic invasive species.
4.2.1	Enforce aquatic invasive species violations.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, Utah Geological Survey [UGS], and DWR)
- Utah Department of Environmental Quality (including the Utah Division of Water Quality)
- Utah Reclamation Mitigation and Conservation Commission

- Water conservancy districts and irrigation companies
- U.S. Bureau of Reclamation
- U.S. Army Corps of Engineers
- NRCS
- USFS
- BLM
- NPS
- USFWS
- Universities
- Conservation NGOs, including fishing groups
- Tribal nations

Threat: Channelization/Bank Alteration (direct, intentional). This threat is one of the most significant to the Streams and Rivers Key Habitat, affecting a wide range of taxa and habitats; however, the overall impact is generally lower than other water use threats, because no taxa or habitats have been assigned a very high impact rating. Fish are the most affected taxonomic group, with 43% of all medium, high, and very high water-related threats impacting them. Many fish species rely on complex habitats—such as oxbows, pools, side channels, and backwaters—to meet essential life stage requirements, including temperature regulation, food availability, cover, and water quality conditions. Channelization and bank alteration have also been shown to reduce habitat viability for keystone aquatic invertebrate species (Birrell et al. 2019).

Channelization and bank alteration projects are commonly implemented for flood control, water delivery facilitation, and the protection of homes, roads, land, and other resources. However, these modifications often reduce essential habitat complexity, making it more challenging for many species to forage, evade predators, seek refuge from high or fast flows, and successfully reach adulthood. Additionally, terrestrial SGCNs are also affected, because these alterations degrade or eliminate riparian areas: critical habitats on which more than 75% of bird species in Utah partially or entirely depend (Norvell et al. 2005). Riparian zones also provide vital roosting and foraging habitat for bats.

Although stream alteration permits are now required for such projects, many waterways have already been significantly degraded due to past activities. Stream alteration permits can be denied or modified based on potential impacts to species, but managers are not always consulted, and the permitting agency may not always be aware of species-specific concerns.

Although flood control and resource protection remain necessary, these projects must be approached more holistically to support healthy wildlife populations and habitats and prevent future listings under the ESA. Improved coordination between permitting agencies and wildlife managers is critical to achieving these goals.

Case Study: The Provo River Delta

June sucker, an ESA-listed species recently downlisted from endangered to threatened, is endemic to Utah Lake. This species primarily relies on the tributaries to Utah Lake for spawning in May to June. Historically, June sucker larvae would drift down into deltas at the interface of the river and lake where they would experience cover for predator avoidance and warmer temperatures that resulted in abundant food and conditions conducive to fast growth. These delta habitats were completely lost over time due to channelization of the rivers to accommodate growing development.

Approximately 80% of the annual June sucker spawning migration occurs in the Provo River, Utah Lake's largest tributary. Dredging and channelization transformed the lower reaches of the Provo River into a deep, cold canal with minimal cover. Although abundant June sucker larvae would drift down into this habitat each year, recruitment was essentially zero because of these habitat conditions. The Provo River Delta Project was initiated by the June Sucker Recovery Implementation Program (JSRIP) (2024), led by the Utah Reclamation, Mitigation, and Conservation Commission to create complex delta habitat to promote June sucker recruitment (Utah Reclamation, Mitigation, and Conservation Commission et al. 2025a).



Provo River Delta. Photograph by UtahByAir, Utah County, 2024.

The delta project officially broke ground on June 11, 2020 (Utah Reclamation, Mitigation, and Conservation Commission et al. 2025b), and the next 3 years were mostly spent excavating a system of braided channels and wetland ponds in 260 acres of acquired agricultural land just north of the original Provo River channel. Major revegetation efforts followed construction each fall, with stewardship activities taking place throughout the year to cultivate and protect plantings.

In 2022, the north end of Skipper Bay Dike, which was initially constructed in the 1940s to keep Utah Lake from flooding the area, was lowered (JSRIP 2022), and four outlet channels were

constructed through the lowered dike (JSRIP 2023a). This reconnected the lake with historical Skipper Bay, allowing Utah Lake to expand eastward toward its historical shoreline. On March 2, 2023, the Provo River was diverted from a point just downstream of Lakeshore Bridge into the newly constructed delta (JSRIP 2023b). The river eventually made its way through the delta and new outlet channels into Utah Lake over the next week.

In the first June sucker spawning event after the river was diverted, a near record number of June suckers migrated through the new delta into the Provo River. Nearly 6,300 tagged June suckers were detected entering the delta, from April 1 through July 12; however, because only a small portion of adult June suckers were tagged, the total number that entered the delta is likely five to 10 times greater. DWR is monitoring the delta and during the first few years, juvenile June sucker have been documented.

Essential Conservation Actions to Address this Threat

Objective #1 for Channelization/Bank Alteration (direct, intentional)

Complex habitats and floodplain connections are restored or maintained in selected rivers/streams.

Potential Indicators of Success Reaching this Objective

- Reduction in artificially channelized or straightened stream miles.
- When making decisions on stream alteration permits, DWRe solicits and, when feasible, incorporates suggestions from DWR and other agencies or organizations with natural resource management or wildlife conservation interests.
- When planning emergency watershed protection projects, the NRCS coordinates with DWR to ensure those projects are not being planned with objectives in conflict with the purposes of a restoration project carried out in the same location or negatively impacts stream processes.
- Maintain ecologically relevant flow regimes that support healthy habitat conditions required for diverse aquatic macroinvertebrate communities (as a key food source for aquatic and riparian wildlife).
- Private landowners are encouraged to consider the downstream impacts from a single stream alteration permit project and make better voluntary decisions on projects permitted through the process, reducing erosion and incursion into the floodplain downstream.

Potential Conservation Actions

CODE	ACTION
1.1.6	Restore floodplain connectivity.
1.2.2	Develop a list of priority locations for restoration of habitats and natural processes.
1.2.2	Identify priority habitat restoration sites for stream flow, stream temperature, and sedimentation.
1.2.3	Restore aquatic habitat complexity (both structural and biological).
2.1.3	Restore functional water flows where possible to promote abundance and diversity of aquatic macroinvertebrates as important food sources for fish, aerial insectivores, and amphibians.
2.2.1	Increase cover and extent of native riparian vegetation by restoring beavers to the landscape where social and environmental factors permit (see USU's Beaver Restoration Assessment Tool [USU 2025b]).
6.1.2	Establish candidate conservation agreements or similar tools for mutually beneficial solutions.
6.4.2	Develop a list of priority locations for resource and habitat protection and identify refugia to protect sensitive aquatic macroinvertebrates from future disturbance.
7.1.3	Pursue mitigation measures for stream alteration projects.
7.1.3	Work with landowners requesting stream alteration permits to voluntarily improve their project design or plans; ultimately decline permits that debilitate the floodplain and downstream habitat.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, UGS, and DWR)
- NRCS
- USFS
- BLM
- NPS
- Conservation NGOs
- Homeowners' associations near channelized streams (e.g., upper Weber River, Cottonwood Creek, Ogden Valley)
- Developers
- Landowners
- City and county stakeholders

Threat: Groundwater Pumping. As Utah's population continues to grow, additional water resources will be needed. Some groundwater resources have been used for decades, and others have been developed more recently. DWRi has created groundwater management plans (DWRi 2025) for areas throughout Utah to promote wise use of the groundwater, protect existing water rights, and address water quality issues and over-appropriation of groundwater. The creation, requirements, management, purpose, and effects of these plans are explained in Section 73-5-15 of the Utah State code. UGS monitors groundwater levels and conditions that DWRi relies upon for these management plans (UGS 2024f).

Many UWAP aquatic key habitats rely on groundwater, and some will be lost if groundwater levels continue to decline. Wetland habitats in Utah's west desert are especially reliant on groundwater; these habitats contain multiple mollusk and amphibian SGCNs and are the habitats that all remaining extant least chub rely upon.

Case Study: Snake Valley Hydrologic Monitoring

Spring and wetland complexes in the Snake Valley of western Utah provide critical habitats for several SGCNs, including Columbia spotted frog, least chub, and several mollusk species. All are fully aquatic and depend on spring-fed, perennial pools or rills for refuge from temperature extremes, droughts, low oxygen levels, and protection from predators (Arkle and Pilliod 2015; Sáenz 2014). Additionally, least chub and Columbia spotted frog depend on shallow, seasonally flooded areas with dense vegetation (Grover 2019; Hovingh 1993) for spawning and larval development. The extent and quality of these refuge and spawning habitats within the Snake Valley wetlands depend on surface water extent, which in turn depends on surrounding groundwater levels (Grover 2019). Declining groundwater levels 1) reduce the amount of suitable refuge or spawning habitats, 2) limit the duration of seasonal flooding impacting the development of Columbia spotted frog and least chub larvae, and 3) isolate and fragment populations (Goodwin et al. 2021; Grover 2019).

In 2009, the UGS established a monitoring network of 55 shallow wells (0.9–1.8 m [3.0–6.0 feet] deep), 68 deeper wells (3.1–45.7 m [10.0–150.0 feet] deep), and five spring gages to collect water level and other hydrologic data throughout Snake Valley. The primary purpose of this monitoring project is to provide baseline data on the magnitude and timing of surface water and groundwater fluctuations in wetlands crucial to SGCNs. Initially conceived in response to a now-withdrawn groundwater pumping project proposed by the Southern Nevada Water Authority, local applications for increased groundwater pumping continue, and groundwater levels in monitoring wells near Garrison, Utah, have declined by 0.06 to 1.83 m (0.20–0.60 feet) per year since the mid-1990s (Hurlow and Inkenbrandt 2016). Based on these measured water level

declines and anecdotal evidence of SGCN habitat decline in Snake Valley wetlands, biologists and other stakeholders have identified a clear need for continued monitoring. Water level monitoring serves as proxy habitat monitoring, providing biologists with a quantitative data set, including more locations and observations than would be feasible through a typical field effort. This quantitative data set can be used to identify long-term trends, plan and measure habitat improvement success, and justify management or water rights protests.

UGS, DWR, and the BLM have collected considerable hydrologic and species data in wetland complexes throughout Snake Valley over the past 15 years. In 2021, UGS published a 10-year summary report evaluating 10-year trends in water levels for individual wells and whole wetland complexes (Goodwin et al. 2021). From 2010 to 2021, the wetland complexes with largest significantly declining trends were in southern Snake Valley (nearest to areas with dense irrigated agriculture) at Big Springs and Burbank Meadows, with trends of -0.025 and -0.029 m (-0.082 and -0.096 feet) per year, respectively (Goodwin et al. 2021). Over the same 2010 to 2021 time period, 10-year trends at Leland-Harris, Bishop Springs, and Gandy Salt Marsh wetland complexes were either insignificant or too contradictory to reliably estimate long-term trends across the entire complex; however, 15-year trends (2009–2023) calculated from early spring readings at deeper wells (3–8 m [10–25 feet]) located near source springheads for Leland-Harris, Bishop Springs, and Gandy Salt Marsh identify declining water levels at rates of -0.012, 0.012, and -0.027 m (-0.04, -0.04, and -0.09 feet) per year, respectively (UGS 2025). UGS continues to collect hydrologic data in Snake Valley and provides current water level data and 15-year trends for deeper wells in the Utah Groundwater Data Hub (UGS 2025).

Essential Conservation Actions to Address this Threat

Objective #1 for Groundwater Pumping

Groundwater pumping is adequately managed and monitored to provide sustainable water for all uses, including maintenance of UWAP key habitats and the SGCNs that rely upon them.

Potential Indicators of Success Reaching this Objective

- UWAP key habitats that rely upon groundwater persist into the future.
- Groundwater levels monitored by UGS are adequate to provide DWRi with information necessary to manage groundwater and update groundwater management plans.
- Unique UWAP key habitats (e.g., desert wetlands) that are primarily groundwater-dependent are adequately considered in groundwater management decisions.

Potential Conservation Actions

CODE	ACTION
1.2.2	Improve groundwater levels through conservation and/or managed aquifer recharge projects.
6.1.2	Establish candidate conservation agreements or similar tools for mutually beneficial solutions toward groundwater protection.
6.4.2	Develop a list of priority groundwater-dependent locations for resource and habitat protection.
7.2.3	Within DNR divisions, maintain regular communication and wildlife consideration regarding groundwater management needs.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, UGS, and DWR)
- NRCS
- UFBF
- USFS
- BLM
- Conservation NGOs
- Landowners

Threat: Agricultural/Municipal/Industrial Water Usage. This is the main driver for all the dams and water management/use threats. All people need water, and society has created a legal framework and a physical delivery system that prioritizes getting water to people. The result is surface water ecosystems that no longer function naturally in terms of water and sediment transport regimes or as fish and wildlife habitat. In addition, groundwater-dependent aquatic ecosystems often no longer provide the conditions necessary for the species that historically occurred there, due to reductions in spring discharge and stream baseflows because of groundwater pumping. Organic pollution from agricultural water usage can also contribute to hypoxia in oxygen-sensitive aquatic invertebrate species (Frakes et al. 2021), which reduces ecological viability for native aquatic species.

This threat is also directly tied to the threat of water allocation policies, which was seen in the UWAP threat assessment as an enabling factor affecting numerous SGCNs and key habitats in all areas of the state. The threat assessment implicates water policy, and the heavy use it permits, in complete dewatering of some stream systems, a pervasive state of diminished flows and levels, and consequent widespread habitat loss and fragmentation. The alteration of flow

regimes is responsible for several extirpations of prey species for native trout and migratory birds occurring in the lower Blacksmith Fork and Spanish Fork Rivers and possibly the Provo River. Future extirpations from dewatering are likely if trends continue (Birrell et al. 2019; Frakes et al. 2021).

Case Study: Coordinating Water Deliveries to Achieve Fish Passage and Maintain Fish Habitat

On the lower Duchesne River, the Central Utah Water Conservancy District, DWR, irrigators, and water user groups coordinate to ensure the delivery of instream flows targeted to achieve fish passage requirements and maintain habitat. This same collection of partners also completed a candidate conservation agreement with an assurances/safe harbor agreement to provide regulatory assurances to landowners and water users prior to the recent restoration of fish passage around the Myton Diversion, which allows fish access to an additional 32 kilometers (20 miles) of riverine habitat.

Essential Conservation Actions to Address this Threat

Objective #1 for Agricultural/Municipal/Industrial Water Use

Aquatic key habitats (especially at those locations important for SGCNs) contain sufficient water to maintain a functioning aquatic ecosystem that supports the conservation target(s).

Potential Indicators of Success Reaching this Objective

- Implement the functional flows framework for the GSL basin streams.
- Develop and implement functional flows for the remainder of Utah beyond the GSL basin.
- Water flows mimic natural conditions.
- Water quality is sufficient to maintain ecosystem health.
- Quantity and timing of flows, groundwater inputs, and surface water levels are appropriate for the aquatic system.
- Healthy aquatic ecosystems (invertebrates, native fish, etc.).
- All age classes of the native fish community are represented.
- Stable or increasing water levels in GSL.

Potential Conservation Actions

CODE	ACTION
1.2.3	Establish monitoring systems for stream flow, stream temperature, and/or groundwater level (as appropriate) in key areas.
1.2.3	Determine functional flow requirements for relevant SGCNs and aquatic habitats.
5.2.1	Develop public information and educational programs aimed at encouraging attitudes and behaviors that are positive for wildlife conservation.
5.2.2	Encourage water managers to implement functional flows framework for GSL basin streams.
6.1.2	Establish candidate conservation agreements or similar tools for mutually beneficial solutions.
6.2.1	Use water leasing programs to provide instream flow.
6.2.2	Acquire water rights from willing sellers to hold instream flow.
6.4.2	Develop a list of priority areas that pose high risk to SGCNs or aquatic habitats from surface or groundwater development where maintaining or enhancing flows or groundwater levels is needed.
7.1.3	Engage with water management authorities and water user groups to find flexibility within existing water laws, policies, and operations for meeting wildlife conservation objectives (e.g., implement functional flows).

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, UGS, FFSL, DWR, and Division of State Parks)
- Utah Department of Environmental Quality
- Conservation NGOs
- Water conservation districts and irrigation canals
- Landowners
- Watershed councils
- Water right owners
- Water conservation groups and consulting firms
- Water user groups
- U.S. Bureau of Reclamation
- U.S. Department of the Interior
- USFWS

Threat: Water Allocation Policies. In Utah, the right to use water is based on the prior appropriations doctrine, which originated in the 1870s. A core principle of this doctrine is that rights are conditional on beneficial use (i.e., agricultural, industrial, or urban). For over a century, maintaining ecosystem services or values was not considered a beneficial use of water, and attempts to do so could result in loss of water rights.

In 1986, the Utah State Legislature passed a bill enabling DWR and the Division of State Parks to acquire and hold instream flow rights under certain circumstances. Although the statutory definition of *beneficial use* remained unchanged, as a practical matter, state agencies began recognizing the beneficial use of instream flows for specific environmental or recreational purposes.

The 1986 law was amended in 2008 and 2013 to allow private, nonprofit fishing groups to lease water to protect or restore stream flows for three native trout taxa. This is an area where there are still great needs, but some progress has been made by working with owners of water rights and state and federal regulations to find mutually beneficial solutions.

Most recently, in 2022, the Utah State Legislature passed House Bill 33 (Instream Water Flow Amendments), which included FFSL as an entity that can hold environmental water rights. Most significantly, this bill recognized instream flow or environmental water as a beneficial use and allows private water right holders to work with one of the three DNR divisions to modify or change their water right beneficial use to instream or environmental purposes. Prior to this legislation, the seniority of water rights was lost if the beneficial use of a water right was changed to instream flow or environmental purposes, but now the water right retains its original priority date, which ensures the water right will provide the environmental benefits that are intended.

Many SGCNs and key habitats are impacted by water allocation policies; however, the worst-affected SGCN are the fish, with 43% of all the medium, high, or very high impacts.

Case Study: Acquiring Instream Flow to Sustain the Habitat of Multiple Species of Greatest Conservation Need

The least chub was a candidate for federal listing under the ESA until August 2014, when the USFWS made the decision to remove the species from candidate status. Many actions (implemented under a candidate conservation agreement) supported the USFWS's decision, including the acquisition of an instream flow for the largest existing population of the species at the Bishop Springs Wetland Complex in western Utah's Snake Valley.

A small spring-fed reservoir is the primary water supply for Bishop Springs Wetland Complex, which also supports populations of Columbia spotted frog and northern leopard frog, which are SGCNs in Utah. A single property owner had water rights associated with this reservoir for agricultural purposes. When the landowner exercised these water rights, up to two-thirds of the wetland complex was dewatered, resulting in the mortality of thousands of least chub as well as impacts to Columbia spotted frog. DWR worked closely with the landowner and USFWS to develop a candidate conservation agreement with assurances that allowed for DWR to purchase and install infrastructure to convert the inefficient flood irrigation operation into a more efficient pressurized irrigation system in return for the landowner agreeing to supply the saved water for least chub. Through this agreement, the landowner also received assurances from the USFWS that if least chub were federally listed in the future, the landowner would not be required to take additional conservation measures on this property. In October 2008, the Utah State Engineer approved an exchange application and granted an instream flow to DWR for the Bishop Springs Wetland Complex.

Essential Conservation Actions to Address this Threat

Objective #1 for Water Allocation Policies

Enabling conditions (i.e., laws and policies) to exist for a broader array of agencies or conservation organizations to hold instream water rights for the benefit of aquatic habitats and SGCNs.

Potential Indicators of Success Reaching this Objective

- Conservation agencies and NGOs have active and regular engagement with state water authorities to discuss options for achieving species and habitat conservation objectives.
- Agencies and NGOs are aware of and use all instream flow authorities for which they are already eligible.
- Agencies and NGOs inventory and communicate any necessary instream flow authorities for which they are not yet eligible.

Objective #2 for Water Allocation Policies

Aquatic key habitats (especially those with occurrences of SGCNs) contain sufficient water to maintain a functioning aquatic ecosystem that supports the conservation target(s).

Potential Indicators of Success Reaching this Objective

- Water distribution considers functional flow targets.
- Quantity and timing of flows are appropriate for the aquatic system.
- All age classes of the native fish community are represented.

- Stable or increasing water levels in GSL.

Potential Conservation Actions

CODE	ACTION
1.2.3	Establish monitoring systems for stream flow, stream temperature, and/or groundwater level (as appropriate) in key areas.
1.2.3	Determine functional flow requirements for relevant SGCNs and aquatic habitats.
6.1.2	Establish candidate conservation agreements or similar tools for mutually beneficial solutions.
6.2.1	Use water leasing or banking programs to provide instream flow and provide water to GSL.
6.2.2	Acquire water rights from willing sellers to hold instream flow and provide water to GSL.
6.4.2	Develop a list of priority areas that pose high risk to SGCNs or aquatic habitats from surface or groundwater development where maintaining or enhancing flows or groundwater levels is needed.
7.1.3	Engage with water management authorities and water user groups to find flexibility within existing water laws, policies, and operations for meeting wildlife conservation objectives (e.g., implement functional flows).

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, UGS, FFSL, DWR, and Division of State Parks)
- Conservation NGOs
- Local conservation districts
- Private landowners
- Watershed councils
- Water conservation groups and consulting firms
- Water user groups

Invasive and Problematic Species, Pathogens, and Genes

Threats from non-native and native plants, animals, pathogens or microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance or virulence.

Within this broad category, two Level-2 threats were ranked as priorities: invasive non-native/alien plants and animals and problematic native plants and animals. Each has been given its own table.

Invasive Non-Native/Alien Plants and Animals

Table 39 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into numerous Level-3 threats, three of which have impacts above the low level. Two of these were ranked as priorities: invasive wildlife species (non-native) and invasive plant species (non-native).

Table 39. *Results of Threat Assessment of Priority Level-2 Threat, Invasive Non-Native/Alien Plants and Animals*

LEVEL-3 THREAT: INVASIVE WILDLIFE SPECIES (NON-NATIVE), INVASIVE PLANT SPECIES (NON-NATIVE)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**6**
Arizona toad	–	2	–	
Columbia spotted frog	2	–	–	
Northern leopard frog	–	–	1	
Western toad	–	–	1	
Aquatic Key Habitats				**7**
Lakes and Reservoirs	–	–	2	
Saline Lakes/Great Salt Lake Ecosystem	–	2	–	
Springs	–	–	1	
Streams and Rivers	–	1	–	
Wetlands	–	–	1	
Birds				**16**
Band-tailed pigeon	–	1	1	
Bendire's thrasher	–	1	–	
Black-throated gray warbler	–	–	1	
Gray vireo	–	–	1	
Greater sage-grouse	2	–	–	
Loggerhead shrike	–	1	–	

LEVEL-3 THREAT: INVASIVE WILDLIFE SPECIES (NON-NATIVE), INVASIVE PLANT SPECIES (NON-NATIVE)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Long-eared owl	–	–	1	
Pinyon jay	–	–	1	
Sharp-tailed grouse	2	–	–	
Short-eared owl	–	–	1	
Snowy plover	–	1	–	
White-faced ibis	–	1	–	
Wilson's phalarope	–	1	–	
Fishes				**17**
Bluehead sucker	2	–	–	
Colorado River cutthroat trout	2	–	–	
Desert sucker	–	2	–	
Flannelmouth sucker	1	–	1	
June sucker	1	–	1	
Least chub	–	1	–	
Virgin River chub	–	2	–	
Virgin spinedace	–	2	–	
Woundfin	–	2	–	
Insects				**1**
Large marble butterfly	–	1	–	
Mammals				**8**
Dark kangaroo mouse	–	1	–	
Kit fox	–	1	–	
Little brown bat	–	–	1	
Pygmy rabbit	–	–	2	
Spotted bat	–	–	1	

LEVEL-3 THREAT: INVASIVE WILDLIFE SPECIES (NON-NATIVE), INVASIVE PLANT SPECIES (NON-NATIVE)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Townsend's big-eared bat	–	–	1	
Utah prairie dog	–	–	1	
Mollusks				**5**
Bear lake springsnail	–	–	1	
Desert springsnail	–	1	–	
Desert tryonia	–	–	1	
Fat-whorled pondsnail	–	–	1	
Wrinkled marshsnail	–	–	1	
Plants				**67**
Ann Kelsey's milkvetch	1	–	–	
Arapien stickleaf	1	–	–	
Argyle Canyon phacelia	1	–	–	
Autumn buttercup	1	–	–	
Bear River Range beardtongue	–	1	–	
Beaver Mountain groundsel	–	1	–	
Ben's beardtongue	1	–	–	
Burke's whitlow-grass	–	1	–	
Canyonlands lomatium	–	–	1	
Cisco milkvetch	1	–	–	
Clay phacelia	1	–	–	
Creeping draba	–	1	–	
Cronquist daisy	–	–	1	
Deep Creek stickseed	–	–	2	
Despain pincushion cactus	1	–		
Frank Smith's violet	–	–	2	

LEVEL-3 THREAT: INVASIVE WILDLIFE SPECIES (NON-NATIVE), INVASIVE PLANT SPECIES (NON-NATIVE)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Frisco buckwheat	1	–	–	
Frisco Mountains mustard	–	1	–	
Garrett bladderpod	–	1	–	
Giant four-wing saltbush	–	–	1	
Gibben's beardtongue	–	–	1	
Gierisch's globemallow	1	–	–	
Goodrich’s cleomella	–	1	–	
Goose Creek milkvetch	–	1	–	
Grouse Creek rockcress	–	1	–	
Hamilton's milkvetch	–	1	–	
Holmgren cinquefoil	–	–	1	
Horse Canyon stickleaf	–	1	–	
Horseshoe milkvetch	–	1	–	
Huber's pepperplant	–	1	–	
Ibex buckwheat	–	1	–	
Idaho penstemon	–	1	–	
La Sal daisy	–	1	–	
La Sal Mountains’ groundsel	–	1	–	
Last Chance townsendia	1	–	–	
Lost Creek buckwheat	1	–	–	
Maguire’s primrose	–	1	–	
Maguire’s whitlow-grass	–	2	–	
Mount Belknap draba	–	1	–	
Mt. Naomi musineon	–	1	–	
Narrow-leaf evening primrose	–	1	–	

LEVEL-3 THREAT: INVASIVE WILDLIFE SPECIES (NON-NATIVE), INVASIVE PLANT SPECIES (NON-NATIVE)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Navajo sedge	1	–	–	
Ostler peppergrass	1	–	–	
Ostler's ivesia	1	–	–	
Paradox milkvetch	1	–	–	
Pariette cactus	1	–	–	
Pavement phacelia	1	–	–	
Pennell’s draba	–	–	1	
Pinyon penstemon	–	1	–	
Purple-spined hedgehog cactus	1	–	–	
Rydberg's musineon	–	1	–	
Shivwits milkvetch	1	–	–	
Sigurd Easter daisy	–	1	–	
Stage Station milkvetch	1	–	–	
Thompson’s flameflower	–	1	–	
Uinta Basin hookless cactus	1	–	–	
Uinta Mountains draba	–	1	–	
Untermann's daisy	–	1	–	
Utah ivesia	–	1	–	
Utah phacelia	–	1	–	
Ute ladies'-tresses	1	–	–	
Wheeler's angelica	2	–	–	
Wright fishhook cactus	1	–	–	
Reptiles				**3**
Common chuckwalla	1	–	–	
Gila monster	1	–	–	

LEVEL-3 THREAT: INVASIVE WILDLIFE SPECIES (NON-NATIVE), INVASIVE PLANT SPECIES (NON-NATIVE)	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Mojave desert tortoise	1	–	–	
Terrestrial Key Habitats				**9**
Desert Grassland	–	1	–	
Desert Shrub	–	–	1	
Lower Montane Mixed Conifer	–	–	1	
Lowland Sagebrush	1	–	–	
Mojave Desert Shrub	1	–	–	
Mountain Sagebrush	–	–	1	
Mountain Shrub	–	–	1	
Riparian	–	1	–	
Salt Desert Shrub	–	1	–	
Total	**43**	**58**	**38**	**139**

Note: This Level-2 threat has more than one priority Level-3 threat; consequently, some threat impacts have a score larger than one.

Threat: Invasive Wildlife Species (non-native). Invasive non-native animals are a significant threat to many of Utah's ecosystems. Not all non-native (introduced) species are considered invasive. Some species have been intentionally and legally introduced to support hunting and sport fishing and, when properly managed, their impacts to native species and habitat can be minimized. A species is classified as invasive when it becomes dominant over one or more desirable species or significantly alters key environmental aspects such as water flow, community composition, or disease transmission. In addition to their economic and occasional human health consequences, invasive species disrupt ecological systems through various mechanisms, including direct predation and competition for resources. Although the specific impacts may vary, UWAP objectives and management actions remain largely consistent across different invasion scenarios.

The management approach for an invasive species—whether prevention, eradication, or suppression—depends on the stage of its introduction. Invasive species can enter ecosystems through various pathways. Some introductions are deliberate and legal but have unintended ecological consequences. Others result from illegal activities, such as the unauthorized transfer of live sport fish between waterbodies or the release of exotic species imported through the pet

trade, including American bullfrogs, velvet longhorned beetles, and apple snails (Lockwood et al. 2019). Many introductions occur unintentionally, often through passive transport, as seen in the spread of quagga mussels, Japanese beetles, and red imported fire ants. In some cases, the mode of introduction remains unknown.

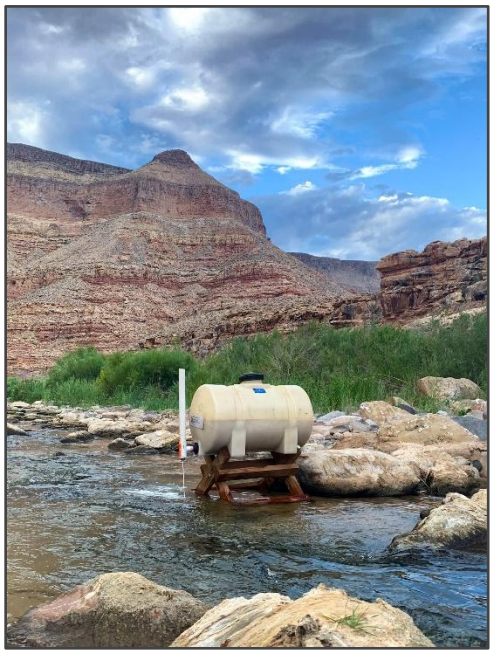
Identifying the source of introduction is crucial for implementing effective management strategies. Once an invasive species is established, control and removal efforts depend on factors such as the affected habitat (e.g., type of waterbody) its connectivity to other susceptible habitats (e.g., tributaries, corridors) the presence of native species, and the feasibility of suppression or eradication measures.

Invasive species control can pose environmental risks. Methods such as insecticide applications can harm non-target native species if not carefully applied, disrupting food webs and affecting other beneficial organisms. Mechanical removal and improper handling of invasive species during removal can disrupt habitat structure and unintentionally facilitate their further spread to new areas. Choosing control strategies that specifically target the invasive species while minimizing harm to native organisms and their habitat, combining multiple methods that maximize effectiveness and reduce reliance on any single method (such as integrated pest management), and regularly monitoring the impact of control efforts on both invasive and native species can inform adaptive management as needed.

Case Study: Eradicating Invasive Fishes from the Virgin River

Eradication of red shiner has been the primary goal for Virgin River native fish recovery in Utah for more than three decades. Between 1996 and 2021, chemical treatment phases were designed to effectively eradicate red shiner from the Virgin River in Utah. Problem reaches were partitioned into manageable units, and eradication phases were implemented in succession between fish barriers with each phase repeated until 100% red shiner eradication was achieved. Phased chemical treatments successfully eradicated red shiner from the Virgin River in Utah in 2021, when the final phase was successfully completed between the Stateline Barrier in Utah and the Virgin River Gorge Barrier in Arizona.

Although the eradication of red shiner from Utah is a significant achievement, it is imperative to continue distribution monitoring, barrier function and maintenance, and downstream eradication to prevent recolonization and facilitate native fish population response. The successful treatment of the Virgin River in Utah provides a buffer between red shiner–free reaches (upstream of Stateline Barrier) and occupied reaches (downstream of Virgin River Gorge Barrier), greatly reducing the likelihood that red shiner will recolonize the Virgin River in Utah. The eradication of red shiner will aid in the expansion of viable populations of woundfin and Virgin River chub, but it is imperative to maintain a buffer reach that is free of red shiner as well as continuing downstream eradication efforts to continue to support recovery of these endangered native fish.



Virgin River Treatment. Photograph by Washington County Field Office, DWR, Washington County, 2021.

Prevention is often cheaper and more effective than either eradication or suppression. Therefore, due to the ongoing threat of recolonization and illegal introductions, intensive early detection monitoring has been implemented biannually to evaluate the status of red shiner in the Virgin River Basin in Utah. Early detection monitoring in 2024 confirmed red shiner are not present in the Virgin River Basin in Utah.

Essential Conservation Actions to Address this Threat

Objective #1 for Invasive Wildlife Species (non-native)

Additional invasive wildlife species are not established.

Objective #2 for Invasive Wildlife Species (non-native)

Invasive non-native wildlife species are removed or controlled through functional eradication or their adverse impacts are reduced in priority habitats or locations.

Potential Indicators of Success Reaching these Objectives

- Public messages and policies are in place to aggressively manage the risk of introductions.
- Native species are occurring, reproducing, and recruiting.

Potential Conservation Actions

CODE	ACTION
1.1.1	Conduct mechanical control of invasive and problematic species.
1.1.2	Conduct chemical control of invasive and problematic species.
2.1.1	Establish a team to prioritize management of invasive and problematic species.
2.1.1	Contain established populations of invasive and problematic species.
2.1.2	Maintain the trend of increased use of sterile non-native sportfish.
2.1.7	Avoid unintentional promotion or spread of existing invasive and problematic species through unrelated actions.
3.1.3	Avoid establishment of new invasive and problematic species through education, planning, management, and/or regulation.
9.2.3	Develop public information and educational programs aimed at encouraging attitudes and behaviors that are positive for wildlife conservation.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, FFSL, DWR, and Division of Outdoor Recreation)
- USFS
- BLM
- Conservation NGOs

Threat: Invasive Plant Species (non-native). Non-native plants that dominate vegetation communities can significantly alter the composition, structure, and function of habitats. In particular, their spread can degrade native biodiversity, reduce soil stability, and disrupt hydrological processes. Additionally, the dominance of invasive plants can fundamentally alter ecological processes such as fire or flood regimes, accelerating the decline or even local extinction of SGCNs. Beyond their ecological impacts, invasive plants also impose economic burdens by increasing agricultural production costs, reducing crop quality, depleting water and fertilizer resources, and heightening wildfire risks.

Many invasive plant species were initially introduced for beneficial purposes, such as erosion control, windbreaks, or ornamental landscaping, but have since spread uncontrollably, threatening Utah's waterways and ecosystems. For example, tamarisk (or saltcedar), a deciduous shrub originally planted to control erosion along river corridors in the Southwest, is now widespread across Utah's floodplains, stream courses, salt flats, marshes, and irrigation

ditches. This species consumes large amounts of water, provides little value to wildlife, increases fire frequency, and disrupts biodiversity and riparian hydrology, creating significant ecological and management challenges. Other invasive species, such as periwinkle and bermudagrass, remain commercially available for landscaping despite their aggressive growth and harmful impacts to native ecosystems.

Certain land use practices unintentionally facilitate the spread of invasive plants by creating disturbances that suppress native biological communities and provide open ecological space for invasion. For example, livestock grazing and road development have contributed to the spread of cheatgrass by eliminating native bunchgrasses and damaging biological soil crusts. As a result, cheatgrass has proliferated across vast areas of the West, monopolizing water and nutrients, altering soil chemistry, and outcompeting native vegetation. It has become the dominant ground cover in many of Utah's sagebrush ecosystems (Molvar et al. 2024). When these practices are recognized as facilitating the spread of invasive plants and practices are altered, the threat is greatly diminished. For example, targeted livestock grazing can be used to manage cheatgrass (Mosely 2018).

Many other invasive plant species continue to spread through various means, making invasive plant management a persistent challenge. Local, state, and federal agencies maintain lists of invasive plants and provide resources for identification and control efforts. In some cases, invasive plants are classified as noxious weeds and are subject to regulatory control measures.

Case Study: Managing Tamarisk to Improve Hydrological Function and Habitat Complexity

The San Rafael River is a tributary of the Green River in southeastern Utah. In some stretches it still supports several SGCNs and key habitats, but viewed as a whole, it is a severely degraded river system. There are multiple factors that have led to the current state, including dams and diversions, water withdrawals, altered flow regime, and invasions by non-native plant and animal species. For much of its length, the San Rafael River resembles a ditch, with little connection between the river and the floodplain and little resemblance to the dynamic, perennial desert river it once was.

The BLM, DWR, and USU developed a restoration plan for the San Rafael River that addresses many of these issues at the watershed scale (Laub et al. 2013). Initial phases of implementation have focused on tamarisk removal on DWR property.

Tamarisk dominance on the San Rafael River has created a vicious cycle by trapping sediment along the river's banks, causing them to rise. This leads to channel incision and narrowing, which leads to further entrapment of the river within its banks and disconnection from its floodplain. The goals of tamarisk removal on the San Rafael River were to increase channel movement laterally, increase instream habitat complexity, recover native vegetation, and increase hydrologic connectivity of the river to its floodplain.



Tamarisk Removal. Photograph by Dan Keller, DWR, Emery County, 2012.

DWR began whole-tree and root-wad removal on the San Rafael River in 2009. Tamarisk was piled and left for future burning. In 2011, a very high snowpack led to a sustained springtime flood, where the river connected with the floodplain. Tamarisk piles were mobilized by the river and moved off the floodplain and back into the channel, enhancing lateral scour and creating habitat complexity. Pools and backwaters were formed, and the channel was able to erode some of its levee-like banks (Keller et al. 2014). By 2012, significant natural recruitment of native vegetation also was occurring.

This fortunate timing of a natural flood following the mechanical vegetation removal highlighted which methods were most effective for achieving the project goals and provided insights into how human-made floods might be employed to accelerate habitat restoration. This knowledge will be applied to future phases of this project, increasing the efficiency and effectiveness of the San Rafael River Restoration Plan as it is implemented up- and downstream of DWR-administered reaches.

Essential Conservation Actions to Address this Threat

Objective #1 for Invasive Plant Species (non-native)

Locations and habitats that currently do not have non-native plant problems remain free from the introduction and spread of invasive non-native plants.

Potential Indicators of Success Reaching this Objective

- Sufficient acres of habitats susceptible to invasion are monitored, and if necessary, treated annually.
- Size and arrangement of fuel breaks are adequate to deter the spread of unwanted fires.

- Acreage of weed-dominated, uncharacteristic vegetation classes in habitats remains stable or declines.

Potential Conservation Actions

CODE	ACTION
1.1.6	Address fire ignition points to minimize the risk of unintended fire starts.
1.1.6	Establish or enhance fuel breaks in locations that are susceptible to large or intense fires.
1.1.6	Mimic or restore the natural hydrograph to promote natural channel and aquatic characteristics and site-appropriate riparian vegetation.
1.1.6	Restore floodplain connectivity.
1.1.6	Conduct better fire suppression in habitats and locations that are susceptible to damage from fire that now would be too frequent or intense.
1.1.8	Close areas, roads, or trails during times of severe fire danger.
2.1.1	Survey and inventory established and new populations of invasive and problematic species.
2.1.1	Eradicate established populations of invasive and problematic species.
2.1.1	Contain established populations of invasive and problematic species.
2.2.1	Increase cover and extent of native riparian vegetation by restoring beavers on the landscape where social and environmental factors permit (see USU's Beaver Restoration Assessment Tool [USU 2025b]).
3.1.1	Avoid establishment of new invasive and problematic species through education, planning, management, and/or regulation.
4.1.2	Support ongoing efforts to reduce illegal OHV use to prevent resource damage and the spread of invasive and problematic plant species.
5.2.1	Continue to require mufflers with approved spark arresters on all OHVs.
5.2.3	Apply weed-free regulations to commercial and recreational transport of plant materials where applicable.
5.2.3	Maintain the trend of decreased use of aggressive non-native perennial seed.
9.2.3	Develop public information and educational programs aimed at encouraging attitudes and behaviors that are positive for wildlife conservation.
9.2.3	Use public/private partnerships to educate outdoor recreationists on the need and methods to decontaminate recreational gear (e.g., waders, boats, caving gear, OHVs) to prevent the spread of invasive and problematic species and/or pathogens.

Likely Authorities, Stakeholders, and/or Partners

- USFS
- BLM
- NPS
- DNR (including FFSL, DWR, Division of State Parks, and Division of Outdoor Recreation)
- WRI
- NRCS
- UDAF
- UFBF
- Cooperative weed management areas
- Local governments
- University extensions

Objective #2 for Invasive Plant Species (non-native)

Invasive plant dominance or presence is reduced or eliminated in locations or habitats where such an outcome is realistic (ecologically and economically).

Potential Indicators of Success Reaching this Objective

- Many land and resource management agencies are conducting long-range planning to identify where and when to implement treatment projects aimed at reducing invasive plant species.
- The distribution of vegetation classes in susceptible habitats is becoming more similar to (less departed from) their natural reference distribution, specifically due to reduction of uncharacteristic invasive plant–dominated classes.
- Annual acreage treated by chemical, biological, or mechanical means is adequate and appropriate.
- Treatment patch size is appropriate.

Potential Conservation Actions

CODE	ACTION
1.1.1	Conduct mechanical control of invasive and problematic species.
1.1.2	Conduct chemical control of invasive and problematic species.

CODE	ACTION
1.1.3	Conduct biological control of invasive and problematic species.
1.1.6	Conduct post-fire rehabilitation.
2.1.1	Survey and inventory established and new populations of invasive and problematic species.
2.1.1	Eradicate established populations of invasive and problematic species.
2.1.1	Conduct upland vegetation treatments to restore characteristic upland vegetation and reduce uncharacteristic fuel types and loadings.
2.1.1	Conduct riparian vegetation treatments to restore characteristic riparian vegetation and reduce uncharacteristic fuel types and loadings.
6.4.2	Use grass banking to promote forage supply reliability in anticipation of more vegetation treatments and wildfire.
7.2.3	Support the use of and inclusion of current information in WRI.

Likely Authorities, Stakeholders, and/or Partners

- USFS
- BLM
- NPS
- DNR (including FFSL, DWR, Division of State Parks, and Division of Outdoor Recreation)
- WRI
- NRCS
- UDAF
- UFBF
- Conservation NGOs

Problematic Native Plants and Animals

Table 40 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into numerous Level-3 threats, seven of which have impacts above the low level. Two of these were ranked as a priority: natural rarity and small isolated populations.

Table 40. *Results of Threat Assessment of Priority Level-2 Threat, Problematic Native Plants and Animals*

LEVEL-3 THREATS: NATURAL RARITY AND SMALL ISOLATED POPULATIONS	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**2**
Western toad	–	1	1	
Birds				**7**
Band-tailed pigeon	2	–	–	
Bendire's thrasher	–	–	2	
Greater sage-grouse	1	–	–	
Sharp-tailed grouse	2	–	–	
Fishes				**9**
Bluehead sucker	–	–	2	
Colorado River cutthroat trout	–	1	–	
Flannelmouth sucker	–	–	2	
June sucker	–	–	1	
Least chub	–	1	–	
Woundfin	2	–	–	
Insects				**7**
Coral Pink Sand Dunes tiger beetle	–	2	–	
Ruddy copper	–	1	–	
Suckley's cuckoo bumble bee	1	–	–	
Tanner's black camel cricket/Sand treader	–	2	–	
Utah wood-nymph	1	–	–	
Mammals				**4**
American pika	–	–	1	
Black-footed ferret	1	–	–	
Wolverine	–	1	1	

LEVEL-3 THREATS: NATURAL RARITY AND SMALL ISOLATED POPULATIONS	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Mollusks				**20**
Bear Lake springsnail	–	–	1	
Desert springsnail	–	2	–	
Fat-whorled pondsnail	–	1	–	
Galba techella	–	2	–	
Lindahl's pyrg	–	–	1	
Mountain marshsnail	–	–	2	
Nuwuvi pyrg	–	2	–	
Pine Grove pyrg	–	–	1	
Prairie fossaria	–	–	2	
Rocky Mountain duskysnail	–	–	2	
Santa Clara pyrg	–	2	–	
Western pearlshell	–	–	1	
Wet-rock physa	–	–	1	
Reptiles				**2**
Arizona mountain kingsnake (formerly pyro mountain kingsnake)	–	–	1	
Common chuckwalla	–	1	–	
Total	**10**	**19**	**22**	**51**

Note: This Level-2 threat has more than one priority Level-3 threat; consequently, some threat impacts have a score larger than one.

Threat: Natural Rarity and Small Isolated Populations. Natural rarity and small isolated populations are not threats per se; rather, they are more of a limiting factor. Nevertheless, they are often a contributing factor to species imperilment and ESA listing; therefore, they demand management awareness and sometimes action to identify and manage threats before they become pervasive. Therefore, these two factors were included in the UWAP threat assessment and ranking process, and they emerged as priorities. Both natural rarity and small isolated populations were identified as threats for several species that are naturally rare in Utah or occur in small, isolated populations.

There are several ways natural rarity and small isolated populations can manifest. They are presented in order of increasing management priority from a listing-prevention perspective:

- A small portion of Utah may be at the extreme end of a much larger range for a species. In these cases, there may (or may not) be a greater risk of losing the species in Utah, even though the species is secure elsewhere in its extensive range. The common chuckwalla is one example.
- In other cases, a species may be widespread within Utah, and often well beyond, and its natural condition is to occur at low densities. Spotted bat is one example.
- Finally, the species may occur in only one or very few locations in Utah, and nowhere else in the world. It may still occur at natural densities, or it may be depleted within its current distribution. This small range may have always been the case for this species, or this may be all that is left of a historically or prehistorically larger range. Many springsnails are good examples.

Actions that managers may choose to take to address these threats depend on how they manifest, as well as any additional threats the species may face. Each species identified as potentially impacted by one or both of these threats should be evaluated on a case-by-case basis to determine what, if any, action can or should be taken to address the threat. As stated above, these threats (which are limiting factors rather than threats) demand management awareness; however, management action is not universally warranted. Deciding to take no action can be technically justified yet still controversial among stakeholders, particularly if the reasoning has not been discussed and communicated.

Case Study: Sub-Globose Snake Pyrg

The sub-globose snake pyrg is a springsnail that occurs in three springs that make up Gandy Warm Springs in Utah, where it exists as a single population. Gandy Warm Springs is contained entirely within the Gandy Mountain Caves Area of Critical Environmental Concern, which is managed by the BLM and is protected from development. This species was petitioned to be listed under the ESA due to the threats of increased recreation and habitat degradation and natural rarity.



Gandy Warm Springs. Photograph by Lauren Otterness, DWR, Millard County, 2024.

While conducting monitoring surveys in 2019, DWR discovered the presence and establishment of a non-native fish, the Loricariid (armored) catfish, throughout the majority of the sub-globose snake pyrg habitat. The potential threat (i.e., competition and predation on pyrgs) was a high concern for conservation partners because the sub-globose snake pyrg only occurs in a single location. A conservation agreement and strategy was developed for the sub-globose snake pyrg in 2020, and armored catfish was identified as the largest threat. The conservation team developed a non-native fish eradication plan and began implementation the same year. More frequent monitoring indicates that armored catfish removals have been successful, at least temporarily, and the sub-globose snake pyrg densities are remaining within historical levels. Following the completion of a species status assessment, the USFWS concluded that the conservation agreement and strategy was implementing the necessary conservation actions for this species, and it was found not warranted for protection under the ESA (USFWS 2020).

Essential Conservation Actions to Address this Threat

Objective #1 for Natural Rarity and Small Isolated Populations

Naturally rare species and critical small, isolated populations remain extant in Utah through the 10-year life of the UWAP.

Potential Indicators of Success Reaching this Objective

- Numbers of populations and/or abundance of individuals and/or area of occupancy of naturally rare species and small, isolated populations show an upward or static (not declining) trend.
- Inventory and monitoring efforts for species richness, abundance, and habitat condition are included criteria for restoration project planning and success metrics.

Potential Conservation Actions

CODE	ACTION
2.1.1	Develop a list of priority reintroduction species and locations.
2.1.1	Develop rare and priority pollinator species distribution maps, habitat connectivity, and migration maps for diverse land managers using existing data sources to assist with identifying inventory and monitoring sites for priority pollinator species.
2.1.1	Support, implement, and promote vegetation mapping using the National Vegetation Classification Standard and select/support the use of other vegetative mapping efforts (e.g., LANDFIRE and Assessment, Inventory, and Monitoring [AIM]) to develop base vegetation layers for rare pollinator and wildlife habitat condition assessment and mapping.
2.2.1	Develop broodstock and a propagation program for species in need.

CODE	ACTION
2.2.1	Establish nurseries, refuge populations, hatcheries, etc., to support management.
2.3.2	Use propagation and translocation management techniques, as needed, to develop, re-establish, or enhance rare pollinator populations and habitat.
2.3.2	Establish a team to prioritize species ex-situ conservation where such efforts are recommended and viable strategies.
6.4.3	Apply the Mitigation Hierarchy to potential surface-disturbance activities within the distribution of naturally rare species.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, FFSL, DWR, and Division of Outdoor Recreation)
- USFS
- USFWS
- BLM
- Conservation NGOs

Climate Change

Change in climate patterns (e.g., those resulting from increased atmospheric greenhouse gases like CO_2) and/or events outside the natural range of variation that could wipe out a vulnerable species or ecosystem.

Increased habitat shifting and extreme weather patterns associated with climate change exacerbate existing threats that are already challenging to address under current conditions. Coupled with projections of a doubling of the state population by 2065 (Kem C. Gardner Policy Institute 2017), the prospects for SGCN conservation have never been more challenging. This population increase will likely impose additional demand on Utah's already limited natural resources, limitations that, under existing levels of use, have already impacted conservation targets and resulted in their status as SGCNs. The list below contains some examples of existing threats being exacerbated by the results of climate change:

- The impacts associated with improper grazing are more severe under drought conditions.
- Drought increases the severity of impacts associated with dams and water management/use, and human population growth will increase the demand for limited water supplies.

- Drought and rising average temperatures increase the risk of inappropriate fire frequency and intensity, and an increased human population likely will elevate human-caused ignitions.
- Altered climate conditions may increase the vulnerability of SGCNs to threats posed by invasive non-native species and may promote invasion, establishment, and competitive advantage of alien species to the detriment of SGCNs.
- SGCNs that fall into the realm of natural rarity or small isolated populations are likely to be most vulnerable to impacts associated with climate change, and mechanisms to promote their survival (e.g., facilitated translocations to establish refuge populations) may run into political resistance (for example, the resistance to moving Utah prairie dogs across county borders).

Environmental change appears certain, but the specifics are still unclear. Existing laws, regulations, and policies present challenges or limitations that must be overcome to address threats (e.g., water management), for the benefit of conservation targets and human society. From a conservation planning perspective, however, abundant opportunities are available to address climate change–related impacts. Continued diligence in addressing existing threats will minimize the compounding effects associated with climate change.

Within this broad category, two Level-2 threats were deemed priorities: ecosystem encroachment and changes in precipitation and hydrological regimes. Each has been given its own table.

Ecosystem Encroachment

Table 41 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat is further subdivided into three Level-3 threats, all of which have impacts above the low level. One of them, increasing stream temperatures, was ranked as a priority.

Table 41. *Results of Threat Assessment of Priority Level-2 Threat, Ecosystem Encroachment*

LEVEL-3 THREAT: INCREASING STREAM TEMPERATURES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**4**
Arizona toad	–	1	–	

LEVEL-3 THREAT: INCREASING STREAM TEMPERATURES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Columbia spotted frog	–	1	–	
Northern leopard frog	–	1	–	
Western toad	–	1	–	
Aquatic Key Habitats				**1**
Streams and Rivers	–	1	–	
Fishes				**8**
Bluehead sucker	–	–	1	
Colorado River cutthroat trout	–	1	–	
Desert sucker	–	1	–	
Flannelmouth sucker	–	–	1	
June sucker	–	–	1	
Virgin River chub	1	–	–	
Virgin spinedace	–	1	–	
Woundfin	1	–	–	
Insects				**2**
Crested sallfly	–	1	–	
Giant salmonfly	–	–	1	
Mollusks				**6**
Galba techella	–	–	1	
Lindahl's pyrg	–	–	1	
Mountain marshsnail	–	–	1	
Prairie fossaria	–	–	1	
Western pearlshell	–	–	1	
Wrinkled marshsnail	–	–	1	

LEVEL-3 THREAT: INCREASING STREAM TEMPERATURES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Reptiles				**1**
Arizona mountain kingsnake (formerly pyro mountain kingsnake)	–	–	1	
Terrestrial Key Habitats				**1**
Lowland Sagebrush	–	–	1	
Total	**2**	**9**	**12**	**23**

The title of this threat refers to major changes in habitat composition and location, possibly leading to species' inability to shift their ranges to follow the changes of their needed habitat conditions.

Threat: Increasing Stream Temperatures. Many aquatic species have a narrow temperature range in which they can persist. Stream temperatures have been rising throughout the West because of drought, diversions, reduced snowpack, decreased spring runoff, and loss of riparian habitat that provides shade. As temperatures warm beyond tolerable ranges, populations of aquatic insects and other macroinvertebrates are particularly impacted, both in abundance and diversity. Many fish distributions retract from the warmer lowlands and are limited to cool temperature refugia such as higher elevations or reaches with cold spring inflows, and thus available habitat and connectivity between drainages may be lost. This results in smaller, more fragmented populations that may not be able to recover naturally from catastrophic disturbances. Aquatic invertebrate populations are in decline due to stream temperature increase (Anderson et al. 2019) and the alteration of host fish presence due to rising stream temperatures poses a significant threat for freshwater mussel reproduction (Hastie and Young 2003).

With continuing climate change, drought and water use are expected to increase and continue, temperatures will continue to warm, and additional cold and cool water fish habitat will be lost. This will necessitate a major intensification of the management of SGCNs and key habitats as well as of all the other threats that impinge upon them (e.g., recreational activities, improper grazing, disease, problematic native species).

Impediments to species movement can happen for various underlying reasons. Two possible response strategies to this scenario are as follows:

- Improve resilience: remove or reduce impediments to species movement as their habitats shift.

- Improve resistance: reduce the rate or severity of habitat shifting itself, so that species can remain in place longer if it is difficult or impossible for them to move.

Many of the coarse-scale terrestrial habitat management actions practiced in Utah support resistance strategies. It is hoped that these actions continue and are accelerated as a component of implementing the UWAP. Atmospheric carbon dioxide concentrations are still increasing rapidly, however; resistance would be a risky standalone strategy for wildlife and habitat managers to adopt. Fortunately, resilience is also an option:

- Utah's wide range of elevational diversity presents numerous opportunities for plant, insect, and animal species to shift their ranges upslope in response to warmer temperatures, specifically increasing stream temperatures.
- Similarly, with more than 70% of the state's total acreage in public ownership, northward migrations of species and communities in response to climate change are a real possibility.
- Utah's public lands also establish boundaries for urban growth and development while providing landscape-level opportunities to manage conservation targets and their opportunities for migration and range shifting.

Therefore, implementing a mixed strategy, including an increasing proportion of actions to improve species' resilience (i.e., their ability to move as circumstances on the ground require it) is a real possibility.

Case Study: Climate Change and Increasing Stream Temperatures Limit Native Trout Distribution

One impact from climate change is warmer stream temperatures. Studies indicate that suitable habitat for native trout could decline by as much as 60% by 2080 (Wenger et al. 2011). Native trout management will need to consider warming stream temperatures when prioritizing projects. Some native trout habitats are already marginal for stream temperatures, consequently, putting time and money into these reaches will ultimately be a waste of resources if these habitats are lost in the near future from rising stream temperatures.

In Utah, additional fine-scale modeling is needed to determine more realistic impacts from rising stream temperatures. These analyses will allow resource managers to better focus on habitats where native trout will be able to persist into the future. Additional restoration of these habitats such as improvement of riparian vegetation and riffle-to-pool ratios, non-native trout eradication, and restoring connectivity will allow native trout to persist in in light of climate change and increasing stream temperatures.

Essential Conservation Actions to Address this Threat

Objective #1 for Increasing Stream Temperatures

Affected aquatic habitats are adaptively managed such that geomorphic and hydromorphic features and associated native plant communities are improved or maintained for SGCN resilience to increasing stream temperatures.

Objective #2 for Increasing Stream Temperatures

Aquatic species' populations and community structure, composition, and genetic diversity are improved and maintained to establish resiliency to persist on the landscape despite suitable habitat location and distribution shifts.

Potential Indicators of Success Reaching these Objectives

- Dissolved oxygen, pH, turbidity, conductivity, sediment, flow, and temperature levels are within a range that typically support native fish and aquatic species.
- Suitable habitat physical conditions (e.g., appropriate-sized substrates, essential channel features) exist for fish and aquatic species to occur.
- Associated surrounding riparian and wetland plant communities occur in aquatic habitat areas, mitigating increasing stream temperatures and abiotic fluctuations associated with shifting climatic conditions.
- Umbrella species and/or SGCN reproduction and recruitment are occurring.
- Viable populations of riparian and aquatic umbrella species occur.

Potential Conservation Actions

CODE	ACTION
1.1.1	Conduct riparian vegetation treatments to restore characteristic riparian vegetation and reduce uncharacteristic fuel types and loadings.
1.1.6	Mimic or restore the natural hydrograph to promote natural channel and aquatic characteristics and site-appropriate riparian vegetation.
1.2.1	Develop a list of priority locations for resource and habitat protection (see the Identifying Climate Refugia section in Chapter 3, Climate Adaptation).
1.2.1	Develop a list of priority locations for restoration of habitats and natural processes (see the Identifying Climate Refugia section in Chapter 3, Climate Adaptation).
2.1.1	Develop list of priority reintroduction species and locations.

CODE	ACTION
2.1.6	Identify and maintain wildlife migration corridors and protected buffers around populations of SGCNs that may need to move up or down in elevation in response to climate change.
2.1.6	Restore aquatic habitat complexity.
2.3.1	Assist wildlife or plant migration in anticipation of climate change.
2.3.2	Establish nurseries, refuge populations, hatcheries, etc., to support management.
7.2.3	Engage with statewide and local efforts to ensure wildlife values are incorporated into visioning and planning efforts.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, FFSL, DWR, and the Division of State Parks)
- USFS
- BLM
- NPS
- NRCS
- UFBF
- Conservation NGOs
- Local conservation districts
- Private landowners
- Watershed councils
- Developers
- Water conservancy districts
- City and county stakeholders

Changes in Precipitation and Hydrological Regimes

Table 42 summarizes the numbers of species and habitats impacted by this priority Level-2 threat by all nested priority Level-3 threats and the level of impacts (very high, high, or medium).

This Level-2 threat has not been further subdivided into Level-3 threats.

Table 42. *Results of Threat Assessment of Priority Level-2 Threat, Changes in Precipitation and Hydrological Regimes*

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Amphibians				**4**
Arizona toad	–	1	–	
Columbia spotted frog	1	–	–	
Northern leopard frog	–	1	–	
Western toad	–	1	–	
Aquatic Key Habitats				**5**
Lakes and Reservoirs	1	–	–	
Saline Lakes/Great Salt Lake Ecosystem	1	–	–	
Springs	–	1	–	
Streams and Rivers	–	1	–	
Wetlands	–	1	–	
Birds				**23**
Band-tailed pigeon	1	–	–	
Bendire's thrasher	–	–	1	
Black-throated gray warbler	–	–	1	
Boreal owl	–	1	–	
Cassin's finch	–	–	1	
Evening grosbeak	–	–	1	
Flammulated owl	–	1	–	
Gray vireo	–	–	1	
Greater sage-grouse	1	–	–	
Lewis's woodpecker	–	–	1	
Loggerhead shrike	–	1	–	
Long-eared owl	–	1	–	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Olive-sided flycatcher	–	–	1	
Pine grosbeak	–	–	1	
Pinyon jay	–	1	–	
Red crossbill	–	–	1	
Rufous hummingbird	–	–	1	
Sharp-tailed grouse	1	–	–	
Short-eared owl	–	1	–	
Snowy plover	–	–	1	
White-faced ibis	–	–	1	
Williamson's sapsucker	–	–	1	
Wilson's phalarope	–	–	1	
Fishes				**10**
Bluehead sucker	1	–	–	
Colorado River cutthroat trout	–	–	1	
Desert sucker	–	1	–	
Flannelmouth sucker	1	–	–	
Green sucker	–	–	1	
June sucker	–	1	–	
Least chub	1	–	–	
Virgin River chub	–	1	–	
Virgin spinedace	–	1	–	
Woundfin	–	1	–	
Insects				**13**
American bumble bee	–	1	–	
Brine fly	1	–	–	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Coral Pink Sand Dunes tiger beetle	–	1	–	
Giant salmonfly	–	1	–	
Large marble butterfly	1	–	–	
Mojave poppy bee	1	–	–	
Monarch butterfly	–	1	–	
Morrison’s bumble bee	1	–	–	
Ruddy copper butterfly	–	1	–	
Suckley's cuckoo bumble bee	1	–	–	
Tanner's black camel cricket/Sand treader	–	1	–	
West Coast lady butterfly	–	1	–	
Western bumble bee	–	1	–	
Mammals				**11**
Allen’s big-eared bat	–	1	–	
American pika	–	–	1	
Black-footed ferret	–	–	1	
Gunnison's prairie dog	–	–	1	
Hoary bat	–	–	1	
Kit fox	–	–	1	
Little brown bat	–	1	–	
Spotted bat	–	–	1	
Townsend's big-eared bat	–	–	1	
Utah prairie dog	–	1	–	
White-tailed prairie dog	–	–	1	
Mollusks				**14**
Bear Lake springsnail	–	–	1	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Creeping ancylid	–	–	1	
Desert springsnail	–	1	–	
Desert tryonia	–	–	1	
Fat-whorled pondsnail	–	–	1	
Galba techella	–	–	1	
Lindahl's pyrg	–	–	1	
Mountain marshsnail	–	–	1	
Nuwuvi pyrg	–	1	–	
Pine Grove pyrg	–	–	1	
Prairie fossaria	–	–	1	
Santa Clara pyrg	–	1	–	
Western pearlshell	–	–	1	
Wrinkled marshsnail	–	1	–	
Plants				**110**
Ackerman green gentian	–	1	–	
Angell cinquefoil	–	1	–	
Aquarius Indian paintbrush	–	1	–	
Arapien stickleaf	1	–	–	
Atwood's camissonia	–	1	–	
Atwood's pretty	–	1	–	
Autumn buttercup	1	–	–	
Avon milkvetch	–	–	1	
Barneby ridgecress	–	1	–	
Barneby's aromatic scurf-pea	–	1	–	
Barneby's reed-mustard	–	1	–	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Barneby's rockaster	–	1	–	
Bear River Range beardtongue	–	1	–	
Beaver Mountain groundsel	–	1	–	
Ben's beardtongue	1	–	–	
Canaan Mountain beardtongue	–	–	1	
Canyonlands lomatium	–	–	1	
Cisco milkvetch	1	–	–	
Clay phacelia	1	–	–	
Clay reed-mustard	1	–	–	
Comb Wash wild buckwheat	1	–	–	
Cottonwood Springs suncup	1	–	–	
Creeping draba	–	1	–	
Cronquist daisy	–	–	1	
Cronquist milkvetch	–	1	–	
Cronquist's phacelia	–	1	–	
Deep Creek stickseed	–	–	1	
Deseret milkvetch	–	1	–	
Despain pincushion cactus	1	–	–	
Dwarf bear-poppy	1	–	–	
Entrada skeletonplant	–	1	–	
Frank Smith's violet	–	–	1	
Frisco buckwheat	1	–	–	
Frisco Mountains mustard	–	1	–	
Garrett bladderpod	–	1	–	
Gate Canyon buckwheat	–	1	–	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Giant four-wing saltbush	–	–	1	
Gibben's beardtongue	–	–	1	
Gierisch's globemallow	1	–	–	
Goodrich's blazingstar	–	1	–	
Goodrich’s cleomella	–	1	–	
Goodrich's columbine	1	–	–	
Goodrich’s penstemon	–	1	–	
Goose Creek milkvetch	–	1	–	
Graham's columbine	–	–	1	
Guard milkvetch	–	1	–	
Gumbo milkvetch	–	1	–	
Hamilton's milkvetch	–	1	–	
Horse Canyon stickleaf	–	1	–	
Horseshoe milkvetch	–	1	–	
Huber's pepperplant	–	1	–	
Ibex buckwheat	–	1	–	
Idaho penstemon	–	1	–	
Isely's milkvetch	1	–	–	
Johnston catseye	–	1	–	
Jones’ false goldenaster	–	–	1	
Jones’ globemallow	–	1	–	
La Sal daisy	–	1	–	
La Sal Mountains’ groundsel	–	1	–	
Last Chance townsendia	1	–	–	
Lost Creek buckwheat	1	–	–	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Maguire’s primrose	–	1	–	
Maguire’s whitlow-grass	–	1	–	
Marcus Jones' penstemon	1	–	–	
Mesic milkvetch	1	–	–	
Mount Belknap draba	–	1	–	
Mt. Naomi musineon	–	1	–	
Murdock's evening primrose	–	–	1	
Narrow-leaf evening primrose	–	1	–	
Navajo Lake milkvetch	–	–	1	
Navajo sedge	1	–	–	
Ostler peppergrass	1	–	–	
Ostler's ivesia	1	–	–	
Paradox milkvetch	1	–	–	
Pariette cactus	1	–	–	
Pavement phacelia	1	–	–	
Pennell’s draba	–	–	1	
Pinyon penstemon	–	1	–	
Pohl's milkvetch	1	–	–	
Purple-spined hedgehog cactus	1	–	–	
Rollin's sweetvetch	–	1	–	
Rydberg's musineon	–	1	–	
September 11 stickleaf	–	–	1	
Shivwits milkvetch	1	–	–	
Shrubby reed-mustard	1	–	–	
Siler pincushion cactus	–	1	–	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Smith's buckwheat	–	1	–	
Snowbasin rockcress	–	1	–	
Stage Station milkvetch	1	–	–	
Stemless beardtongue	–	1	–	
Stone rubberweed	–	–	1	
Sunnyside green-gentian	–	1	–	
Sweet penstemon	–	1	–	
Table Cliff milkvetch	–	–	1	
Thompson’s flameflower	–	1	–	
Tuhy aromatic scurf-pea	1	–	–	
Uinta Basin hookless cactus	1	–	–	
Uinta Mountains draba	–	1	–	
Untermann's daisy	–	1	–	
Utah ivesia	–	1	–	
Utah phacelia	–	1	–	
Ute ladies'-tresses	1	–	–	
Wasatch fitweed	–	1	–	
Welsh's milkweed	–	1	–	
Western Townsend-daisy	–	1	–	
Wheeler's angelica	1	–	–	
White River beardtongue	1	–	–	
Winkler's pincushion cactus	1	–	–	
Wright fishhook cactus	1	–	–	
Zion buckwheat	–	–	1	

LEVEL-2 THREAT: CHANGES IN PRECIPITATION AND HYDROLOGICAL REGIMES	THREAT IMPACT (SCOPE × SEVERITY)			
	VERY HIGH	HIGH	MEDIUM	TOTAL
Reptiles				**4**
Arizona mountain kingsnake (formerly pyro mountain kingsnake)	–	1	–	
Common chuckwalla	1	–	–	
Gila monster	1	–	–	
Midget faded rattlesnake	–	–	1	
Terrestrial Key Habitats				**9**
Aspen-Conifer	–	–	1	
Desert Shrub	–	–	1	
Lower Montane Mixed Conifer	–	–	1	
Lowland Sagebrush	–	–	1	
Mojave Desert Shrub	–	1	–	
Mountain Sagebrush	–	–	1	
Riparian	–	1	–	
Salt Desert Shrub	–	–	1	
Subalpine Grassland	–	–	1	
Total	**52**	**92**	**59**	**203**

Historically, fish and wildlife management has been based on stable, long-term climate conditions within a predictable range of variation; however, credible climate projections for Utah indicate a departure from historical norms, with increasing climatic extremes and variability. Ensuring the long-term preservation of fish, wildlife, plants, and invertebrates will require a fundamental shift in management strategies—one that prioritizes population and habitat resilience in the face of future uncertainties. This shift must be realized through targeted conservation actions aimed at maintaining, conserving, connecting, restoring, and enhancing species' habitats, thereby enabling them to persist in or adapt to rapidly changing environmental conditions.

Threat: Changes in Precipitation and Hydrological Regimes. Utah, one of the most arid states in the nation (Sowby 2024), faces significant challenges in addressing the increasing frequency

and severity of drought. These challenges are particularly acute for aquatic species and their habitats, especially in isolated or terminal drainages. Decreased stream flows and warmer temperatures can be harmful to species richness and abundance at multiple trophic levels, leading to overall aquatic habitat degradation. Drought, compounded by other effects of climate change and existing anthropogenic pressures—such as water depletion and inappropriate grazing practices—exacerbates the impact to aquatic and riparian ecosystems, threatening the diverse wildlife that depend on them.

Drier conditions and reduced vegetation moisture can have serious impacts to unique and sensitive ecosystems such as alpine meadows and springs—complex habitats that often have relatively high plant and aquatic insect species richness, as well as endemic species found in these habitats and nowhere else (Bonelli et al. 2021; Claret and Marmonier 2019). Periods of severe drought contribute to delayed spring phenology (Li et al. 2023) and an increased risk of large and intense wildfires (Kitzberger et al. 2007), which further hinder ecosystem recovery and resiliency.

Downward trends in overall abundance and diversity of pollinators—especially wild bees and butterflies—are largely driven by the effects of increased drought and altered precipitation patterns (Forister et al. 2010; Forister et al. 2023; Kammerer et al. 2021). Drought especially leads to reduced floral resources for at-risk pollinator species, as well as common species that maintain healthy and diverse plant communities.

Case Study: Cascading Effects of Drought on the Great Salt Lake Ecosystem



Great Salt Lake at Record Low Water Levels in 2022. Copernicus Sentinel data 2022. Map data from OpenStreetMap.

GSL is an ecologically vital yet highly sensitive system, particularly vulnerable to climate change, prolonged drought, and anthropogenic water use. As a large, but relatively shallow, terminal lake within the Great Basin, its water levels fluctuate based on precipitation, streamflow, and evaporation. Increasing water diversions and ongoing drought have caused unprecedented declines in lake elevation, triggering cascading ecological consequences that threaten the entire ecosystem.

A key impact of lower lake levels is rising salinity, which disrupts the delicate balance of life in GSL. As water recedes, microbialites—carbonate

structures layered with microbial mats—become exposed, leading to their desiccation and loss of photosynthetic communities that sustain brine fly larvae. Simultaneously, increased salinity forces brine shrimp and brine fly pupae in the benthic water column to expend more energy on osmoregulation, reducing brine shrimp populations and shrinking the adult body size of brine flies. These changes significantly decrease the available biomass of both key prey species, threatening millions of migratory birds that depend on them.

One species at immediate risk is the Wilson's phalarope, which relies on GSL as a crucial stopover to refuel before its long winter migration south. More than one-third of the global population of Wilson's phalaropes depends on the lake for an abundant brine fly population, which allows the phalarope to gain weight during its stopover before migration. A GSL ecosystem collapse due to declining water levels and increased salinity was highlighted as a threat in a recent petition to list the species as threatened under the ESA.

Beyond its ecological role, the declining GSL poses serious risks to public health and regional climate stability. As the lakebed is exposed, windblown dust degrades air quality, affecting human health throughout the Salt Lake Valley. Additionally, the lake's influence on weather patterns and snow deposition is critical for maintaining water resources along the Wasatch Front, as well as a draw for winter recreation that drives the state's tourism.

Recognizing the urgency of this crisis, Utah has taken significant legislative and collaborative action. In 2023, the Utah Legislature established the GSL Commission to coordinate response efforts, followed by the creation of the GSL Strike Team, the GSL Advisory Council, and the GSL Watershed Council—all focused on mitigating public health, economic, and ecological impacts. Current strategies include policy reforms, funding allocations, and water reallocation initiatives aimed at restoring thousands of acres of GSL wetlands, managing lake salinity, and securing water flows through voluntary water transactions and shifts toward native, drought-resilient landscaping.

Although these efforts represent progress, the long-term sustainability of GSL remains uncertain, requiring continued commitment to conservation, responsible water management, and climate adaptation strategies.

Case Study: Extended Droughts Will Become More Frequent

Utah was in an extended drought that peaked in 2022. During this drought, some streams dried up or fisheries suffered from poor water quality due to low water levels, terrestrial wildlife and plants suffered without rain and water sources, and GSL recorded an all-time elevational low of 1,276.7 m (4,188.5 feet). These extended drought conditions are forecasted to become more

frequent into the future due to climate change. This recent drought highlighted the need to change management in Utah to accommodate extreme conditions. Many DNR divisions, water conservancy districts, and cities developed drought contingency plans to highlight necessary management changes. During extreme drought conditions, for example, DWR will reduce big game permits, redirect fish stockings away from waters being impacted by low water levels, increase fishery creel limits in waters that likely will be lost due limited water, and transport water to guzzlers in dry habitats to ensure terrestrial wildlife have water.

Essential Conservation Actions to Address this Threat

Objective #1 for Droughts

Terrestrial SGCNs and key habitats persist on the landscape, despite increasing drought conditions.

Objective #2 for Droughts

Aquatic SGCNs and key habitats persist on the landscape, despite increasing drought conditions.

Potential Indicators of Success Reaching these Objectives

- Effects of habitat fragmentation and loss from the effects of drought conditions are identified and minimized through partner coordination.
- Dissolved oxygen, pH, turbidity, conductivity, sediment, flow, and temperature levels persist within a range that typically support native fish and aquatic species.
- Suitable physical habitat conditions (e.g., appropriate-sized substrates, essential channel features) exist for fish and aquatic species to occur.
- Suitable physical habitat conditions (e.g., appropriate vegetation structures and compositions, essential water sources) exist for diverse terrestrial communities to occur.
- Surrounding riparian and wetland plant communities occur within historical aquatic habitat areas.
- Viable, indicator riparian, aquatic, and upland wildlife populations occur.

Potential Conservation Actions

CODE	ACTION
1.1.1	Conduct riparian vegetation treatments to restore characteristic riparian vegetation and reduce uncharacteristic fuel types and loadings.

CODE	ACTION
1.1.6	Restore aquatic habitat complexity, including structural diversity that supports habitat needs for macroinvertebrate communities.
1.1.6	Restore drained wetlands through methods such as ditch blocking and targeted native planting (with key host plant species) to promote insect diversity, support wildlife needs, and enhance wetland ecosystem function.
1.2.1	Develop a list of priority locations for resource and habitat protection.
2.1.1	Develop a list of priority reintroduction species and locations.
2.1.6	Use geospatial modeling to identify potential shifts in the distribution of SGCNs and priority pollinator species and habitats and associated avoidance areas in response to climate change.
2.1.6	Identify and maintain wildlife migration corridors and protected buffers around populations of SGCNs that may need to move up or down in elevation or within watersheds in response to climate change.
2.2.1	Increase cover and extent of native riparian vegetation by restoring beavers on the landscape where social and environmental factors permit (see USU's Beaver Restoration Assessment Tool [USU 2025b]).
7.1.3	Use opportunities to obtain or deliver more water for the environment (e.g., purchase/lease, water banking, functional flows, etc.) and promote water supply reliability.

Likely Authorities, Stakeholders, and/or Partners

- DNR (including DWRi, DWRe, FFSL, DWR, and the Division of State Parks)
- USFS
- BLM
- TNC
- Conservation NGOs
- Local conservation districts
- Private landowners
- Watershed councils
- Water conservancy districts
- City and county stakeholders

Data Gaps

Gaps in knowledge or understanding that severely impede managers' ability to detect, diagnose, and abate threats to species and habitats.

Data gaps are not included in the standardized lexicon of threats available for national use (CMP 2016); however, UWAP partners believe that data gaps exist that have hampered the ability to manage SGCNs and UWAP key habitats. The 2015 UWAP developed seven Level-2 data gaps and multiple Level-3 data gaps (Table 43). Data gaps were not included in the priority threats analysis.

Table 43 summarizes the conservation targets impacted by data gaps. Each of these has been broken out in turn into the numbers of conservation targets (birds, fishes, habitats, etc.) for which each Level-2 or Level-3 data gap was identified.

Table 43. *Full List of Data Gaps*

LEVEL-2 AND LEVEL-3 DATA GAPS	TOTAL
12.1 Inadequate Understanding of Ecology and Life History (all)	**150**
12.1 Inadequate Understanding of Ecology and Life History*	**43**
12.1.1 Cheatgrass Impacts	10
12.1.2 Importance and Contribution of Fluvial Populations	3
12.1.3 Interaction with Non-Native Species Unknown	4
12.1.4 Vulnerability to Emerging or Introduced Disease	8
12.1.5 Relative Impacts of Fragmentation	7
12.1.6 Persistent Declines in Prey Species	25
12.1.7 Impacts to Migrating Birds	5
12.1.8 Unknown Population Status	26
12.1.9 Renewable Energy Impacts	9
12.1.10 Pollinator Ecology	4
12.1.11 Demography	6
12.2 Inadequate Understanding of Distribution or Range	**22**
12.3 Inadequate Inventory and Assessment Methods (all)	**48**
12.3 Inadequate Inventory and Assessment Methods*	**20**
12.3.1 No Morphological Key or Other Means to Identify	6
12.3.2 Inventory Techniques Poorly Developed	4
12.3.3 No Standardized Condition Assessment Method	18

LEVEL-2 AND LEVEL-3 DATA GAPS	TOTAL
12.4 Taxonomic Debate (all)	**5**
12.4 Taxonomic Debate*	**3**
12.4.1 Uncertain Management or Conservation Units	2
12.5 Abiotic Conditions and Processes (all)	**18**
12.5 Abiotic Conditions and Processes*	**5**
12.5.1 Atmospheric Deposition and Snowmelt Chemistry	3
12.5.2 Relationship between Groundwater and Surface Water	8
12.5.3 Mercury Deposition	2
12.6 Climate Change (all)	**112**
12.6 Climate Change*	**36**
12.6.1 Future Effects of Greater Temperature Variability Under Climate Change	41
12.6.2 Future effects of Greater Precipitation Variability Under Climate Change	35
12.7 Inadequate Restoration Tools or Methods (all)	**24**
12.7 Inadequate Restoration Tools or Methods*	**13**
12.7.1 Plant Material Development	11
Total (all)	**357**

* Conservation targets shown at Level-2 because this threat was not broken down into Level-3 threats for those targets.

The SGCN Subcommittee identified the following three Level-2 data gaps as significant and hampering the ability to effectively manage species:

- 12.1 Inadequate Understanding of Ecology and Life History
- 12.2 Inadequate Understanding of Distribution or Range
- 12.4 Taxonomic Debate

Collectively, these data gaps make up nearly half of the data gaps identified in Table 43. To better address these three data gaps, the SGIN list was developed and is included in the 2025 UWAP (see Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance for more details). In addition, uncertainty related to climate change was a data gap that has become more pervasive since the 2015 UWAP, now encompassing 30% of the data gaps identified.

Threat: 12.3 Inadequate Inventory and Assessment Methods. Data gaps relating to lack of inventory and assessment methods are one of the most widespread and actionable threats in this category. Survey methods for understudied species, while often developed, implemented, and documented, still lack proper allocation of resources and personnel to sustain consistent monitoring efforts (USU 2025a). The lack of repeated inventory monitoring in areas of ecological impairment is a prominent reason for the data deficit on population declines in species facing this threat. Revisiting sites where species have been observed to conduct surveys using the same methods will be an effective and cost-efficient way to improve data on population declines (Birrell et al. 2024). Improvement of proper short- and long-term inventory and assessment methods will be imperative to future understanding of impacts to biodiversity from changes to Utah's landscape and climate (Kendrick and Huryn 2014).

Essential Conservation Actions to Address this Threat

Objective #1 for Inadequate Inventory and Assessment Methods

Regularly reoccurring inventory and monitoring of relevant SGCN species and associated environmental conditions.

Objective #2 for Inadequate Inventory and Assessment Methods

Adequate species inventory and habitat data collection to project short- and long-term population trends to support conservation status assessment by DWR's data standards.

Potential Indicators of Success Reaching these Objectives

- Fewer instances of Inadequate Inventory and Assessment Methods are being cited by species coordinators as a large-scope and severe threat to Utah's SGCNs.
- Robust species population trend data and occurrence data sets have been created to assess species distribution, population trends, and ultimately conservation status for SGCNs and SGCN candidates.
- Inter-regional standardization of survey methods for understudied species have been developed to develop uniform and accurate occurrence and habitat profiles for under-surveyed SGCNs.

Potential Conservation Actions

CODE	ACTION
6.4.3	Incorporate known monitoring efforts for understudied species into existing rapid bioassessment and biodiversity surveys and monitoring efforts and feasible sampling techniques that are easy to learn and teach.
6.4.4	Initiate reoccurring survey efforts for understudied SGCNs that face significant data gaps and suspected population declines.
8.1.3	Conduct interdisciplinary research on regional ecological impairment to determine optimal restoration methods and procedures.
9.1.3	Provide inventory and monitoring courses, modules, or materials for college or university conservation education to develop and contribute to monitoring efforts.
9.1.4	Provide inventory and monitoring courses, modules, or materials for community science efforts to supplement existing SGCN population data sets.

Likely Authorities, Stakeholders, and/or Partners

- DWR
- FFSL
- USFS
- BLM
- Universities
- Conservation NGOs

Chapter 5. Monitoring and Adapting

Introduction

In wildlife and habitat management, there are two basic categories of information that monitoring programs are intended to create and communicate:

1. The status of a conservation target.
2. The effectiveness of a management action.

Evaluating conservation effectiveness requires some measurement of the change in target status from current or baseline condition resulting from management actions. In natural resource management, *indicators* are often used to detect changes in targets and threats; thus, they are vital to status assessment and effectiveness monitoring. They are also important to implementation because they are used to make management decisions.

Indicators are meant to integrate many ecological functions and represent aspects of the larger ecosystem that may be either too expensive or time consuming to monitor. The best indicators address one or more of the following types of values:

- Ecological values – how well the indicator represents targets and threats, and how those respond to natural and human-driven changes on the landscape.
- Practical values – how readily the indicator can be monitored and modeled, based on existing programs and resources.
- Social values – how well the indicator resonates with partners, stakeholders, and other audiences.

Indicators always have at least one scale that is used for measurement. A common example from game management is fawn:doe ratio, which is an indicator of fawn production and survival. This indicator's measurement scale (or *measure*) is the number of live fawns per 100 doe deer. This measure is derived by a particular set of people, using a defined method.

The purpose of this chapter is to define the indicators, measures, and methods that will be employed to monitor 1) the status of the Utah Wildlife Action Plan's (UWAP's) monitoring targets and 2) the effectiveness of management actions to define, maintain, or improve target status.

Periodic Status Assessments of Species of Greatest Conservation Need

Indicators

For each one of Utah's species of greatest conservation need (SGCNs), the fundamental properties to be assessed are "distribution and abundance . . . indicative of the health of wildlife." The UWAP indicators that measure these properties on a statewide basis for each species are the three conservation status factor categories of the NatureServe Conservation Rank Calculator[1] (NatureServe 2020):

- Rarity
- Threats
- Trends

Measures for all status factors that make up each of these three factor categories (Master et al. 2012) are contained in the Conservation Rank Calculator. Users have some choice of which status factors they can use.

The status factor chosen to represent the indicator Rarity in Utah is Area of Occupancy. Table **44** shows the measure used for a species' Area of Occupancy (larger grid cells are the default option, whereas the smaller grid is used for species inhabiting linear habitats, such as river fishes) (Master et al. 2012).

Table 44. *NatureServe Area of Occupancy Used to Represent Rarity*

NATURESERVE CODE	NUMBER OF 4-KM^2 GRID CELLS OCCUPIED	NUMBER OF 1-KM^2 GRID CELLS OCCUPIED
Z	0	0
A	1	1–4
B	2	5–10

[1] The Conservation Rank Calculator is a tool that automates the process of assigning a conservation status rank—an evaluation of the level of risk of extinction of species and elimination of ecosystems. It is used extensively by state natural heritage programs, which collect and evaluate data for species and ecosystems of concern using a common methodology. The Conservation Rank Calculator tool facilitates the accurate application of this method and promotes greater accuracy and consistency of the assessments. It is available for download at https://www.natureserve.org/products/conservation-rank-calculator/download (NatureServe 2020).

NATURESERVE CODE	NUMBER OF 4-KM^2 GRID CELLS OCCUPIED	NUMBER OF 1-KM^2 GRID CELLS OCCUPIED
C	3–5	11–20
D	6–25	21–100
E	26–125	101–500
F	126–500	501–2,000
G	501–2,500	2,001–10,000
H	2,501–12,500	10,001–50,000
I	>12,500	>50,000
U	Unknown	Unknown

Note: km^2 = square kilometers.

The indicator Threats is measured by Threat Impact and has two status factors used as measures in Utah: Scope and Severity. Threat Scope is measured as the proportion of the species' population in the state that is affected by the threat. It is assessed within a 10-year time frame, and is measured as follows:

Pervasive	Affects all or most (71%–100%) of the total population or occurrences
Large	Affects much (31%–70%) of the total population or occurrences
Restricted	Affects some (11%–30%) of the total population or occurrences
Small	Affects a small proportion (1%–10%) of the total population or occurrences

Threat Severity is assessed within the geographic scope and within a 10-year time frame and is measured as follows:

Extreme	Likely to destroy or eliminate occurrences or reduce the population by 71% to 100%
Serious	Likely to seriously degrade/reduce affected occurrences or habitat or reduce the population by 31% to 70%
Moderate	Likely to moderately degrade/reduce affected occurrences or habitat or reduce the population by 11% to 30%
Slight	Likely to only slightly degrade/reduce affected occurrences or habitat or reduce the population by 1% to 10%

Severity and Scope are combined into Threat Impact (which was used in the threat prioritization—see the Introduction section of Chapter 4, Threats, Data Gaps, and Conservation Actions, and Appendix E for more detail). Table 45 shows how impact categories are derived.

Table 45. *Threat Impact Based on Threat Severity and Threat Scope*

THREAT IMPACT		THREAT SCOPE			
		PERVASIVE	LARGE	RESTRICTED	SMALL
Threat Severity	Extreme	Very High	High	Medium	Low
	Serious	High	High	Medium	Low
	Moderate	Medium	Medium	Low	Low
	Slight	Low	Low	Low	Low

The indicator Trends is measured on two time scales in the Conservation Rank Calculator: long term (approximately 200 years) and short term (10 years or three generations, whichever is longer). Short-term trend is the measure used in the UWAP. The following rating codes are used to describe the observed, estimated, inferred, or suspected degree of change in Rarity (whichever factor was used):

A	Decline of >90%
B	Decline of 80% to 90%
C	Decline of 70% to 80%
D	Decline of 50% to 70%
E	Decline of 30% to 50%
F	Decline of 10% to 30%
G	Relatively stable (<10% change)
H	Increase of 10% to 25%
I	Increase of >25%
U	Short-term trend unknown
Null	Factor not assessed

Methods

Scores for these three factor categories are integrated using the NatureServe Conservation Rank Calculator to derive each SGCN's S-ranks and N-ranks. S-ranks are subnational ranks assigned and maintained by state, territory, provincial, or tribal NatureServe network programs. N-ranks are national ranks assigned and maintained by NatureServe. Those ranks were a core component of the process for selecting SGCNs from the entire list of jurisdictional wildlife (see Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance, for more details).

Utah Division of Wildlife Resource's (DWR's) Natural Heritage Program operates the Conservation Rank Calculator to create and update state S-ranks. Most SGCNs will have their state Rarity and Threat status assessed every 10 years, but this could be more frequent if biologists believe there have been recent factors that are affecting the species. Data are managed with Biotics 5 (DWR et al. 2025) and are regularly shared with NatureServe.

NatureServe updates national ranks on their own schedule, typically on the order of 15 to 20 years. Species may be added to or removed from the Utah SGCN list as a result of these updates to state and/or national ranks. Such changes would prompt a consultation with U.S. Fish and Wildlife Service (USFWS) on the need for a major or minor revision of the UWAP.

Several of Utah's SGCNs have significant data gaps, which impinge on DWR's ability to confidently assess Rarity (and thus short-term trends) and Threat scope. These data gaps must be filled to improve the accuracy and precision of status assessments as well as enable development of effective management actions and associated effectiveness monitoring. The intent of the inclusion of a species of greatest information need (SGIN) list in the 2025 UWAP was to highlight three of the most pervasive data gap threats that impact understanding and management for SGIN species and larger SGIN taxonomic groups: Inadequate Understanding of Ecology and Life History, Inadequate Understanding of Distribution or Range, and Taxonomic Debate.

Species Distribution and Habitat Suitability Models

Species Distribution and Habitat Suitability Models (SDHMs) are being developed for many Utah SGCNs. SDHMs show a predicted suitable habitat for a species based on various biotic and abiotic environmental factors. Consequently, SDHMs also depict a possible geographic distribution of the species, which can be particularly useful when surveying for species that are not well described. As more information is used in the development of SDHMs, the models will become more useful in UWAP implementation. Assessments of S-ranks were developed to use

observed distributional species information, and although it would not be appropriate to use SDHMs as species-occupied habitat in these rankings, these models do demonstrate where additional surveys could and should be conducted to improve the knowledge of SGCN distribution on the landscape. SDHMs are present in the DWR Wildlife Habitat Analysis Tool to help inform project managers (DWR 2024a). SDHMs assess habitats' spatial arrangement and connectivity, identify crucial habitats, or describe the environmental conditions a species selects. SDHMs provide an understanding of the impacts of invasive species spread and identify suitable areas for species translocations or reintroductions. SDHMs can inform wildlife management decisions such as habitat protection, enhancement, and restoration.

Periodic Status Assessments of Key Habitats

For all of Utah's key habitats, the fundamental properties to be assessed are location and condition. Adequately describing location requires mapped habitat data. Assessing condition requires a condition assessment methodology. Many habitat condition assessment methodologies exist, but most are intended for use at the site or local scale and are incapable of being used at a landscape or statewide scale.

In developing the UWAP it quickly became clear that terrestrial and aquatic habitats would need to be approached in very different ways. The Introduction section of Chapter 2, Key Habitats – Location and Condition, has more detail on these parallel processes, as does Appendix D. Matters most relevant to monitoring are discussed here.

For terrestrial habitats, several statewide spatial data sets were available to describe location. LANDFIRE was chosen because—unlike the other options—it also provided a means of describing and monitoring conditions. Some of the indicators and measures selected to monitor terrestrial habitat condition were borrowed directly from the national LANDFIRE program. Other indicators relate more directly to threats than to condition. Some threats already have statewide spatial data sets, whereas others still need to have such data developed.

For aquatic habitats, no single statewide spatial data set was available that would cover all habitats. Spatial data sets were identified for individual aquatic key habitats. Condition and assessment indicators for aquatic habitats are not standardized at a statewide level and are typically structured on a project need basis. The 2025 UWAP Aquatic Key Habitat Subcommittee stressed the importance of collecting more continuous water temperature data as water quality continues to change with climate change and increasing water demands. This subcommittee also encouraged the use of the Barrier Assessment and Inventory Tool (BAIT) to evaluate and standardize habitat fragmentation of streams.

As is the case for SGCNs, there are also some significant data gaps that interfere with assessing the status of terrestrial and aquatic key habitats. These data gaps must be filled to improve the accuracy and precision of status assessments as well as to develop effective management actions and to monitor the effectiveness of those actions.

Location and Condition of Terrestrial Habitats

Indicators

The UWAP is currently using two monitoring indicators for terrestrial key habitats (others may be added by stakeholder request, or as opportunities emerge):

- Extent
- LANDFIRE-based condition assessment

Measures

Extent is measured in acres, square kilometers, and fractional percentage of Utah's state surface area. Its main purpose is to document conservation or conversion of key habitat land cover.

The LANDFIRE-based condition assessment (customized ecological departure) is its own metric representing the dissimilarity between the current distribution of a habitat's successional age classes present in an area, and the amounts that would be expected under reference baseline disturbance regime and climate. Traditionally, low ecological departure was assumed to be best for the conservation of all species because this indicator was used to measure and forecast the landscape-scale effects of active and passive management interventions and natural processes over time. More recently, however, determining whether a change is good or bad has been determined on a case-by-case basis. Some SGCNs may thrive in an area exhibiting higher ecological departure. Furthermore, landscape and climate changes may prevent archetypal states from being supported into the future. To begin addressing these challenges, LANDFIRE Existing Vegetation Types (EVTs) (modeled representations of the current distribution of habitat types across the landscape), rather than LANDFIRE Biophysical Settings (BpS) (which represent more archetypal habitat conditions in the absence of disturbance or changes in climate), were used to identify key habitats and customize the default ecological departure assessment to more closely represent the level of naturalness for Utah's current key habitats (see Chapter 2, Key Habitats – Location and Condition, and Appendix D for more detailed information).

Methods

The UWAP uses 12-digit Hydrologic Unit Code (HUC) landscape parcels (known as subwatersheds) in its terrestrial condition assessments. The principal data set used in terrestrial condition assessment is produced by the national LANDFIRE program. The LANDFIRE program updates its geospatial data sets every 2 years. The U.S. Forest Service, Bureau of Land Management, DWR, and other UWAP partners all contribute detailed project and disturbance data to inform the LANDFIRE updates. These updates will enable UWAP partners to periodically recalculate extent and fire regime condition. Baseline conditions for the 2025 UWAP were derived from LANDFIRE version 2.2.0 data (LANDFIRE 2020b). For more details on LANDFIRE methodology, see the Terrestrial Key Habitats section of Chapter 2, Key Habitats – Location and Condition, and Appendix D and references therein.

Location and Condition of Aquatic Habitats

In common with terrestrial habitats, the condition of aquatic habitats can be assessed and monitored at varying scales depending on the management goals, the variables of interest, and the resources available to perform the assessments. Aquatic habitats are dynamic, however, and comprehensive monitoring to obtain meaningful condition metrics is time intensive. Recognizing the difficulties of developing a comprehensive statewide approach, aquatic habitat monitoring and condition assessments will be conducted on a case-by-case basis. This marks a departure from the 2015 UWAP, which assessed the total extent of aquatic key habitats (in acres) and an aquatic intactness metric developed from Utah Geological Survey (UGS) models (Menuz 2015) as a high-level approach to monitoring aquatic habitat condition across Utah. Shifting to a case-by-case monitoring approach provides several benefits to biologists and resource managers: 1) flexibility to develop monitoring programs specific to SGCN species, region, or availability; 2) adaptability to changing priorities or management concerns; and 3) easy adoption of existing condition data for monitoring.

Five main types of condition data are available for aquatic habitats in Utah:

1. Comprehensive measures that take into account multiple factors to assign condition ratings (applicable to all key habitats).
2. Water quality data for streams and lakes collected by the UGS, Utah Division of Water Quality (DWQ), and the U.S. Environmental Protection Agency (EPA) (Rivers and Streams and Lakes and Reservoirs Key Habitats).
3. Bioassessment data for aquatic ecosystems that estimate ecological integrity, collected by the National Aquatic Monitoring Center (NAMC) (applicable to all key habitats).

4. Hydrologic data from stream gages, groundwater well measurements, and remotely sensed products (applicable to all key habitats).
5. The Utah Springs Assessment Database (developed for the 2025 UWAP to provide a spatial data set for springs, this database also includes habitat threats and condition metrics [applicable to the Springs Key Habitat]).

Collectively, these data will provide the best measure of aquatic habitat condition in Utah.

Comprehensive Data

The UGS conducts wetland mapping and wetland field assessment projects across Utah, and DWQ and the UGS collect comprehensive data about Great Salt Lake's wetland condition, which accounts for the greatest density of wetland area in Utah. UGS continues work that was started by Downard (2021) to test and develop vegetation-based condition assessments of Great Salt Lake and Great Basin wetlands. After the Clean Water Act was enacted in 1972, the EPA, in partnership with states and tribal nations, began a nationwide water quality monitoring effort for lakes, rivers and streams, coastal condition, and wetland condition once every 5 years called the National Aquatic Resource Surveys (EPA 2024a). These surveys established a national water quality baseline and tracked changes over time. The data can be broken down into regions, such as the Western Mountains and Xeric region, which includes Utah (EPA 2024a).

The National Wetlands Inventory mapping provides baseline information about wetland distribution and extent by mapping individual wetland features visible in aerial imagery; however, National Wetlands Inventory mapping accuracy varies greatly across Utah with much of the state reflecting conditions present in the original mapping from the 1980s. Since the publication of the 2015 UWAP, UGS, DWR, the Bureau of Land Management, and many other mapping organizations have been working to update National Wetlands Inventory mapping within Utah. As of November 2024, these organizations have succeeded in updating mapping across 35% of Utah and expect to complete projects across 70% of Utah by the end of 2025. This updated mapping provides key baseline, distribution, and extent information for any assessment project.

Water Quality Data

States must submit biennial reports to the EPA on water quality of surface water to comply with the Clean Water Act. States also are required to submit a list of waterbodies that do not meet the state's water quality standards. Surface waters that are measured for water quality are placed into discrete assessment units. Lakes, reservoirs, ponds, flowing surface waters, and canals are distinguished as individual assessment units (see DWQ 2024 for more details).

Although assessments do not cover the entire state, they do cover all areas with perennial streams and lakes. DWQ's most recent report for Utah was submitted in 2024 (DWQ 2024) (Table 46). Water quality was evaluated in five categories: 1) waterbodies fully support their beneficial use (e.g., recreation, drinking water); 2) waterbodies support some but not all designated uses, but there is no evidence of impairment; 3) waterbodies with insufficient information to make a support determination; 4) at least one designated use is not being supported but a total maximum daily load (TMDL) (a measure that accounts for all sources of pollutants that caused the waterbody to receive an impaired determination) is not needed; or 5) at least one designated use is not being supported and a TMDL is needed (impaired waterbodies). For waterbodies listed as impaired, the Clean Water Act requires a TMDL to be developed. Most impairments in all waterbodies are linked to exceeding the maximum criterion for dissolved oxygen, pH, or temperature (DWQ 2024).

Table 46. *Assessment Units Evaluated for Water Quality*

WATER QUALITY CATEGORIES	NUMBER OF ASSESSMENT UNITS EVALUATED	
	2014*	2024*
Fully supported units	84 (9%)	103 (11%)
No evidence of impairment	155 (17%)	184 (20%)
Insufficient information	382 (41%)	216 (24%)
At least one designated use not supported; no TMDL needed	36 (4%)	27 (3%)
Impaired – at least one designated use not supported; TMDL needed	268 (29%)	388 (42%)
Total assessment units	925 (100%)	918 (100%)

Note: Assessment units are surface waters that are measured for water quality and include lakes, ponds, reservoirs, flowing surface waters, and canals as discrete units. See DWQ (2024) for more details.

* Number in parentheses represents the proportion of the total assessment units for each year.

Bioassessment Data

The challenge of quantifying environmental and ecological impairment to aquatic ecosystems was addressed in 1992 through a partnership between aquatic scientists from Utah State University (USU), the U.S. Forest Service, and the Bureau of Land Management, who developed a biological monitoring and assessment process using aquatic invertebrate assemblages. The NAMC evaluates the functional components or biological integrity of aquatic ecosystems (meaning, "the capability of supporting and maintaining a balanced, integrated, adaptive

community of organisms having a composition and diversity comparable to that of the natural habitats in the region" [Frey 1977]) that are measured as a departure from reference conditions with the least disturbance on the landscape. The NAMC works with agencies and academic partners to quantify environmental and biological conditions using benthic macroinvertebrate and water chemistry samples collected from streams, rivers, lakes, springs, and reservoirs. Water quality and physical habitat can be modeled at local and regional scales by assessing biological indicator traits such as tolerance values, functional feeding groups, and thermal preferences. Aquatic biological assessments quantify species richness and community composition. As sampling is repeated at sites, these data may be able to identify macroinvertebrate trends in the future. NAMC maintains the Aquatic Invertebrates Database, a spatial database that contains nearly 4,000 unique records for aquatic invertebrate taxa in Utah associated with samples processed by its laboratory and data incorporated from other collection surveys. These publicly available data, as well as field protocols, are provided on the NAMC website, hosted by USU's Quinney College of Natural Resources (USU 2025a).

Hydrologic Data

Stream Gages

Water diversions have had a significant impact to Utah's aquatic resources; water management has been identified as the most pervasive threat (in scope and severity) to SGCNs and their habitats. U.S. Geological Survey stream gages monitor many of Utah's stream resources (U.S. Geological Survey 2025b). Utah Division of Water Rights (DWRi) provides additional gaging information, and some stream flow information is monitored by individual water districts. Despite the existing stream gaging network, many streams and stream segments remain ungaged. The Utah Division of Water Resources' *Great Salt Lake Basin Integrated Plan* (2024) identified the lack of stream flow gages as an impediment to effective water monitoring. During 2023 and 2024, Utah Division of Water Resources worked with USU to complete a stream flow gap analysis to identify priority stream reaches or canals that lack stream flow gaging (Lukens et al. 2024). This study recommended the consolidation of all stream flow information and, as of 2025, this information is being compiled.

Groundwater Monitoring

DWRi manages groundwater resources in Utah, and groundwater management plans exist for most basins impacted by water withdrawals (DWRi 2025). To better understand and monitor groundwater resources, DWRi works closely with the UGS to monitor groundwater resources. The UGS conducts water budget studies and monitors groundwater levels in wells and springs

to provide data to support DWRi decision making. The UGS also has developed a groundwater dashboard that compiles data from previous UGS water budget studies and showcases water level trends for wells across the state over intervals of 5, 10, and 30 years (UGS 2025). In 2024, the UGS analyzed water levels in wells measured by the U.S. Geological Survey for 265 wells in Utah with 30 years of groundwater measurements between 1994 and 2024 and found that 6% of the wells had a significant increasing or stable water level trend (0–0.4 meter [0–1.3 feet] per year); 86% had a significant moderate rate of decline (-0.6–0 meter [-2.0–0 feet] per year); and 8% had a significant large rate of decline (-1.5 to -0.6 meters [-4.8 to -2.0 feet] per year) (UGS 2025).

Remotely Sensed Products

Remote sensing data have also been used to study patterns in surface water extent over time. Both the Wetland Evaluation Tool (USFWS 2025a) and Global Surface Water Explorer (2020) provide resources that indicate declines in surface water extent from the early 1980s to more recent years. It is worth noting, however, that the 1980s were a historically wet time in Utah.

Springs Data

The Utah Springs Assessment Database was developed for the 2025 UWAP to provide a spatial data set for springs. This database began with a 2023 Springs Stewardship Institute geodatabase export of more than 11,000 Utah spring data entries. During 2023 and 2024, DWR developed a Springs Assessment Inventory Application (Springs App), created in ArcGIS Field Maps, to allow UWAP partners to build the Utah Springs Assessment Database. The threats to spring habitats (see Chapter 4, Threats, Data Gaps, and Conservation Actions) and high-level condition metrics have been incorporated into the Springs App and database. As more springs are documented, the knowledge of the extent of spring habitat in Utah will continue to grow, and, as springs are revisited, condition metrics and threats will be tracked through time.

In addition to these data sources, the UWAP Aquatic Key Habitat Subcommittee provided these recommendations for measuring the condition of UWAP aquatic key habitats:

- Make existing aquatic key habitat condition data readily available (see the Aquatic Key Habitat Descriptions section in Chapter 2, Key Habitats – Location and Condition, for additional resources).
- All UWAP partners should use the Springs App to continue determining the extent and condition for the Springs Key Habitat.

- All UWAP partners that evaluate barriers to fish and aquatic SGCN movement should use the BAIT to collect data. Using this Survey 123 app will standardize the assessment and information collected on potential barriers to aquatic SGCN movement.
- Collect more aquatic temperature data, especially continuous data, through temperature loggers.
- Continue to identify meaningful aquatic habitat condition metrics and standardize the collection of these metrics through UWAP partner discussions.

Periodic Status Assessments of Threats

The status of the threats impacting conservation targets needs to be measured periodically for several important reasons. Threats are

- an integral component of the five-factor analysis that the USFWS uses to make its decisions about threatened and endangered species listing and recovery;
- one of three factor categories used in the NatureServe Conservation Rank Calculator (NatureServe 2020), which is how the UWAP proposes to periodically determine SGCN performance and conservation status;
- an integral part of the UWAP's habitat condition assessments; and
- what the UWAP should seek to prevent or reduce with conservation management interventions.

The fundamental property to be assessed for threats is threat impact. An earlier section of this chapter, Periodic Status Assessments of Species of Greatest Conservation Need, has more detail on the target-by-target scale of inquiry and how impact is calculated. This section, however, is concerned with aggregating threats to characterize their impact across the state and across the entire suite of SGCNs and key habitats.

Indicators

An evaluation of the statewide scope, severity, timing, and reversibility of every standardized threat for every target resulted in the statewide threat assessment. This assessment's data set was then subjected to a prioritization scheme. The prioritization scheme used a screening and averaging algorithm to yield a set of priority Level-2 and Level-3 threats (see Chapter 4, Threats, Data Gaps, and Conservation Actions, and Appendix E for details). Each priority threat has a defined, categorized degree of impact (very high, high, or medium) to a quantified set of targets. A few priority threats were only defined at Level-2; in those cases, the indicator is its Level-2

impact category. Refer to Table 29 in Chapter 4, Threats, Data Gaps, and Conservation Actions to see the Level-2 prioritized threats and how many conservation targets they impact across the state.

Measures

The sole measure for the indicator impact category is the number of targets impacted in each category organized by each priority threat. Conservation targets are SGCN and key habitats. The number of SGCN and key habitats impacted by threats are summarized for the ranking process. The impact categories used to prioritize threats are very high, high, and medium. Threats considered to have a low or unknown impact to conservation targets were removed from the prioritization process.

Methods

To accurately measure the scope (and thus derive the impact) of a threat, it is necessary to have accurate, current distribution maps of both the target and the threat. Many existing spatial data sets for threats serve as model inputs for Terrestrial and Aquatic Intactness. These existing data sets are maintained and updated by several organizations, including DWR. Some data sets are housed on DWR or other UWAP partners' servers, but many are housed at the Utah Automated Geographic Reference Center, which makes them available to the public. Comparing current and older versions of these spatial data sets enables DWR and partners to track changes in the distribution of targets and threats and thus judge the implementation and effectiveness of the UWAP. As the previous section illustrates, the realm of spatial data sets for both threats and targets is one of constant change and improvement.

Similar to SGCNs and key habitats, there are some significant data gaps that interfere with assessing the status (scope and severity) of certain threats. These data gaps—most often, the absence of an initial baseline—must be filled to improve the accuracy and precision of periodic status assessments. In some cases, such data gaps are due to existing data not yet having been developed into spatial data sets. In other cases, the raw data have yet to be collected, or they only exist for limited areas and are unsuitable for statewide use. In the absence of appropriate data, the best judgment of subject-matter experts will be used.

Periodic Status Assessments of Data Gaps

The status of the data gaps impinging upon the management of conservation targets also needs to be measured periodically. Fundamentally, data gaps can pose severe impediments to vital conservation, sometimes to the degree that nothing useful can be done until the data gap

is filled. Conversely, data gaps can also cause undue concern for cryptic or unstudied species that may in fact be secure. These are the extremes on a continuum. Discerning where reality falls on this continuum in any given situation cannot be clarified without some cost and effort.

Data gaps impede status assessment and effectiveness monitoring in the following general ways:

- Obscuring the true abundance and/or distribution of SGCNs
- Obscuring the true location and/or condition of key habitats
- Obscuring the true scope and/or severity (thus impact) of threats
- Obscuring the actual need for, and/or the effectiveness of, conservation actions

The fundamental question to be assessed for data gaps is, "Do they still exist?" As in the previous section on threats, the concern here is with aggregating data gaps to characterize their statewide status across the entire suite of SGCNs and key habitats and the threats thought to be impacting them.

Indicators

There is still a lot to learn about most conservation targets, but not all the data gaps prevent action, and not all data gaps are crucial. This is an important distinction that needs to be accounted for when applying the following two indicators of progress toward filling data gaps:

- The number of UWAP SGIN
- The number of data gaps remaining

Measures

Measures for these two indicators are embodied in the indicators themselves (see the Methods section below and Table 43 in Chapter 4, Threats, Data Gaps, and Conservation Actions for more information).

Methods

The UWAP SGCN Subcommittee identified the following three Level-2 data gaps as significant and ones that hampered the ability to effectively manage species:

- 12.1 Inadequate Understanding of Ecology and Life History
- 12.2 Inadequate Understanding of Distribution or Range
- 12.4 Taxonomic Debate

Collectively, these data gaps make up nearly half of the data gaps identified in Table 43. To better address these three data gaps, the SGIN list was developed and included in the 2025 UWAP. If species qualified as SGCN through the UWAP SGCN rubric primarily due to one or more of these three data gaps, they were moved to the SGIN list. The SGIN table (see Table 4) identifies which of these three data gaps are relevant by SGIN (see Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance for more information).

Through time, tracking the number of SGIN will provide an assessment on these three data gaps. Measures of success demonstrating that these data gaps are being addressed include the following:

- Fewer broad taxon groups on the SGIN list. Currently, the SGIN list contains some higher taxon levels (e.g., genus, family) rather than individual species, which demonstrates larger fundamental data gaps for these species' groups. As these data gaps are addressed, a better understanding of which species in these broader taxon groups need conservation attention will be achieved.
- Fewer species on the SGIN list. As these data gaps are addressed, a better understanding of which species need conservation attention will be known. With better knowledge, species that are not declining or in need of conservation attention can be removed from the SGIN list. Conversely, as these data gaps are filled, if the new information does indicate that species need conservation attention, these species can be elevated to the SGCN list.

Tracking the total number of data gaps is another measure of progress toward filling those gaps. As the number of data gaps decreases, UWAP partners will be in a better position to understand which species need conservation attention and what actions will result in effective conservation. Beyond the three data gaps used to highlight SGIN, the remaining data gaps have been recorded through the species threats assessments as part of the S-rank process. These data gaps can be referenced and tracked when S-ranks are updated. Similarly, threats to key habitats can be tracked through time as key habitat threat assessments are updated.

For example, the 2025 UWAP threat assessment highlighted that uncertainty related to climate change is a data gap that has become more pervasive since 2015 and now encompasses 30% of the data gaps identified in Table 43. The UWAP Climate Adaptation Subcommittee has committed to meeting into the foreseeable future to better address UWAP climate needs.

Measuring the Effectiveness of Conservation Actions

There are hundreds of potential conservation actions outlined in Chapter 4, Threats, Data Gaps, and Conservation Actions, that can be taken to implement the UWAP. Each project and action will be evaluated differently to determine the effectiveness of the desired conservation action. Evaluating UWAP projects and actions will be critical in determining Utah's progress in native species conservation efforts.

Verifying and Tracking Utah Wildlife Action Plan Implementation

Before the effectiveness of actions can be determined, it is necessary to first document that the actions were implemented as intended and designed. There are several reasons for this, including the following:

- If an action has not been implemented, then looking for a resulting effect might be a waste of resources.
- If no action has been implemented, but an effect that would be expected to result from that action is still observed, further investigation would be warranted. Specifically, the problem–action–effect–solution results chain might need to be refined.
- If some action other than the intended action has been implemented, then making inference to the efficacy of the intended but untaken action would be inaccurate.
- Time lags between actions and outcomes are very common. Tracking outcomes but not actions is likely to result in negatively biased perceptions of conservation effectiveness.

Actions taken to address certain threats and data gaps and for most routine status assessment work are relatively easy to track. Reporting systems exist for key DWR implementation programs (see the Species Protection Account and State and Tribal Wildlife Grants sections in Chapter 6, Partnerships, Implementation, and Regional Collaboration). In addition, all UWAP partners and stakeholders already have a powerful tool for tracking implementation of many projects undertaken to reduce threats: the Utah Watershed Restoration Initiative project database (Utah Department of Natural Resources 2025b). This database, which can be queried, contains Utah restoration projects (including overview, methods, results, conclusions, and funding) carried out since 2006 and Species Protection Account–funded UWAP projects carried out since 2019. Finally, many partners doing their own monitoring and threat abatement have in-house project tracking and accounting systems.

Indicators

- Projects that address UWAP priority threats or data gaps.

- Programs conducting periodic status assessments of SGCNs, key habitats, and priority threats.

Measures

- Numbers of projects/conservation actions completed.
- Expenditures on such projects/conservation actions.
- Number of partners submitting implementation data formatted to standard threats and actions and to status assessment indicators.
- Adapting and incorporating new information or changing conditions that impact threats and conservation actions.
- Quantity of data submitted.

Methods

By adopting the standardized naming system for threats and conservation actions and reporting their efforts via the online Watershed Restoration Initiative project database, any current or future UWAP partner can contribute to the efforts to monitor some aspects of UWAP implementation—mainly on-the-ground, direct actions. The Core Team will meet each year to coordinate UWAP implementation and prioritize conservation actions. If new threats to SGCNs or key habitats arise, these threats will be incorporated into the appropriate threat assessments. The same applies to conservation actions. If new information or changing conditions impact and change priority threats to SGCNs and key habitats, the conservation actions to address those threats will to be reviewed and adapted. Changes in priority threats will be incorporated into the Watershed Restoration Initiative to ensure that conservation projects/actions remain relevant with new information and changing conditions.

Relying solely on indicators and measures related to completed projects and expended funds as indicators and measures of implementation, however, might be inadequate and problematic. As described in Chapter 4, Threats, Data Gaps, and Conservation Actions, some of the highest-impact threats to Utah SGCN and key habitats are especially challenging to address. Several factors contribute to this. For example, there may be questions or confusion surrounding who has legal authority to address a threat, conflicting resource demands, and influential factors that are outside the purview of conservation organizations.

Taking effective action against such complex, challenging threats will require cooperation among the agencies and organizations that are the administrators and stakeholders of those threats. Those actions currently listed in the UWAP for which DWR lacks full capacity and

authority to undertake alone have been presented as starting points in an inclusive discussion, not as requirements or decisions that have already been made. Not being cooperative and inclusive is, in effect, deciding that the most-challenging, highest-impact threats are not going to be addressed. The statewide, all-targets threat assessment demonstrates that failing to address such threats to wildlife would likely lead to numerous Endangered Species Act listings, a disastrous outcome for Utahns and an abdication of many UWAP stakeholders' public responsibilities.

This raises some difficulties for traditional natural resources professionals. Besides the indicators of natural resources outcomes described elsewhere in this chapter, it could be beneficial to note indicators that assess and can improve joint performance navigating social processes such as facilitating meetings, involving stakeholders in planning and decision making, optimizing communication among stakeholders, and two-way learning. These processes would have their own indicators, measures, and methods.

Measuring and Verifying Overall Utah Wildlife Action Plan Effectiveness

UWAP partners still need some way to determine whether they are being effective. Effectiveness is ultimately defined as meeting the stated purpose of the UWAP: *The purpose of Utah's 2025 Wildlife Action Plan is to manage native wildlife species and their habitats to help prevent listings under the Endangered Species Act.*

The target status indicators help detect degraded or precarious wildlife populations and habitats that are often precursors to Endangered Species Act listings. Measures for all indicators have already been obtained; in 2025, all chosen target status indicators have baseline values. If filling the data gaps and taking action to address the priority threats succeed, then those successes will be reflected in future measurements of the chosen indicators. It will be evident that the status of targets has improved and that degraded or precarious SGCN populations and habitats have been restored and conserved. This is the conceptual model for preventing Endangered Species Act listings and the resulting negative impacts to Utah. This is how overall UWAP effectiveness should be measured, verified, and judged.

Chapter 6. Partnerships, Implementation, and Regional Collaboration

Introduction

The task of preserving and managing Utah's fish and wildlife is far too large and complex for one agency to achieve alone. Although Utah Division of Wildlife Resources (DWR) is the lead agency for the Utah Wildlife Action Plan (UWAP), the UWAP is not a singular plan for one agency or entity. DWR does not bear the sole responsibility or authority for its implementation; in fact, UWAP partners have authority over most of the pervasive threats to Utah species and habitats (see Chapter 4, Threats, Data Gaps, and Conservation Actions) and have their own sensitive species lists and mandates for species conservation. To address this challenge, DWR has actively pursued new partners (e.g., other Utah Department of Natural Resources [DNR] divisions, water managers, industry, and transportation) since the development of the 2015 UWAP. Ultimately, success in preserving and managing Utah's fish, wildlife, plants, and invertebrates and their habitats depends on many organizations working together and across disciplines. While the UWAP Core Team included many of the UWAP partner agencies/organizations and was the overarching partner team that helped guide the UWAP revision, many other partners and stakeholders worked collaboratively to develop this version of the UWAP (Table 47). These groups incorporate the UWAP into their decision making and daily workflows and collaborate with DWR when developing and implementing projects across the state. The UWAP is intended to facilitate cooperation with adjacent states, as well as local and regional conservation organizations and tribal nations, to achieve range-wide species and habitat conservation.

Table 47. *Agencies and Other Organizations that Participated in the Utah Wildlife Action Plan Revision*

STATE AND LOCAL AGENCIES/TRIBAL NATIONS	FEDERAL AGENCIES AND TRIBAL NATIONS	NONPROFITS AND PRIVATE ORGANIZATIONS
Central Utah Water Conservation District	Natural Resources Conservation Service	Conservation Science Partners, Inc.
National Aquatic Monitoring Center at Utah State University Bug Lab	U.S. Air Force Hill Air Force Base	HawkWatch International
Navajo Nation Department of Fish and Wildlife	U.S. Bureau of Land Management	Utah's Hogle Zoo
Utah Department of Environmental Quality	U.S. Bureau of Reclamation	National Audubon Society
DNR • Utah Geological Survey • DWR ○ Natural Heritage Program • Division of Outdoor Recreation • Division of Forestry, Fire and State Lands • Public Lands Policy Coordinating Office	U.S. Army Dugway Proving Ground	NatureServe
Utah Department of Transportation	U.S. Fish and Wildlife Service	Sageland Collaborative
Utah National Guard, Environmental Resource Management	U.S. Forest Service	SWCA Environmental Consultants
Utah State University	U.S. Geological Survey	The Nature Conservancy
Weber Basin Water Conservation District	Utah Reclamation Mitigation and Conservation Commission	The Wildlife Connectivity Institute
		Tracy Aviary
		Trout Unlimited
		Utah Farm Bureau Federation
		Utah Mining Association
		Utah Wildlife Federation
		Utah Petroleum Association
		Working Lands Conservation

Collaborative Planning and Implementation

In preparation for the 2025 UWAP revision, DWR surveyed the UWAP partners in January 2022 to better understand how they were using the UWAP and where they felt improvements to the plan were needed. A partner meeting was held in March 2022 to refresh partners on state wildlife action plans (SWAPs), lay out 2025 revision timelines, and discuss this survey and areas of the UWAP that need improvement or revision. A second survey in May 2022 gathered additional input and ultimately identified the areas where UWAP partners wanted to see UWAP improvement or revision. This process resulted in the formation of nine subcommittees that addressed specific aspects of the 2015 plan to improve. Many new partners joined the UWAP revision process that were not part of or only played a minor role in the development of the 2015 UWAP. There was an open door to participation, and additional partners were continually added to the subcommittees during the revision process. To keep all UWAP partners appraised of the revision progress, solicit input, and provide opportunity for review, a UWAP Core Team with representation from all partners began meeting quarterly in January 2023 and continued meetings through the fall of 2025.

Committees

- UWAP Core Team
- Utah DWR Wildlife Action Plan Implementation Team

Subcommittees

- Agency Organization and Integration
- Aquatic Key Habitats
- Terrestrial Key Habitats
- Climate Adaptation
- Landscape and Regional Focus
- Plant and Insect Integration
- Species of Greatest Conservation Need (SGCN)
- Habitat Connectivity
- Water

Tribal Engagement

DWR extended an open invitation to tribal nations for the first time in a comprehensive UWAP revision. The Utah Division of Indian Affairs was contacted to help develop a UWAP tribal nations engagement plan. This plan consisted of the following outreach to federally recognized Utah tribal nations in order to build stronger partnerships for native species conservation efforts:

- A formal UWAP presentation was made in January 2023 to the Utah Tribal Council, which is made up of representatives from bands and nations belonging to the eight federally recognized Utah tribal nations: Confederated Tribes of Goshute, Navajo Nation, Northwestern Band of the Shoshone Nation, Paiute Indian Tribe of Utah, San Juan Southern Paiute Tribe, Skull Valley Band of Goshute, Ute Mountain Ute Tribe, Ute Indian Tribe of the Uintah and Ouray Reservation, and White Mesa Community (part of the Ute Mountain Ute Tribe). This presentation provided a high-level overview of the purpose and objectives of the UWAP, discussed communication processes, and encouraged tribal nation participation in the 2025 UWAP revision and implementation.
- Letters were sent in April 2023 to the eight federally recognized Utah tribal nations following the presentation. The letters provided a higher-level overview of the UWAP purpose and objectives and DWR staff resource information and encouraged the tribal nations to participate in the 2025 UWAP revision.
- Direct contact was made from DWR regional offices where current working relationships exist to encourage participation of tribal nations in the 2025 revision.

Ultimately, these efforts led to the Navajo Nation Department of Fish and Wildlife joining the UWAP Core Team. DWR and UWAP partners will continue to reach out to Utah tribal nations to build relationships, determine their conservation priorities, and encourage participation in the UWAP.

Regional Collaboration

The 2025 UWAP incorporates ecoregions for the first time. Ecoregions extend beyond state borders; state conservation area boundaries and SGCN ranges are larger than states. States must work regionally, nationally, and internationally to accomplish conservation objectives for many habitats and species. A goal of SWAPs is to facilitate cooperation with adjacent state wildlife agencies, as well as with local, state, and regional organizations, to more successfully achieve range-wide SGCN conservation within Utah's area of influence.

Twenty years ago, Congress created the State and Tribal Wildlife Grants (STWG) Program, which led to the development of SWAPs nationwide. Many of the first SWAPs from 2005 were inconsistent in the terminology used to describe threats, data gaps, and essential conservation actions. This inconsistency impeded conservation across state borders, and challenged efforts toward collaboration, coordination, and joint fundraising within states. Recently, the Association of Fish and Wildlife Agencies (AFWA) President's Task Force on Shared Science and Landscape Conservation Priorities assembled the SWAP and Landscape Conservation Work Group to develop recommendations on how SWAPs can be made even more effective at improving range-wide conservation of SGCN (AFWA 2021a). The work group adopted guiding principles and provided recommended actions to facilitate implementation. Utah is implementing this guidance by participating in the initiatives described below.

Regional Initiatives

Association of Fish and Wildlife Agencies Initiatives

Southern Wings

To prevent migratory species from becoming endangered, and recover those already endangered, researchers must understand and address the totality of threats facing the species throughout their full life cycle and Utah's role in supporting their populations. This is particularly important for neotropical migratory birds.

Case Study - Southwestern Collaboration: Western Yellow-Billed Cuckoo

State wildlife managers face a persistent structural challenge to the effective conservation of wide-ranging and migratory SGCN: coordination among states. The threats these SGCN face accumulate across migrations and seasons and are rarely confined to state or national jurisdictions. Research shows that effective conservation actions must be coordinated across the full annual cycle (FAC) of these species (Marra et al. 2015), meeting species' needs when and where they occur. The FAC encompasses a species' full range of habitat associations and biological activities throughout a year, including breeding, nonbreeding, and migration or dispersal periods (Marra et al. 2015; Schuster et al. 2019). Thus, conservation actions that focus on migratory birds need to span political boundaries and emphasize approaches with the greatest return on investment. The AFWA Southern Wings program has been designed to facilitate cross-boundary work focused on neotropical migratory birds.

This section explores one migrant that is a priority and was listed as an SGCN ca. 2015 in SWAPs for six southwestern states and Texas (U.S. Geological Survey 2015): the western

yellow-billed cuckoo. This section outlines current and potential future collaborative efforts to better conserve this important species. Conservation of wide-ranging, migrant species at the state level is critical; however, it is also important to understand the value of coordinating each state's resources and conservation initiatives in the context of delivering population-level conservation successes.



Western Yellow-Billed Cuckoo. Photograph by Chrissy Kondrat, Arizona Game and Fish Department, 2018.

The recovery and sustainability of regionally important SGCNs, such as the federally threatened western yellow-billed cuckoo, depends on cross-border (state and international) collaboration. Western states encompass important breeding habitats for this subspecies of yellow-billed cuckoo (Birds of the World 2024), including federally designated critical habitats within Arizona, California, Colorado, Idaho, New Mexico, Texas, and Utah (U.S. Fish and Wildlife Service [USFWS] 2021) (Figure 57). River corridors represent especially important habitat for this subspecies across its range; xeroriparian habitat is consistently used in southeastern Arizona.

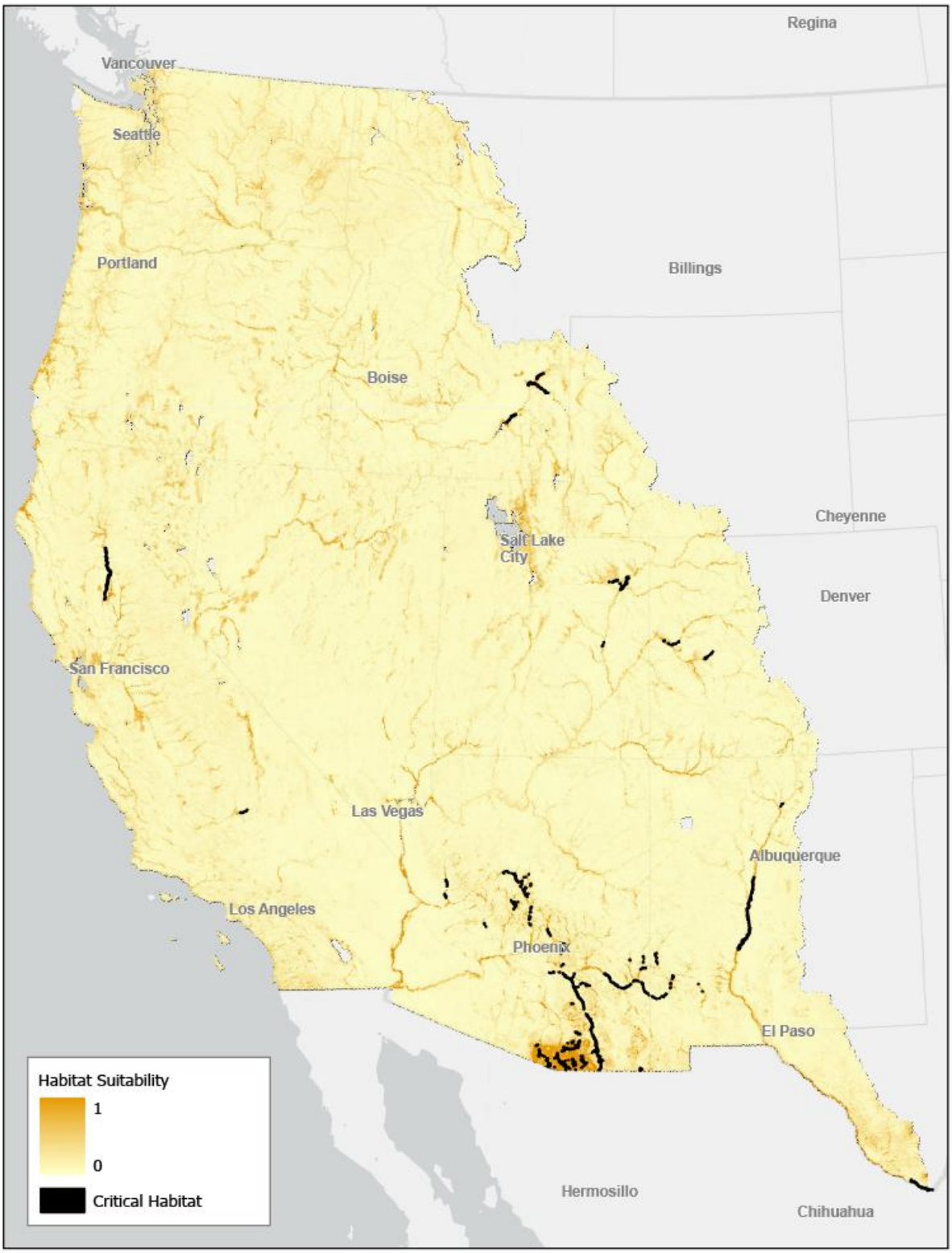


Figure 57. *Habitat Suitability and Critical Habitat for Western Yellow-Billed Cuckoo in the United States*

Sources: NatureServe and Heritage Network Partners (2023); USFWS (2024b).

Since 2020, 12 states, including several southwestern states (i.e., Arizona, California, Colorado, Nevada, New Mexico, Utah, and Texas), have been participating in a competitive STWG Program project to develop a range-wide distribution model, implement a range-wide survey, and investigate the use of autonomous recording units in detecting this species. As an example of the cross-boundary collaboration this STWG Program funding catalyzed; the participating states completed over 300 surveys, which was more than initially proposed. The western subspecies is the focus of a working group that promotes yellow-billed cuckoo science, conservation, recovery, and partnerships. This working group has also adopted the Road to Recovery process, which integrates biological and social science to identify and address specific causes of yellow-billed cuckoo decline throughout its annual cycle (Road to Recovery 2023).

As the above examples show, conservation and management of SGCN regularly require working beyond state and national borders. Watersheds (such as the Gila River watershed, which contains western yellow-billed cuckoo critical habitat) and flyways (important regional partnerships for bird conservation) often encompass all or parts of multiple states and require complex coordination among many partners and jurisdictions to improve conditions and provide needed habitat. Recovery of declining species that have large ranges, like the western yellow-billed cuckoo, requires coordination with partners and agencies with interest and jurisdiction throughout the species' range. This includes partnerships between neighboring states and with regional or international organizations and alliances (e.g., Partners in Flight) that can accomplish needed conservation actions to achieve shared goals.

Threats to landscapes and ecosystems used by birds, such as the western yellow-billed cuckoo, during the migratory and nonbreeding season vary by country and region but include deforestation, commodity agriculture (palm oil), illegal logging, contaminants, and insufficient enforcement in protected areas. Poverty across this region of the world adds to the dire need for support from international partners that have a common interest in the protection and conservation of shared avifauna. Projects also need to consider the needs and interests of local communities to be successful. International conservation actions intended to curb these threats include the acquisition and protection of lands used as migratory pathways and nonbreeding sites; education of landowners on regenerative agricultural and ranching practices, including shade-grown coffee farming; the creation and maintenance of native tree nurseries; and reforestation efforts.

To address these threats, multiple southwestern states have committed to participating in cross-border FAC conservation for migratory species, including the western yellow-billed

cuckoo. This commitment is critical to the improvement and long-term sustainability of species like the yellow-billed cuckoo that migrate and winter south of the United States (Figure 58).

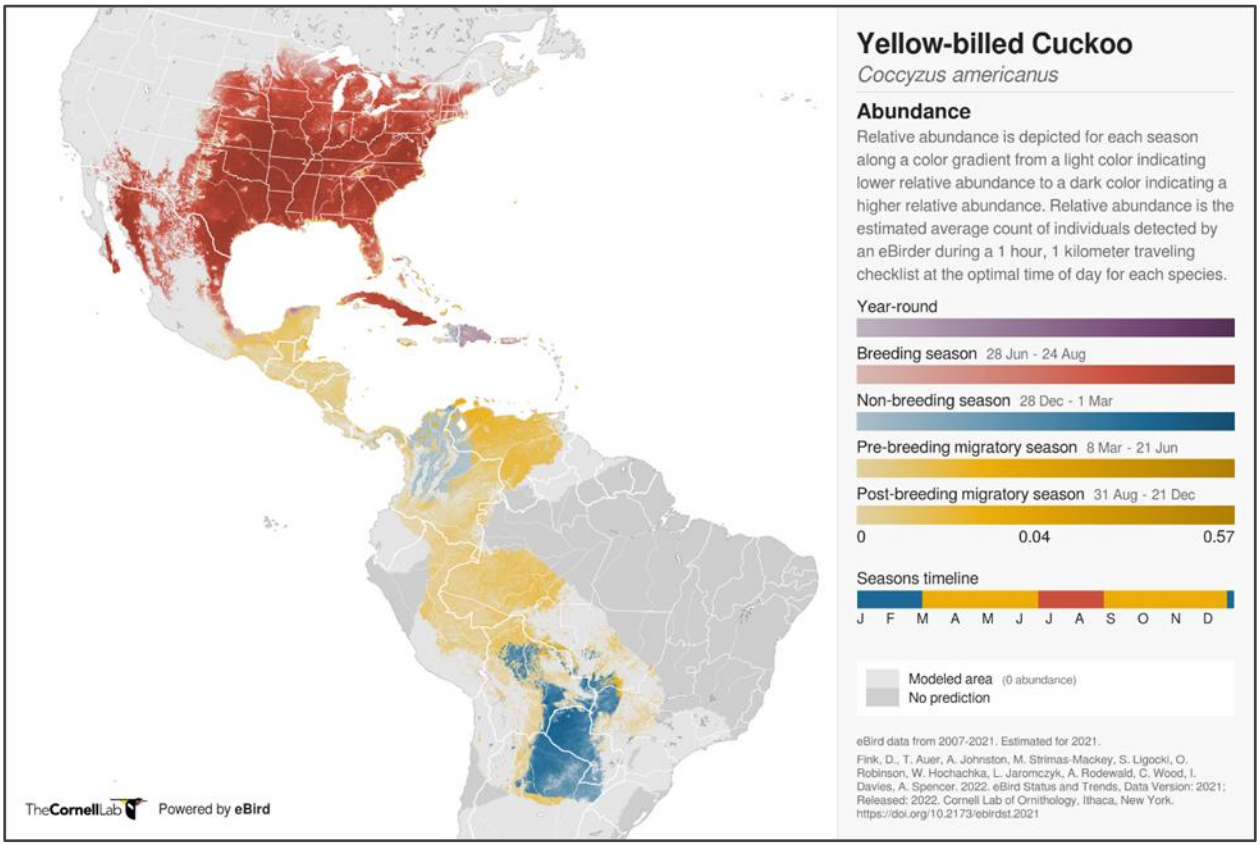


Figure 58. *Yellow-Billed Cuckoo Abundance Map Across its Full Annual Cycle*

Source: Fink et al. (2022).

Actions that require implementation of FAC conservation and those that were identified by the western yellow-billed cuckoo working group as important to implement on wintering grounds for this subspecies include conserving the Gran Chaco (scrub-forest formation); identifying and conserving critical stopover sites in tropical dry forests and other habitats; and identifying population-specific migratory routes. There are at least four Southern Wings projects that have addressed, or currently are addressing, some of these and other important actions for the yellow-billed cuckoo (Southern Wings 2024). The urgent need for additional work in the yellow-billed cuckoo's wintering grounds, such as a Southern Wings project that focuses on the Gran Chaco, presents new collaborative opportunities for states to advance FAC conservation of the species.

In summary, FAC conservation is important to consider for many SGCNs. Many breeding birds in southwestern states are neotropical migrants and spend up to 8 months of the year beyond the borders of the United States, some traveling thousands of miles each way. The millions of

migratory birds of different species that breed across Canada and the United States and winter in relatively small geographies within Mexico, Central America, South America, and the Caribbean during migration and the nonbreeding season put into perspective the importance of international FAC conservation work.

Western Association of Fish and Wildlife Agencies Initiatives

Sagebrush Conservation Design and Sagebrush Conservation Strategy

The Western Association of Fish and Wildlife Agencies (WAFWA) Sagebrush Conservation Strategy is an international collaborative effort to provide guidance for conservation efforts across the sagebrush biome, which includes 14 western states and two Canadian provinces. It was created by a team of scientists and specialists from a mix of federal and state agencies, universities, and nongovernmental organizations (NGOs). DWR participated in the production of the strategy. The WAFWA Sagebrush Conservation Strategy provides a biome-wide model to measure the ecological integrity of sagebrush ecosystems. This effort has also identified the major threats to the sagebrush ecosystem, which include invasive annual grasses, conifer encroachment, and human modifications. The ecological integrity index quantifies the trend over time of the ecosystem and the individual threats. The Sagebrush Conservation Strategy is a tool that project managers throughout the sagebrush biome can use to strengthen and justify habitat restoration projects that mitigate the threats to sagebrush ecosystems and can inform where projects can be done to protect core sagebrush habitats (WAFWA 2020).

Southwest State Wildlife Action Plan Cross Borders Group

Regional collaboration occurs across the West, but the large size of western states can often make coordination of native species conservation efforts across state boundaries challenging, especially with limited funding. Effectively implementing SWAPs within state boundaries has been the focus in the West, and wildlife diversity and SWAP coordination has suffered accordingly. Other AFWA regions have Wildlife Diversity/SWAP committees (e.g., Northeast Association of Fish and Wildlife Agencies, Midwest Association of Fish and Wildlife Agencies) and they have been effectively aligning their SWAPs over the past decade. Seeing the need for better SWAP coordination, the states of Arizona, California, New Mexico, Nevada, and Utah began meeting monthly in 2021 (Colorado and Texas joined this group in 2023) to share information and better coordinate SWAP alignment. These meetings facilitated cross-border discussions on aligning SWAP SGCNs, habitats, and threats.

The Southwest SWAP Cross Borders Group organized a WAFWA Wildlife Diversity and SWAP workshop in January 2023 to discuss opportunities to further collaborate across borders and

align SWAPs. The primary recommendation that materialized from the workshop was the need for a WAFWA Wildlife Diversity/SWAP Committee to allow a space for western states to better discuss and align SWAPs. The WAFWA Nongame/Endangered Fish and Wildlife Species Committee discussed this need at WAFWA's 2023 summer meeting and approved the formation of a WAFWA Wildlife Diversity/SWAP Committee. Since its formation, the WAFWA committee has met three times as of March 2025. In addition, the Southwest SWAP Cross Borders Group has continued to meet monthly to share ideas specific to the southwestern United States.

Western Monarch and Native Insect Pollinator Working Group

The Western Monarch and Native Insect Pollinator (WMNIP) Working Group is a multistate group organized within WAFWA that identifies regional strategies to benefit declining insect pollinator populations. One of the goals of this group is to avoid the need for federal Endangered Species Act (ESA) species listings for native insect pollinators by benefiting multiple target species through landscape-level, data-driven conservation actions. The approved 2023–2026 work plan specifically prioritizes western state and federal agency coordination and identifies shared species priorities, conservation needs and opportunities, and best management practices for native insect pollinators and their habitats.

From 2020 to 2024, Utah's representative to the WMNIP Working Group served as chairperson and steered the activities accomplished by the WMNIP Working Group. The chairperson coordinated monthly meetings, reported minutes and accomplishments, developed the WMNIP Working Group Shared Priority Species database, recruited additional state involvement beyond the seven original member states (Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington), and led both the working group charter revision and the development of the 3-year work plan. The chairperson engaged in extensive public outreach to promote awareness of the *Western Monarch Butterfly Conservation Plan 2019–2069* (WAFWA 2019) and the conservation needs of insect pollinators, virtually and in person, through multiple presentations to stakeholders, partners, and professional societies. The chairperson also facilitated partnerships with academic and nonprofit organizations to benefit western monarch and native insect pollinator data collection, information sharing, and community building. As a result, the WMNIP Working Group priorities and approach closely resemble those of Utah's Rare Insect Conservation Program, effectively setting a standard model that can be followed by other state insect conservation efforts (WAFWA 2025).

North American Wetlands Conservation Act

The North American Wetlands Conservation Act (NAWCA) provides matching grants to organizations and partnerships for wetlands conservation projects through several grant programs. NAWCA is implemented by the North American Wetlands Conservation Council, which is composed of staff from multiple federal and state agencies as well as NGOs. NAWCA projects align with the North American Waterfowl Management Plan, an international agreement supporting the long-term protection of wetlands and associated upland habitats for waterfowl and other migratory birds. DWR actively supports NAWCA in several ways.

The Utah waterfowl program consistently seeks to enhance or restore wetlands around Great Salt Lake and other regions of Utah, aligning with the core components of NAWCA's grant program. Utah's waterfowl program also supports the core strategies of the North American Waterfowl Management Plan, including habitat conservation, banding, habitat purchases, joint ventures, and public partnerships. Collaborative efforts with NGOs like Ducks Unlimited have enabled Utah to secure NAWCA grant funds.

Additionally, Utah contributes to NAWCA and the North American Waterfowl Management Plan through its involvement in the Pacific Flyway Council, helping to develop regulatory frameworks and management plans for migratory game and nongame bird species in the western United States.

DWR further supports NAWCA by voluntarily providing staff members to the NAWCA grant program. Their participation involves significant responsibility and effort, allowing Utah to share its expertise in wetlands, waterfowl, and shorebird management with the NAWCA grant program.

Pacific Flyway Council

The Pacific Flyway Council coordinates bird conservation across the western United States, Mexico, and Canada among public wildlife agencies for the purpose of protecting and conserving migratory birds that inhabit western North America. Flyway councils also have responsibilities in the annual process of setting migratory bird policy and regulations within the United States and conduct and contribute to migratory bird research and management throughout the United States, Canada, and Mexico (Pacific Flyway Council 2025).

Western Working Group of Partners in Flight

The Western Working Group of Partners in Flight promotes and implements bird conservation through development of conservation plans and land manager guides. It also identifies data gaps and coordinates bird conservation across agencies, NGOs, and individuals interested in conserving birds in the western United States, Mexico, and Canada (Partners in Flight 2025).

Intermountain West Joint Venture

Joint ventures are collaborative, regional partnerships that bring together government agencies, nonprofit organizations, corporations, tribal nations, and individuals under the guidance of national and international bird conservation plans to design and implement landscape-scale conservation efforts in support of bird management plans. Utah is located within the Intermountain West Joint Venture and is a partner in regional planning and management initiatives for this group (Intermountain West Joint Venture 2025).

U.S. Geological Survey National Species of Greatest Conservation Need List

Utah has participated in an AFWA effort with the U.S. Geological Survey to update the national SGCN list (U.S. Geological Survey 2015). Pulling SWAP information together into a national list provides a better picture of SGCN across the country. This database is a useful tool for states, territories, and partners to inform management actions for species most in need. The national SGCN list is currently updated with SWAP information through 2015 and updated state SGCN lists to seamlessly incorporate those lists as more current information becomes available.

Regional Distribution Modeling

Regional species distribution habitat models are being developed for an increasing number of SGCN species. Utah is committed to working with partners to provide data for these modeling efforts, which are an iterative process of creation, use, and refinement. Two recent efforts were the development of distribution models produced from the USFWS Science Applications program in Legacy Region 2 (USFWS 2025b) and a range-wide model for the western yellow-billed cuckoo that was a result from a competitive STWG Program project (USFWS 2024c).

Local and Statewide Initiatives

Landscape Conservation Forecasting

Landscape Conservation Forecasting (LCF) is a land mapping project effort led by The Nature Conservancy. After LCF was initiated by The Nature Conservancy, Utah partners, including DWR,

the Bureau of Land Management (BLM), the Natural Resources Conservation Service, and the U.S. Forest Service (USFS), worked together to help fund this project through DNR's Watershed Restoration Initiative (WRI) to map ecological systems and current vegetation classes and estimate departure from reference and desired management conditions (similar to LANDFIRE). This particular LCF is completed at discrete sites when funding is available, with the intention of mapping more high-priority sites across Utah. The first LCF site covered a large area of high conservation value for all partners, allowing for more comprehensive management of wildlife and vegetation across jurisdictional boundaries. For example, this tool facilitated management and reconnection of the Hamlin Valley and Pine Valley greater sage-grouse populations (Provencher et al. 2022). As of 2024, there are a total of nine LCF sites that have been completed, totaling 3.0 million acres across Utah (Figure 59).

The switch from using LANDFIRE Biophysical Settings (BpS) to LANDFIRE Existing Vegetation Type (EVT) categories for defining terrestrial key habitats (see Chapter 2, Key Habitats – Location and Condition) has created an issue with how terrestrial key habitat condition will be measured. If LCF could be extended across the entire state of Utah, this tool would allow the use of current vegetation types to define key habitats with the added benefit of a built-in condition metric.

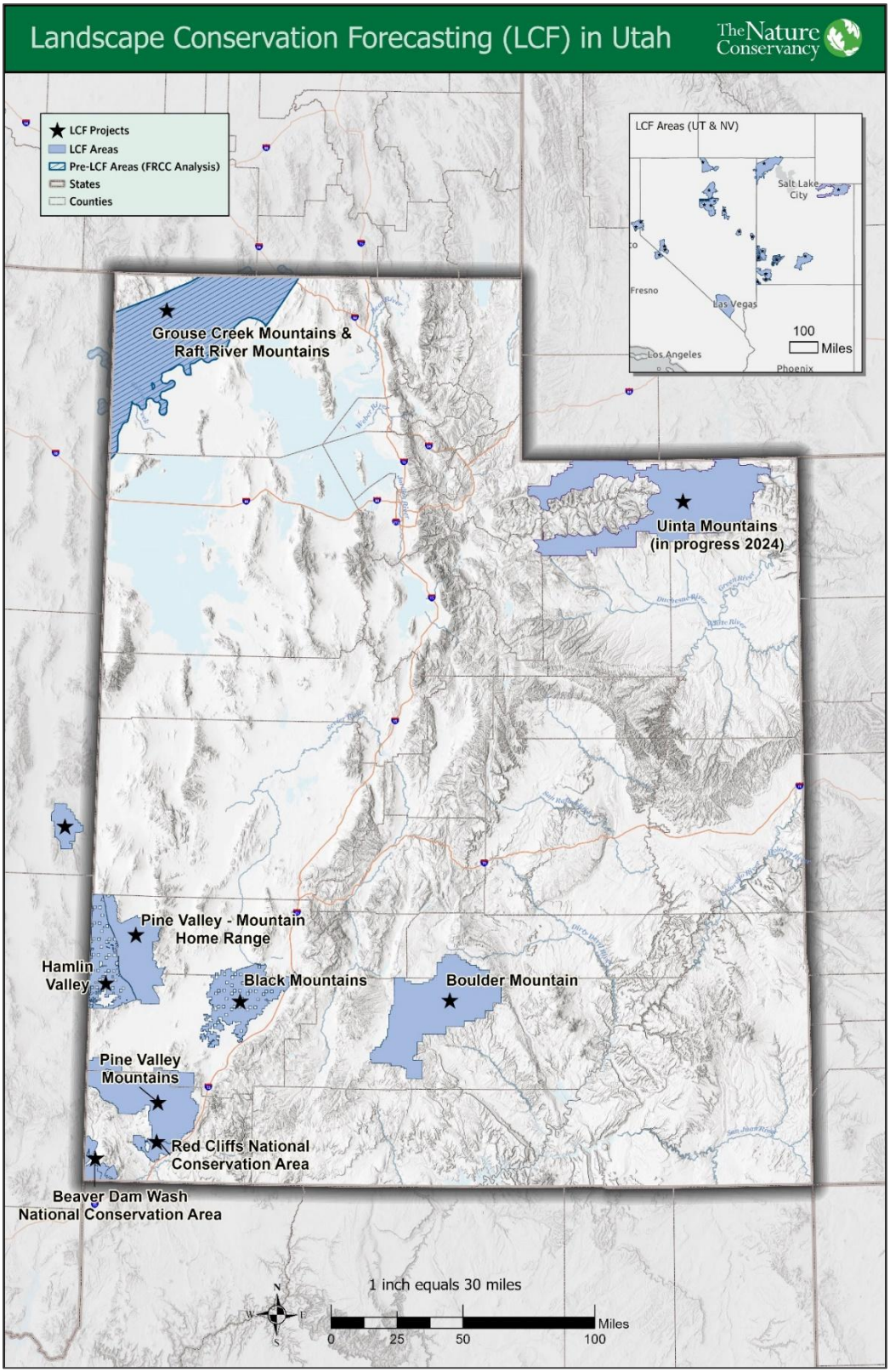


Figure 59. *The Nature Conservancy's Landscape Conservation Forecasting projects in Utah as of June 2024*

Source: Provencher (2024).

Utah's Wildlife Migration Initiative

Utah's Wildlife Migration Initiative is a statewide campaign to identify, preserve, and enhance wildlife movement. This initiative's purpose is to identify migration and movement patterns, seasonal habitat and wildlife stopover sites, priority areas that can reconnect fragmented habitat ranges, and locations that allow terrestrial and aquatic wildlife species throughout Utah to move safely from one habitat area to another. Through extensive tracking efforts to document and analyze wildlife movement and an award-winning, user-controlled database, Wildlife Migration Initiative's partners have implemented projects across jurisdictional boundaries to improve habitat connectivity, reduce highway safety concerns, and assist with land use planning.

The effort to document wildlife movement in Utah has already amassed over 43 million animal locations, and the amount of data is growing at an exponential rate. To manage, analyze, and share big data, DWR developed cloud-based data storage and processing tools that can scale as the amount of and demand for data increases. DWR is also automating the flow of data so that it can be accessed and analyzed in near real time by approved users. Dashboards are being developed that allow biologists and researchers to rapidly analyze and mine data. As data increase for SGCN species, Wildlife Migration Initiative data systems can be used to improve understanding of movement patterns (DWR 2025c).

Public Involvement

Since the development of the 2005 and 2015 UWAPs, the public has become more involved in native species conservation in the state. DWR relies heavily on partners, and several community science projects have been developed to better engage the public and implement the UWAP. A few of the communications and event outreach efforts and recent community science projects are listed below.

Communications and Outreach Efforts

News Media

DWR provides weekly news releases and invitations to all Utah media outlets. Many suggested stories feature native wildlife, plant, and invertebrate conservation efforts by DWR and partners through the implementation of the UWAP. Examples include the following:

- "Endangered Species Day: How DWR and its partners help Utah prairie dogs recover" (DWR 2024g)

- “Utah’s Endangered Species Mitigation Fund allocates $5.5 million to fund 60 projects that help wildlife recover” (DWR 2024h)

Podcasts

DWR’s monthly Wild podcast features native wildlife and local conservation efforts, such as the following (DWR 2025d):

- The three species (Episode 70)
- Hummingbird banding (Episode 66)
- Frogs, lizards and snakes, oh my! (Episode 64)
- Recovering razorback suckers (Episode 62)
- Cutthroat trout restoration (Episode 57)
- Virgin River Program (Episode 54)
- Recovery programs (Episode 48)
- Desert tortoises (Episode 47)
- Gila monsters (Episode 46)
- Helping endangered species (Episode 43)
- Rattlesnakes of Utah (Episode 30)
- Prairie dog relocations (Episode 27)
- Creatures of the night (Episode 25)
- Sunrise dance party (Episode 9)
- Unusual Easter egg hunt (Episode 7)

Blog Posts

DWR publishes a monthly blog post on its website highlighting native wildlife, including these topics (DWR 2024i):

- Conserving wild Bonneville cutthroat trout in the midst of cattle country
- Uniting for shorebirds
- Ask a herpetologist
- Tracking the recovery of one of Utah's rarest fish
- The wonderfully weird world of mollusks

Events

DWR promotes native wildlife and educates the public about the unique species found in Utah through a variety of wildlife viewing events hosted around the state each year. These events, a few of which appear below, build public appreciation and support for Utah wildlife and conservation efforts (DWR 2025e):

- Hummingbird banding and viewing near Vernal
- Desert tortoise viewing in southern Utah
- Bat survey and viewing in central Utah
- Osprey viewing at Flaming Gorge Reservoir

Social Media

As well as sharing the aforementioned examples on its social media platforms (Facebook, Instagram, Threads, X [formally Twitter], YouTube, Pinterest, and LinkedIn), DWR also creates original content for social media, much of which highlights the native species mentioned in the UWAP:

- Bat surveys and ways to help protect bats.
- Celebrating World Snake Day with fun facts about snakes.
- Impacts to woundfin habitat and programs that are addressing the issue.
- The ongoing successful recovery of the Virgin spinedace: this species was once reduced to 60% of its historical range, but due to conservation actions, this species has recovered to occupy 90% of its historical range.

Community Science Projects

Western Toad Project

Utah's Hogle Zoo and Sageland Collaborative's Western Toad Project have assisted with surveys and monitoring of western toad in Utah for over 10 years. These efforts provide valuable information to help manage this species and allow DWR biologists to focus limited time and resources on other species and native conservation projects. In addition, Utah's Hogle Zoo tells the conservation story of the western toad in its Wild Utah exhibit to engage the public and raise awareness of the species at the zoo, where they are repatriated to new and existing western toad habitats in Utah (Sageland Collaborative 2022a).

Utah Herp Search

Sageland Collaborative's Utah Herp Search uses community science to highlight unique native amphibians and reptiles in Utah where limited locality information is available. This kind of reporting has increased the number of midget faded rattlesnake observations beyond the limited survey work completed by DWR, leading to the realization that the species' distribution is larger and likely more abundant than originally believed (Sageland Collaborative 2022b). If sightings continue to be reported for this species, it likely will be removed from the SGCN list when its S-rank is next updated.

Utah Pollinator Pursuit

Utah Pollinator Pursuit encourages the public to become involved in species conservation in two key ways: 1) join a program to visit and monitor specific pollinator habitats across Utah, and 2) record pollinator sightings through a phone application to help better understand the distribution of pollinators across Utah (Utah Pollinator Pursuit 2025).

Rosy-Finch Project

The 3-year Rosy-Finch Project brought Utah community scientists together to conduct gray-crowned rosy-finch feeder counts throughout Utah (Sageland Collaborative 2022c).

Riverscape Restoration Project



Beaver Dam Analog, South Fork Chalk Creek. Photograph by Rose Smith, Sageland Collaborative, Summit County, 2024.

The Riverscape Restoration Project, led by Sageland Collaborative (2022d), brings together community scientists, restoration practitioners, and regulators to build beaver dam analog structures in important streams throughout Utah. Beaver dam analogs are low-tech, human-made wood structures that increase structural and habitat complexity in degraded riverscapes (river-riparian to floodplain systems). These structures slow water velocity, create additional stream depth during the dry times of the year, and enhance riparian habitat for the benefit of SGCNs.

Improper grazing, vegetation removal, and extirpation of American beaver have left much of Utah's riparian habitat in poor condition. Without healthy riparian vegetation and beaver dams or

large wood or other structural components, streams and rivers lose the habitat complexity needed to sustain wildlife populations and water resources.

Sageland Collaborative has worked closely with DWR and several other agencies and organizations to increase acceptance and use of simple, process-based restoration methods in Utah through volunteer opportunities, including education and outreach such as workshops cohosted with conservation districts. This work facilitated formal and informal coordination through the establishment of a working group in 2020 and coordination with partner programs such as Utah's Stream Alteration Program.

Partnerships with Agricultural Producers

In Utah, farmers, ranchers, and private landowners play a large role in the implementation of the UWAP. Partner agencies such as the Utah Farm Bureau Federation and the Natural Resources Conservation Service help message and implement projects that benefit native species. The UWAP invites and supports voluntary stewardship efforts that are essential for achieving landscape-scale conservation outcomes. Voluntary incentive-driven programs have demonstrated success in Utah and should be expanded to empower private landowners, farmers, and ranchers as conservation leaders. Some existing programs that assist private landowners' involvement are provided below.

Heart of the Rockies

The Heart of the Rockies is a regional partnership of 30 land trusts across the Rocky Mountain West that keeps family farms, ranches, and timberlands in family hands through capacity assistance, collaborative fundraising, data sharing, and networking.

Partners for Conservation

Partners for Conservation embodies a grassroots movement of private landowners working with agencies, nonprofit organizations, and policymakers to collaborate on conservation projects to sustain working landscapes for present and future generations. Partners for Conservation supports working landscapes through voluntary, incentive-based public and private programs.

Utah Grazing Improvement Program

A standout example of successful public-private partnership in Utah is the Utah Grazing Improvement Program (GIP). Established by the 2006 Rangeland Improvement Act (Utah House Bill 145), GIP provides cost-share grants and technical assistance to livestock producers for

projects that improve rangeland health, productivity, and sustainability. Eligible projects include water developments, fencing, grazing management planning, and vegetation treatments, with grants available for both large and small livestock operations (Utah Department of Agriculture and Food 2025). GIP also plays a critical role in advocating for and facilitating collaborative, landscape-scale conservation among agricultural producers.

One of GIP's most recognized achievements is its pivotal support of the Three Creeks Grazing Project in Rich County. Facing the threat of grazing permit reductions due to impaired streams and regulatory pressure, 38 ranchers formed the Three Creeks Grazing LLC. With technical guidance and advocacy from GIP, these ranchers developed and implemented a new, science-based grazing management plan across 146,000 acres of public land managed by both the BLM and the USFS (Hemken 2021). The plan, inspired by successful models on neighboring private lands, consolidated 10 separate grazing allotments into a single, coordinated system using high-density, short-duration, time-controlled grazing.

GIP's involvement was instrumental in navigating the complex federal permitting process, securing funding, and building consensus among producers and agencies. The collaborative approach enabled the implementation of infrastructure improvements, active grazing management, and robust monitoring of rangeland health and water quality. The results have been significant: improved water quality, enhanced wildlife habitat (including for greater sage-grouse), increased forage productivity, and greater economic sustainability for participating ranchers.

Implementation Mechanisms

Utah has a variety of mechanisms that are vital to UWAP implementation and public involvement. One of the goals of the UWAP is to help prevent species being listed under the ESA. UWAP is a tool for prioritizing SGCN species and key habitats for management and conservation. The UWAP enables partners (e.g., USFWS, USFS, BLM) to prioritize projects that would benefit those species and habitats. The UWAP also provides guidance for tools such as the DWR's WRI to help implement the plan. Descriptions of the important tools used to implement the UWAP are provided below.

Resource Development Coordinating Committee

The Utah Legislature created the Resource Development Coordinating Committee (RDCC) (Utah Code 63L-11-401) to

- assist the state planning coordinator in fulfilling the responsibilities of reviewing and coordinating technical and policy actions that may affect the physical resources of the state; and
- facilitate the exchange of information on those actions among state agencies and other levels of government.

Federal law provides for state collaboration and participation throughout the federal project planning process. The RDCC includes representatives from state agencies, which are generally involved in public lands management. Committee members communicate through the RDCC by submitting projects for review and commenting on federal, state, or local proposed actions.

State agency comments make known a project's potential for positive or adverse impacts and provide recommendations for mitigation. When necessary, RDCC staff coordinate and facilitate state agency comments by publishing a unified state comment. Comments may be most important in accomplishing successful outcomes. The RDCC coordinates the review of many proposed public land planning and development projects such as

- forest health and watershed improvement plans,
- wetland reviews,
- use of public range resources by livestock operators and wildlife,
- oil and gas and mining development, and
- use of public lands by off-highway vehicles (OHVs) and other recreational opportunities.

The status of every project can be viewed through the RDCC Project Management System (Public Lands Policy Coordinating Office 2025). The 2015 UWAP was submitted to the RDCC for review.

The following state agencies are represented on the RDCC:

- Office of the Governor
- DNR
- Utah Department of Environmental Quality
- Utah Department of Agriculture and Food
- Utah Trust Lands Administration
- Utah Department of Transportation
- Utah Department of Public Safety
- Utah Department of Heritage and Arts

The formal RDCC process and preliminary informal consultations are a very important mechanism for local, state, and federal projects or developments to come to the attention of DNR and DWR. This awareness is crucial, because these projects or developments may be a substantial source of threats to wildlife or their habitats. Informing, consulting, and/or collaborating with DNR and other RDCC subject-matter experts who can suggest helpful project modifications is a key mechanism for project proponents to avoid, minimize, and mitigate impacts that can escalate into ESA listing threats. Coordination for the 2025 UWAP was completed through the Public Lands Policy Coordinating Office and the Office of the Governor.

Public Meetings

DWR's Regional Advisory Councils (RACs) and Utah Wildlife Board (Board) together are the policy arm of DWR. As the ultimate decision makers for matters over which the agency has sole or lead authority, they play a vital role in adapting state wildlife management to new realities.

In each of DWR's five administrative regions, a RAC exists to recommend actions and advise the Board in wildlife and habitat management decisions. Each RAC includes representatives of agriculture, sportsmen, watchable wildlife, local government, federal land agencies, tribal nations (where appropriate), and the public at large. The RACs gather and compile information from DWR staff, the public, and government agencies before making recommendations to the Board.

The Board establishes policies designed to accomplish the purposes and to fulfill the intent of all laws pertaining to wildlife and the preservation, protection, conservation, perpetuation, introduction, and management of wildlife in Utah. In developing wildlife policy, the Board considers the recommendations of DWR personnel and each RAC but may reject recommendations with written explanation. Like RACs, the Board has open meetings where public comment is welcome prior to the finalization of any policy decisions. The governor-appointed Board is composed of seven members with expertise or experience in at least one of the following: 1) wildlife management or biology; 2) habitat management, including range or aquatic habitats; 3) business, including knowledge of private land issues; or 4) economics, including knowledge of recreational wildlife uses such as hunting and fishing.

The 2005 UWAP was directed through these channels as it was developed and finalized. Because the 2025 UWAP is an updated version of an approved plan, an informational presentation was given to the Board to highlight important updates and changes to the plan.

Species Protection Account

The Species Protection Account is a native species conservation fund established during the 1997 Utah general legislative session; the account is administered by DWR. The purpose of the Species Protection Account is to facilitate the conservation of fish, wildlife, plants, and invertebrate species and their habitats in greatest need of conservation attention. An underlying concern is to avoid, minimize, or mitigate the impacts of ESA listings to the people of Utah. The primary Species Protection Account objective is to fund projects that

- protect, conserve, and recover ESA-listed species; and
- help preclude the need for listing additional species under the ESA by implementing the UWAP.

From 1997 to 2025, the Species Protection Account was funded through a portion of a 1/16th-percent sales tax on water and by a tax provided for in the Brine Shrimp Royalty Act (Utah Code 59-23). Approximately $3.5 million was available on an annual basis. During the 2025 Utah Legislative Session, House Bill 378 was passed, which will provide revenue through taxes on certain energy projects. The anticipated revenue from this new legislation is an additional $5 million per year. Through multi-partner cooperative agreements, Utah is committed to participating in three recovery implementation programs for ESA-listed fish species: the JSRIP, the Virgin River Recovery Implementation Program, and the Colorado River Fishes Recovery Implementation Program. Utah's fiscal contribution to these programs is provided through the Species Protection Account. Additional funding is provided to the Utah Prairie Dog and Mojave Desert Tortoise ESA Programs and to the DWR to fund their native species conservation program. The remainder of Species Protection Account funds are distributed through a competitive grants program.

To receive funding, grant applications must meet the legislative intent and be consistent with the mission and objectives of DNR. Conservation organizations are encouraged to apply for funding on an annual basis. DWR projects have competed annually for Species Protection Account grants to secure the required 1:1 state matching funds to complement federal STWG Program appropriations.

State and Tribal Wildlife Grants

The STWG Program provides federal grant funds for developing and implementing SWAPs. Grant funds must be used to address conservation needs identified in a state's SWAP, such as research, surveys, species and habitat management, and monitoring. These funds may also be used to update, revise, or modify a SWAP.

Congress appropriates funds for the STWG Program on an annual basis. Funds are then apportioned to states, commonwealths, and U.S. territories based on a formula. In addition, Congress has authorized funding since 2008 for a competitive STWG Program to encourage multi-partner projects that implement actions contained in SWAPs.

As described in the Species Protection Account section above, any STWG Program dollar accepted by Utah must be matched with at least one state dollar. DWR has devoted these pooled funds to develop and maintain program capacity in three of its sections: Habitat (UWAP implementation, geographic information system [GIS], and the Utah Natural Heritage Program), Aquatics (Native Aquatics Program), and Wildlife (Native Wildlife Program).

Most of the target inventory and periodic status assessment work required for UWAP implementation will be accomplished by UWAP partner staff and community scientists, with funding from the Species Protection Account, STWG Program, and other leveraged funding from diverse sources. Most of the intensive research needs will be addressed by the academic sector, which competes for and receives funding from UWAP partner agencies (e.g., DNR, DWR, BLM, USFS, USFWS, U.S. Bureau of Reclamation) as well as other diverse sources, including private and public charities.

Utah's Watershed Restoration Initiative

Utah's WRI is the primary tool for implementing the UWAP and for tracking conservation actions. The WRI is a partnership-driven effort administered by DNR to conserve, restore, and manage ecosystems in priority areas across the state to enhance Utah's

- wildlife and biological diversity,
- water quality and yield for all uses, and
- opportunities for sustainable uses.

The WRI is an initiative sponsored by Utah Partners for Conservation and Development that serves as a clearinghouse to coordinate and share participants' conservation concerns and priorities; to discuss and implement solutions; and to promote an atmosphere of collaboration among landowners, private organizations, and state and federal agencies.

A unifying concern and priority for all Utah Partners for Conservation and Development and WRI participants is to preclude the need for ESA listings.

The WRI is committed to providing novel and dynamic solutions for statewide issues of soil, water, and species health. In an unprecedented collaborative effort, the WRI combines the

resources of agencies and organizations with long histories of ecosystem management and restoration endeavors in Utah into a single, functional partnership. From 2005 through 2024, the WRI has leveraged well over $377 million to affect the management of over 2.5 million acres. In recent years, approximately $25 to $30 million in diverse public and private funding has been applied to dozens of projects, averaging 110,000–150,000 acres annually.

The WRI has developed three general approaches to address the risks to the shared interests of the partnership:

- Ecosystem restoration through physical manipulations such as seeding, reconstruction, vegetation management, and other means
- Administrative changes in land management made through permitted or allowed uses and management prescriptions
- Communication and team building among the public, stakeholders, and the WRI to promote the understanding of risks to natural resources and values and to improve cooperation and problem solving across boundaries

The partnership is represented at four levels of organization:

- Director's council: Agency and organization administrators meet regularly.
- Statewide core teams: Each member has a representative on a state-level team that meets regularly with conservation organizations to monitor the effectiveness of each group's involvement in the partnership, share information about new programs, discuss problems, and address resource-allocation needs.
- Regional teams: Organized in each of DWR's five administrative regions, these teams consist of Utah Partners for Conservation and Development members, conservation organizations, and stakeholders who meet to discuss priority conservation focus areas, identify potential projects, and pool resources (e.g., funding, technical assistance, logistics support) needed to implement restoration projects.
- Local conservation work groups: These work groups identify local conservation concerns and develop strategies to meet local needs.

Regional teams fill the important role of acting as clearinghouses for conservation priorities and actions. Each team defines focus areas for their region and habitat restoration objectives for those areas. Objectives are developed collaboratively while focusing on management plans, the best available science, and targeted public outreach.

Each year, resource managers within the partnership propose projects to the regional teams. Proposals are entered into a statewide projects database and reviewed at regional team meetings. This approach helps the partners share information and resources, and many of the projects receive support from several partners. The following three criteria are used to evaluate the merits of project proposals:

- How well the project proposal is tied to meeting goals and objectives in plans such as the UWAP, which have been approved through a public process
- How well the project mitigates threats to land, water, and species health
- Whether the project maximizes the return on an investment made to implement the project

Part of the implementation vision for the 2025 UWAP is that most on-the-ground habitat work will be accomplished via projects initiated within or routed through the WRI. This will strengthen and formalize the consensus that has developed since approval and adoption of the 2005 UWAP, which coincided with the formation of the WRI (DNR 2024a). WRI funding is competitive, so all project managers are striving to submit the best projects that will receive the most points during the ranking process. WRI projects receive points for implementing the UWAP, specifically if the project benefits SGCNs, improves UWAP key habitats, and alleviates priority threats. SGCNs, key habitats, and priority threats are updated in the WRI each year (if needed) to ensure that UWAP projects/conservation actions are responding to new information or changing conditions.

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Appendix A

List of Subcommittees that Contributed to the Utah Wildlife Action Plan Revision

Agency Organization and Integration Subcommittee

Member	Affiliation
Adam Shaw	U.S. Forest Service (USFS)
Brianne Emery	Utah Division of Forestry, Fire and State Lands
Buck Ehler	Utah Division of Wildlife Resources (DWR)
Cassie Mellon	Bureau of Land Management (BLM)
Danielle Finlayson	DWR
Douglas (Doug) Johnson	Utah National Guard, Environmental Resource Management
Katrina Derieg	Natural History Museum of Utah
Kayleigh Mullen	Trout Unlimited
Kevin Bunnell	DWR
Mary Pendergast	Sageland Collaborative
Nate Long	U.S. Department of Defense Dugway Proving Ground
Paul Thompson (lead)	**DWR**
Russ Lawrence	U.S. Air Force (USAF) Hill Air Force Base (AFB)
Russell Norvell	DWR
Stephanie Graham	SWCA Environmental Consultants (SWCA)
Tyler Thompson	Utah Department of Natural Resources (DNR)

Aquatic Key Habitats Subcommittee

Member	Affiliation
Adam Brewerton	DWR
Alison Whittaker	DWR
Audrey McCulley	SWCA

Cassie Mellon	BLM
Chance Broderius	DWR
Diane Menuz (co-lead)	**Utah Geological Survey (UGS)**
Emily Hamel	National Audubon Society
Janice Gardner	Sageland Collaborative
Jessica Pierson	DWR
Jim Spencer	Natural Resources Conservation Service
Jordan Nielson	Trout Unlimited
Josh Rasmussen	U.S. Fish and Wildlife Service (USFWS)
Kayleigh Mullen	Trout Unlimited
Lee Jacobson	USFS
Paul Thompson (co-lead)	**DWR**
Peter Goodwin	UGS
Phaedra Budy	Utah State University (USU)
Randy Oplinger	DWR
Rose Smith	Sageland Collaborative
Sarah Seegert	DWR
Todd Volkening	DWR
Tyler Stratman	DWR

Climate Adaptation Subcommittee

Member Name	**Affiliation**
Buck Ehler	DWR
Danielle Costantini	USFWS
Diane Menuz	UGS
Edward Hammill	USU
George Oliver	DWR
Janice Gardner	Sageland Collaborative
Kevin Gunnell	DWR

Member Name	Affiliation
Kris Hulvey	Working Lands Conservation
Lorelle Berkeley	SWCA
Marin Glenney	USFS
Mary Pendergast	Sageland Collaborative
Michael Clifford (co-lead)	**The Nature Conservancy**
Michelle Baragona	Public Lands Policy Coordinating Office
Mindy Wheeler	USU/DWR
Natalie Little	USFS
Olivia Miller	U.S. Geological Survey
Patrick Belmont	USU
Paul Thompson (co-lead)	**DWR**
Russell Norvell	DWR
Scott Harding	USU
Tyler Stratman	DWR

Habitat Connectivity Subcommittee

Member Name	Affiliation
Allison Jones	Conservation Science Partners
Blair Stringham	DWR
Danny Summers	DWR
Dave Cook	BLM
Elaine York	The Nature Conservancy
Isobel Lingenfelter (co-lead)	**Utah Wildlife Federation**
John Shivik	USFS
Kate Novak	USFWS
Kimberly Hersey	DWR
Lacey Wilder	SWCA
Mary Pendergast	Sageland Collaborative

Member Name	Affiliation
Matt Howard	Utah Department of Transportation
Nate Long	U.S. Department of Defense Dugway Proving Ground
Nicole Nielson	DWR
Patrick Anderson	DWR
Patty Cramer	The Wildlife Connectivity Institute
Paul Thompson (co-lead)	**DWR**
Russ Lawrence	USAF Hill AFB
Randy Oplinger	DWR
Tim Brown	Tracy Aviary
Tyler Stratman	DWR
Tyler Thompson	DNR
Zachary Clausen	DWR

Landscape and Regional Focus Subcommittee

Member	Affiliation
Allison Jones	Conservation Science Partners
Brian Maxfield	DWR
Cooper Farr	Tracy Aviary
Danny Summers	DWR
Elaine York	The Nature Conservancy
Erica Stuber	USU
Jillian Cosgrove	USFWS
Kimberly Hersey	DWR
Lorelle Berkeley	SWCA
Mary Pendergast	Sageland Collaborative
Matt Howard	Utah Department of Transportation
Mindy Wheeler	USU/DWR
Nicole Nielson (co-lead)	**DWR**

Member	Affiliation
Paul Thompson (co-lead)	**DWR**
Russ Lawerence	USAF Hill AFB
Tyler Stratman	DWR
Tyler Stratman	DWR

Plant and Insect Integration Subcommittee

Member	Affiliation
Aaron Roe	BLM
Amanda Barth	USU/DWR
Danny Summers	DWR
Erica Stuber	USU
George Oliver	DWR
Lorelle Berkeley	SWCA
Mary Pendergast	Sageland Collaborative
Matthew Utley	Tracy Aviary
Mindy Wheeler	USU/DWR
Paul Thompson (lead)	**DWR**
Rachel Irvin	USU
Rita Reisor	USFWS
Tova Spector	USFS

Species of Greatest Conservation Need (SGCN) Subcommittee

Member	Affiliation
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Adam Sovinsky	DWR
Amanda Barth	USU/DWR
Bryant Olsen	Tracy Aviary
Chance Broderius	DWR
Chanté Lundskog	DWR

Member	Affiliation
Christy Bills	Natural History Museum of Utah
Erica Stuber	USU
George Oliver	DWR
George Weekley	USFWS
Jace Taylor	USAF
Jason DeForest	Public Lands Policy Coordinating Office
Jordan Herman	HawkWatch
Katrina Derieg	Natural History Museum of Utah
Kimberly Hersey	DWR
Laura Ault	Public Lands Policy Coordinating Office
Lorelle Berkeley	SWCA
Tyler Stratman	DWR
Lisa Graham	DWR
Lizzie Carroll	DWR
Mary Pendergast	Sageland Collaborative
Matt Phillippi	Natural Resources Conservation Service
Megan Halaburda	DWR
Megen Kepas	DWR
Mindy Wheeler	USU/DWR
Paul Thompson (co-lead)	**DWR**
Rachel Irvin	USU
Russell Norvell	DWR
Sarah Lindsey (co-lead)	**DWR**
Sarah Seegert	DWR
Scott Gibson	DWR
Tova Spector	USFS
Trip Armstrong	USU/National Aquatic Monitoring Center

Member	Affiliation
Zachary Clausen	DWR

Terrestrial Key Habitats Subcommittee

Member	Affiliation
Adam Sovinsky	DWR
Alison Whittaker	DWR
Benjamin Gibbons	USU
Daniel Eddington	DWR
Danny Summers	DWR
Kimberly Hersey	DWR
Maeve Stevens	DWR
Meghan McCormick	USU
Mindy Wheeler	DWR/USU
Nicole Nielson	DWR
Paul Thompson (lead)	**DWR**
Rachel Irvin	USU
Russell Norvell	DWR
Sarah Lindsey	DWR
Tyler Stratman	DWR

Water Subcommittee

Member	Affiliation
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Diane Menuz	UGS
Emily Hamel	National Audubon Society
Emily Jainarain	UGS
Hugh Hurlow	UGS
Jared Dalebout	BLM
Kade Lazenby	DWR

Member	Affiliation
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Melissa Early	DWR
Olivia Miller	U.S. Geological Survey
Paul Thompson (lead)	**DWR**
Todd Volkening	DWR

Appendix B

Glossary

Abiotic: The non-living physical and chemical components that affect living organisms.

Alkali flats (alkali soils): Alkali land, also known as alkaline land, refers to soils with a high pH level (above 7.0) and often high levels of soluble salts. These soils are typically found in arid and semiarid regions where evaporation exceeds precipitation, leading to salt accumulation. Alkali soils can be saline-alkali, meaning they have both high salt and exchangeable sodium content.

Alpine: Refers to a mountainous region with high elevations. Alpine climate is typically cold, snowy, and windy.

Appropriation: Money or assets devoted to a special purpose, such as wildlife protections, in regard to the Utah Wildlife Action Plan (UWAP).

Aquaculture: Breeding, raising, and harvesting fish, shellfish, and aquatic plants.

Archetypal: The historic or reference habitat condition.

Atmospheric deposition: A process in which particles and/or substances from the atmosphere are deposited onto the Earth's surface. In UWAP, this term describes the threat of air pollutants being returned to the Earth that can negatively affect land and water resources.

Badlands: Colloquial term for dry terrain that is typically characterized by steep slopes, minimal vegetation, and extensively eroded soft sedimentary rocks (e.g., mudrock and sandstone) and clay-rich soils. Badlands often encompass different-shaped landforms such as buttes, which are small hills with steep sides and a flat top. Typically unsuitable for agriculture.

Biological community (ecological community): Encompasses a group of interacting species (populations) living in a prescribed area (delineated habitat) at the same time that form a network of relationships within a particular environment, interact with each other and with the available resources, and influence subsequent biological interactions and population dynamics. Biological communities are essentially the living constituents of a given ecosystem (Stroud et al. 2015).

Biophysical gradient: A characteristic or property that varies from one point to another, physically or chemically (e.g., temperature, pH, concentration, or pressure).

Biophysical Settings (BpS): A modeled representation of the vegetation system that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of modeled past disturbance regimes (LANDFIRE 2024a).

Biotic: Anything living, from plants and animals to microbes.

Channel downcutting: An overall geological process in which hydraulic action deepens a stream or valley by removing material from its floor.

Channelization: Occurs when a river or stream channel has been modified (e.g., straightening, widening, deepening, clearing, or changing location). Reasons a stream may have been modified include flood control, navigation, and drainage.

Climate adaptation: Actions that aid in reducing current or potential foreseeable impacts from climate change.

Climate change: Change in climate patterns (e.g., those resulting from increased atmospheric greenhouse gases like carbon dioxide) and/or events outside the natural range of variation.

Climate refugia: Areas relatively buffered from contemporary climate change over time that enable persistence of valued physical, ecological, and sociocultural resources. More broadly, climate refugia are habitats that components of biodiversity retreat to, persist in, and can potentially expand from under changing environmental conditions.

Community (ecological community): An assemblage of species that coexist in a similar environment.

Conservation Opportunity Areas: Delineated part of the landscape where conservation efforts can have significant benefits to species of greatest conservation need.

Decadence: Forestry term for dead, broken, or deformed tops and/or bole or root rot (U.S. Forest Service 2007).

Ecoregion: Areas at the spatial scale of ecosystems similar in type, quality, and quantity of environmental resources, including biotic, abiotic, terrestrial, and aquatic ecosystem components (U.S. Environmental Protection Agency 2023).

Ecosystem: A physiogeographically defined area wherein the aggregate physical, chemical, and biological processes and services distinguish it from surrounding areas. Ecosystems are the product of the interacting biodiversity within a given habitat.

Edge effect: Edge refers to the boundary or transition zone between two adjacent land cover types (Cadanasso et al. 2003), such as the boundary between riparian habitat and forest or agriculture and shrub-steppe. Edges can affect several ecological parameters, including species distributions and interactions (Fagan et al. 1999; Ries et al. 2004), which have implications for the structure of habitat and the support habitat provides for species (e.g., providing appropriate temperature and cover) as well as implications for the function and management of ecosystems (Porensky and Young 2013). Edge effects can be affected by and associated with habitat fragmentation and habitat connectivity (see the definitions for these terms in this glossary), which can alter the impacts of edge effects (Porensky and Young 2013).

Effluent: Liquid waste that is discharged usually from sewers into a waterbody.

Endangered species; Endangered Species Act–listed species: Species of plants or animals that are listed or proposed for listing as endangered or threatened and are protected under the Endangered Species Act of 1973.

Endemic: A plant or animal that is native to a certain ecosystem.

Environmental gradients: A change in abiotic factors over time such as altitude, depth, temperature, and soil humidity.

Evapotranspiration: Loss of water from soil by evaporation from the soil surface and by transpiration from the leaves of plants.

Exceptional Drought: According to the U.S. Drought Monitor, Exceptional Drought is the most intense or severe drought; it generally occurs once or twice in a 100-year period. During this type of drought, losses of crops and pastures as well as widespread water shortages occur. This type of drought is also known as *D4* within the categories of drought. These range from D1 (the least intense) to D4 (the most intense) (U.S. Drought Monitor 2025).

Existing Vegetation Type (EVT): Modeled representations of the current distribution of habitat types across the landscape defined as plant community types that tend to co-occur in similar landscapes with similar ecological processes, substrates, or environmental gradients (LANDFIRE 2024b).

Extent: Location or geographic distribution within the state along with the amount of coverage, both of which can be represented via maps or associated tables.

Fluvial: Found in or related to a river or flowing water.

Habitat connectivity (landscape connectivity): The degree to which the landscape facilitates or impedes species dispersal movement among habitat patches, which may allow movement of genes, individuals, populations, and species and mitigate population isolation in fragmented habitat. Connectivity focuses on structural or functional corridors that increase dispersal rates between habitat patches across unsuitable, poor quality, or matrix (nonbreeding) habitat and depends on species' movement abilities in crossing landscape mosaics. Habitat connectivity can be associated with and impacted by edge effects and habitat fragmentation (see these terms in this glossary).

Habitat fragmentation: The breaking up of a large intact area of a single land cover type into smaller patches (Lord and Norton 1990). In the case of UWAP, this term refers to breaking up once large and contiguous areas of a land cover type into less contiguous areas as a result of anthropogenic disturbances (Franklin et al. 2002) such as conversion of a native land cover to agriculture. Habitat fragmentation can be associated with and alter the impacts of edge effects (see this term in this glossary) and can impact habitat connectivity (see this term in this glossary).

Hydrologic Unit Codes (HUCs): A hierarchical numbering system developed by the U.S. Geological Survey specifically for watersheds. Each HUC number references a specific watershed. This numbering system enables agencies to agree on watershed boundaries and pinpoint issues such as water quality problems.

Imperiled: At high risk of extinction or extirpation due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

Invasive non-native/alien plants and animals: Species introduced either intentionally or accidentally by humans in the last 10,000 years. Also, harmful plants and animals not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread by human activities (Conservation Measures Partnership 2016).

Invertebrates: Animals that do not possess or develop a spinal column. Includes insects and crustaceans.

Key habitat: In this case, key habitat refers to habitats that are prioritized within Utah. These habitats are based on EVT categories in LANDFIRE (2020a).

LANDFIRE: Also known as Landscape Fire and Resource Management Planning Tools (LANDFIRE 2025). This regularly updated geospatial data source aids in strategic fire and resource management planning and analysis and provides landcover and associated condition

data across the United States. LANDFIRE was used for the UWAP to identify terrestrial key habitats and their associated condition.

Landsat imagery: Satellite imagery that captures high-quality images of Earth's surface. This imagery aids in tracking land use, climate changes, and other environmental and natural resource concerns, such as drought and wildfire (U.S. Geological Survey 2025b).

Landscape Conservation Forecasting: A land mapping effort developed by The Nature Conservancy. The Nature Conservancy worked in partnership with Utah Division of Wildlife Resources, the Bureau of Land Management, the Natural Resources Conservation Service, and the U.S. Forest Service to help fund this project through the Utah Department of Natural Resources Watershed Restoration Initiative to map ecological systems and current vegetation classes and estimate departure from reference and desired management conditions (similar to LANDFIRE but with much finer resolution).

Morphological: Relating to the branch of biology that deals with the form of living organisms and relationships between their structures.

Perennial: Things that are enduring or continually recurring.

Phenology: The study of phases or events in biological life cycles such as bird migration or emergence of leaves and flowers.

Population: A collection of individuals of a species in a defined area that may or may not breed with other groups of that species in other places (Mills 2013).

Problematic native plants and animals: Harmful plants and animals that are originally found within the ecosystem(s) in question but have become out of balance or been released directly or indirectly due to human activities (e.g., overabundant native deer, overabundant algae due to loss of native grazing fish, plague that affects rodents, invasive grasses).

Propagation: Captive breeding to aid the recovery of or augment species with declining populations or help maintain genetic diversity in small, isolated populations.

Regime: The conditions or characteristic behaviors of scientific or natural processes.

- **Fire regime:** The frequency, duration, intensity, extent, and seasonality of wildfire disturbance at a location**.**
- **Flow regime:** The pattern of flow or fluid distribution of one fluid phase relative to another.

- **Geochemical regime:** The relative abundance, distribution, and movement of the Earth's chemical elements.
- **Hydrologic or flooding regime:** The timing, duration, volume, and pattern of flow or flood events during a defined period of time**.**
- **Precipitation regime:** The characteristics of the seasonal distribution of precipitation at a location.
- **Sediment regime:** Refers to the size, quantity, and distribution of sediments.

Restoration: The action of returning something to a former owner, place, or condition.

Riparian: Relating to, on, or along the banks of a river.

Ruderal: Plants that grow on disturbed areas where vegetation cover has been interrupted.

Seral: A specific vegetation community occurring on a site at some point in time. For example, a vegetation community that grows after a disturbance event (Old Growth Forest Ecology 2025).

N-rank and S-rank: NatureServe's national (N-rank) and subnational (S-rank) levels are part of NatureServe's larger conservation status ranking system to determine level of vulnerability; they are used to help determine which species should be considered a species of greatest conservation need for the UWAP. N-ranks for species of greatest conservation need were determined by NatureServe and partners; S-ranks were determined by the Utah Division of Wildlife Resources.

Stakeholders: Individuals, groups, organizations, or their representatives (interested parties) that work closely with Utah Division of Wildlife Resources or that may have an interest in or be affected by the activities and decisions included within the UWAP. Interested parties may also seek to influence Utah Division of Wildlife Resources' future direction.

State and Tribal Wildlife Grants Program: "Funds states and territories [and tribal nations] to help develop and implement programs that benefit wildlife and wildlife habitat through two programs: 1) a competitive national grants program and 2) a formula, or mandatory, grant program" (National Wildlife Federation 2025). This program funds more than half of all nongame work in Utah when matched with state funds.

Steppe: A semiarid grassland that occurs in temperate climates.

- Sagebrush steppe: A vegetation community in the Intermountain West dominated by sagebrush that includes other native shrubs, grasses, and flowering plants.

Subspecies: A taxonomic category that ranks below species.

Substrates: Of or relating to sediment, soil, bedrock, or other materials that make up the floor or bed or a waterbody; an underlying layer of rock or other materials beneath the soil.

Successional (ecological succession): The gradual change in species composition causing the structure of a biological community to change over time.

Suppression: In this case, the act of reducing, controlling, or preventing wildfire events.

Taxonomic: Scientific classification of organisms.

Terrestrial: In this case, species or habitats found on land, versus those found in water (aquatic).

Threatened species: Species of plants or animals of concern that have the potential to become endangered and are protected under the Endangered Species Act of 1973.

Translocation: Capturing and moving a free-ranging animal from one location to another.

Urbanization: The process of transforming rural areas or areas with no human settlement to cities with a higher density of infrastructure and human populations.

Vegetation type: The characteristic dominant plant species in a community (see this term in this glossary) (Ornduff et al. 2003:112).

Vertebrates: Animals that have a spinal column.

Appendix C

Scientific Names for Species Found in the Utah Wildlife Action Plan

COMMON NAME	*SCIENTIFIC NAME*
Amphibians	
American bullfrog	*Lithobates catesbeianus*
Arizona toad	*Anaxyrus microscaphus*
Columbia spotted frog	*Rana luteiventris*
Northern leopard frog	*Lithobates pipiens*
Relict leopard frog	*Lithobates onca*
Western toad	*Anaxyrus boreas*
Birds	
American avocet	*Recurvirostra americana*
American bittern	*Botaurus lentiginosus*
American goshawk	*Accipiter atricapillus*
American kestrel	*Falco sparverius*
American white pelican	*Pelecanus erythrorhynchos*
Band-tailed pigeon	*Patagioenas fasciata*
Bank swallow	*Riparia riparia*
Bendire's thrasher	*Toxostoma bendirei*
Black-necked stilt	*Himantopus mexicanus*
Black rosy-finch	*Leucosticte atrata*
Black swift	*Cypseloides niger*
Black tern	*Chlidonias niger*
Black-throated gray warbler	*Setophaga nigrescens*
Boreal owl	*Aegolius funereus*

COMMON NAME	*SCIENTIFIC NAME*
Burrowing owl	*Athene cunicularia*
California condor	*Gymnogyps californianus*
California gull	*Larus californicus*
Calliope hummingbird	*Selasphorus calliope*
Carolina parakeet	*Conuropsis carolinensis*
Caspian tern	*Hydroprogne caspia*
Cassin's finch	*Haemorhous cassinii*
Clark's grebe	*Aechmophorus clarkii*
Common nighthawk	*Chordeiles minor*
Costa's hummingbird	*Calypte costae*
Eared grebe	*Podiceps nigricollis*
Evening grosbeak	*Coccothraustes vespertinus*
Ferruginous hawk	*Buteo regalis*
Flammulated owl	*Psiloscops flammeolus*
Golden eagle	*Aquila chrysaetos*
Gray-crowned rosy-finch	*Leucosticte tephrocotis*
Gray vireo	*Vireo vicinior*
Greater sage-grouse	*Centrocercus urophasianus*
Greater yellowlegs	*Tringa melanoleuca*
Gunnison sage-grouse	*Centrocercus minimus*
Heath hen	*Tympanuchus cupido cupido*
Lewis's woodpecker	*Melanerpes lewis*
Loggerhead shrike	*Lanius ludovicianus*
Long-billed curlew	*Numenius americanus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Long-eared owl	*Asio otus*
Marbled godwit	*Limosa fedoa*

COMMON NAME	*SCIENTIFIC NAME*
Mexican spotted owl	*Strix occidentalis lucida*
Olive-sided flycatcher	*Contopus cooperi*
Osprey	*Pandion haliaetus*
Passenger pigeon	*Ectopistes migratorius*
Pine grosbeak	*Pinicola enucleator*
Pinyon jay	*Gymnorhinus cyanocephalus*
Red crossbill	*Loxia curvirostra*
Red-necked phalarope	*Phalaropus lobatus*
Rufous hummingbird	*Selasphorus rufus*
Sagebrush sparrow	*Artemisiospiza nevadensis*
Sharp-tailed grouse (subspecies: Columbian sharp-tailed grouse)	*Tympanuchus phasianellus* (*Tympanuchus phasianellus columbianus*)
Short-eared owl	*Asio flammeus*
Snowy plover	*Anarhynchus nivosus*
Southwestern willow flycatcher	*Empidonax traillii extimus*
Spectacled cormorant	*Urile perspicillatus*
Western sandpiper	*Calidris mauri*
White-faced ibis	*Plegadis chihi*
Willet	*Tringa semipalmata*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Wilson's phalarope	*Phalaropus tricolor*
Yellow-billed cuckoo (subspecies: western yellow-billed cuckoo)	*Coccyzus americanus* (*Coccyzus americanus occidentalis*)
Crustaceans	
Brine shrimp	*Artemia* spp.
Pilose crayfish	*Pacifastacus gambelii*
Utah amphipod	*Stygobromus utahensis*

COMMON NAME	*SCIENTIFIC NAME*
Fishes	
Bear Lake sculpin	*Cottus extensus*
Bear Lake whitefish	*Prosopium abyssicola*
Bluehead sucker	*Pantosteus discobolus*
Bonneville cisco	*Prosopium gemmifer*
Bonneville cutthroat trout	*Oncorhynchus virginalis utah*
Bonneville whitefish	*Prosopium spilonotus*
Bonytail	*Gila elegans*
Brown trout	*Salmo trutta*
Colorado pikeminnow	*Ptychocheilus lucius*
Colorado River cutthroat trout	*Oncorhynchus virginalis pleuriticus*
Desert sucker	*Pantosteus clarkii*
Flannelmouth sucker	*Catostomus latipinnis*
Green sucker	*Pantosteus virescens*
Humpback chub	*Gila cypha*
June sucker	*Chasmistes liorus*
Least chub	*Iotichthys phlegethontis*
Loricariid (armored) catfish	*Ancistrus* spp.
Northern leatherside	*Lepidomeda copei*
Rainbow trout	*Oncorhynchus mykiss*
Razorback sucker	*Xyrauchen texanus*
Red shiner	*Cyprinella lutrensis*
Roundtail chub	*Gila robusta*
Southern leatherside	*Lepidomeda aliciae*
Virgin River chub	*Gila seminuda*
Virgin spinedace	*Lepidomeda mollispinis*
Westslope cutthroat trout	*Oncorhynchus lewisi*

COMMON NAME	*SCIENTIFIC NAME*
Woundfin	*Plagopterus argentissimus*
Yellowstone cutthroat trout	*Oncorhynchus virginalis bouvieri*
Insects	
A checkered beetle	*Trichodes simulator*
A geometrid moth	*Sicya crocearia*
A sweat bee	*Dieunomia triangulifera*
A sweat bee	*Nomia howardi*
Alkali fly	*Ephydra hians*
American bumble bee/Sonoran bumble bee	*Bombus pensylvanicus*/*Bombus sonorus*
Apache spiketail	*Cordulegaster diadema*
Bark beetles (subspecies: Ips beetle)	*Dendroctonus* spp. (*Ips* spp.)
Bauer's blue	*Euphilotes baueri*
Bleached skimmer	*Libellula composita*
Bowman's tiger moth	*Grammia bowmani*
Brimstone clubtail	*Stylurus intricatus*
Brine fly	*Ephydra gracilis*
Bumble bees	*Bombus* spp.
California marble	*Euchloe hyantis*
Carpenter bees	*Xylocopa* spp.
Checkered-skippers	*Pyrgus* spp.
Cockerell's bumble bee	*Bombus cockerelli*
Common loosestrife oil bee	*Macropis nuda*
Coral Pink Sand Dunes tiger beetle	*Cicindela albissima*
Crested sallfly	*Gaufinia cristata*
Cuckoo bumble bees	*Psithyrus* spp.
Dainty sulphur	*Nathalis iole*

COMMON NAME	*SCIENTIFIC NAME*
Desert forktail	*Ischnura barberi*
Desert orange-tip	*Anthocharis cethura*
Digger bees	Anthophora spp.
Douglas-fir beetle	*Dendroctonus pseudotsugae*
Dune scarab beetles	*Polyphylla* spp.
Ellis' dotted-blue	*Euphilotes ellisii* complex
Fairy bees	*Perdita*
Fir engraver beetle	*Scolytus ventralis*
Fritillaries, crescents, checkerspots	Tribe Melitaeini
Giant skippers	*Megathymus* spp.
Giant salmonfly	*Pteronarcys californica*
Goblin bees	*Macrotera* spp.
Golden-belted bumble bee	*Bombus kirbiellis/balteatus*
Great Basin snaketail	*Ophiogomphus morrisoni*
Griffin's sheepmoth	*Hemileuca griffini*
High country bumble bee	*Bombus balteatus*
Inept miner bee	*Panurginus ineptus*
Japanese beetle	*Popillia japonica*
Large marble butterfly	*Euchloe ausonides*
Lavender dancer	*Argia hinei*
Leafcutter bees	*Megachile* spp.
Leafcutting bees	*Ashmeadiella* spp.
Lichen moth	*Lycomorpha regulus*
Marsh-treader bugs	*Hydrometra* spp.
Mason bees	*Osmia* spp.
MacNeill’s saltbush sootywing	*Hesperopsis gracielae*
Melissa arctic	*Oeneis melissa*

COMMON NAME	*SCIENTIFIC NAME*
Miner bees	*Calliopsis* spp.
Mojave blue	*Euphilotes mojave* complex
Mojave poppy bee	*Perdita meconis*
Mojave sootywing	*Hesperopsis libya libya*
Monarch butterfly	*Danaus plexippus*
Morrison's bumble bee	*Bombus morrisoni*
Mountain digger bees	*Habropoda* spp.
Mountain pine beetle	*Dendroctonus ponderosae*
Nevada cloudywing	*Thorybes nevada*
Nevada nomia	*Dieunomia nevadensis*
Nimble squash bee	*Xenoglossa strenua*
Nokomis/Silverspot butterfly	*Speyeria nokomis nokomis*
Olive clubtail	*Stylurus olivaceus*
Pallid blue	*Euphilotes pallescens* complex
Persephone's darner	*Aeshna persephone*
Pine sawflies	*Neodiprion* spp.
Pronuba moth	*Noctua pronuba*
Pyramid ants	*Dorymyrmex* spp.
Red imported fire ants	*Solenopsis invicta*
Redheaded sphecid wasps	*Eucerceris* spp.
Relict fritillary	*Boloria kriemhild*
Riffle darner	*Oplonaeschna armata*
Rita blue	*Euphilotes rita* complex
Ruddy copper butterfly	*Tharsalea rubidus*
Salmonflies	*Pteronarcys californica*
Sandstone digger bee	*Anthophora pueblo*
Sara orange-tip butterfly	*Anthocharis sara*

COMMON NAME	*SCIENTIFIC NAME*
Scullen's potter wasp	*Eumenes sculleni*
Sheridan's green hairstreak butterfly	*Callophrys sheridanii* complex
Shield-handed wasps	*Crabro* spp.
Silver-bordered fritillary butterfly	*Boloria myrina tollandensis/selene*
Silver-spotted skipper	*Epargyreus clarus*
Small blue	*Philotiella speciosa*
Spangler’s hydroporus diving beetle	*Hydroporus spangleri*
Spruce beetle	*Dendroctonus rufipennis*
Spruce budworm	*Choristoneura occidentalis*
Suckley's cuckoo bumble bee	*Bombus suckleyi*
Sunflower sweat bee	*Dieunomia heteropoda*
Tanner’s black camel cricket/Sand treader	*Utabaenetes tanneri*
Thicket hairstreak	*Callophrys spinetorum*
Toad bugs	*Gelastocoris* spp.
Utah Chaetarthrian water scavenger beetle	*Chaetarthria utahensis*
Utah hydroporus diving beetle	*Hydroporus longiusculus*
Utah limnebius minute moss beetle	*Limnebius utahensis*
Utah wood-nymph	*Cercyonis pegala utahensis*
Velvet longhorned beetles	*Trichoferus campestris*
Viceroy	*Limenitis archippus* complex
Water boatmen	*Callicorixa* spp.
Water bugs	*Ambrysus* spp.
Water strider	*Aquarius remigis*
West Coast lady butterfly	*Vanessa annabella*
Western bumble bee	*Bombus occidentalis*
Western monarch	*Danaus plexippus plexippus*
Wiest's sphinx moth	*Euproserpinus wiesti*

COMMON NAME	*SCIENTIFIC NAME*
Mammals	
A subspecies of the American deermouse	*Peromyscus maniculatus inclarus*
A subspecies of Botta's pocket gopher	*Thomomys bottae minimus*
A subspecies of Botta's pocket gopher	*Thomomys bottae nesophilus*
A subspecies of the chisel-toothed kangaroo rat	*Dipodomys microps alfredi*
A subspecies of the chisel-toothed kangaroo rat	*Dipodomys microps russeolus*
A subspecies of the chisel-toothed kangaroo rat	*Dipodomys microps subtenuis*
A subspecies of the desert woodrat	*Neotoma lepida marshalli*
A subspecies of Ord's kangaroo rat	*Dipodomys ordii cineraceus*
A subspecies of the western harvest mouse	*Reithrodontomys megalotis ravus*
Allen's big-eared bat	*Idionycteris phyllotis*
American beaver	*Castor canadensis*
American pika	*Ochotona princeps*
Banner-tailed kangaroo rat	*Dipodomys spectabilis*
Beaver	*Castor* spp.
Bighorn sheep	*Ovis canadensis*
Bison	*Bison bison*
Black bear	*Ursus americanus*
Black-footed ferret	*Mustela nigripes*
Bobcat	*Lynx rufus*
Burro	*Equus asinus*
Caribbean monk seal	*Neomonachus tropicalis*
Coyote	*Canis latrans*
Crawford's gray shrew	*Notiosorex crawfordi*
Dark kangaroo mouse	*Microdipodops megacephalus*
Dwarf shrew	*Sorex nanus*
Eastern elk	*Cervus elaphus canadensis*

COMMON NAME	*SCIENTIFIC NAME*
Elk	*Cervus canadensis*
Fringed bat	*Myotis thysanodes*
Gunnison’s prairie dog	*Cynomys gunnisoni*
Hoary bat	*Lasiurus cinereus*
Horse	*Equus caballus*
Inyo shrew	*Sorex tenellus*
Jackrabbit	*Lepus* spp.
Kit fox	*Vulpes macrotis*
Little brown bat	*Myotis lucifugus*
Long-eared bat	*Myotis evotis*
Long-legged bat	*Myotis volans*
Long-tailed pocket mouse	*Chaetodipus formosus*
Merriam's shrew	*Sorex merriami*
Moose	*Alces alces*
Mountain lion	*Puma concolor*
Mule deer	*Odocoileus hemionus*
North American water vole	*Microtus richardsoni*
Oregon jumping mouse	*Zapus oregonus*
Preble's shrew	*Sorex preblei*
Pronghorn	*Antilocapra americana*
Pygmy rabbit	*Brachylagus idahoensis*
Southwestern jumping mouse	*Zapus princeps*
Spotted bat	*Euderma maculatum*
Steller’s sea cow	*Hydrodamalis gigas*
Stephens’ woodrat	*Neotoma stephensi*
Townsend's big-eared bat	*Corynorhinus townsendii*
Utah prairie dog	*Cynomys parvidens*

COMMON NAME	*SCIENTIFIC NAME*
Western red bat	*Lasiurus frantzii*
Western water shrew	*Sorex navigator*
White-tailed jackrabbit	*Lepus townsendii*
White-tailed prairie dog	*Cynomys leucurus*
Wolverine	*Gulo gulo*
Yuma bat	*Myotis yumanensis*
Mollusks	
Apple snails	*Pomacea* spp.
Bear Lake springsnail	*Pyrgulopsis pilsbryana*
Bifid duct pyrg	*Pyrgulopsis peculiaris*
Black Canyon pyrg	*Pyrgulopsis plicata*
Carinate Glenwood pyrg	*Pyrgulopsis inopinata*
Creeping ancylid	*Ferrissia rivularis*
Desert springsnail	*Pyrgulopsis deserta*
Desert tryonia	*Tryonia porrecta*
Fat-whorled pondsnail	*Ladislavella bonnevillensis*
Green River pebblesnail	*Fluminicola coloradoensis*
Hamlin Valley pyrg	*Pyrgulopsis hamlinensis*
Lindahl's pyrg	*Pyrgulopsis lindahlae*
Longitudinal gland pyrg	*Pyrgulopsis anguina*
Mountain marshsnail	*Walterigalba montanensis*
Northwest Bonneville pyrg	*Pyrgulopsis variegata*
Nuwuvi pyrg	*Pyrgulopsis nuwuvi*
Otter Creek pyrg	*Pyrgulopsis fusca*
Pine Grove pyrg	*Pyrgulopsis pinetorum*
Prairie fossaria	*Galba bulimoides*
Quagga mussel	*Dreissena bugensis*

COMMON NAME	*SCIENTIFIC NAME*
Rocky Mountain duskysnail	*Colligyrus greggi*
Santa Clara pyrg	*Pyrgulopsis santaclarensis*
Smooth Glenwood pyrg	*Pyrgulopsis chamberlini*
Springsnails	*Pyrgulopsis* spp.
Sub-globose snake pyrg	*Pyrgulopsis saxatilis*
Western pearlshell	*Margaritifera falcata*
Wet-rock physa	*Physella zionis*
Winged floater	*Anodonta nutalliana*
Wrinkled marshsnail	*Hinkleyia caperata*
(No common name)	*Galba techella*
Plants	
Abajo daisy	*Erigeron abajoensis*
Ackerman green gentian	*Frasera ackermaniae*
Alcove daisy	*Erigeron zothecinus*
Alcove rock-daisy	*Perityle specicola*
Alfalfa	*Medicago sativa*
Alkali sacaton	*Sporobolus airoides*
Alpine avens	*Geum rossii*
Alpine besseya	*Synthyris alpina*
Alpine bog laurel	*Kalmia microphylla*
Alpine buttercup	*Ranunculus adoneus*
Alpine locoweed	*Oxytropis deflexa* var. *pulcherrima*
Alpine peppergrass	*Lepidium montanum* var. *alpinum*
Alpine sagebrush	*Artemisia scopulorum*
Alpine shooting star	*Dodecatheon alpinum*
Alpine sorrel	*Oxyria digyna*
American alpine speedwell	*Veronica wormskjoldii*

COMMON NAME	*SCIENTIFIC NAME*
American vetch	*Vicia americana*
Angell cinquefoil	*Potentilla angelliae*
Ann Kelsey's milkvetch	*Astragalus kelseyae*
Antelope bitterbrush	*Purshia tridentata*
Aquarius Indian paintbrush	*Castilleja aquariensis*
Arapien stickleaf	*Mentzelia argillosa*
Arctic bluegrass	*Poa arctica*
Arctic gentian	*Gentiana algida*
Arctic rush	*Juncus arcticus*
Argyle Canyon phacelia	*Phacelia argylensis*
Aromatic scurf-pea	*Pediomelum aromaticum* var. *aromaticum*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Aspen	*Populus* spp.
Atwood's camissonia	*Chylismia atwoodii*
Atwood's columbine	*Aquilegia atwoodii*
Atwood's pretty	*Phacelia pulchella* var. *atwoodii*
Autumn buttercup	*Ranunculus aestivalis*
Avon milkvetch	*Astragalus praelongus* var. *avonensis*
Baker's alpineparsley	*Oreoxis bakeri*
Ball cacti	*Parodia* spp.
Barneby ridgecress	*Lepidium barnebyanum*
Barneby's aromatic scurf-pea	*Pediomelum aromaticum* var. *barnebyi*
Barneby's reed-mustard	*Hesperidanthus barnebyi*
Barneby's rockaster	*Herrickia kingii* var. *barnebyana*
Barren-ground willow	*Salix brachycarpa*
Basalt milkvetch	*Astragalus subcinereus* var. *basalticus*
Basin big sagebrush	*Artemisia tridentata* ssp. *tridentata*

COMMON NAME	*SCIENTIFIC NAME*
Basin jamesia	*Jamesia tetrapetala*
Basin wildrye	*Leymus cinereus*
Beaked sedge	*Carex utriculata*
Beardtongue	*Penstemon* spp.
Bear River Range beardtongue	*Penstemon compactus*
Beaver Mountain groundsel	*Packera castoreus*
Bebb's willow	*Salix bebbiana*
Bellardi bog sedge	*Kobresia myosuroides*
Ben's beardtongue	*Penstemon franklinii*
Bermuda grass	*Cynodon dactylon*
Bitterbrush	*Callophrys spinetorum*
Big galleta	*Hilaria rigida*
Big sagebrush	*Artemisia tridentata*
Big tooth maple	*Acer grandidentatum*
Birch leaf mountain mahogany	*Cercocarpus montanus*
Biscuitroot	*Lomatium* spp.
Bistort	*Bistorta* spp.
Black sagebrush	*Artemisia nova*
Black sedge	*Carex nigra*
Blackbrush	*Coleogyne ramosissima*
Blackroot sedge	*Carex elynoides*
Blaine's pincushion	*Sclerocactus blainei*
Bluebell	*Mertensia* spp.
Blue elder	*Sambucus cerulea*
Blue flax	*Linum lewisii*
Blue grama grass	*Bouteloua gracilis*
Blue mountain beardtongue	*Penstemon scariosus* var. *cyanomontanus*

COMMON NAME	*SCIENTIFIC NAME*
Blue spruce	*Picea pungens*
Blue wildrye	*Elymus glaucus*
Bluebunch wheatgrass	*Pseudoroegnaria spicata*
Bluegrass	*Poa* spp.
Booth's willow	*Salix boothii*
Bottlebrush squirreltail	*Elymus elymoides*
Boxelder	*Acer negundo*
Bristlecone pine	*Pinus longaeva*
Broom snakeweed	*Gutierrezia sarothrae*
Broom spurge	*Chamaesyce spp.*
Brown's tansy-mustard	*Descurainia browniae*
Buckwheat	*Eriogonum* spp.
Bud sagebrush/Budsage	*Picrothamnus desertorum*
Bulldog knolls buckwheat	*Eriogonum heermannii* var. *subspinosum*
Bullrush	*Schoenoplectus* spp.
Burke's whitlow-grass	*Draba burkei*
Burrobush	*Ambrosia dumosa*
Bush muhly	*Muhlenbergia porteri*
California barrel cactus	*Ferocactus cylindraceus*
Canaan Mountain beardtongue	*Penstemon ammophilus*
Canada thistle	*Cirsium arvense*
Canyon sweetvetch	*Hedysarum occidentale* var. *canone*
Canyonlands lomatium	*Lomatium latilobum*
Cat's eye	*Oreocarya* spp.
Cattail	*Typha* spp.
Cedar Breaks biscuitroot	*Cymopterus minimus*
Cedar Breaks sandwort	*Arenaria kingii* ssp. *plateauensis*

COMMON NAME	*SCIENTIFIC NAME*
Chatterley's onion	*Allium geyeri* var. *chatterleyi*
Cheatgrass	*Bromus tectorum*
Chokecherry	*Prunus virginiana*
Cholla	*Cylindropuntia* spp.
Cinquefoil	*Potentilla* spp.
Cisco milkvetch	*Astragalus sabulosus*
Clark's lomatium	*Lomatium graveolens* var. *clarkii*
Claron pepperplant	*Lepidium montanum* var. *claronense*
Claron twinpod	*Physaria chambersii* var. *sobolifera*
Clausen’s violet	*Viola clauseniana*
Clay phacelia	*Phacelia argillacea*
Clay reed-mustard	*Hesperidanthus argillaceus*
Cliffrose	*Purshia mexicana*
Columbine	*Aquilegia* spp.
Comb Wash wild buckwheat	*Eriogonum clavellatum*
Common dandelion	*Taraxacum officinale*
Common juniper	*Juniperus communis*
Common Mediterranean grass	*Schismus barbatus*
Coneflower	*Echinacea* spp.
Copper Canyon milkvetch	*Astragalus cutleri*
Cottam's buckwheat	*Eriogonum brevicaule* var. *cottamii*
Cottam's cinquefoil	*Potentilla cottamii*
Cottonwood	*Populus* spp.
Cottonwood Springs suncup	*Chylismia exilis*
Cow parsnip	*Heracleum maximum*
Coyote willow	*Salix exigua*
Creeping draba	*Draba sobolifera*

COMMON NAME	*SCIENTIFIC NAME*
Creeping sibbaldia	*Sibbaldia procumbens*
Creosote bush	*Larrea tridentata*
Crested wheatgrass	*Agropyron cristatum*
Creutzfeldt-flower	*Cryptantha creutzfeldtii*
Cronquist daisy	*Erigeron cronquistii*
Cronquist milkvetch	*Astragalus cronquistii*
Cronquist wild buckwheat	*Eriogonum cronquistii*
Cronquist woodyaster	*Xylorhiza cronquistii*
Cronquist's phacelia	*Phacelia cronquistiana*
Curl-leaf mountain mahogany	*Cercocarcups ledifolius*
Currant milkvetch	*Astragalus uncialis*
Cushion phlox	*Phlox pulvinata*
Cutler's spurred lupine	*Lupinus caudatus* var. *cutleri*
Dad's penstemon	*Penstemon patricus*
Daisy	*Tetraneuris* spp.
Dandelion	*Taraxacum* spp.
Death camas	*Toxicoscordion venenosum*
Deep Creek stickseed	*Hackelia ibapensis*
Dense spikemoss	*Selaginella densa*
Deseret milkvetch	*Astragalus desereticus*
Deseret penstemon	*Penstemon humilis* var. *desereticus*
Desert almond	*Prunus fasciculata*
Desert marigold	*Baileya multiradiata*
Desert valley fishhook-cactus	*Sclerocactus spinosior*
Desert willow	*Chilopsis linearis*
Desolation Canyon columbine	*Aquilegia desolaticola*
Despain pincushion cactus	*Pediocactus despainii*

COMMON NAME	*SCIENTIFIC NAME*
Diamond Valley suncup	*Eremothera gouldii*
Different groundsel	*Packera dimorphophylla* var. *intermedia*
Dogbane	*Apocynum cannabinum*
Dogwood	*Cornus* spp.
Douglas-fir	*Pseudotsuga menziesii*
Drab phacelia	*Phacelia indecora*
Drooping star-of-Bethlehem	*Ornithogalum nutans*
Drummond's willow	*Salix drummondiana*
Dryspike sedge	*Carex siccata*
Duchesne hawthorne	*Crataegus douglasii* var. *duchesnensis*
Duchesne penstemon	*Penstemon duchesnensis*
Duchesne River twinpod	*Physaria stylosa*
Duchesne rockcress	*Boechera duchesnensis*
Dwarf alpine Indian paintbrush	*Castilleja nana*
Dwarf bear-poppy	*Arctomecon humilis*
Eastwood evening-primrose	*Chylismia eastwoodiae*
Eastwood's podistera	*Podistera eastwoodiae*
Elderflower	*Sambucus racemosa*
Elk sedge	*Carex geyeri*
Engelmann aster	*Aster engelmannii*
Engelmann spruce	*Picea englemanii*
Entrada skeletonplant	*Lygodesmia grandiflora* var. *entrada*
Evening primrose	*Oenothera* spp.
False fluffgrass	*Dasyochloa pulchella*
False hellebore	*Veratrum californicum*
Franklin's ceanothus	*Ceanothus franklinii*
Fendler’s bluegrass	*Poa fendleriana*

COMMON NAME	*SCIENTIFIC NAME*
Fir	*Abies* spp.
Firleaf beardtongue	*Penstemon abietinus*
Fleabane	*Erigeron* spp.
Foster's columbine	*Aquilegia fosteri*
Fourwing saltbush	*Atriplex canescens*
Frank Smith's violet	*Viola frank-smithii*
Fremont cottonwood	*Populus fremontii*
Frisco buckwheat	*Eriogonum soredium*
Frisco Mountains mustard	*Terraria haydenii*
Galleta	*Pleuraphis jamesii Torr.*
Gambel oak	*Quercus gambelii*
Gardner's saltbush	*Atriplex gardneri*
Garrett bladderpod	*Physaria garrettii*
Garrett's fleabane	*Erigeron garrettii*
Gate Canyon buckwheat	*Eriogonum hylophilum*
Gentians	*Gentiana* spp.
Giant four-wing saltbush	*Atriplex canescens* var. *gigantea*
Gibben's beardtongue	*Penstemon gibbensii*
Gierisch's globemallow	*Sphaeralcea gierischii*
Glandular cinquefoil	*Drymocallis micropetala*
Glenwood milkvetch	*Astragalus loanus*
Globe sedge	*Carex perglobosa*
Globemallow	*Sphaeralcea* spp.
Golden banners	*Thermopsis* spp.
Golden currant	*Ribes aureum*
Goodhope oak	*Quercus gambelii* var. *bonina*
Goodrich eared rockcress	*Boechera goodrichii*

COMMON NAME	*SCIENTIFIC NAME*
Goodrich's blazingstar	*Mentzelia goodrichii*
Goodrich's cleomella	*Cleomella hillmanii* var. *goodrichii*
Goodrich's columbine	*Aquilegia scopulorum* var. *goodrichii*
Goodrich's penstemon	*Penstemon goodrichii*
Goose Creek milkvetch	*Astragalus anserinus*
Graham cryptanth	*Cryptantha grahamii*
Graham's beardtongue	*Penstemon grahamii*
Graham's columbine	*Aquilegia grahamii*
Graham's twinpod	*Physaria grahamii*
Grand Canyon evening daisy	*Haplopappus scopulorum* var. *hirtellus*
Greasewood	*Sarcobatus vermiculatus*
Great Basin wildrye	*Leymus cinereus*
Green's rabbitbrush	*Chrysothamnus greenei*
Groundsel	*Senecio* spp.
Grouse Creek rockcress	*Boechera falcatoria*
Guard milkvetch	*Astragalus zionis* var. *vigulus*
Gumbo milkvetch	*Astragalus ampullarius*
Gumweed	*Grindelia* spp.
Hairy arnica	*Arnica mollis*
Halogeton	*Halogeton glomeratus*
Hamilton's milkvetch	*Astragalus hamiltonii*
Harrison's rockcress	*Boechera harrisonii*
Harrison's thistle	*Cirsium harrisonii*
Heartleaf arnica	*Arnica cordifolia*
Hedgehog cactus	*Echinocereus* spp.
Heil's wild buckwheat	*Eriogonum corymbosum* var. *heilii*
Heliotrope milkvetch	*Astragalus montii*

COMMON NAME	*SCIENTIFIC NAME*
Hemlock parsley	*Conioselinum scopulorum*
Henry Mountain phacelia	*Phacelia crenulata* var. *orbicularis*
Hidden wirelettuce	*Stephanomeria occultata*
Higgins biscuitroot	*Cymopterus glomeratus* var. *higginsii*
Higgin's fleabane	*Erigeron higginsii*
Holmgren cinquefoil	*Potentilla holmgrenii*
Horsebrush	*Tetradymia* spp.
Horse Canyon stickleaf	*Mentzelia librina*
Horseshoe milkvetch	*Astragalus equisolensis*
Houndstongue	*Cynoglossum officinale*
House range primrose	*Primula domensis*
House Rock Valley indigobush	*Psorothamnus arborescens* var. *pubescens*
Huber's daisy	*Erigeron radicatus*
Huber's pepperplant	*Lepidium huberi*
Huckleberry	*Vaccinium* spp.
Hughes' phacelia	*Phacelia hughesii*
Hyssop/Nettle-leaf Giant-hyssop	*Agastache urticifolia*
Ibex buckwheat	*Eriogonum ammophilum*
Idaho fescue	*Festuca idahoensis*
Idaho penstemon	*Penstemon idahoensis*
Indian paintbrush	*Castilleja* spp.
Indian ricegrass	*Achnatherum hymenoides*
Intermediate wheatgrass	*Thinopyrum intermedium*
Intermountain wavewing	*Cymopterus basalticus*
Intrusive milkvetch	*Astragalus laccoliticus*
Iodinebush	*Allenrolfea occidentalis*
Isely's milkvetch	*Astragalus iselyi*

COMMON NAME	*SCIENTIFIC NAME*
James' galleta grass	*Hilaria jamesii*
Japanese brome	*Bromus japonicus*
Jimsonweed	*Datura stramonium*
Joanna's thistle	*Cirsium joannae*
Johnston catseye	*Cryptantha johnstonii*
Jones cycladenia	*Cycladenia humilis* var. *jonesii*
Jones' false goldenaster	*Heterotheca jonesii*
Jones' globemallow	*Sphaeralcea caespitosa* var. *caespitosa*
Jones indigobush	*Psorothamnus polydenius* var. *jonesii*
Juniper	*Juniperus* spp.
Joshua tree	*Yucca brevifolia*
Kane breadroot	*Pediomelum megalanthum* var. *epipsilum*
Kass rockcress	*Draba kassii*
Katie's daisy	*Erigeron katiae*
Kaye's wild buckwheat	*Eriogonum artificis*
Kentucky bluegrass	*Poa pratensis*
Kinnikinnick	*Arctostaphylos uva-ursi*
Kodachrome bladderpod	*Physaria tumulosa*
Larkspur	*Delphinium* spp.
La Sal cinquefoil	*Potentilla paucijuga*
La Sal daisy	*Erigeron mancus*
La Sal Mountains' groundsel	*Senecio fremontii* var. *inexpectatus*
Last Chance townsendia	*Townsendia aprica*
Limber pine	*Pinus flexilis*
Link trail columbine	*Aquilegia rubicunda*
Little alkali-grass	*Puccinellia simplex*
Little bluestem	*Schizachyrium scoparium*

COMMON NAME	*SCIENTIFIC NAME*
Little sagebrush	*Artemisia arbuscula*
Locoweed	*Astragalus* spp.; *Oxytropis* spp.
Lodgepole pine	*Pinus contorta*
Logan wild buckwheat	*Eriogonum loganum*
Longleaf phlox	*Phlox longifolia*
Lori's columbine	*Aquilegia loriae*
Lost Creek buckwheat	*Eriogonum mitophyllum*
Low sagebrush	*Artemisia arbuscula*
Lupine	*Lupinus* spp.
Maguire’s primrose	*Primula maguirei*
Maguire’s whitlow-grass	*Draba maguirei* var. *maguirei*
Maguire's bitterroot	*Lewisia maguirei*
Mallow bark ninebark	*Physocarpus malvaceus*
Manyflowered stoneseed	*Lithospermum multiflorum*
Maple	*Acer* spp.
Marcus Jones' penstemon	*Penstemon marcusii*
Mat penstemon	*Penstemon caespitosus*
Mat saltbush	*Atriplex corrugata*
Maybell loco	*Oxytropis besseyi* var. *obnapiformis*
Meager camissonia	*Chylismia exilis*
Mesic milkvetch	*Astragalus diversifolius*
Milkweed	*Asclepias* spp.
Mock orange	*Peraphyllum ramosissimum*
Modest milkvetch	*Astragalus amphioxys* var. *modestus*
Monkshood	*Aconitum columbianum*
Mormon tea/Joint firs	*Ephedra* spp.
Moss campion	*Silene acaulis*

COMMON NAME	*SCIENTIFIC NAME*
Mount Belknap draba	*Draba ramulosa*
Mountain avens	*Dryas octopetala*
Mountain big sagebrush	*Artemisia tridentata vaseyana*
Mountain brome	*Bromus carinatus*
Mountain coyote mint	*Monardella odoratissima*
Mountain mahogany	*Cercocarpus* spp.
Mountain pine	*Pinus* spp.
Mountain snowberry	*Symphorocarpos orepohilus*
Mt. Bartles buckwheat	*Eriogonum brevicaule* var. *promiscuum*
Mt. Carmel twinpod	*Physaria lepidota* var. *lepidota*
Mt. Naomi musineon	*Musineon naomiensis*
Muhly	*Muhlenbergia* spp.
Mule's ears	*Wyethia amplexicaulis*
Murdock's evening primrose	*Oenothera murdockii*
Musinea groundsel	*Packera musiniensis*
Musk thistle	*Carduus nutans*
Mussentuchit gilia	*Aliciella tenuis*
Muttongrass	*Poa fendleriana*
Mystery wormwood	*Artemisia biennis* var. *diffusa*
Nachlinger catchfly	*Silene nachlingerae*
Narrow-leaf cottonwood	*Populus angustifolia*
Narrow-leaf evening primrose	*Oenothera acutissima*
Narrow-leaved skeletonplant	*Stephanomeria tenuifolia* var. *uintaensis*
Navajo beardtongue	*Penstemon navajoa*
Navajo Lake milkvetch	*Astragalus limnocharis* var. *limnocharis*
Navajo sedge	*Carex specuicola*
Nebraska sedge	*Carex nebrascensis*

COMMON NAME	*SCIENTIFIC NAME*
Needle and thread grass	*Hesperostipa comata*
Neese's pepperplant	*Lepidium montanum* var. *neeseae*
Netleaf hackberry	*Celtis reticulata*
Net-veined willow	*Salix reticulata*
Nevada Mormon tea	*Ephedra nevadensis*
Noel’s columbine	*Aquilegia holmgrenii*
Nootka rose	*Rosa nutkana*
Nuttall's saltbush	*Atriplex nuttallii*
Oak	*Quercus* spp.
Oatgrass	*Danthonia* spp.
Ocean spray	*Holodiscus discolor*
Orchard grass	*Dactylis glomerata*
Oregon grape	*Mahonia repens*
Orpine stonecrop	*Sedum debile*
Osha	*Ligusticum porteri*
Ostler peppergrass	*Lepidium ostleri*
Ostler's ivesia	*Ivesia shockleyi* var. *ostleri*
Out-of-the-way yucca	*Yucca angustissima* var. *avia*
Paradox milkvetch	*Astragalus holmgreniorum*
Paria spurge	*Euphorbia nephradenia*
Paria sunflower	*Heliomeris soliceps*
Pariette cactus	*Sclerocactus brevispinus*
Parish's Great Basin sagebrush	*Artemisia tridentata* ssp. *parishii*
Parry's clover	*Trifolium parryi*
Parry's oatgrass	*Danthonia parryi*
Parry's primrose	*Primula parryi*
Passey's onion	*Allium passeyi*

COMMON NAME	*SCIENTIFIC NAME*
Pavement phacelia	*Phacelia sabulonum*
Peabody's milkvetch	*Astragalus pubentissimus* var. *peabodianus*
Penland's beardtongue	*Penstemon yampaensis*
Pennell’s draba	*Draba pennellii*
Penstemon	*Penstemon* spp.
Periwinkle	*Vinca spp.*
Phlox	*Phlox* spp.
Phragmites	*Phragmites australis*
Pickleweed	*Salicornia* spp.; *Sarcocomia* spp.
Pine	*Pinus* spp.
Pine dropseed	*Blepharoneuron tricholepis*
Pine Valley goldenbush	*Ericameria crispa*
Pink alumroot	Heuchera rubescens
Pinyon	*Pinus* spp.
Pinyon penstemon	*Penstemon pinorum*
Pinyon pine	*Pinus edulis*
Plane-leaf willow	*Salix planifolia*
Podunk groundsel	*Packera malmstenii*
Pohl's milkvetch	*Astragalus lentiginosus* var. *pohlii*
Ponderosa pine	*Pinus ponderosa*
Potato cactus	*Opuntia fragilis*
Prairie junegrass	*Koeleria macrantha*
Prairie sagebrush	*Artemisia frigida*
Prickly pear	*Opuntia* spp.
Prince’s plume	*Stanleya* spp.
Pritchett Canyon goldenaster	*Heterotheca postpetrinis*
Pullup muhly	*Muhlenbergia filiformis*

COMMON NAME	*SCIENTIFIC NAME*
Purple-spined hedgehog cactus	*Echinocereus relictus*
Pursh's plantain	*Plantago patagonica*
Quaking aspen	*Populus tremuloides*
Rabbit Valley gilia	*Aliciella caespitosa*
Rabbit Valley greenthread	*Thelesperma subnudum* var. *alpinum*
Rabbitbrush	*Ericameria* spp.; *Chrysothamnus* spp.
Range Creek bladderpod	*Physaria hemiphysaria* ssp. *lucens*
Raspberry	*Rubus* spp.
Rayless coneflower	*Rudbeckia occidentalis*
Red brome	*Bromus rubens*
Red Canyon twinpod	*Physaria lepidota* ssp. *membranacea*
Redberry desert-thorn	*Lycium andersonii*
Reed canarygrass	*Phalaris arundinacea*
Reedgrass	*Calamagrostis purpurescens*
Resin birch	*Betula glandulosa*
Reveal Indian paintbrush	*Castilleja revealii*
River hawthorn	*Crataegus rivularis*
Rockfoil	*Saxifraga* spp.
Rocky Mountain juniper	*Juniperus scopulorum*
Rocky Mountain maple	*Acer glabrum*
Rollin's sweetvetch	*Hedysarum boreale* var. *gremiale*
Ross’ avens	*Geum rossii*
Rubber rabbitbrush	*Ericameria nauseosa*
Russian knapweed	*Centaurea repens*
Russian olive	*Elaeagnus angustifolia*
Russian thistle	*Salsola tragus*
Rydberg's musineon	*Musineon lineare*

COMMON NAME	*SCIENTIFIC NAME*
Sagebrush	*Artemisia* spp.
Salt wheatgrass	*Leymus salinus*
Saltbush	*Atriplex* spp.
Saltgrass	*Distichlis spicata*
Sand dropseed	*Sporobolus cryptandrus*
Sand sagebrush	*Artemisia filifolia*
Sandberg bluegrass	*Poa secunda*
Sanderson's bursage	*Hymenoclea sandersonii*
Sandhill muhly	*Muhlenbergia pungens*
Santaquin draba	*Draba santaquinensis*
Saskatoon serviceberry	*Amelanchier alnifolia*
Scarlet buckwheat	*Eriogonum microtheca* var. *phoeniceum*
Scorpionweed	*Phacelia* spp.
Scouler's willow	*Salix scouleriana*
Sedge	*Carex* spp.
September 11 stickleaf	*Mentzelia memorabilis*
Sevier Canyon stickleaf	*Mentzelia flumensevera*
Shadscale saltbush	*Atriplex confertifolia*
Sheathed deathcamus	*Anticlea vaginatus*
Sheep fescue	*Festuca ovina*
Shiny rabbitbrush	*Chrysothamnus nauseosa* ssp. *nitidus*
Shivwits milkvetch	*Astragalus ampullarioides*
Shortleaf fescue	*Festuca brachyphylla*
Showy fleabane	*Erigeron speciosus*
Shrubby reed-mustard	*Hesperidanthus suffretescens*
Shultz stickleaf	*Mentzelia shultziorum*
Siberian elm	*Ulmus pumila*

COMMON NAME	*SCIENTIFIC NAME*
Sigurd Easter daisy	*Townsendia jonesii* var. *lutea*
Siler pincushion cactus	*Pediocactus sileri*
Silver milkvetch	*Astragalus subcinereus* var. *subcinereus*
Silver sage	*Salvia argentea*
Silver sagebrush	*Artemisia cana*
Silverleaf buffaloberry	*Sheperdia argentea*
Silver-leaf sunray	*Enceliopsis argophylla*
Single-leaf pinyon	*Pinus monophylla*
Skunk cabbage	*Verbascum thapsis*
Skunkbush sumac	*Rhus trilobata*
Skypilot	*Polemonium eximium*
Slender phlox	*Microsteris gracilis*
Slender thelypody	*Thelypodium sagittatum* ssp. *ovalifolium*
Slender wheatgrass	*Elymus trachycaulis*
Slimstem muhly	*Muhlenbergia filiculmis*
Small-leaf pussytoes	*Antennaria parvifolia*
Smith's buckwheat	*Eriogonum smithii*
Smoky Mountain globemallow	*Sphaeralcea fumariensis*
Smooth brome	*Bromus inermis*
Smooth sumac	*Rhus glabra*
Snakeweed	*Gutierrezia sarothrae*
Snowbasin rockcress	*Boechera glareosa*
Snowberry	*Symphoricarpos* spp.
Snowfield big sagebrush	*Artemisia tridentata spiciformis*
Spanish bayonet	*Yucca sterilis*
Spearleaf rabbitbrush	*Chrysothamnus linifolius*
Speckled alder	*Alnus incana*

COMMON NAME	*SCIENTIFIC NAME*
Spike fescue	*Festuca kingii*
Spike sedge	*Carex spicata*
Spiny hopsage	*Grayia spinosa*
Spiny milkvetch	*Astragalus kentrophyta*
Spiny phlox	*Phlox hoodii*
Spruce	*Picea* spp.
Stage Station milkvetch	*Astragalus vehiculus*
Stemless beardtongue	*Penstemon acaulis*
Sticky laurel	*Ceanothus velutinus*
Sticky-leaf rabbitbrush	*Chrysothamnus viscidiflorus*
Stonecrop	*Sedum* spp.
Stone rubberweed	*Hymenoxys lapidicola*
Stoneseed	*Lithospermum* spp.
Subalpine fir	*Abies lasiocarpa*
Sumac	*Rhus* spp.
Sunnyside green-gentian	*Frasera gypsicola*
Sweet cicely	*Osmorhiza chilensis*
Sweet penstemon	*Penstemon angustifolius* var. *dulcis*
Table Cliff milkvetch	*Astragalus limnocharis* var. *tabulaeus*
Tamarisk/Saltcedar	*Tamarix ramosissima*
Thick-spike wheatgrass	*Elymus lanceolatus*
Thimbleberry	*Rubus parviflorus*
Thompson’s flameflower	*Phemeranthus thompsonii*
Three-awn grass	*Aristida* spp.
Thurber's fescue	*Festuca thurberi*
Thurber's needlegrass	*Achnatherum thurberianum*
Timber oatgrass	*Danthonia intermedia*

COMMON NAME	*SCIENTIFIC NAME*
Timothy	*Phleum pratense*
Tolmie's owl's-clover	*Orthocarpus holmgreniorum*
Torrey’s milkvetch	*Astragalus calycosus*
Trefoil	*Lotus* spp.
Trelease's alkali milkvetch	*Astragalus racemosus* var. *treleasei*
Trotter oreoxis	*Oreoxis trotteri*
Trumpet buckwheat	*Eriogonum inflatum*
Tufted hairgrass	*Deschampsia cespitosa*
Tuhy aromatic scurf-pea	*Pediomelum aromaticum* var. *tuhyi*
Turbinella oak	*Quercus turbinella*
Tushar gilia	*Ipomopsis spicata* ssp. *tridactyla*
Tushar paintbrush	*Castilleja parvula*
Tushar Range beardtongue	*Penstemon xylus*
Two-needle pinyon	*Pinus edulis*
Twinberry honeysuckle	*Lonicera involucrata*
Uinta Basin hookless cactus	*Sclerocactus wetlandicus*
Uinta Mountains draba	*Draba inexpectata*
Uinta poppy	*Papaver uintaense*
Untermann's daisy	*Erigeron untermannii*
Utah blue-eyed grass	*Sisyrinchium radicatum*
Utah ivesia	*Ivesia utahensis*
Utah juniper	*Juniperus osteosperma*
Utah phacelia	*Phacelia utahensis*
Utah serviceberry	*Amalanchier utahensis*
Utah shootingstar	*Dodecatheon utahense*
Ute ladies'-tresses	*Spiranthes diluvialis*
Varied peppergrass	*Lepidium integrifolium* var. *heterophyllum*

COMMON NAME	*SCIENTIFIC NAME*
Velvet ash	*Fraxinus velutina*
Virgin thistle	*Cirsium virginense*
Wasatch draba	*Draba brachystylis*
Wasatch fitweed	*Corydalis caseana* ssp. *brachycarpa*
Water birch	*Betula occidentalis*
Water sedge	*Carex aquatilis*
Wax currant	*Ribes cereum*
Welsh's milkweed	*Asclepias welshii*
Western blue flag	*Iris missouriensis*
Western dwarf mistletoe	*Arceuthobium campylopodum*
Western Joshua tree	*Yucca brevifolia*
Western labrador-tea	*Ledum glandulosum*
Western prickly gooseberry	*Ribes montigenum*
Western roseroot	*Rhodiola integrifolia*
Western serviceberry	*Amelanchier alnifolia*
Western snowberry	*Symphoricapos occidentalis*
Western sticktight	*Lappula occidentalis*
Western Townsend-daisy	*Townsendia mensana*
Western wheatgrass	*Pascopyrum smithii*
Western yarrow	*Achillea millefolium* var. *occidentalis*
Wheatgrass	*Elymus* spp.
Wheeler's angelica	*Angelica wheeleri*
Whipple's penstemon	*Penstemon whippleanus*
Whip root clover	*Trifolium dasyphyllum*
White bursage	*Ambrosia dumosa*
White fir	*Abies concolor*
White flowered lupine	*Lupinus latifolius* ssp. *leucanthus*

COMMON NAME	*SCIENTIFIC NAME*
White River beardtongue	*Penstemon scariosus* var. *albifluvis*
White top	*Lepidium draba*
Whiting indigobush	*Psorothamnus thompsoniae* var. *whitingii*
Widtsoe wild buckwheat	*Eriogonum aretioides*
Wild onions	*Allium* spp.
Wild rose	*Rosa nutkana*
Wild strawberry	*Fragaria vesca*
Willow	*Salix* spp.
Winkler's pincushion cactus	*Pediocactus winkleri*
Winterfat (subspecies: Ruin Park winterfat)	*Krascheninnikovia lanata* (*Krascheninnikovia lanata* var. *ruinina*)
Wire-stemmed wild buckwheat	*Eriogonum pharnaceoides* var. *cervinum*
Wood's rose	*Rosa woodsii*
Woolly locoweed	*Astragalus mollissimus*
Wooly clover	*Trifolium eriocephalum* ssp. *villiferum*
Wright fishhook cactus	*Sclerocactus wrightiae*
Wyoming big sagebrush	*Artemisia tridentata* ssp. *Wyomingensis*
Yellow rabbitbrush	*Chrysothamnus viscidiflorus*
Yellow sweet clover	*Melilotus officinalis*
Yellow-white catseye	*Cryptantha ochroleuca*
Yucca	*Yucca* spp.
Zion buckwheat	*Eriogonum zionis* var. *zionis*
Zion jamesia	*Jamesia americana* var. *zionis*
Zion tansy	*Sphaeromeria ruthiae*
(No common name)	*Phacelia demissa var. heterotricha*
Reptiles	
Arizona mountain kingsnake (formerly pyro mountain kingsnake)	*Lampropeltis pyromelana*

COMMON NAME	*SCIENTIFIC NAME*
Black-necked gartersnake	*Thamnophis cyrtopsis*
Common chuckwalla	*Sauromalus ater*
Common lesser earless lizard	*Holbrookia maculata*
Desert tortoise	*Gopherus* spp.
Gila monster	*Heloderma suspectum*
Midget faded rattlesnake	*Crotalus oreganus concolor*
Mojave desert tortoise	*Gopherus agassizii*
Southwestern black-headed snake	*Tantilla hobartsmithi*
Spiders	
Tarantulas	*Aphonopelma* spp.

Appendix D

Methods for Ranking Terrestrial Key Habitats and Measuring Condition

Creating the Utah Wildlife Action Plan Terrestrial Key Habitats List

Among the eight required elements of a state wildlife action plan, the second element calls for describing the *extent* and *condition* of key habitats and community types essential to the conservation of species of greatest conservation need (SGCN). Here, the term *extent* refers to location or geographic distribution within the state along with the amount of areal coverage—both of which can be represented via maps and associated tables. *Condition* refers to departure of the habitat from the historical reference condition.

A large portion of the process used to select terrestrial key habitats for the 2015 Utah Wildlife Action Plan (UWAP) was retained in the 2025 UWAP. The methods described in this appendix outline the 2015 process (UWAP Joint Team [Joint Team] 2015) and changes made for the 2025 UWAP. The methods used to identify and measure extent and condition of aquatic key habitats are fully outlined in UWAP Chapter 2, Key Habitats – Location and Condition.

Revising Terrestrial Key Habitats for the 2025 Utah Wildlife Action Plan

In 2015, the Joint Team evaluated several existing habitat data sources and selected the source best suited to describe the habitat's extent and condition. Four existing data sources were evaluated for terrestrial habitats in the 2015 UWAP according to eight selection factors. Table D-1 shows these data sets and selection factors along with the evaluation results. Included in Table D-1 are criteria from the *Best Practices for State Wildlife Action Plans: Voluntary Guidance to States for Revision and Implementation* (Association of Fish and Wildlife Agencies' Teaming with Wildlife Committee's State Wildlife Action Plan [SWAP] Best Practices Working Group 2012), such as multistate usage and consistent terminology. Toward the bottom of Table D-1 are specific factors related to the following:

- The data source used for the extent of habitats must be in spatial format and cover Utah consistently from border to border, statewide.
- The data source must include both the current and future condition of habitats to detect change over time.

The arrows in Table D-1 show the results of the Joint Team's evaluation: up arrows indicate that existing data meet the criteria well; down arrows indicate that data meet the factor poorly or not at all; and sideways arrows indicate that data meet the factor neither well nor poorly and are somewhere in the middle. When the Joint Team worked on the 2015 UWAP revision, LANDFIRE (La Puma 2023) was the only candidate data set with all the selection factor arrows either up or sideways (i.e., it had no serious flaws from the perspective of the Joint Team's selection criteria). All other candidate data sets contained at least one serious flaw (down arrow). For the selection criteria that assess condition of habitats (bottom row in Table D-1), LANDFIRE had the only adequate data set—in the Joint Team's judgment—for the entire state and could be used again in the 2025 revision. In 2025, the Landscape Conservation Forecasting data set was added for consideration, and the data sources were reassessed (see Table D-1), but LANDFIRE was again determined to be the best available data source by the UWAP Core Team (Core Team) and the Utah Division of Wildlife Resources (DWR) Wildlife Action Plan Implementation Team.

Table D-1. *Criteria for Electing a Full Set of Habitats to Use as the Basis for Identifying Utah Wildlife Action Plan Key Habitats*

SELECTION FACTORS	EXISTING HABITAT SETS			
	SWReGAP	LANDFIRE BpS AND LANDFIRE EVT	NRCS ECOLOGICAL SITE	LANDSCAPE CONSERVATION FORECASTING
Habitat names and definitions (concepts) are consistent or standardized throughout Utah and beyond, at least throughout the surrounding states, as well as regionally or nationally.	↑	↑	↑	↑
Types of habitats (classification units) are mutually exclusive; they do not overlap in concept.	↑	↑	↑	↑
Types of habitats are comprehensive: every acre in Utah can be assigned to a type of habitat (some will be non-natural [e.g., urban, agriculture]).	↑	↑	↓	↓
The number of habitats, which is related to how finely or coarsely they are defined, is considered appropriate for the whole-state scope of the UWAP.	↔	↔	↓	↔
The habitats are definable, have broad support and utility (management usefulness), and match or can be cross-walked with habitat schemes of major partners.	↔	↔	↓	↔
Habitat data exist in spatial format; maps of habitat locations can be made.	↑	↑	↔	↑
Habitat spatial data cover all of Utah from border to border and are consistent throughout that range.	↑	↑	↓	↓
Habitats and their spatial data allow for the assessment of the habitats' condition, both current and in the future, all at locations or occurrences within Utah (without extensive fieldwork).	↑	↑	↓	↑

Note: BpS = Biophysical Settings; EVT = Existing Vegetation Type; NRCS = Natural Resources Conservation Service; SWReGAP = Southwest Regional Gap Analysis Project.

The 2015 UWAP used LANDFIRE version 1.2 (2012). In 2016, LANDFIRE received updates, improvements, and a remap. Ultimately, LANDFIRE version 2.2 (2020a) was used for the 2025 UWAP. One reason LANDFIRE was chosen in 2015 was to measure changes in habitat extent and condition from the 2015 to 2025 UWAP. Some issues prevented the DWR geographic information system (GIS) team from comparing extent and condition in the 2015 UWAP with that of terrestrial key habitats in the 2025 UWAP. However, the DWR GIS team has determined that comparisons will be feasible between revisions using LANDFIRE going forward. These issues are discussed in more detail below.

LANDFIRE was not suitable for aquatic habitats and could only be used for terrestrial habitats for the following reasons:

- The coarse-resolution 30 × 30–meter LANDFIRE pixels do not capture the common types of aquatic spatial features very well (e.g., lines, small polygons, long narrow polygons). One result of this is a systematic under-representation of pixels classified as these kinds of aquatic habitats. The pixels are instead classified as their dominant feature—typically, a terrestrial habitat.
- Two of the key habitats that were considered—Wet Meadow and Wetland—had no corresponding LANDFIRE-defined biophysical settings (BpS). LANDFIRE also does not fully consider purely aquatic habitats (e.g., streams and rivers, ponds and lakes). Better data sets were identified for all aquatic habitats, and these are described below.

Utah Geological Survey partner Diane Menuz contributed a significant amount of time to help identify appropriate data sources for aquatic habitats. Riparian habitat was evaluated with both National Hydrography Dataset Plus and LANDFIRE, and LANDFIRE was determined to be adequate for this habitat.

For the 2025 UWAP, DWR wanted to understand how UWAP partners were using UWAP key habitats and if there was a need to revisit these habitats for the 2025 UWAP. In preparation for the 2025 UWAP comprehensive revision, a UWAP partners meeting was held in March 2022. Through this meeting and partner surveys conducted before and after the meeting, the UWAP partners indicated a need for some revision of the key habitats. These changes are briefly outlined below. The Core Team was formed from the UWAP partners to help guide the development of the 2025 UWAP revision. The Terrestrial Key Habitat and Aquatic Key Habitat Subcommittees were then formed to revise key habitats for the 2025 UWAP.

For the 2025 UWAP, the DWR GIS team downloaded LANDFIRE version 2.2 (2020a) data for Utah from the LANDFIRE website (LANDFIRE 2024b). Specifically, for determining both the

extent and condition of habitats, the DWR GIS team obtained the BpS and Existing Vegetation Type (EVT) data products shown in Table D-1.

LANDFIRE BpS are derived from the current biophysical environment but also from an approximation of the historical disturbance regime. They are a modeled representation of the vegetation that might have been dominant on the landscape before Euro-American settlement (LANDFIRE 2020b) rather than the existing vegetation on the landscape. See the discussion of weighted departure scores in the A Three-Step Process to Determine Extent and Condition of Terrestrial Key Habitats section below.

EVTs represent the current distribution of plant communities on the landscape. They are mapped within similar ecological processes, substrates, and/or environmental gradients using decision tree models and Landsat imagery along with elevation, disturbance, biophysical gradient, and field observation data. EVTs also include ruderal or semi-natural vegetation types.

EVTs are described by LANDFIRE in four ways:

1. A name is assigned to each classified habitat community.
2. A modeled spatial distribution is provided for each habitat community within the landscape.
3. Each EVT is further classified into strata of successional stages (largely determined by vegetation height [Smith 2024]) designated by the letters A, B, C, D, and E (although D and E are not always used); these generally correspond with advancing age or succession status (i.e., A→B→C→D→E = Young → Middle-Aged → Old = Early → Mid → Late Succession).
4. Some portions of most EVTs are identified as uncharacteristic and are designated by the letter U.

These uncharacteristic EVT identities reflect altered conditions resulting from post-settlement human activities, either unnatural disturbances such as agriculture and development or proactive management or restoration. The uncharacteristic class can include situations such as dominance of invasive annual grasses (e.g., cheatgrass), shrublands where the herbaceous understory is depleted, a former floodplain with a decreased gradient and energy flow because of stream-channel downcutting, urban infrastructure, or even a range or wildlife seeding with crested wheatgrass.

The 2015 UWAP used LANDFIRE BpS categories to define terrestrial key habitats. For the 2025 UWAP, some UWAP partners encouraged a re-examination of the reasons for using BpS over

EVT categories. LANDFIRE BpS categories only represent the vegetation types that would be present in the absence of human impacts. Moreover, BpS represent the vegetation composition and structure that would be present under historical undisturbed conditions rather than what is present today. Given this, BpS serve best as a target for restoration and a standard to describe historical losses rather than a description of current conditions, which is the purpose of the EVT. The partners believed that it was important to consider the current vegetation composition and structure that Utah's wildlife is experiencing and do their best to manage that rather than trying to reach an unrealistic goal of managing for the vegetation composition and structure present prior to Euro-American settlement. The UWAP partners recognize that this represents a significant shift in how UWAP progress is measured, and if EVT's descriptions of current conditions are endorsed as the best expression of remaining habitat potential or taken at face value as the target of restoration, there is a danger that the shift from BpS to EVT as the means of describing vegetation baselines codifies a shifted baseline. Nonetheless, the Terrestrial Key Habitat Subcommittee, the Utah DWR Wildlife Action Plan Implementation Team, and the Core Team discussed this potential change and agreed to use EVT LANDFIRE categories for the 2025 UWAP. The grouping of habitat categories for the 2015 BpS and 2025 EVT data sets were similar, and, in both instances, these broader habitat groupings were then analyzed to ultimately determine key habitats. The Terrestrial Key Habitat Subcommittee considered the extent of landcover in the state, the presence of SGCN, and the feasibility of management to help decide which habitats would be prioritized as key habitats for the 2025 UWAP.

A Three-Step Process to Determine Extent and Condition of Terrestrial Key Habitats

Using the LANDFIRE data downloaded for the state of Utah—each 30-meter pixel having both its BpS identity and its corresponding EVT—the Terrestrial Key Habitat Subcommittee followed three steps:

1. Identify the habitats in Utah that make up the full candidate set (candidate habitats)
2. From among the candidate habitats, design and run a process to pick out the key habitats
3. Determine the current extent and condition of the key habitats

For Step 1, the Terrestrial Key Habitat Subcommittee assessed the candidate habitats identified in the 2005 and 2015 UWAPs and revised the candidate habitat list. For Step 2, LANDFIRE BpS habitat classifications were used and aggregated into broader groups to create candidate habitats in 2015. For Step 2 of the 2025 revision, EVT habitat classifications were aggregated into broader habitat groups to ultimately create candidate habitats. Some refinements to the

habitats were made to identify broadly defined, user-friendly names that made sense for how DWR biologists manage habitat and to ensure these habitats represented plant and insect SGCN that are new in the 2025 UWAP. Table D-2 presents the revised candidate habitats for the 2025 UWAP alongside their 2005 and 2015 counterparts.

Table D-2. *2025 Utah Wildlife Action Plan Terrestrial Candidate Habitats with their Counterparts from the 2005 and 2015 Utah Wildlife Action Plans*

2005	2015	2025
1995 Gap Analysis Project	LANDFIRE BpS version 2010 (1.2.0)	LANDFIRE EVT Remap 2.0
–	–	Disturbed
		Developed
		Ruderal
		Agricultural
	Alpine	**Alpine**
Aspen	**Aspen-Conifer**	**Aspen-Conifer**
Rock	Barren	Sparse Vegetation
Desert Oak	Chaparral	Lower Montane Chaparral
–	Colorado Plateau Desert Scrub	**Desert Shrub**
Grassland	**Desert Grassland**	**Desert Grassland**
Northern Oak	**Gambel Oak**	**Mountain Shrub**
Mountain Shrub	**Mountain Shrub**	
High Desert Scrub	Salt Desert Shrub	**Salt Desert Shrub**
Shrub-Steppe	**Lowland Sagebrush**	**Lowland Sagebrush**
Subalpine Conifer	Subalpine Conifer	**Montane and Subalpine Conifer**
Lodgepole Pine	Lodgepole Pine	
Mixed Conifer	Mixed Conifer	
		Lower Montane Mixed Conifer
Pinyon-Juniper	Pinyon-Juniper	
Ponderosa Pine	Ponderosa Pine	

2005	2015	2025
Low Desert Scrub	**Mojave Desert Shrub**	**Mojave Desert Shrub**
Grassland	Mountain Grassland	**Subalpine Grassland**
–	**Mountain Meadow**	
Shrub-Steppe	**Mountain Sagebrush**	**Mountain Sagebrush**
–	Sparsely Vegetated	Sparse Vegetation
	Playa	
Lowland Riparian	Riparian	**Riparian**
Mountain Riparian		

Note: The habitats in bold font are key habitats. An en dash (–) indicates that no candidate habitat was designated in that UWAP revision.

The candidate habitats were names only, without usable substance or a way to determine their extent and condition, until the EVT categories that make up each were identified using LANDFIRE. Table D-3 displays the EVT categories that make up each 2025 terrestrial candidate habitat. Developed and ruderal habitats fall under the disturbed candidate habitat in Table D-3.

Table D-3. *2025 Candidate Habitats with the Associated Finer-Level LANDFIRE Existing Vegetation Types*

2025 CANDIDATE HABITATS	EVTS
Agriculture	Western Cool Temperate Orchard
	Western Cool Temperate Row Crop - Close Grown Crop
	Western Cool Temperate Row Crop
	Western Cool Temperate Close Grown Crop
	Western Cool Temperate Fallow/Idle Cropland
	Western Cool Temperate Pasture and Hayland
	Western Cool Temperate Wheat
	Western Warm Temperate Orchard
	Western Warm Temperate Row Crop - Close Grown Crop
	Western Warm Temperate Row Crop
	Western Warm Temperate Close Grown Crop

2025 CANDIDATE HABITATS	EVTS
	Western Warm Temperate Fallow/Idle Cropland
	Western Warm Temperate Pasture and Hayland
	Western Warm Temperate Wheat
Alpine	Rocky Mountain Alpine Bedrock and Scree
	Rocky Mountain Alpine Dwarf-Shrubland
	Rocky Mountain Alpine Fell-Field
	Rocky Mountain Alpine Turf
Aspen-Conifer	Rocky Mountain Aspen Forest and Woodland
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland
Desert Grassland	Inter-Mountain Basins Semi-Desert Grassland
Desert Shrub	Colorado Plateau Blackbrush-Mormon-tea Shrubland
	Inter-Mountain Basins Semi-Desert Shrub-Steppe
	Mojave Mid-Elevation Mixed Desert Scrub
	Southern Colorado Plateau Sand Shrubland
Disturbed	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads
	Developed-Low Intensity
	Developed-Medium Intensity
	Developed-High Intensity
	Developed-Roads
	Western Cool Temperate Urban Deciduous Forest
	Western Cool Temperate Urban Evergreen Forest
	Western Cool Temperate Urban Mixed Forest
	Western Cool Temperate Urban Herbaceous
	Western Cool Temperate Urban Shrubland
	Western Warm Temperate Urban Deciduous Forest
	Western Warm Temperate Urban Evergreen Forest

2025 CANDIDATE HABITATS	EVTS
	Western Warm Temperate Urban Mixed Forest
	Western Warm Temperate Urban Herbaceous
	Western Warm Temperate Urban Shrubland
	Western Cool Temperate Developed Deciduous Forest
	Western Cool Temperate Developed Evergreen Forest
	Western Cool Temperate Developed Mixed Forest
	Western Cool Temperate Developed Shrubland
	Western Cool Temperate Developed Herbaceous
	Western Warm Temperate Developed Deciduous Forest
	Western Warm Temperate Developed Evergreen Forest
	Western Warm Temperate Developed Mixed Forest
	Western Warm Temperate Developed Shrubland
	Western Warm Temperate Developed Herbaceous
	Great Basin and Intermountain Introduced Annual and Biennial Forbland
	Great Basin and Intermountain Introduced Annual Grassland
	Great Basin and Intermountain Introduced Perennial Grassland and Forbland
	Interior Western North American Temperate Ruderal Shrubland
	Great Basin and Intermountain Ruderal Shrubland
	Interior Western North American Temperate Ruderal Grassland
Lower Montane Mixed Conifer	Colorado Plateau Pinyon-Juniper Shrubland
	Colorado Plateau Pinyon-Juniper Woodland
	Great Basin Pinyon-Juniper Woodland
	Inter-Mountain Basins Juniper Savanna
	Rocky Mountain Foothill Limber Pine-Juniper Woodland
	Southern Rocky Mountain Ponderosa Pine Savanna
	Southern Rocky Mountain Ponderosa Pine Woodland

2025 CANDIDATE HABITATS	EVTS
Lowland Sagebrush	Colorado Plateau Mixed Low Sagebrush Shrubland
	Great Basin Xeric Mixed Sagebrush Shrubland
	Inter-Mountain Basins Big Sagebrush Shrubland
	Inter-Mountain Basins Big Sagebrush Steppe
	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe
Mojave Desert Shrub	Sonora-Mojave Creosotebush-White Bursage Desert Scrub
	Sonora-Mojave Mixed Salt Desert Scrub
	Sonora-Mojave Semi-Desert Chaparral
Montane and Subalpine Conifer	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland
	Northern Rocky Mountain Subalpine Woodland and Parkland
	Rocky Mountain Lodgepole Pine Forest
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland
	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland
Mountain Sagebrush	Columbia Plateau Low Sagebrush Steppe
	Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe
	Columbia Plateau Steppe and Grassland
	Inter-Mountain Basins Montane Sagebrush Steppe
Mountain Shrub	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Shrubland
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland
	Rocky Mountain Bigtooth Maple Ravine Woodland
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland
	Rocky Mountain Lower Montane-Foothill Shrubland

2025 CANDIDATE HABITATS	EVTS
Riparian	Great Basin Foothill and Lower Montane Riparian Woodland
	Rocky Mountain Lower Montane-Foothill Riparian Woodland
	Rocky Mountain Subalpine-Montane Riparian Shrubland
	Rocky Mountain Subalpine-Montane Riparian Woodland
	North American Warm Desert Riparian Woodland
	North American Warm Desert Lower Montane Riparian Woodland
	North American Warm Desert Riparian Mesquite Bosque Woodland
	Interior West Ruderal Riparian Forest
	Great Basin Foothill and Lower Montane Riparian Shrubland
	Great Basin Foothill and Lower Montane Riparian Herbaceous
	Rocky Mountain Lower Montane-Foothill Riparian Shrubland
	North American Warm Desert Riparian Herbaceous
	North American Warm Desert Riparian Shrubland
	North American Warm Desert Lower Montane Riparian Shrubland
	North American Warm Desert Riparian Mesquite Bosque Shrubland
	Interior West Ruderal Riparian Scrub
Salt Desert Shrub	Inter-Mountain Basins Mat Saltbush Shrubland
	Inter-Mountain Basins Mixed Salt Desert Scrub
	Inter-Mountain Basins Greasewood Flat
Sparse Vegetation	Colorado Plateau Mixed Bedrock Canyon and Tableland
	Inter-Mountain Basins Active and Stabilized Dune
	Inter-Mountain Basins Alkaline Closed Depression
	Inter-Mountain Basins Cliff and Canyon
	Inter-Mountain Basins Playa
	Inter-Mountain Basins Shale Badland
	Inter-Mountain Basins Wash

2025 CANDIDATE HABITATS	EVTS
	Rocky Mountain Cliff Canyon and Massive Bedrock
	Inter-Mountain Basins Volcanic Rock and Cinder Land
	North American Warm Desert Badland
	North American Warm Desert Bedrock Cliff and Outcrop
	North American Warm Desert Pavement
	North American Warm Desert Playa
	North American Warm Desert Volcanic Rockland
	North American Warm Desert Wash Woodland
	North American Warm Desert Ruderal and Planted Scrub
	North American Warm Desert Wash Shrubland
	North American Warm Desert Ruderal and Planted Grassland
Subalpine Grasslands	Southern Rocky Mountain Montane-Subalpine Grassland
Wet Meadow	Rocky Mountain Subalpine-Montane Mesic Meadow
	Rocky Mountain Alpine-Montane Wet Meadow
	North American Warm Desert Cienega

Following discussion with the Utah DWR Wildlife Action Plan Implementation Team and the Core Team, the Terrestrial Key Habitat Subcommittee decided to exclude disturbed, developed, ruderal, and agricultural habitats from consideration for key habitats. Although some SGCNs use these habitats, key habitats are more natural and have larger numbers of SGCN that depend on them. The Sparse Vegetation Key Habitat ultimately encompassed multiple habitats that were included in the Other Habitats category; consequently, sparse vegetation was not included as a terrestrial key habitat.

The third and final step was to determine the current condition of the terrestrial key habitats. In 2015, the Joint Team used the LANDFIRE data to calculate a measure of condition known as *ecological departure*. The calculation of ecological departure uses both the BpS and the associated vegetation successional class assigned to pixels in the LANDFIRE data set. Terrestrial key habitats for the 2025 UWAP were developed using EVT categories rather than BpS, however, and there is no condition metric directly associated with EVTs. BpS and EVT

boundaries are not the same, so the 2015 UWAP key habitat analyses were not directly applicable to the 2025 UWAP key habitats. Furthermore, 2015 and 2025 UWAP key habitat statistics could not be directly compared against each other to show changes in habitat scale or structure over the past decade because LANDFIRE underwent a data remap (LANDFIRE 2016) to improve its mapping performance. The impacts of that remap were broad enough to cause noticeable changes in habitat areas that could not be explained biologically. This led the Terrestrial Key Habitat Subcommittee to exclude these comparisons from analysis. Despite the infeasibility of analyzing a comparison from 2015 to 2025, DWR plans to present comparisons between 2025 and 2035 UWAP revisions as metrics of change and progress for more complete habitat condition assessments. The 2025 and 2035 comparison analyses will be more feasible in future revisions because there will be a more direct comparison of EVT categories across decades, combined with a (presumptively) more consistent LANDFIRE model on which to base the comparisons versus the previous 2015 to 2025 comparison analysis.

Despite not being able to analyze meaningful comparisons between 2015 and 2025 terrestrial key habitats, the DWR GIS team still provided an assessment of habitat condition for each key habitat using a modification to the ecological departure calculations performed in the 2015 UWAP. To describe this modified condition assessment, it is essential to grasp the concept of ecological departure in the LANDFIRE context. Below are two definitions of ecological departure using different words to describe the same concept.

The ecological departure of a BpS is the dissimilarity between

1. the amounts (proportion) of vegetation successional classes (age classes) expected under reference conditions; and
2. the amounts (proportion) of vegetation successional classes (age classes) that are currently present on the landscape.

Ecological departure summarizes, in a single number, how out of balance a BpS is in terms of dissimilarity between

1. the current distribution of a habitat's successional classes that are present in an area, and
2. the amounts of those classes that would be expected to occur under a reference baseline of natural disturbance regimes and climate.

Ecological departure is fundamentally a comparison of current habitat coverage and successional age classes compared to archetypal conditions, or, conditions prior to Euro-American settlement. The departure scores are calculated within specifically defined

geographic areas. In the 2025 UWAP, ecological departure metrics are summarized at both the statewide and 12-digit Hydrologic Unit Code (HUC) landscape parcels (known as subwatersheds) (HUC-12) that overlap the state of Utah. This is a modification from the 2015 UWAP, which summarized metrics at the 8-digit HUC scale (HUC-8). In all, 2,558 of the HUC-12 subwatersheds were used for UWAP analyses.

To maintain consistency with the 2015 UWAP, the condition assessment began by calculating ecological departure values for every BpS within a HUC-12 subwatershed in the same way the 2015 UWAP did with HUC-8s. This step was calculated as the magnitude of differences in the BpS reference proportions of each successional stage (A–E; see EVT discussion in the Revising Terrestrial Key Habitats for the 2025 Utah Wildlife Action Plan section above) and LANDFIRE-modeled proportions of each existing successional stage. The equation for this calculation is provided below and described in further detail in Figure D-1.

$$Ecological\ Departure = 100\% - \sum_{i=1}^{n} \min\{Current, Reference\}$$

Current = Existing proportions of each succession class within a HUC-12 subwatershed and BpS
Reference = Reference proportions of each succession class within a HUC-12 subwatershed and BpS

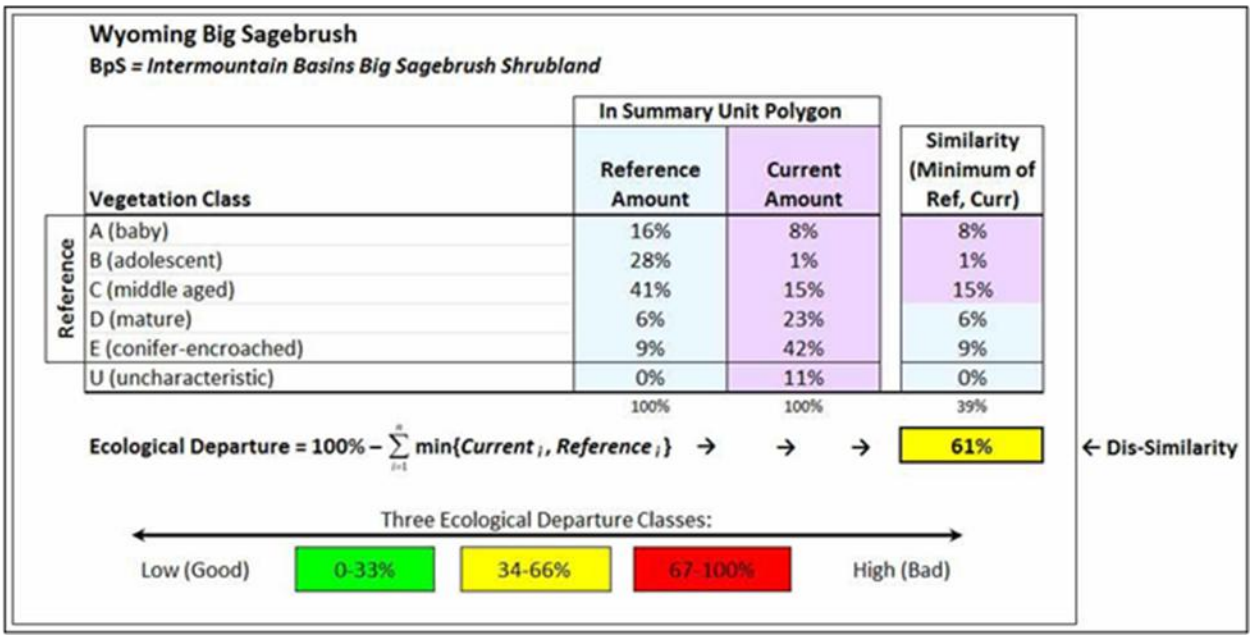


Figure D-1. *Example Calculation of Ecological Departure on a National Forest Ranger District*

Figure D-1 describes a real-life example of the ecological departure calculation for a BpS known as Intermountain Basins Big Sagebrush Shrubland (similar to a Wyoming Big Sagebrush site) within a national forest ranger district. In this case, the ranger district is the specific large

geographic area, known as a Summary Unit, within which ecological departure is calculated. The possible range of values of ecological departure is 0% to 100%. Lower values (smaller departure) represent a theoretically better condition, and higher values (greater departure) represent a theoretically worse condition. The 0% to 100% range is traditionally broken into three classes that can be color coded for purposes of visual display: green, yellow, and red represent good to bad conditions, respectively.

Figure D-1 shows a single BpS's vegetation classes (A–E successional classes and U). The light blue column (Reference Amount) shows the expected reference proportions of vegetation succession classes. These conceptual amounts are based on LANDFIRE vegetation models. Note that the reference percentage of the uncharacteristic class is always zero. The light purple column (Current Amount) shows the proportions of existing vegetation successional classes in this ranger district at the present time. These actual amounts come from GIS analysis of the LANDFIRE data of BpS and EVT clipped to the boundary of the ranger district. The Similarity column contains the smaller, or minimum, value of the Reference Amount and Current Amount columns in that particular vegetation class row. The sum of these minimum class values (39%) is the overall similarity between the Reference Amount and Current Amount columns. Therefore, the dissimilarity between the two columns is the ecological departure of the Current Amounts from the Reference Amounts (in this case, 61%).

This ecological departure analysis is a common approach when working with BpS-based key habitats (as was done in the 2015 UWAP), but it carries issues for the 2025 UWAP because key habitats are defined using EVTs. Because ecological departure is given on the BpS scale, and because a single BpS is likely to contain many EVTs within it, these ecological departure scores become meaningless because they cannot be directly summarized into key habitats. Moreover, ecological departure analyses describe departure only as departure from archetypal or natural successional stage distributions (proportional breakdown of succession classes A–E) and does not address to what extent each of the existing habitats is different from those natural BpS. Therefore, the 2025 UWAP adopted a solution using weighted means of ecological departures that could be assigned to each EVT. A weighted mean is based on the proportional area of each EVT within a BpS within a HUC-12. In other words, ecological departures were calculated for each BpS within each HUC but also identified the acreage of each EVT within that area unit. The area acreage was used to approximate how much of each ecological departure score was accounted for by each EVT. Doing so provided weighted ecological departure scores for every EVT that could be grouped into terrestrial key habitats and summarized at the HUC-12 or statewide scale.

$$\sum_{Key\ Habitat}^{n}\left(\sum KH_{A2} \div KH_A \times \left(100\% - \sum_{i=1}^{n} \min\{Current, Reference\}\right)\right)$$

KH_A = Total key habitat area (could be either statewide or per HUC-12)

KH_{A2} = Total key habitat area within each HUC-12 and BpS grouping

The result of these calculations was a large body of tabular data. A small fragment of the Lowland Sagebrush Key Habitat is illustrated in Table D-4. All necessary variables for calculating a 2025 UWAP weighted ecological departure are present in Table D-4; however, the data have been trimmed to save space. Although the example in Table D-4 informs the way that habitat condition can be assessed, it does not represent either the entirety of this HUC-12 or the majority of the Lowland Sagebrush Key Habitat overall. Nonetheless, in this example, there are multiple ecological departure scores that combine to an average of 71.67 for the HUC-12, which vastly overestimates the amount of departure by not accounting for the area of land that receives those scores. When area-based weights are considered, the overall ecological departure for that key habitat within that HUC-12 drops to only 19.34%, which would be considered a low amount of departure. This behavior is common throughout the complete UWAP data set and highlights the importance of factoring habitat area into the ecological departure value for a more accurate depiction of departure for EVT-based key habitats.

Table D-4. *Example Calculation Summary of Custom-Weighted Ecological Departure Score Based on Lowland Sagebrush Key Habitat within a Single Hydrologic Unit Code 12 Subwatershed*

1. BpS CODE	2. SUCCESSION CLASS*	3. STATEWIDE KEY HABITAT AREA†	4. KEY HABITAT AREA PER HUC-12†	5. KEY HABITAT AREA PER HUC-12, BpS, SUCCESSION†	6. REFERENCE PERCENTAGE‡	7. CURRENT PERCENTAGE	8. MINIMUM OF REFERENCE AND CURRENT PERCENTAGE	9. ECOLOGICAL DEPARTURE	10. KEY HABITAT STATEWIDE WEIGHT§	11. KEY HABITAT HUC-12 WEIGHT§	12. WEIGHTED ECOLOGICAL DEPARTURE¶
10190	A	29,083,665	4,962	654	5	37.76	5.00	67.46	4.68E-04	0.180	49.799
10190	B	29,083,665	4,962	44	5	2.54	2.54	–	4.68E-04	0.180	–
10190	C	29,083,665	4,962	1034	25	59.70	25.00	–	4.68E-04	0.180	–
10190	D	29,083,665	4,962	0	?	0.00	0.00	–	4.68E-04	0.180	–
10190	E	29,083,665	4,962	0	?	0.00	0.00	–	4.68E-04	0.180	–
10620	A	29,083,665	4,962	15	10	100.00	10.00	90.00	5.16E-07	0.003	–
10790	C	29,083,665	4,962	28	15	100.00	15.00	85.00	9.63E-07	0.006	–
10804	C	29,083,665	4,962	121	25	100.00	25.00	75.00	4.16E-06	0.024	–
10810	C	29,083,665	4,962	3	45	100.00	45.00	55.00	1.03E-07	0.001	–
10820	A	29,083,665	4,962	2	10	0.10	0.10	66.60	6.88E-08	0.420	–
10820	B	29,083,665	4,962	486	70	23.30	23.30	–	7.17E-05	0.420	–
10820	C	29,083,665	4,962	1598	10	76.61	10.00	–	7.17E-05	0.420	–
10860	A	29,083,665	4,962	154	5	100.00	5.00	9.94	8.15E-06	0.048	–
10860	B	29,083,665	4,962	29	20	34.94	20.00	–	8.15E-06	0.048	–
10860	C	29,083,665	4,962	54	70	65.06	65.06	–	8.15E-06	0.048	–
11030	A	29,083,665	4,962	380	15	68.22	15.00	42.96	1.92E-05	0.112	–
11030	B	29,083,665	4,962	177	85	42.04	42.04	–	1.92E-05	0.112	–
11040	A	29,083,665	4,962	15	15	57.69	15.00	37.17	8.94E-07	0.005	–
11040	B	29,083,665	4,962	11	85	47.83	47.83	–	8.94E-07	0.005	–
11070	A	29,083,665	4,962	10	5	100	5.00	95.00	3.44E-07	0.002	–
11080	A	29,083,665	4,962	139	65	74.73	65.00	3.63	6.43E-06	0.038	–
11080	B	29,083,665	4,962	48	35	31.37	31.37	–	6.43E-06	0.038	–
11260	C	29,083,665	4,962	3	15	100	15.00	85.00	1.03E-07	0.001	–
11270	B	29,083,665	4,962	25	70	100	70.00	30.00	8.59589E-07	0.005	–

1. BpS CODE	2. SUCCESSION CLASS*	3. STATEWIDE KEY HABITAT AREA†	4. KEY HABITAT AREA PER HUC-12†	5. KEY HABITAT AREA PER HUC-12, BpS, SUCCESSION†	6. REFERENCE PERCENTAGE‡	7. CURRENT PERCENTAGE	8. MINIMUM OF REFERENCE AND CURRENT PERCENTAGE	9. ECOLOGICAL DEPARTURE	10. KEY HABITAT STATEWIDE WEIGHT§	11. KEY HABITAT HUC-12 WEIGHT§	12. WEIGHTED ECOLOGICAL DEPARTURE¶
11540	A	29,083,665	4,962	89	20	53.29	20.00	30.00	5.77644E-06	0.034	–
11540	B	29,083,665	4,962	79	50	61.24	50.00	–	5.77644E-06	0.034	–

Notes: Aside from the first five rows, unassigned succession classes were removed from the table and are not necessary for analysis. Because some habitat succession classes are not observed by the LANDFIRE model, their reference percentages may not be known, such as with BpS:10190, HUC-12:29083665; however, those values are not necessary for the ecological departure calculations. Given this, aside from BpS:10190, HUC-12:29083665, which is represented with a "?," unobserved succession classes have been excluded from this table for brevity.

An en dash (–) indicates that there is no value for that particular row because there are multiple rows for each BpS composing the lowland sagebrush key habitat and only one ecological departure calculated for each BpS and for the lowland sagebrush key habitat.

* Succession class is the general successional stage that the current habitat is classified within, from A (early successional stage) to E (late successional stage).

† Columns three through five represent arbitrary area units for the key habitat at statewide, HUC, and local scales, respectively.

‡ Reference percentage is the LANDFIRE-modeled percentage of the sampling unit that would fall within the corresponding successional stage under archetypal conditions.

§ Columns 10 and 11 were calculated by dividing column five (Key Habitat Area per HUC-12, BpS, Succession) by columns three and four, respectively.

¶ Weighted ecological departure in column 12 was calculated using the equation presented above.

Overall, this condition assessment provides an expanded understanding of Utah's key habitats' current level of naturalness. This assessment addresses key habitats as LANDFIRE-modeled EVTs and provides a weighted ecological departure score for each key habitat that falls within each BpS and HUC-12 sampling unit, thereby summarizing ecological departures at the HUC-12 or statewide scales in a more representative way. As a result, this assessment, as described above, satisfies the condition assessment described under State Wildlife Action Plan Required Element 2 (Association of Fish and Wildlife Agencies and the U.S. Fish and Wildlife Service 2017).

There are several components that could be improved to gain more insight and accuracy in future analyses. First, this approach is lacking because it does not identify the amount of departure of an EVT or key habitat from natural BpS habitat types. For example, a Desert Shrub BpS and a Mojave Desert Shrub EVT are similar habitats to one another, but a Desert Shrub BpS and an Alpine EVT are very distinct from one another. Furthermore, those BpS-to-EVT differences that result in large changes to the combined height of the vegetation community lead to increased biases over habitats similar in height. For example, comparing Desert Shrub BpS to a pinyon-juniper–dominated habitat would result in greater height discrepancy than comparing Desert Shrub BpS to a sagebrush-dominated habitat. The more drastic change in height between Desert Shrub BpS and a pinyon-juniper–dominated habitat would result in a larger ecological departure score and, consequently, more bias.

Because ecological departure is calculated at the community level within a sampling unit, key habitats that present more drastic changes (compared to BpS) in canopy height will be more costly in final departure scores. Therefore, the extent of these differences in habitat type and habitat height should be accounted for in future analyses to improve condition assessments.

A key area for improvement in future habitat condition assessments is the integration of climate change impacts and expert input to enhance model accuracy and interpretive value. The current assessment does not sufficiently account for how shifting climate conditions may render some BpS unsuitable or obsolete over time, nor does it evaluate whether LANDFIRE's modeled successional proportions and BpS classifications continue to represent natural or desirable ecological states. As a result, high ecological departure scores may reflect either genuine habitat degradation or simply a transformation into a different, potentially more appropriate habitat under changing conditions. In such cases, reliance on legacy standards may lead to mischaracterization of habitat quality, portraying adaptive or transitional ecosystems as ecologically deficient.

To address these shortcomings, future assessments would benefit from incorporating expert-curated inputs such as refined acreage targets, detailed successional stage distributions, quantified penalties for invasive species, and models tailored specifically to Utah's ecosystems. In addition to improving the accuracy of ecological evaluations, these enhancements would help clarify the causes of departure and distinguish between degraded and naturally evolving habitats. Expert interpretation is particularly valuable in validating such findings and mitigating the influence of outdated modeling assumptions, especially in the context of ongoing climate-driven landscape change.

Appendix E

Threat Methods

Creating the 2015 Utah Wildlife Action Plan Threat Assessment

Identifying threats and stressors is one of the eight required elements of a state wildlife action plan because they are the problems that adversely affect species of greatest conservation need (SGCNs) and/or their habitats (Association of Fish and Wildlife Agencies and the U.S. Fish and Wildlife Service 2017). In Utah, these threats are incorporated into the Utah Department of Natural Resources Watershed Restoration Initiative (WRI), which is the primary implementation tool of the Utah Wildlife Action Plan (UWAP). Therefore, successfully funded conservation projects must demonstrate how the projects will alleviate stressors to SGCNs and the UWAP key habitats (see Chapter 6, Partnerships, Implementation, and Regional Collaboration for more on WRI). In addition, threats to SGCNs are part of NatureServe's ranking methodology (Faber-Langendoen et al. 2012), which is the cornerstone of the rubric used to develop the UWAP SGCNs (see Chapter 1, Species of Greatest Conservation Need – Distribution and Abundance).

The UWAP Joint Team worked through a structured and thoughtful process of developing threats for the 2015 UWAP, including pros and cons of the process they adopted. Because the 2015 threats performed well for UWAP implementation in the WRI, the 2025 UWAP threats list was built from the existing 2015 list (Table E-1). The following is a brief overview of the 2015 UWAP threats process rationale and rubric (UWAP Joint Team 2015):

- Salafsky et al. (2008) was used for Level-1 and Level-2 threats language (see Table E-1). A threats calculator spreadsheet was created to capture results of the species and habitat threats assessments.
    - The standardized threats were updated slightly (Conservation Measures Partnership 2016), but the majority of the species and habitat threat assessments had been completed before this newer version was discovered. For continuity, the same Level-1 and Level-2 threats that were used for the 2015 UWAP were used for the 2025 UWAP (Salafsky et al. 2008). The newer standardized threats version will be used for future UWAP threat assessments.
- A twelfth Level-2 threat was created: Data Gaps (see Table E-1). This threat acknowledges that the lack of actionable information can in itself be a roadblock to effective conservation.

- A third level of detail (Level-3 threats) was created (see Table E-1) and built into the threats calculator to allow users to incorporate additional threat details and specificity to Utah. The number of Level-3 threats per Level-2 threat, including the scope and severity of those threats, were evaluated and aggregated to provide the Level-2 threat impacts to SGCNs or key habitats.

To update threats for the 2025 UWAP and use the updated threats list, the following was completed:

- The SGCN subcommittee reviewed all of the Level-3 threats, and the Climate Adaptation Subcommittee reviewed the Level-3 climate-related threats to ensure new and/or emerging threats were represented in the UWAP threats list and calculator. The updated threats list was presented, discussed, and adopted by the UWAP Core Team (Core Team).
- The updated threats list was used for any NatureServe S-ranks that were calculated to help establish the 2025 UWAP SGCN list. NatureServe methodology was used to aggregate Level-3 threats into Level-2 threats (Master et al. 2012).
- The updated threats list (see Table E-1) was used to complete a threat assessment for the 2025 UWAP key habitats. The Aquatic Key Habitat Subcommittee completed the threat assessments for the 2025 aquatic key habitats. A subset of the Utah Division of Wildlife Resources Wildlife Action Plan Implementation Team completed the threat assessment for the 2025 terrestrial key habitats. The key habitat threat assessments were presented, discussed, and adopted by the Core Team.
- The threat assessments were analyzed using the prioritization process outlined in the 2015 UWAP (UWAP Joint Team 2015). The results were reviewed to ensure they made sense as priority threats across the state. The priority threats (see Table E-1) shifted with the addition of plant and insect SGCNs. Many water-related threats that were prioritized in 2015 were no longer prioritized because they were washed out with the addition of numerous plant SGCN. The Core Team decided to add these water-related threats back into the priority list given the importance of water in the state.
- The updated SGCN threats and key habitat threats will be integrated into the WRI upon approval of the 2025 UWAP.

Table E-1. *2025 Utah Wildlife Action Plan Threats with Priority Threats in Highlighted Rows*

IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
1			**Residential and Commercial Development** Threats from human settlements or other nonagricultural land uses with a substantial footprint.
	1.1		**Housing and Urban Areas:** Human cities, towns, and settlements, including non-housing development typically integrated with housing (e.g., urban areas, suburbs, villages, vacation homes, shopping areas, offices, schools, hospitals).
		1.1.1	Cabin Communities/Development
		1.1.2	Expansion of Urban Footprint
		1.1.3	Building/Window Strikes
	1.2		**Commercial and Industrial Areas:** Factories and other commercial centers (e.g., manufacturing plants, shopping centers, office parks, military bases, power plants, train yards and shipyards, airports).
		1.2.1	Expansion of Military Installations
		1.2.2	Landfill Operation
		1.2.3	Power Generation
	1.3		**Tourism and Recreational Areas:** Tourism and recreational sites with a substantial footprint (e.g., ski areas, golf courses, beach resorts, cricket fields, county parks, campgrounds).
		1.3.1	Campground Development
		1.3.2	Trail, Trailhead, and Staging Area Development
		1.3.3	Ski Area Development

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
2			**Agriculture and Aquaculture** Threats from improper farming and ranching practices as a result of agricultural expansion and intensification or practices; includes silviculture, mariculture, and aquaculture.
	2.1		**Annual and Perennial Non-Timber Crops:** Crops planted for food, fodder, fiber, fuel, or other uses (e.g., farms, household swidden plots, plantations, orchards, vineyards, mixed agroforestry systems).
		2.1.1	Conversion from Flood to Sprinkler Irrigation
		2.1.2	Conversion of Cropland or Pasture
		2.1.3	Grain and Hay Harvest
	2.2		**Wood and Pulp Plantations:** Stands of trees planted for timber or fiber outside of natural forests, often with non-native species (e.g., teak or eucalyptus plantations, silviculture, Christmas tree farms).
	2.3		**Livestock Farming and Ranching:** Domestic terrestrial animals raised in one location on farmed or nonlocal resources (farming); also domestic or semidomesticated animals allowed to roam in the wild and supported by natural habitats (ranching) (e.g., cattle feed lots, dairy farms, cattle ranching, chicken farms, goat, camel, or yak herding).
		2.3.1	Improper Grazing – Livestock (current)
		2.3.2	Livestock Feedlot
		2.3.3	Water Developments for Livestock
		2.3.4	Improper Grazing – Livestock (historic)

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
	2.4		**Marine and Freshwater Aquaculture:** Aquatic animals raised in one location on farmed or nonlocal resources; also hatchery fish allowed to roam in the wild (e.g., shrimp or fin fish aquaculture, fish ponds on farms, hatchery salmon, seeded shellfish beds, artificial algal beds).
		2.4.1	Unintentional Spread of Non-Native Species
3			**Energy Production and Mining** Threats from production of non-biological resources.
	3.1		**Oil and Gas Drilling:** Exploring for, developing, and producing petroleum and other liquid hydrocarbons (e.g., oil wells, deep sea natural gas drilling).
		3.1.1	Well Pad Development
		3.1.2	Spills and Production Water
	3.2		**Mining and Quarrying:** Exploring for, developing, and producing minerals and rocks (e.g., coal mines, alluvial gold panning, gold mines, rock quarries, coral mining, deep sea nodules, guano harvesting).
		3.2.1	Hardrock Minerals
		3.2.2	Sand and Gravel
		3.2.3	Oil Shale
		3.2.4	Tar Sands
	3.3		**Renewable Energy:** Exploring, developing, and producing renewable energy (e.g., geothermal power production, solar farms, wind farms [including birds flying into windmills], tidal farms).
		3.3.1	Geothermal Power Facilities
		3.3.2	Solar Power Facilities

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		3.3.3	Wind Power Facilities
		3.3.4	Hydropower Facilities
		3.3.5	Nuclear Power Facilities
4			**Transportation and Service Corridors** Threats from long, narrow transport corridors and the vehicles that use them, including associated wildlife mortality.
	4.1		**Roads and Railroads:** Surface transport on roadways and dedicated tracks (e.g., highways, secondary roads, logging roads, bridges and causeways, road kill, fencing associated with roads, railroads).
		4.1.1	Roads – Transportation Network
		4.1.2	Roads – Energy Development
		4.1.3	Railroads
	4.2		**Utility and Service Lines:** Transport of energy and resources (e.g., electrical and phone wires, aqueducts, oil and gas pipelines, electrocution of wildlife).
		4.2.1	Utility Lines/Towers – Power and Communication
		4.2.2	Pipelines/Powerlines – Energy Development
	4.3		**Shipping Lanes:** Transport on and in freshwater and ocean waterways (e.g., dredging, canals, shipping lanes, ships running into whales, wakes from cargo ships).
	4.4		**Flight Paths:** Air and space transport (e.g., flight paths, jets impacting birds).

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
5			**Biological Resource Use** Threats from consumptive use of "wild" biological resources, including deliberate and unintentional harvesting effects; also persecution or control of specific species.
	5.1		**Hunting and Collecting Terrestrial Animals:** Killing or trapping terrestrial wild animals or animal products for commercial, recreation, subsistence, research or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch (e.g., bushmeat hunting, trophy hunting, fur trapping, insect collecting, honey or bird nest hunting, predator control, pest control, persecution).
		5.1.1	Excessive Harvest – Unregulated/Illegal
		5.1.2	Excessive Harvest – Regulated/Legal
		5.1.3	Incidental Poisoning
	5.2		**Gathering Terrestrial Plants:** Harvesting plants, fungi, and other nontimber/nonanimal products for commercial, recreation, subsistence, research or cultural purposes, or for control reasons (e.g., wild mushrooms, forage for stall fed animals, orchids, rattan, control of host plants to combat timber diseases).
		5.2.1	Excessive Harvest – Unregulated/Illegal
		5.2.2	Excessive Harvest – Regulated/Legal
	5.3		**Logging and Wood Harvesting:** Harvesting trees and other woody vegetation for timber, fiber, or fuel, including site preparation and other forestry management practices (e.g., clear cutting of hardwoods, selective commercial logging of ironwood, pulp operations, fuel wood collection, charcoal production).
		5.3.1	Improper Forest Management
		5.3.2	Woodcutting for Fuel/Posts/Christmas Trees

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
	5.4		**Fishing and Harvesting Aquatic Resources:** Harvesting aquatic wild animals or plants for commercial, recreation, subsistence, research, or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch (e.g., trawling, blast fishing, spear fishing, shellfish harvesting, whaling, seal hunting, turtle egg collection, live coral collection, seaweed collection).
		5.4.1	Excessive Harvest – Unregulated/Illegal
		5.4.2	Excessive Harvest – Regulated/Legal
6			**Human Intrusions and Disturbance** Threats from human activities that alter, destroy, and disturb habitats and species associated with nonconsumptive uses of biological resources.
	6.1		**Recreational Activities:** People spending time in nature or traveling in vehicles outside of established transport corridors, usually for recreational reasons (e.g., off-road vehicles, motorboats, jet skis, snowmobiles, ultralight planes, dive boats, whale watching, mountain bikes, hikers, birdwatchers, skiers, pets in recreation areas, temporary campsites, caving, rock climbing).
		6.1.1	OHV Motorized Recreation
		6.1.2	Camping/Campground Development (dispersed)
		6.1.3	Cave/Mine Exploration
		6.1.4	Hiking/Foot Travel
		6.1.5	Low-Level Aircraft Flights (tourism and recreation)
		6.1.6	Mountain Biking
		6.1.7	Pack/Saddle Stock

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		6.1.8	River Rafting
		6.1.9	Rock Climbing
		6.1.10	Skiing
		6.1.11	Snowmobiling
		6.1.12	Unauthorized Species Introductions
		6.1.13	Swimming/Bathing
		6.1.14	UAV/Drone Use
	6.2		**War, Civil Unrest, and Military Exercises:** Actions by formal or paramilitary forces without a permanent footprint (e.g., armed conflict, mine fields, tanks and other military vehicles, training exercises and ranges, defoliation, munitions testing).
		6.2.1	Military Testing and Training Activities
	6.3		**Work and Other Activities:** People spending time in or traveling in natural environments for reasons other than recreation or military activities (e.g., law enforcement, drug smugglers, illegal immigrants, species research, vandalism).
		6.3.1	Low-Level Aircraft Flights (law enforcement, medical)
		6.3.2	Motorized Travel
		6.3.3	Research and Monitoring

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
7			**Natural System Modifications** Threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare.
	7.1		**Fire and Fire Suppression:** Suppression or increase in fire frequency and/or intensity outside of its natural range of variation (e.g., fire suppression to protect homes, inappropriate fire management, escaped agricultural fires, arson, campfires, fires for hunting).
		7.1.1	Inappropriate Fire Frequency and Intensity
		7.1.2	Fire Suppression Tactics
		7.1.3	Canal Burning
		7.1.4	Prescribed Fire
		7.1.5	Post-Fire Precipitation/Flooding (resulting water quality issues)
	7.2		**Dams and Water Management/Use:** Changing water flow patterns from their natural range of variation either deliberately or as a result of other activities (e.g., dam construction, dam operations, sediment control, change in salt regime, wetland filling for mosquito control, levees and dikes, surface water diversion, groundwater pumping, channelization, artificial lakes).
		7.2.1	Presence of Dams
		7.2.2	Presence of Diversions
		7.2.3	Dam/Reservoir Operation
		7.2.4	Dam Safety
		7.2.5	Channelization/Bank Alteration (direct, intentional)

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		7.2.6	Groundwater Pumping
		7.2.7	Spring Development/Capping
		7.2.8	Agricultural/Municipal/Industrial Water Usage
		7.2.9	Water Allocation Policies
		7.2.10	Salinity Alteration (of water)
		7.2.11	Sediment Transport Imbalance (sediment poor)
		7.2.12	Sediment Transport Imbalance (sediment rich)
		7.2.13	
		7.2.14	Piping or Covering Streams
	7.3		**Other Ecosystem Modifications:** Other actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare (e.g., land reclamation projects, rip-rap along shoreline, mowing grass, tree thinning in parks, beach construction, removal of snags from streams).
		7.3.1	Brush Eradication/Vegetation Treatments
		7.3.2	Seeding Non-Native Plants
		7.3.3	Channel Downcutting (indirect, unintentional)
		7.3.4	Water Developments for Wildlife
		7.3.5	Mine Shaft/Adit Closures
		7.3.6	Rotenone Treatments for Fish Control

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		7.3.7	Stocking Non-Native Wildlife
		7.3.8	Intentional Poisoning of "Nuisance" Wildlife
	7.4		**Removing/Reducing Human Maintenance:** Absence or reduction of current or historical maintenance regimes important for key ecological attributes. Includes regimes historically maintained by protected area staff, farmers and ranchers, Indigenous peoples, private landowners, or any other resource manager (e.g., lack of mowing of meadows, reduction in controlled burns, lack of indigenous management of key ecosystems, ceasing supplemental feeding of condors).
8			**Invasive and Problematic Species, Pathogens, and Genes** Threats from non-native and native plants, animals, pathogens or microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance or virulence.
	8.1		**Invasive Non-Native/Alien Plants and Animals:** Harmful plants and animals not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities (e.g., feral horses, feral household pets, zebra mussels, Miconia tree, introduction of species for biocontrol).
		8.1.1	Invasive Wildlife Species (non-native)
		8.1.2	Invasive Plant Species (non-native)
		8.1.3	Feral Domesticated Animals
		8.1.4	Insects (alien organisms)

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
	8.2		**Problematic Native Plants and Animals:** Harmful plants and animals that are originally found within the ecosystem(s) in question but have become "out-of-balance" or "released" directly or indirectly due to human activities (e.g., overabundant native deer, overabundant algae due to loss of native grazing fish, plague that affects rodents, invasive grasses).
		8.2.1	Problematic Animal Species (native)
		8.2.2	Problematic Insects (native)
		8.2.3	Problematic Plant Species (native upland)
		8.2.4	Problematic Plant Species (native wetland)
		8.2.5	
		8.2.6	Loss of Genetic Exchange/Inbreeding
		8.2.7	Natural Rarity
		8.2.8	Small Isolated Populations
	8.3		**Introduced Genetic Material:** Human-altered or transported organisms or genes (e.g., pesticide-resistant crops, hatchery salmon, restoration projects using nonlocal seed stock, genetically modified insects for biocontrol, genetically modified trees, genetically modified salmon).
	8.4		**Pathogens and Microbes:** Harmful native and non-native agents that cause disease or illness to a host, including bacteria, viruses, prions, fungi, and other microorganisms (e.g., plague affecting rodents, Dutch elm disease or chestnut blight, Chytrid fungus affecting amphibians outside of Africa).

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
9			**Pollution** Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources.
	9.1		**Household Sewage and Urban Wastewater:** Water-borne sewage and nonpoint runoff from housing and urban areas that include nutrients, toxic chemicals and/or sediments (e.g., discharge from municipal waste treatment plants, leaking septic systems, untreated sewage, outhouses, oil or sediment from roads, fertilizers and pesticides from lawns and golf courses, road salt).
		9.1.1	Stormwater Runoff
		9.1.2	Lack of Comprehensive Watershed Planning to Improve Water Quality (total maximum daily load)
		9.1.3	Wastewater Treatment Plant Effluent
	9.2		**Industrial and Military Effluents:** Water-borne pollutants from industrial and military sources, including mining, energy production, and other resource extraction industries that include nutrients, toxic chemicals and/or sediments (e.g., toxic chemicals from factories, illegal dumping of chemicals, mine tailings, arsenic from gold mining, leakage from fuel tanks, polychlorinated biphenyls (PCBs) in river sediments).
		9.2.1	Heavy Metal Deposition
		9.2.2	Acid Mine Drainage
	9.3		**Agricultural and Forestry Effluents:** Water-borne pollutants from agricultural, silvicultural, and aquaculture systems that include nutrients, toxic chemicals, and/or sediments, including the effects of these pollutants on the site where they are applied (e.g., nutrient loading from fertilizer runoff, herbicide runoff, manure from feedlots, nutrients from aquaculture, soil erosion).
		9.3.1	Agricultural Pollution
		9.3.2	Soil Erosion/Loss

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		9.3.3	Pesticides (insecticides/herbicides/fungicides)
	9.4		**Garbage and Solid Waste:** Rubbish and other solid materials, including those that entangle wildlife (e.g., municipal waste, litter from cars, flotsam and jetsam from recreational boats, waste that entangles wildlife, construction debris).
	9.5		**Airborne Pollutants:** Atmospheric pollutants from point and nonpoint sources (e.g., acid rain, smog from vehicle emissions, excess nitrogen deposition, radioactive fallout, wind dispersion of pollutants or sediments from farm fields, smoke from forest fires or wood stoves).
		9.5.1	Atmospheric Deposition
		9.5.2	Soil Movement/Deposition
	9.6		**Excess Energy:** Inputs of heat, sound, or light that disturb wildlife or ecosystems (e.g., noise from highways or airplanes, sonar from submarines that disturbs whales, heated water from power plants, lamps attracting insects, beach lights disorienting turtles, atmospheric radiation from ozone holes).
		9.6.1	Noise Pollution
		9.6.2	Thermal Alteration of Water (e.g., by power plant)
		9.6.3	Light Pollution
10			**Geological Events** Threats from catastrophic geological events.
	10.1		**Volcanoes:** Volcanic events (e.g., eruptions, emissions of volcanic gases).
	10.2		**Earthquakes/Tsunamis:** Earthquakes and associated events (e.g., earthquakes, tsunamis).
	10.3		**Avalanches/Landslides:** Avalanches or landslides (e.g., avalanches, landslides, mudslides).

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
11			**Climate Change** Change in climate patterns (e.g., those resulting from increased atmospheric greenhouse gases like carbon dioxide) and/or events outside the natural range of variation that could wipe out a vulnerable species or ecosystem.
	11.1		**Ecosystem Encroachment:** Large-scale effects of ecosystems shifting and impinging on other species and ecosystems (e.g., sea level rise [inundation of shoreline ecosystems, drowning of coral reefs], desertification [sand dune encroachment]).
		11.1.1	Increasing Stream Temperatures
		11.1.2	Encroachment of Woody Vegetation/Shifting Tree Line
		11.1.3	Shifting Phenology
	11.2		**Changes in Geochemical Regimes:** Broad-scale changes in the geochemical conditions of ecosystems, including ocean acidification (e.g., ocean acidification, changes in atmospheric carbon dioxide affecting plant growth, loss of sediment leading to broad-scale subsidence).
	11.3		**Changes in Temperature:** Broad-scale changes in temperature mean, variability, seasonality and extremes, including changes in temperature extremes, increased average summer temperature, and decreased minimum winter/spring temperature (e.g., heat waves, cold spells, oceanic temperature changes, melting of glaciers/sea ice).
	11.4		**Changes in Precipitation and Hydrological Regimes:** Broad-scale changes in precipitation mean, variability, seasonality, and extremes, including decreased or increased precipitation, changes in timing of precipitation, changes in form of precipitation (e.g., snow versus rain; snow cover and snowpack where applicable), changes in evapotranspiration rates and hydrological cycles, and droughts and floods (e.g., droughts, changes in timing of rains, loss of snow cover, increased severity of floods).
	11.5		**Severe/Extreme Weather Events**

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12			**Data Gaps** Gaps in our knowledge or understanding that severely impede our ability to detect, diagnose, and abate threats to species and habitats.
	12.1		**Inadequate Understanding of Ecology and Life History:** Poor knowledge of the target and its relationship to its environment complicates or impedes effective conservation.
		12.1.1	Cheatgrass Impacts
		12.1.2	Importance and Contribution of Fluvial Populations
		12.1.3	Interaction with Non-Native Species Unknown
		12.1.4	Vulnerability to Emerging or Introduced Disease
		12.1.5	Relative Impacts of Fragmentation
		12.1.6	Persistent Declines in Prey Species
		12.1.7	Impacts to Migrating Birds
		12.1.8	Unknown Population Status
		12.1.9	Renewable Energy Impacts
		12.1.10	Pollinator Ecology
		12.1.11	Demography
	12.2		**Inadequate Understanding of Distribution or Range:** Poor knowledge of location, extent, timing, and/or seasonal variation of occurrence complicates or impedes effective conservation.

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	THREAT DESCRIPTION
	12.3		**Inadequate Inventory and Assessment Methods:** Inability to sample or characterize condition of individuals or population complicates or impedes effective conservation.
		12.3.1	No Morphological Key or Other Means to Identify
		12.3.2	Inventory Techniques Poorly Developed
		12.3.3	No Standardized Condition Assessment Method
	12.4		**Taxonomic Debate:** Uncertain identity complicates or impedes effective conservation.
		12.4.1	Uncertain Management or Conservation Units
	12.5		**Abiotic Conditions and Processes:** Uncertainty concerning specific physical or chemical processes complicates or impedes effective conservation.
		12.5.1	Atmospheric Deposition and Snowmelt Chemistry
		12.5.2	Relationship between Groundwater and Surface Water
		12.5.3	Mercury Deposition
	12.6		**Climate Change:** Uncertain climatic parameters and/or target tolerance and needs complicates or impedes effective conservation.
		12.6.1	Future Effects of Greater Temperature Variability under Climate Change
		12.6.2	Future Effects of Greater Precipitation Variability under Climate Change

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	12.7		**Inadequate Restoration Tools or Methods:** Lack of adequate restoration materials or methods complicates or impedes effective conservation.
		12.7.1	Plant Material Development

Source: Conservation Measures Partnership (2016) with the addition of Utah Level-3 threats.

Note: The threat descriptions that are in highlighted rows denote a priority threat. For the 2025 UWAP, the Utah Level-3 threats were reviewed and modified, but the overall classification structure from the 2015 UWAP was retained. Some Utah Level-3 threats developed for the 2015 UWAP have been absorbed under new Level-2 threats that are part of Conservation Measures Partnership Direct Threats Classification version 2.0, which resulted in blank rows in the 2025 UWAP threats classification. These blank rows are denoted by gray shading in the cells.

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† Level-1 and Level-2 threats are standardized national threats that all state wildlife action plans use. Level-3 threats were created by Utah Division of Wildlife Resources and are specific to Utah.

Conservation Actions

The structure of the standardized conservation actions used for UWAP is detailed in The Standardized Conservation Actions System section in Chapter 4, Threats, Data Gaps, and Conservation Actions. The Core Team and UWAP partners reviewed and updated the conservation actions recommended in this UWAP revision after the priority threats for the state were updated. The UWAP conservation actions then were assigned a three-digit numeric code to best match the closest nationally standardized actions. The entire list of nationally standardized actions are presented in Table E-2 (Conservation Measures Partnership 2016).

Table E-2. *Conservation Actions*

IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	CONSERVATION ACTION DESCRIPTION
1			**Land/Water Management** Actions to directly restore a target or mitigate a stress. Actions directly managing or restoring sites, ecosystems and the wider environment.
	1.1		**Site/Area Stewardship:** Cutting invasive vines off trees, liming acid ponds, using microbes to clean up oil spills, use of noise makers to scare off birds, gating caves to protect hibernating bats, routine maintenance in a protected area, use of traditional fire management practices by Indigenous peoples, releasing daughterless male mosquitoes, managing park visitors to reduce disturbance.
		1.1.1	Restoring targets or mitigating stresses via mechanical actions (e.g., removing invasives, mowing).
		1.1.2	Restoring targets or mitigating stresses via chemical actions (e.g., herbicides, liming ponds).
		1.1.3	Restoring targets or mitigating stresses via biological control (e.g., oil-eating microbes).
		1.1.4	Restoring targets or mitigating stresses via sensory control (e.g., predator urine, noise deterrents).
		1.1.5	Restoring targets or mitigating stresses via separation or border actions (e.g., fencing, gating caves).
		1.1.6	Restoring targets or mitigating stresses via ecological management (e.g., prescribed fire).
		1.1.7	Restoring targets or mitigating stresses via genetic manipulation (e.g., sterile males of an invasive species).
		1.1.8	Restoring targets or mitigating stresses via visitor management (e.g., routing trails around wetlands).

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	CONSERVATION ACTION DESCRIPTION
	1.2		**Ecosystem and Natural Process (Re)Creation:** Creating forest corridors, grasslands, or mangroves on degraded lands, creating artificial oyster reefs, breaching levees to restore wetlands, managing dams to simulate natural hydrological regimes, using livestock to simulate herbivore grazing.
		1.2.1	Building or restoring key ecosystem structural components.
		1.2.2	Building or restoring key ecosystem abiotic functions and processes.
		1.2.3	Building or restoring key ecosystem biotic functions and processes.
2			**Species Management** Actions directly managing or restoring specific species or taxonomic groups.
	2.1		**Species Stewardship:** Culling ungulates, heating bat roosts to reduce white-nose syndrome effects, artificial bird nesting boxes or platforms, supplementary feeding, planting food trees, manual pollination of orchids, vaccinating wild dogs, guiding elephants on migrations, shooting or trapping invasive competitors, using false brood parasite eggs to reduce brood parasitism.
		2.1.1	Assisting specific taxa in-situ via population management.
		2.1.2	Assisting specific taxa in-situ via shelter management.
		2.1.3	Assisting specific taxa in-situ via nutrient or water management.
		2.1.4	Assisting specific taxa in-situ via reproduction management.
		2.1.5	Assisting specific taxa in-situ via disease or injury management.
		2.1.6	Assisting specific taxa in-situ via movement or migration management.

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	CONSERVATION ACTION DESCRIPTION
		2.1.7	Assisting specific taxa in-situ via interspecific interaction management.
	2.2		**Species Reintroduction and Translocation:** Reintroduction of wolves, translocation of species imperiled by climate change to new suitable locations, benign introductions of top predator fish to an ecosystem, transferring monkeys to improve genetic diversity.
		2.2.1	Facilitation of reintroduction of species where they previously existed.
		2.2.2	Facilitation of translocation of species to new places (benign introduction).
		2.2.3	Facilitation of transfer of individuals or genes to increase genetic diversity.
	2.3		**Ex-Situ Conservation:** Off-site rehabilitation of injured raptors, captive rearing of mussels for reintroduction, captive breeding of an endangered frog to avoid disease, seed banking, genetic restoration of mammoths from DNA, restoration of tortoises from back-crosses, synthetic species creation.
		2.3.1	Providing ex-situ protection to species via support within the life of an individual.
		2.3.2	Providing ex-situ protection to species via support or captive breeding over generations.
		2.3.3	Providing ex-situ protection to species via gene banking (e.g., seeds, sperm, DNA).
		2.3.4	Providing ex-situ protection to species via genetic reconstruction (e.g., restoring extinct species).
		2.3.5	Providing ex-situ protection to species via synthetic species creation.

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	CONSERVATION ACTION DESCRIPTION
3			**Awareness-Raising Actions** To reduce direct threats or increase positive behaviors. Actions making people aware of key issues and/or feeling desired emotions, leading to behavior change.
	3.1		**Outreach and Communications:** Briefing newspaper reporters on conservation issues, social media campaigns, public service radio ads, zoo exhibits about threats to animal habitat, recording conservation songs, producing puppet shows with conservation message, door-to-door engagement, taking children on nature walks.
		3.1.1	Raising awareness via reported media (e.g., newspapers, TV, radio, curated blogs).
		3.1.2	Raising awareness via social media (e.g., Facebook, personal blogs).
		3.1.3	Raising awareness via ads and marketing (e.g., mail campaign, celebrity media ads).
		3.1.4	Raising awareness via displays (e.g., museum or zoo exhibits, park signs).
		3.1.5	Raising awareness via art (e.g., paintings, recorded music).
		3.1.6	Raising awareness via performances (e.g., puppet shows, theater).
		3.1.7	Raising awareness via person-to-person engagement (e.g., info booth, peer mentor).
		3.1.8	Raising awareness via experiential learning (e.g., nature walks, outdoor education).
	3.2		**Protests and Civil Disobedience:** Organizing protest marches against oil drilling, investigative journalism naming and shaming polluting companies, impeding whaling vessels, sitting in trees to prevent logging, sabotaging wildlife traps.
		3.2.1	Organizing or engaging in protests (confrontations or refusing to engage).

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		3.2.2	Organizing or engaging in public identification of wrong-doers.
		3.2.3	Organizing or engaging in impeding activities (legal or illegal passive civil disobedience).
		3.2.4	Organizing or engaging in sabotage (illegal active monkeywrenching).
4			**Law Enforcement and Prosecution** Actions monitoring and enforcing compliance with existing laws and policies at all levels to deter threats or compel conservation action.
	4.1		**Detection and Arrest:** Monitoring wildlife trafficking across borders, investigating reports of illegal grazing, setting up informer network against tiger poaching, interdicting an illegal fishing vessel.
		4.1.1	Reducing or deterring illegal behaviors through surveillance.
		4.1.2	Reducing or deterring illegal behaviors through patrolling.
		4.1.3	Reducing or deterring illegal behaviors through guarding checkpoints or borders.
		4.1.4	Reducing or deterring illegal behaviors through carrying out investigations.
		4.1.5	Reducing or deterring illegal behaviors through establishing and maintaining informer networks.
		4.1.6	Reducing or deterring illegal behaviors through arrest and interdiction.

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	4.2		**Criminal Prosecution and Conviction:** Collecting evidence to prosecute a wildlife trader, holding trials for alleged law breakers, monitoring to ensure criminals serve time and pay fines.
		4.2.1	Deterring threat behaviors through prosecuting alleged crimes.
		4.2.2	Deterring threat behaviors through trying alleged crimes.
		4.2.3	Deterring threat behaviors through punishing proven crimes (prisons, fine collection, rehabilitation).
	4.3		**Non-Criminal Legal Action:** Suing an agency to take action to protect an endangered species, suing a company to stop illegal logging, citing homeowners for sewage violations, agency review of policies or projects.
		4.3.1	Changing behavior through civil lawsuits.
		4.3.2	Changing behavior through agency enforcement.
		4.3.3	Changing behavior through agency or judicial review.
5			**Livelihood, Economic, and Moral Incentives** Actions using livelihood or other economic and moral incentives to directly influence attitudes and behaviors.
	5.1		**Linked Enterprises and Alternative Livelihoods:** Non-timber forest product harvesting business, wild salmon fishery, subsistence hunting and gathering, training loggers to be ecotourism guides, training loggers for factory jobs.
		5.1.1	Creating incentives to change behaviors through linked product-producing enterprises (consumptive).
		5.1.2	Creating incentives to change behaviors through linked ecological service–using enterprises (nonconsumptive).

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IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	CONSERVATION ACTION DESCRIPTION
		5.1.3	Creating incentives to change behaviors through non-linked enterprises and livelihoods.
	5.2		**Better Products and Management:** Practice competition to develop sea turtle–friendly fishhooks, research to develop low water use crops, providing access to weed-free hay, setting up recycling services, training in chicken production as a substitute protein source for bushmeat, setting up grass and forest banking systems to mitigate farmer risk, engagement with corporations to "green" their supply chains.
		5.2.1	Changing behaviors by developing better products and practices.
		5.2.2	Changing behaviors by promoting better products and practices.
		5.2.3	Changing behaviors by providing better products.
		5.2.4	Changing behaviors by providing training or technical assistance for better practices.
		5.2.5	Changing behaviors by removing barriers to adoption of better products or practices.
	5.3		**Market-Based Incentives:** Promoting responsible palm oil production, educating consumers about seafood sustainability, boycotts of non–dolphin safe tuna, creating carbon market for forest conservation, providing loan guarantees to green businesses, campaign to get universities to divest from fossil fuel companies.
		5.3.1	Creating incentives to change behaviors through "green" certification of products or services.
		5.3.2	Creating incentives to change behaviors through boycotts of "non-green" products or services.
		5.3.3	Creating incentives to change behaviors through environmental markets (e.g., carbon dioxide emissions, water).
		5.3.4	Creating incentives to change behaviors through "green" financing (e.g., bank loans, divestiture).

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	5.4		**Direct Economic Incentives:** Compensation payments for elephant crop-damage, giving or raising money for "green" political candidates, providing medical clinic in return for conservation, tax incentives to promote conservation, punitive taxes on high–fuel consuming cars, using economic valuation of wetland flood protection services to promote wetland conservation, prizes for environmental work.
		5.4.1	Creating incentive to change behaviors through direct payments or subsidies for desired behaviors.
		5.4.2	Creating incentive to change behaviors through taxes on undesired behaviors.
		5.4.3	Creating incentive to change behaviors through valuation of ecological services.
		5.4.4	Creating incentive to change behaviors through monetary awards and prizes.
	5.5		**Non-Monetary Values:** Linking conservation to human health, linking conservation to food security, developing religious or cultural arguments for conservation.
		5.5.1	Creating incentives to change behaviors by appealing to health and social service benefits.
		5.5.2	Creating incentives to change behaviors by appealing to security benefits.
		5.5.3	Creating incentives to change behaviors by appealing to spiritual, moral, or cultural benefits.
6			**Conservation Designation and Planning** Actions to create the conditions necessary for other conservation efforts to succeed; actions directly protecting sites and/or species.
	6.1		**Protected Area Designation and/or Acquisition:** Gazetting a national park, demarcating a town wildlife sanctuary, purchasing a land trust property, establishing tribally owned hunting ground.
		6.1.1	Establishing or demarcating government protected area.

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		6.1.2	Establishing or demarcating private protected area.
		6.1.3	Establishing or demarcating community or tribal natural resource use area.
	6.2		**Easements and Resource Rights:** Convincing landowners to establish easements restricting development rights, purchasing water or instream flow rights, securing resource tenure rights for local communities.
		6.2.1	Purchasing or promoting conservation easements.
		6.2.2	Purchasing or promoting specific resource rights.
	6.3		**Land or Water Use Zoning and Designation:** Zoning development versus conservation areas; designating a wild and scenic river or an important bat conservation area (without formal protection).
		6.3.1	Conducting or doing land use zoning (where to put plantations, housing).
		6.3.2	Conducting or doing conservation area designation (beyond protected areas).
	6.4		**Conservation Planning:** Developing a management plan for a national park, revision of an existing plan for a migratory bird species across its range, spatial planning and prioritization effort to identify important bat areas, planning a livelihood project.
		6.4.1	Planning for managing ecoregions or large land or seascapes.
		6.4.2	Planning for managing sites and protected areas.
		6.4.3	Planning for managing species and taxonomic groups.
		6.4.4	Planning for managing thematic projects and programs.

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	6.5		**Site Infrastructure:** Creating guard posts, border fences, roads, recreational areas.
		6.5.1	Building or maintaining infrastructure to support site protection (e.g., border fences, patrol huts).
		6.5.2	Building or maintaining infrastructure to support site direct management (e.g., greenhouses, supply sheds).
		6.5.3	Building or maintaining infrastructure to support site resource extraction (e.g., sawmill, fish processing building).
		6.5.4	Building or maintaining infrastructure to support site transport (e.g., roads, airstrips).
		6.5.5	Building or maintaining infrastructure to support site tourism and recreation (e.g., visitor centers, boat ramps).
		6.5.6	Building or maintaining infrastructure to support site learning and research (e.g., student dorms, labs).
		6.5.7	Building or maintaining infrastructure to support site administration (e.g., headquarters, power plants).
7			**Legal and Policy Frameworks** Actions developing and influencing legislation; policies and voluntary standards affecting conservation.
	7.1		**Laws, Regulations, and Codes:** Advocating for strengthening international wildlife trade laws, writing national legislation for endangered species conservation, proposing state or provincial ballot initiatives to fund conservation, making the case for town sewage regulations, enacting tribal laws governing hunting seasons, creating a roundtable of key soy producers to create standards for responsible soy production.
		7.1.1	Creating, amending, or influencing environment-related international law, conventions, and treaties.
		7.1.2	Creating, amending, or influencing environment-related national law or regulations.
		7.1.3	Creating, amending, or influencing environment-related state or provincial law or regulations.

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		7.1.4	Creating, amending, or influencing environment-related municipal law or regulations.
		7.1.5	Creating, amending, or influencing environment-related tribal law and formal customs.
		7.1.6	Creating, amending, or influencing environment-related private sector or civil society codes.
		7.1.7	Creating, amending, or influencing environment-related cross-sectoral regulations and codes.
	7.2		**Policies and Guidelines:** Advocating for agency implementation of international wildlife trade laws, writing national policies for endangered species conservation, serving on agency-nongovernmental organization committees to determine hunting permitting processes, providing support to tribal leaders on environmental matters.
		7.2.1	Creating, amending, or influencing environment-related international policies.
		7.2.2	Creating, amending, or influencing environment-related national polices.
		7.2.3	Creating, amending, or influencing environment-related state or provincial policies.
		7.2.4	Creating, amending, or influencing environment-related municipal policies.
		7.2.5	Creating, amending, or influencing environment-related tribal policies.
		7.2.6	Creating, amending, or influencing environment-related private sector or civil society policies.
		7.2.7	Creating, amending, or influencing environment-related cross-sectoral policies and guidelines.

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8			**Research and Monitoring** Actions collecting and transforming data into information to support conservation work.
	8.1		**Basic Research and Status Monitoring:** Biological research on the distribution of an endangered bird, setting up a database or scorecard on the status of wetlands in a region, modeling climate change effects, surveying income and attitudes of local community members.
		8.1.1	Conducting research or analysis in different disciplines on biological targets.
		8.1.2	Conducting research or analysis in different disciplines on human well-being targets.
		8.1.3	Conducting research or analysis in different disciplines on threats or biophysical factors.
		8.1.4	Conducting research or analysis in different disciplines on socioeconomic drivers.
	8.2		**Evaluation, Effectiveness Measures, and Learning:** Formative evaluation of a conservation project, conducting a systematic review of the effectiveness of an action, creating a database of conservation projects, developing standard classifications.
		8.2.1	Collecting information about conservation work–specific projects.
		8.2.2	Collecting information about conservation work cross-project or program comparisons.
		8.2.3	Collecting information about conservation work discipline-level frameworks (double loop learning).

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9			**Education and Training** Actions enhancing the knowledge and skills of specific individuals.
	9.1		**Formal Education:** Creating a high school environmental course, teaching a conservation module in a university course, writing a conservation text book.
		9.1.1	Providing conservation courses, modules, or materials for primary education.
		9.1.2	Providing conservation courses, modules, or materials for secondary education.
		9.1.3	Providing conservation courses, modules, or materials for college or university education.
		9.1.4	Providing conservation courses, modules, or materials for adult or continuing education.
	9.2		**Training and Individual Capacity Development:** Coaching a team developing a strategic plan, providing technical assistance to landowners to use better practices, offering a training course in prescribed fire, writing how-to manuals for project managers, sharing traditional ecological knowledge with elders.
		9.2.1	Providing conservation capacity development through hands-on coaching and technical assistance.
		9.2.2	Providing conservation capacity development through workshops and professional development training courses.
		9.2.3	Providing conservation capacity development through developing training materials (manuals, software, videos).

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10			**Institutional Development** Actions creating the institutions needed to support conservation work.
	10.1		**Internal Organizational Management and Administration:** Hiring and managing staff for protected areas or conservation agencies, serving on the board of a conservation organization, managing a conservation program, providing basic support functions for a reserve.
		10.1.1	Establishing and managing conservation organizations' governance.
		10.1.2	Establishing and managing conservation organizations' executive management.
		10.1.3	Establishing and managing conservation organizations' human resources.
		10.1.4	Establishing and managing conservation organizations' financial and legal management.
		10.1.5	Establishing and managing conservation organizations' fundraising.
		10.1.6	Establishing and managing conservation organizations' communications.
		10.1.7	Establishing and managing conservation organizations' program or project management.
		10.1.8	Establishing and managing conservation organizations' provision of organization facilities and technology.
		10.1.9	Establishing and managing conservation organizations' support functions (secretaries, guards, drivers).

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	10.2		**External Organizational Development and Support:** Providing consulting services to a conservation organization, international volunteers or circuit riders helping to develop organizational capacity, working to create and strengthen courts that can prosecute wildlife crimes, helping catalyze and incubate formation of a new land trust, developing work planning software for conservation organizations.
		10.2.1	Establishing and supporting organizations through direct organizational support (consulting or volunteering).
		10.2.2	Establishing and supporting organizations through organizational establishment and incubation.
		10.2.3	Establishing and supporting organizations through providing association or membership services (Land Trust Alliance, Association of Zoos and Aquariums).
		10.2.4	Establishing and supporting organizations through developing or providing organizational management tools.
	10.3		**Alliance and Partnership Development:** Convening meetings of local stakeholders in a community reserve, an international forum to share information about wildlife crimes, a membership services association of land trusts, a regional learning network, an international academic society.
		10.3.1	Creating or maintaining partnerships focused on coordinating conservation implementation.
		10.3.2	Creating or maintaining partnerships focused on knowledge generation and sharing.
	10.4		**Financing Conservation:** Door-to-door fundraising efforts, private foundation or government grants, foundation investments in green businesses, corporate philanthropy, national debt-for-nature swaps.
		10.4.1	Providing funds for conservation, including member or small contributions.
		10.4.2	Providing funds for conservation, including unrestricted grants.
		10.4.3	Providing funds for conservation, including restricted grants (e.g., scholarships for a specific project).

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† Level-1 actions: Broad, landscape-scale strategies that address multiple SGCN or key habitats. These actions focus on general intervention types, such as water protection, land conservation, or policy changes. Level-2 actions: More specific measures that fall within the most relevant Level-1 category. Level-3 actions: Highly targeted efforts nested within the appropriate Level-2 category. The coding format is #.#.#, where the first digit represents the Level-1 category, the second corresponds to Level-2, and the third indicates Level-3.

IUCN-CMP* LEVEL-1 CODE†	IUCN-CMP* LEVEL-2 CODE†	UTAH LEVEL-3 CODE†	CONSERVATION ACTION DESCRIPTION
		10.4.4	Providing funds for conservation, including program-related investments or soft loans.
		10.4.5	Providing funds for conservation, including commercial loans.
		10.4.6	Providing funds for conservation, including in-kind services.
		10.4.7	Providing funds for conservation, including financing mechanisms (e.g., debt-for-nature swaps).

Source: Conservation Measures Partnership (2016).

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† Level-1 actions: Broad, landscape-scale strategies that address multiple SGCN or key habitats. These actions focus on general intervention types, such as water protection, land conservation, or policy changes. Level-2 actions: More specific measures that fall within the most relevant Level-1 category. Level-3 actions: Highly targeted efforts nested within the appropriate Level-2 category. The coding format is #.#.#, where the first digit represents the Level-1 category, the second corresponds to Level-2, and the third indicates Level-3.