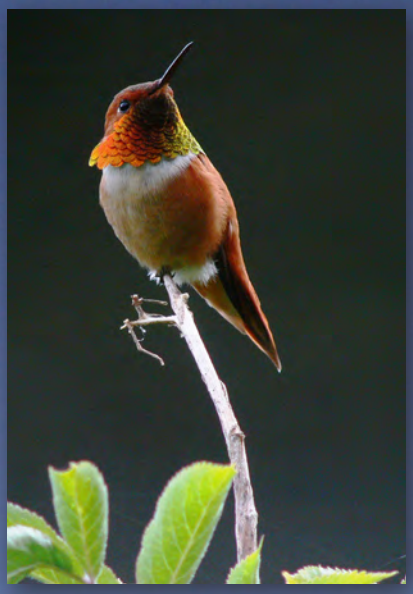
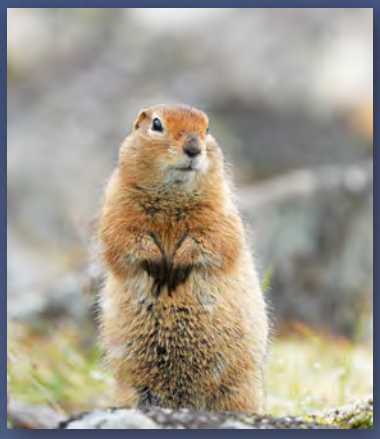

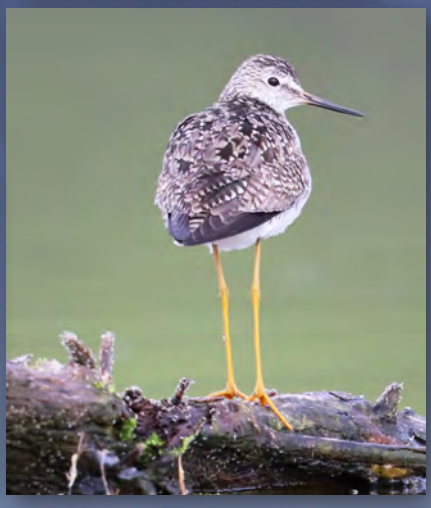

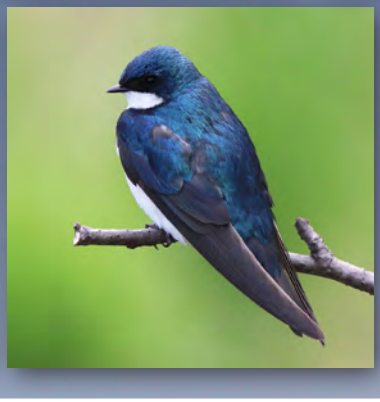

2025 ALASKA WILDLIFE ACTION PLAN

A 10-year plan for managing fish and wildlife species and their habitats to help avoid listings under the Endangered Species Act

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Alaska Department of Fish and Game
PO Box 115526
Juneau, Alaska 99811-5526

This plan identifies the wildlife species and habitats in greatest conservation need in Alaska, key threats to those species, and conservation actions needed to ensure their populations are healthy into the future. Congress mandated that state fish and wildlife agencies develop the plans to receive federal funding through the State Wildlife Grants Program. This document is that plan. If higher resolution images of the maps and photos presented in this State Wildlife Action Plan are desired, the reader can download separate, higher resolution copies of all chapters.

Cover: Clockwise from top left: Rufous Hummingbird, A. Underwood, ADF&G; Arctic ground squirrel, A. Underwood, ADF&G; bee on Sitka valerian flower, A. Underwood, ADF&G; Golden Eagle, R. Bartz, Wikimedia Commons; northern sea otter, M. Baird; sunflower sea star, ABR; Tree Swallow, A. Underwood, ADF&G; Tiger Rockfish, R. Ragan; Pacific walrus, A. Underwood, ADF&G; Lesser Yellowlegs, ADF&G; Mt. Hayes, Alaska Range, K. Titus, ADF&G.

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Executive Summary

Dwarf fireweed on the Stikine River, Shakes Slough. ADF&G.

Alaska's State Wildlife Action Plan (SWAP) serves as a framework for prioritizing fish and wildlife conservation efforts and is required for the Alaska Department of Fish and Game (ADF&G) to remain eligible for United States Fish and Wildlife Service (USFWS) funding under the State Wildlife Grants (SWG) program. The U.S. Congress created the SWG program in 2000 to provide essential conservation funding to every state and territory to proactively reduce the need for Endangered Species Act (ESA) listings of the nation's fish and wildlife. ADF&G receives approximately $2.7 million per year in federal funding from the SWG program and is required to provide nonfederal matching funds at a rate of 35% of the total project costs. This funding helps ADF&G reduce inappropriate, expensive, or prescriptive regulatory burdens of the ESA. The 2025 SWAP fulfills the congressionally mandated 10-year "major revision" requirement of the SWG program. ADF&G developed the 2025 SWAP with input from conservation partners and the public to function as a living document to guide fish and wildlife conservation efforts in Alaska over the next 10 years.

The Alaska SWAP is framed by the Alaska Constitution (Art. VIII) and ADF&G's mission, both of which emphasize the compatibility of long-term natural resource use and fish and wildlife conservation under the sustained yield principle. SWG funds help Alaska maintain robust populations of fish and wildlife, while the state's existing legal frameworks on natural resource use and development address localized impacts. Examples include multiple statutes and regulations to conserve and manage anadromous waters (e.g., Fishway Act, AS 16.05.841; Anadromous Fish Act, AS 16.05.871-

.901; Anadromous Waters Catalog, 5 AAC 95.011), which promote the long-term sustained yield of anadromous fish, such as salmon.

Alaska's 2025 SWAP creates opportunities for collaboration between agencies, conservation organizations, and the public in proactive, voluntary efforts to conserve fish and wildlife species while supporting sustainable natural resource use that benefits all Alaskans. The following objectives form the foundation of this plan:

- Avoid the need for future ESA listings.
- Maintain state-led management authority for Alaska's fish and wildlife.
- Manage Alaska's fish and wildlife according to the sustained yield principle to ensure they can be used and enjoyed by future generations.
- Provide for maximum natural resource use to benefit Alaskans.
- Maintain management flexibility to enable timely responses to emerging threats to fish and wildlife.
- Sustain healthy, functioning ecosystems.
- Increase public engagement in fish and wildlife conservation.
- Foster partnerships to leverage available resources for conservation.

SWG funding can be spent on research, monitoring, habitat assessments, conservation actions, and planning activities that benefit "species of greatest conservation need," or SGCN, and their habitats. The SWAP describes the selection process for SGCN, including our use of the Alaska Species Ranking System (ASRS), and the basis for inclusion on the resulting SGCN list, which includes 266 vertebrate species, one rockfish genus, nine invertebrate species, and 17 invertebrate taxa. The broad scope of the SGCN list enables timely responses to emerging issues that mitigate impacts, reverse declines, and fill knowledge gaps before species become imperiled, reducing the need for ESA listings.

Throughout the SWAP we refer to nine biogeographic regions, which reflect areas of Alaska's land and waters that have similar ecological and environmental characteristics. These biogeographic regions are the foundation for our description of 33 terrestrial and freshwater habitats using the U.S. National Vegetation Classification (USNVC) and the occurrence of SGCN within each habitat in each biogeographic region. The use of this national standard promotes consistent habitat classification and supports interagency collaboration on efforts to monitor changes in wildlife habitat over time and to manage broad-scale threats such as invasive species introductions.

We organize our summary of the potential threats to Alaska's fish and wildlife using the Conservation Measures Partnership Direct Threats Classification. Most of these potential threats are not expected to have population-level impacts on fish and wildlife in Alaska, due to their small spatial scale relative to the amount of undisturbed habitat, the large extent of land already managed for fish and wildlife conservation across the state, and existing adequate regulatory mechanisms to ensure that development and other human activities are compatible with fish and wildlife conservation. By contrast, threats that affect fish and wildlife at broad scales are more likely to result in petitions to list species as threatened or endangered, which the 2025 SWAP aims to reduce. Of particular concern for some SGCN are broad-scale threats like invasive species introductions, and environmental changes resulting in diminished sea ice, melting permafrost, and ocean acidification.

The SWAP describes Alaska's priorities for fish and wildlife conservation over the next decade, which are intended as general or strategic guidance. Budgets, staff capacity, partnerships, emerging conservation and management needs, and cost-benefit analyses also drive annual decisions on what specific research, monitoring, and planning projects ADF&G conducts. Highest priority is currently assigned to SGCN for which Alaska has high stewardship responsibility due to a large percentage of a species' population or range occurring in the state, and for which there is a documented conservation concern, such as a known population decline. The SWAP also identifies several priority habitats experiencing rapid environmental change (e.g., sea ice, tundra), as well as areas and habitats where multiple SGCN co-occur, enabling managers to prioritize limited resources and develop practical, solution-oriented conservation strategies.

K. Christie, ADF&G biologist, scanning the mudflats for Red Knots. A. Underwood, ADF&G.

Gulls on open water. ADF&G.

High-priority conservation actions in Alaska include research and monitoring efforts that identify drivers of decline, promote partnerships, and implement effective and achievable projects to mitigate threats and ensure sustained yield of SGCN. Alaska's SGCN are among the least studied populations in North America, therefore, quantifying population size, rate of population change, habitat use, reproduction, and migratory movements are important conservation actions. Such data help identify which species are resilient

Hubbard Glacier. ADF&G.

to broad-scale environmental change and which may require further conservation actions to support their resilience. Migration data have the added benefit of highlighting opportunities for partnerships outside the state to ensure breeding individuals return to Alaska by implementing conservation and management actions throughout a species' annual life cycle (e.g., restoring habitat along the migratory path, reducing stressors on the wintering grounds).

Overall, Alaska has ecologically intact habitats and abundant wildlife populations due to its expansive size, rugged and remote location, small human population, adequate existing regulations, and constitutional sustained yield mandate. The 2025 SWAP, developed with input from conservation partners and the public, will continue to provide the strategic guidance necessary over the next decade to help ensure Alaska's fish and wildlife populations remain diverse and abundant.

Double rainbow over fields at McNeil River State Game Sanctuary. ADF&G.

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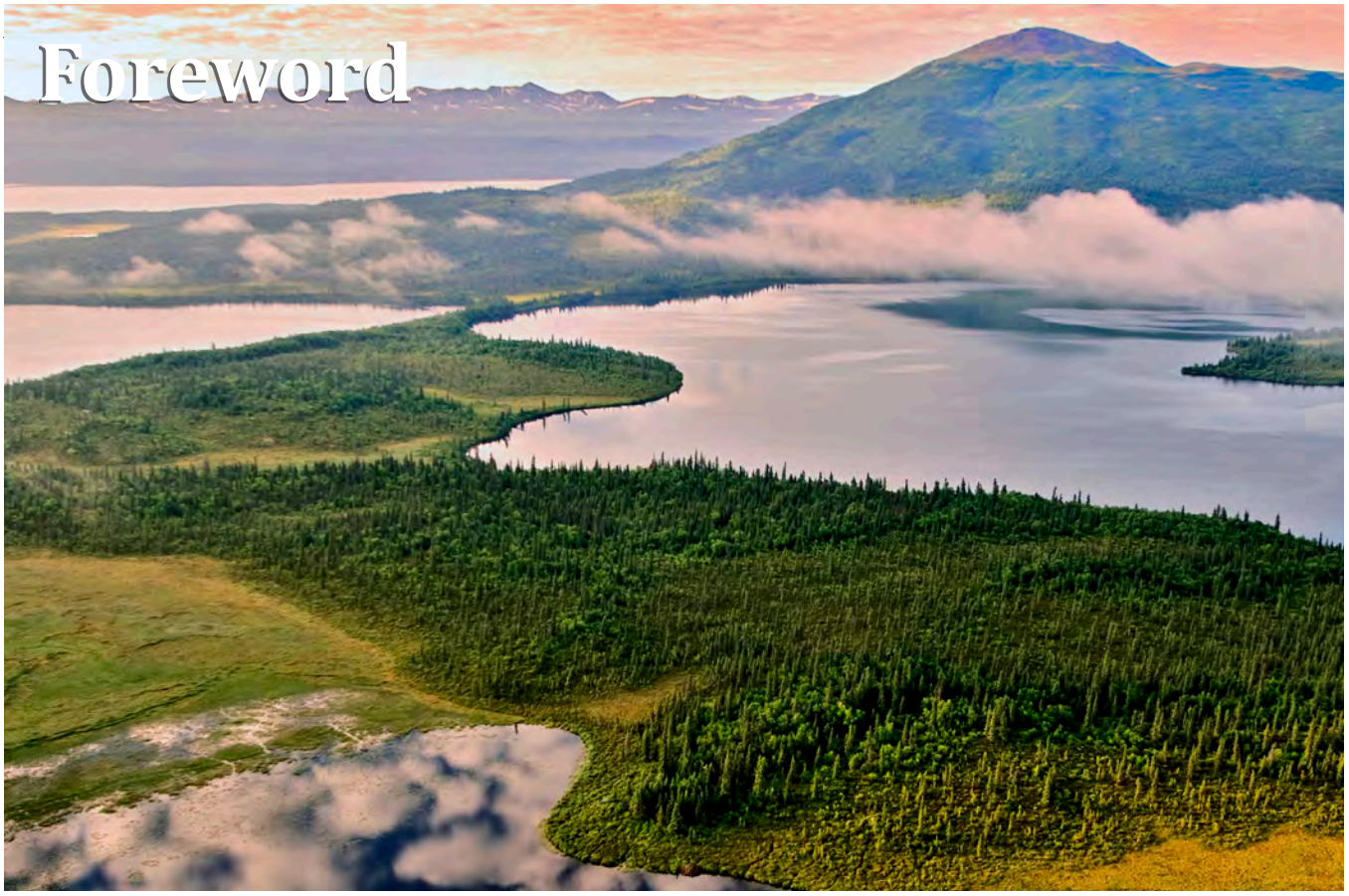
Foreword



Brooks Range. © M. Emery, used with permission.

Alaska is home to an incredible diversity of fish and wildlife species, many of which are unique to our great state. These species are foundationally important to our ecosystems and many are valued commercially, recreationally, and culturally.

The founders of our Alaska constitution wisely recognized the importance of sustaining these resources for future generations. They embedded into the constitution, yes our constitution, a requirement for common use of these resources and to sustainably manage them under the sustained yield principle. We take this responsibility seriously.

Based on this, Alaska has developed a robust management program that ensures the conservation of our fish and wildlife and their habitats. And we have been successful in our efforts. Our resource management programs are recognized as some of the best in the world.

I want to highlight the word "conservation." Our programs are not built on "protection," rather conservation of our resources, recognizing that wise use is an element of our management. People are part of the equation. This is our home, and we take pride in caring for it.

Alaska's State Wildlife Action Plan is a conservation plan for those species that we have identified as species needing focus. It is not a suggestion that these species are critically imperiled and need to be listed under the Endangered Species Act, rather it is a blueprint to identify threats facing these species and their habitats to sustain and conserve them for future generations.

I want to thank my staff and all those that contributed to this plan, recognizing that it is a living document that will evolve over time.

The Alaska Department of Fish and Game is entrusted to be good stewards of our resources. But conservation is a team effort. We are in this together.

—Doug Vincent-Lang, Commissioner, Alaska Department of Fish and Game

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Acronyms and Abbreviations

ABR	ABR, Inc.—Environmental Research & Services
ABRT	Alaska Bycatch Review Task Force
ACAC	Alaska Copper Ammo Challenge
ACAD	Avian Conservation Assessment Database
ACCS	Alaska Center for Conservation Science
ACUASI	Alaska Center for Unmanned Aerial System Integration (UAF program)
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADR	Alaska Department of Revenue
AEA	Alaska Energy Authority
AFFF	Aqueous Film Forming Foam
AFWA	Association of Fish and Wildlife Agencies
AKRDC	Alaska Resource Development Council
AKRR	Alaska Railroad
ALMS	Alaska Landbird Monitoring Surveys
AMA	Alaska Miners Association
AMBCC	Alaska Migratory Bird Co-Management Council
APHIS	Animal and Plant Health Inspection Service
ARC	Alaska Research Consortium
ASA	American Sportfishing Association
ASC	Alaska Science Center
ASCE	American Society of Civil Engineers
ASG	Alaska Shorebird Group
ASRS	Alaska Species Ranking System
ATBA	Areas to be avoided
ATIA	Alaska Travel Industry Association
BCC	Birds of Conservation Concern
BCI	Bat Conservation International
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BPIF	Boreal Partners in Flight
C3S	Copernicus Climate Change Service
CMP	Conservation Measures Partnership
CO2	Carbon dioxide
DNR	Alaska Department of Natural Resources
DOF	Alaska Division of Forestry and Fire Protection
DOLWD	Alaska Department of Labor and Workforce Development
DOT&PF	Alaska Department of Transportation and Public Facilities
DPS	Distinct population segment
EFH	Essential fish habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
EVT	Existing vegetation type
FAA	Federal Aviation Administration
FGDC	Federal Geographic Data Committee

Acronyms and Abbreviations (continued)

FRPA	Forest Resources Protection Act
FUDS	Formerly Used Defense Sites (managed by U.S. Army Corps of Engineers)
GAP	U.S. Geological Survey Gap Analysis Project
GDP	Gross domestic product
HAB	Harmful algal bloom
HPAI	Highly Pathogenic Avian Influenza
IARC	International Arctic Research Center
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
JPARC	Joint Pacific Alaska Range Complex
MG	McDowell Group
MMC	Marine Mammal Commission
MRG	McKinley Research Group
NABCI	North American Bird Conservation Initiative
NGO	Nongovernmental organization
NMFS	National Marine Fisheries Service
NOAA	National Ocean and Atmospheric Administration
NPAFC	North Pacific Anadromous Fish Commission
NPFMC	North Pacific Fishery Management Council
NPR-A	National Petroleum Reserve in Alaska
NPS	National Park Service
NRCS	National Resources Conservation Service
OCI	Office of Conservation Investment
PAME	Protection of the Arctic Marine Environment (Arctic Council Working Group Program)
PCB	Polychlorinated biphenyls
PFAS	Polyfluoroalkyl substances
PRISM	Program for Regional and International Shorebird Monitoring
SGCN	Species of greatest conservation need
SNAP	Scenarios Network for Alaska + Arctic Planning (UAF program)
SWAP	State Wildlife Action Plan
SWG	State Wildlife Grant
TED	Threatened, Endangered, and Diversity (ADF&G program)
UAF	University of Alaska Fairbanks
UAS	Unmanned aerial system
USACE	U.S. Army Corps of Engineers
USBEA	U.S. Bureau of Economic Analysis
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USEIA	U.S. Energy Information Administration
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNVC	U.S. National Vegetation Classification
WHESAP	Wildlife Habitat Enhancement and Spatial Analysis Program (ADF&G program)
WNS	White-nose syndrome

1 | Introduction

Arctic ground squirrel. T. Rains, NPS, used with permission.

The Alaska State Wildlife Action Plan (SWAP) is guided by the Alaska Constitution (Art. VIII, § 4) and the Alaska Department of Fish and Game's (ADF&G) mission to ensure the long-term viability of the state's fish and wildlife resources, managed to promote the well-being of Alaskans and the state's economy. Alaska is the only state with the sustained yield principle enshrined in its constitution, reflecting the state's commitment to the responsible use and conservation of its natural resources (Alaska Constitution, Art. VIII). The sustained yield principle emphasizes that renewable resources such as fish, wildlife, and their habitats must be maintained in a manner that does not restrict use, but rather ensures continued availability for future generations. The SWAP applies this definition to both harvested species (i.e., fish and game) as well as nongame species. The SWAP serves as a tool to help ADF&G and its partners proactively identify and address conservation needs, ensuring that healthy, viable populations of fish and wildlife persist, while allowing for the economic benefits provided by responsible resource use.

Alaska is required to have a SWAP to be eligible for funding through the State Wildlife Grants (SWG) program. The U.S. Congress created the SWG program in 2000 to provide critical funding to every state and territory to plan and implement proactive conservation actions to prevent the nation's fish and wildlife from becoming endangered. Funding is provided to the states through the U.S. Fish and Wildlife Service (USFWS). SWG is the only federal program that explicitly aims to avoid the need to list species as threatened or endangered under the Endangered Species Act (ESA). This program continues the long history of cooperation between the federal government and the states to manage and conserve wildlife species, returning to landmark laws such as the 1937 Pittman-Robertson Wildlife Restoration Act and the 1950 Dingell-Johnson Sportfish Restoration Act.

Gulkana River. ADF&G.

Golden Eagle nestlings. ADF&G.

Collared pika. ADF&G.

To help avoid ESA listings, SWG funding was used by each state and territory to develop a SWAP. Congress intended state action plans to be adaptive, requiring that they be revised periodically (at least once every 10 years) to incorporate new information and reflect up-to-date projected threats and priorities. These plans bring together the best science available to conserve and manage priority fish and wildlife species and their habitats. State action plans identify species with important conservation needs and offer a set of actions to address key threats, providing a voluntary, nonregulatory alternative to the federal ESA listing process. Grant funds must be used for activities that address conservation needs identified within a state's plan, such as research, surveys, monitoring, and species and habitat management.

Before the establishment of the SWG program, conservation funding was typically only available once species were critically endangered or officially listed under the ESA. While the ESA has been instrumental in conserving species, it has faced criticism for being costly and inefficient (Bunnell et al. 2004a, 2004b; Evans et al. 2016). Some key critiques include 1) most funding has not been used on essential habitat for recovery, 2) monitoring and recovery efforts often fail to focus on the main threats to species, 3) conservation actions are most effective when initiated while populations and their ranges are relatively large, and 4) priority ranking systems have not always guided expenditure decisions.

Application of the SWAP

Alaska's SWAP is intended to serve as a framework for identifying priority species and habitats, addressing threats, and implementing effective conservation actions to manage species under the sustained yield principle as stipulated in the Alaska Constitution (Art.

VIII, § 4). Additionally, the SWAP is envisioned to inform decision-making, allocate resources, and coordinate across agencies and partners to ensure the long-term conservation and management of wildlife species. The target species within the SWAP, referred to as "species of greatest conservation need" (SGCN), are identified based on multiple scientific criteria (e.g., a declining trend or other concerns, as detailed in Chapter 4). SGCN are eligible for SWG funds, which aim to implement proactive measures that keep species of concern from being listed under the ESA. Continued use of the SWAP framework and the SGCN list helps to focus priorities, secure funding, and develop projects that conserve wildlife. The approach promotes collaboration with partners to achieve conservation and management goals, while also allowing flexibility to address emerging issues.

Eight appendices are included at the end of the 2025 SWAP and provide in-depth information that we think will be useful to our partners and members of the public. Comprehensive lists of terrestrial and aquatic SGCN, as well as their conservation status and justifications for their inclusion, appear in Appendices A through C. Geographic distribution of SGCN and population estimates (where known) are provided in Appendices D and E. Appendices F and G contain detailed habitat descriptions and plant taxonomy that can be used to gain a better understanding of the wealth of wildlife habitats in Alaska. Finally, Appendix H includes online resources relating to current and ongoing wildlife and habitat monitoring efforts.

Fishing for Arctic grayling in the Delta River. ADF&G.

Throughout the 2025 SWAP, we include "vignettes" describing the life history, behavior, and habitats of SGCN and the conservation challenges they face. The purpose of the vignettes is to share additional information that we think provides interesting facts about Alaska's fish and wildlife and increases a reader's engagement with the SWAP. Vignettes feature SGCN and projects, providing examples of the kinds of work SWG funding allows ADF&G to do. Vignettes are not meant to imply the highest priority or top-ranked SGCN.

ADF&G authored this plan as the State of Alaska agency charged with the following mission: *"To protect, maintain, and improve fish, game and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the sustained yield principle."* SWG funds are used within ADF&G to help the state ensure that robust populations of fish and wildlife are maintained, while additional natural resources continue to be developed. Funds support research, conservation, and management efforts of the ADF&G Division of Wildlife Conservation's Threatened, Endangered, and Diversity (TED) Program, Marine Mammals Program, and Lands and Refuges Program, as well as the Division of Sport Fish. SWG funds enable these ADF&G programs to conserve and manage many Alaska species that do not receive sufficient traditional funding (e.g., Pittman-Robertson, Dingell-Johnson). Examples include declining migratory songbirds and shorebirds, bats, marine mammals, and certain aquatic species that have data deficiencies or are impacted by invasive species (see Chapter 4).

Species of Conservation Need: Lesser Yellowlegs *(Tringa flavipes)*

Lesser Yellowlegs. A. Underwood, ADF&G.

The Lesser Yellowlegs is a medium-sized shorebird that breeds in boreal wetlands throughout Alaska. These shorebirds are easily identifiable by their long, bright yellow legs and dark, slender bills. Lesser Yellowlegs are long-distance neotropical migrants. Transmitter data from GPS tags deployed on adults by ADF&G and others have revealed that these birds fly from Alaska, through the prairie pothole region, and continue as far south as Argentina. Wetlands and agricultural areas in Eastern Argentina appear to be important wintering areas. Unregulated subsistence hunting in South America on the fall and overwintering grounds is considered a primary threat to the species. Lesser Yellowlegs populations have been declining at a rate of approximately 5–9% per year in Alaska according to survey data, and the species has lost 60–70% of its population rangewide since the 1970s. Additional threats, which occur primarily outside of Alaska, include agricultural expansion, wetland drying, shoreline hardening, and exposure to pesticides and contaminants. ADF&G's Threatened, Endangered, and Diversity Program is conducting a mark-resight study to estimate the annual survival of migrating adults, assessing nest fate and breeding habitat characteristics, and assessing pesticide exposure to address various knowledge gaps for this rapidly declining species. ADF&G is working with partners across the species' range to reverse population declines.

How SWG Funds have Benefitted Alaska Wildlife

Since 2015, the State of Alaska has received $27 million (about $2.7 million annually) from Congress to implement the SWG program. The state and its partners have also provided more than $14 million in matching funds. This funding was used in Alaska to accomplish the work needed on various taxa of concern, including marine mammals, small mammals, seabirds, shorebirds, landbirds, and fish. Activities funded have included invasive species removals as well as surveys, monitoring, and research on habitat use, vital rates (e.g., reproductive success and mortality), and long-distance migratory movements of various species where adult survival is at risk.

The State of Alaska has prioritized SWG funding to monitor, conserve, and manage a diverse suite of species, such as those provided in Table 1.1. These projects aimed to take a proactive approach to conservation and management by first quantifying the key parameters of target SGCN (e.g., reproductive success, migratory patterns, diet, and survival) to reveal potential threats or stressors that may be responsible for current or future declines. ADF&G then used this information to implement effective population management or mitigation strategies to reduce or

Table 1.1. Example research projects conducted by the Alaska Department of Fish and Game's Threatened, Endangered, and Diversity Program using State Wildlife Grant funding (2015–2025).

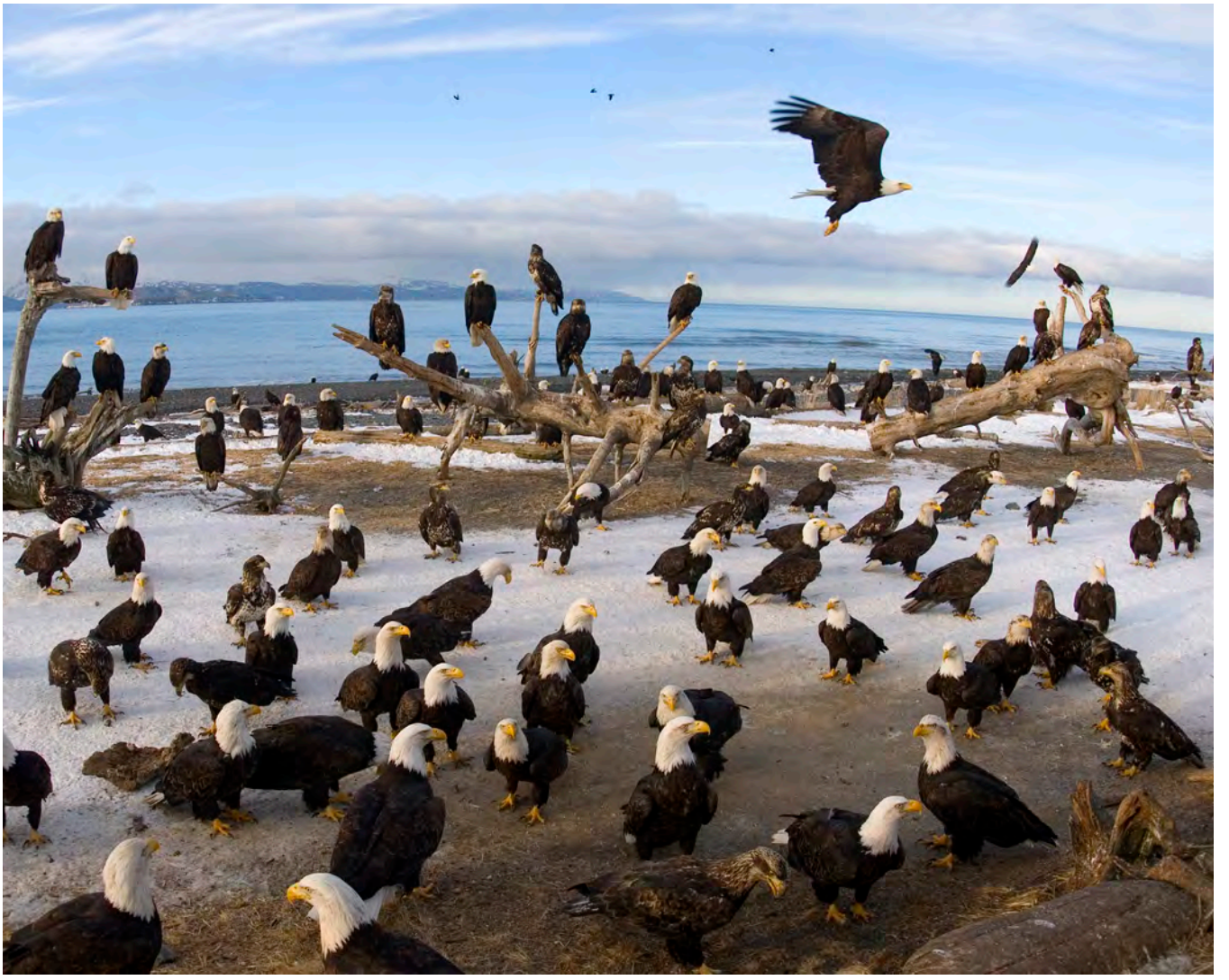
Birds	Research Focus
Lesser Yellowlegs	Migratory patterns, genetics, demography, threats assessment
Golden Eagle	Reproduction, survival, movement ecology
Aleutian Tern	Population monitoring, movement ecology
Kittlitz's Murrelet	Population monitoring, reproduction, abundance, nest success
Red Knot	Abundance, habitat hotspots, diet, migration patterns
Bank Swallow	Population monitoring, migratory patterns
Olive-sided Flycatcher	Migratory patterns, important stopover areas, survival, reproduction
Gray-headed Chickadee	Range estimation, abundance
Mammals	
Collared pika	Distribution, abundance, survival, genetics, diet
Little brown bat	Habitat, hibernation ecology, distribution, threat of white-nose syndrome
Arctic ground squirrel	Diet composition
Northern bog lemming	Diet composition, habitat use, resilience to environmental change
Alaska hare	Population monitoring, genetics, diet, management
Other (e.g., multiple species)	
Managing for timber and SGCN wildlife	Best management practices that benefit forest regeneration and provide habitat for SGCN birds and mammals
Reducing losses of Alaska's migratory SGCN	Migratory patterns, identification of actions to reduce mortality during the nonbreeding season
Monitoring SGCN songbirds	Long-term population monitoring and changes in migration timing
Pollinators	Diversity, abundance, distribution

reverse decline and avoid the need for species to be listed as endangered or threatened under the ESA. Successful projects benefit Alaskans because species are conserved, and expensive or prescriptive regulatory burdens of the ESA are more likely to be avoided. For more detailed information on ESA successes over the past 10 years, please see the "Defining Success" section of Chapter 9 and Table 9.1.

Creating the 2025 SWAP

ADF&G has reviewed the 2015 SWAP, new status assessments, and pertinent scientific literature from the last decade. In consultation with our partners, the SWAP was revised to identify threats to priority species in addition to conservation and management actions envisioned for the next 10 years. A detailed list of major changes in this revision is provided in Chapter 2.

Briefly, the 2025 revision offers updated information on the distribution, abundance, habitat use, threats, conservation actions, and status of SGCN. As in the 2015 SWAP, we have maintained a streamlined approach to the plan rather than providing an encyclopedic treatise about every



Gathering of Bald Eagles. ADF&G.

Little brown bat. D. Owens, ADF&G.

Emperor Geese with goslings. ADF&G.

species, threat, or possible conservation action in Alaska. We found the encyclopedic approach used in the original 2005 SWAP to be less practical and effective for users of the plan.

We consulted with partners and the public during the development and review of the 2025 SWAP with the intent that this plan will provide useful guidance for a wide array of partners, agencies, nongovernmental organizations (NGOs), Alaska Native groups, and others interested in conservation and management of Alaska's wildlife. Consultation will continue as ADF&G implements this revised plan and seeks to ensure that Alaska's wildlife and fish remain healthy and abundant into the future—a goal all Alaskans share.

Eight Required Elements

The 2025 SWAP must adequately address all eight elements below to ensure its approval and continued eligibility for SWG funding.

Congress directed that states include the following eight elements in their revision:

1. Information on the distribution and abundance of species, including low and declining populations that are indicative of the diversity and health of the state's wildlife.
2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in element 1.
3. Descriptions of problems that may adversely affect species identified in element 1 or their habitats, and priority research and survey efforts needed to identify factors that may assist in restoration and improved conservation of these species and habit.
4. Descriptions of actions proposed to conserve the identified species and habitats and priorities for implementing such actions.
5. Proposed strategies for monitoring species identified in element 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in element 4, and for adapting these conservation actions to respond appropriately to new information or changing conditions.

6. Descriptions of procedures to review the SWAP at intervals not to exceed 10 years.
7. Strategies for coordinating the development, implementation, review, and revision of the SWAP with federal, state, and local agencies and Alaska Native organizations that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats.
8. Provisions to ensure broad public participation in the development, implementation, and revision of the SWAP, along with associated projects and programs.

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View from a survey route on the Kenai Peninsula. ADF&G.

2 | Road Map to Plan Elements

Salmon jumping out of the water heading upstream. © M. Emery, used with permission.

This revision of Alaska's State Wildlife Action Plan (SWAP) represents a 10-year comprehensive revision to the 2015 plan. The state is required to provide a summary of all significant revisions, describe how the revisions meet the original required eight elements, and provide a "road map" to locate revisions in the plan. This chapter addresses these three requirements. The State of Alaska's intent to revise the SWAP was communicated to Region 7 of the U.S. Fish and Wildlife Service (USFWS) by letter on April 1, 2024, and amendment on May 2, 2024.

The revision process for the 2025 plan began with over 40 targeted interviews of staff from natural resource agencies, industry associations, nongovernmental organizations (NGOs), Alaska Native organizations, and wildlife user groups. The goal was to collect feedback on familiarity with the 2015 SWAP and the Threatened, Endangered, and Diversity (TED) Program, the nongame wildlife program at the Alaska of Fish & Game (ADF&G). This solicited feedback also identified potential collaborations and effective engagement with partners in the future. In addition to targeted interviews, TED Program staff led three workshops with statewide working groups of species specialists, including the Alaska Shorebird Group, Boreal Partners in Flight, and the Alaska Small Mammal Working Group. The purpose of these workshops was to share information about the SWAP and identify priority research projects and conservation and management objectives for wildlife in the next decade. The ADF&G Marine Mammals Program and Division of Sport Fish provided SWAP updates for marine

mammals and aquatic species, respectively. The state elicited input from the public during a comment period held in June 2025. At that time, a draft of the plan was widely circulated along with a survey that included free-form response options. Feedback from the public comment period was subsequently incorporated into the final document.

The plan was revised to incorporate current information on the distribution, habitats, status, threats, and conservation and management priorities for "species of greatest conservation need" (SGCN) in Alaska while maintaining the more readable and engaging format adopted in 2015.

Anchorage, Alaska's largest city, celebrates the outdoors with many lakes, parks, and developed trails for walking, biking, and skiing throughout the city. © K. Marsh, used with permission.

Demographics

Because of its remote, northern location, Alaska has seen relatively little of the urbanization and land conversion (e.g., for agriculture, ranching, housing) common in many areas of the lower 48 states. It is the most sparsely populated state in the country (1.3 people per square mile). About 40 percent of Alaska's 733,391 residents live in a single city (Anchorage), and most development is centered in a narrow northsouth "Railbelt" that parallels the Alaska Railroad route between the Kenai Peninsula, Anchorage, the Matanuska-Susitna Valley, and Fairbanks. The state's capital, Juneau, is in Southeast Alaska. It is the state's third-largest city, with about 32,000 residents, and is not connected to the road or rail system, except by marine ferry. Alaska's population increased by 3% between 2000 and 2020, with growth concentrated in the Southcentral region of the state, but has decreased in recent years. In addition to urban centers, there are many small communities, typically with hundreds of residents, including 229 federally recognized Alaska Native Tribes (40% of tribes in the United States). In 2023, Alaska Natives comprised nearly 16% of the state's total population (U.S. Census Bureau 2024).

Major Improvements to the 2025 SWAP

In addition to incorporating input from partner organizations, specialists, and the public, the 2025 revision includes the following improvements:

1. A thorough review of SGCN, particularly criteria for species inclusion (Chapter 4). The 2025 revision specifically adopts the Alaska Species Ranking System (ASRS), created by ADF&G and the Alaska Center for Conservation Science, to quantify the at-risk status of Alaska's terrestrial vertebrates and marine mammals (Gotthardt et al. 2012).
2. A new landscape-level focus that provides the first-ever spatial information on SGCN distributions in Alaska. In Chapter 5, we provide statewide, multispecies heatmaps for terrestrial vertebrate and marine mammal SGCN to inform future research on the drivers of SGCN biodiversity. Furthermore, we identify study locations where State Wildlife Grant (SWG) dollars can be spent most effectively to address multiple SGCN species.

3. A more thorough description of Alaska's habitats. Habitats are updated across terrestrial biogeographic regions for the first time to align with the U.S. National Vegetation Classification at the macrogroup level (USNVC 2025). In addition, Chapter 6 provides some of the first information on species richness (e.g., numbers of SGCN) of major habitat types across the state and within each biogeographic region.
4. Updated descriptions of threats in Chapter 7, including a more in-depth treatment of climate change and its direct and indirect impacts on Alaska's fish and wildlife in recent decades, and a range of projected outcomes for the future.
5. More strategic, focused approaches to implementing conservation and management actions for Alaska's fish and wildlife. For example, the 2025 SWAP identifies new opportunities to reduce steep declines of migratory species that breed in Alaska by fostering multistate or cross-border collaborations that target locations during the nonbreeding season, where adult survival is lowest.

Species of Greatest Conservation Need

The 2025 SWAP specifies SGCN taxonomy at the species level and above; however, if conservation concerns are restricted to lower taxonomic levels, we also provide information on subspecies, distinct population segments (DPS), or stocks (for marine mammals). Species were considered SGCN based on at-risk status, stewardship, and cultural importance. Economic and ecological importance was also considered, especially for aquatic species, given the importance of commercial harvest to Alaska (e.g., salmon and crab) and the role of lower trophic levels that feed many vertebrate SGCN.

Alaska's immense size, location, and intact ecosystems provide important habitat for a large proportion of the total population size for many species. To reflect Alaska's high stewardship responsibility in these cases, a species qualified as an SGCN when a large proportion of the population occurred in Alaska (e.g., 50% or more of the North American population is in Alaska at any time of the year; Chapter 4). Hunted species were excluded from SGCN status unless considered a candidate for listing under the Endangered Species Act (ESA) or traditional funding (e.g., Pittman-Robertson) was insufficient to implement a conservation and management program (e.g., Alaska hare, several sea ducks).

The SGCN list includes 266 vertebrate species, six orders of terrestrial arthropods, five classes of freshwater macroinvertebrates, one species of freshwater mollusk, three orders and one subclass of marine zooplankton, two classes of deep-sea corals, and eight species of other marine invertebrates. Of the vertebrates, the SGCN list includes 12 fish species and one genus of rockfish (Appendix C), five amphibians, 183 birds, 42 terrestrial mammals, and 24 marine mammals. The revised plan includes a complete list of all SGCN and the basis for their inclusion (Appendices A through C) and

Alaska hare. C. Barger, ADF&G.

Alaska pipeline. ADF&G.

updated information of distribution and habitat use (for all species), abundance (where known), and monitoring efforts (see Appendices D through H).

The revised plan provides criteria for including SGCN (Appendices A through C) and updated information on distribution and habitat use (for all species), abundance (where known), and monitoring efforts (see Appendices D through H). Scattered throughout the revision are vignettes describing SGCN in Alaska.

Threats and Conservation Actions

This revised plan identifies major threats facing wildlife in Alaska (Chapter 7). It sets clear priorities for research in addition to conservation and management actions for SGCN over the next decade (Chapter 8). We also use the standard terminology of Salafsky et al. (2024) to characterize threats and actions, which is a best practice for SWAP revision and implementation (AFWA 2012). Chapter 7 and others provide an updated and more complete picture of how wildlife and their habitats in Alaska are being impacted by climate change and how the changes can inform the conservation and management of SGCN.

Unlike most other states, Alaska has a great deal of intact, high-quality habitat for wildlife. Still, for many declining SGCN, the causes of population loss are difficult to pinpoint because wildlife spend only part of their life cycle in Alaska. These challenges require new partnerships to prevent species listings as threatened or endangered under the ESA. For example, many populations of long-distance migratory birds that breed in the state are declining (Handel and Sauer 2017), and collaborative international conservation efforts will be needed to address, mitigate, or reverse cross-border declines. In addition, monitoring the status of populations and habitat connectivity may be important methods to ensure that sustainable populations continue to return to Alaska's intact habitats for breeding and thrive into the future. This revised plan points to strategic research priorities such as population monitoring, mapping important habitats, and identifying specific

causes for population declines. Priority actions are guided by the likelihood of improving a species' conservation and management status by internal capacity and by the current work of other agencies, NGOs, or partners that align with SWAP needs.

The Revision Process

The public participation component of the plan was multifaceted and involved targeted interviews with current and future partners, facilitated workshops with species working groups, and broad public outreach to elicit feedback on a draft version of the 2025 SWAP. These steps ensured the effective multidirectional flow of information regarding species of conservation concern, their habitats, and conservation challenges in Alaska and beyond. The in-depth process has strengthened the document so that it can be used as an effective conservation and management tool and an important source of information over the next decade.

The SWAP must minimally satisfy eight required elements (Chapter 1). To ease the reading and review of the document, we summarize the elements and their corresponding chapters in Table 2.1.

Table 2.1. Locations in this document where the eight required SWAP elements are addressed.

Required Element	Description	Chapter
1	Identify species indicative of the diversity and health of the state's wildlife, including low and declining populations (i.e., "species of greatest conservation need" [SGCN]).	Species of Greatest Conservation Need (Chapter 4)
1	Information on the distribution and abundance of SGCN.	Distribution and Abundance of Wildlife in Alaska (Chapter 5)
2	Descriptions of location and relative condition of habitats and community types essential to SGCN.	Key Habitats of Wildlife in Alaska (Chapter 6)
3	Descriptions of problems that may adversely affect SGCN or their habitats.	Threats to Wildlife (Chapter 7)
3	Priority research and survey efforts to identify factors that may assist in the restoration and improved conservation of SGCN or their habitats.	Alaska Priorities (Chapter 10)
4	Descriptions of conservation actions proposed to conserve SGCN or their habitats.	Conservation Actions (Chapter 8)
4	Priorities for implementing conservation actions.	Alaska Priorities (Chapter 10)
5	Proposed strategies for monitoring SGCN, their habitats, and the effectiveness of conservation actions.	Monitoring and Evaluation (Chapter 9)
6	Descriptions of procedures to review the SWAP at intervals not to exceed 10 years.	Plan Development, Implementation, and Review (Chapter 11)
7	Strategies for coordinating the development, implementation, review, and revision of the SWAP with federal, state, and local agencies and Alaska Native organizations that manage significant land and water areas within the state.	Plan Development, Implementation, and Review (Chapter 11)
8	Description of public participation in developing and revising this SWAP.	Plan Development, Implementation, and Review (Chapter 11)

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3 | Alaska Overview

Denali Highway pika survey. A. Underwood, ADF&G.

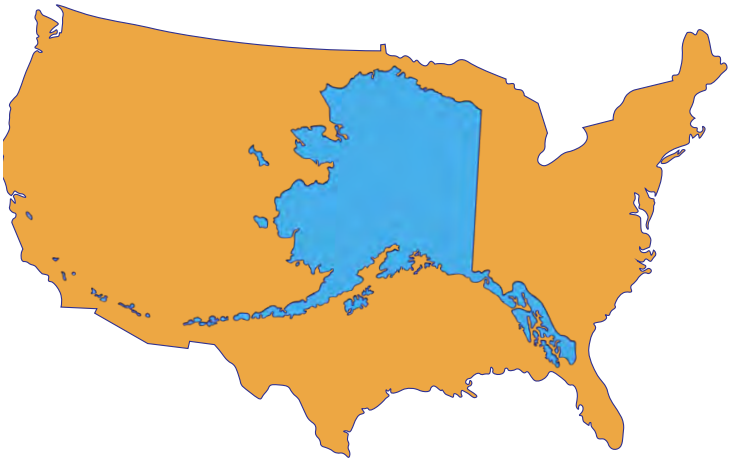
People

Alaska is the largest, most northerly, and most sparsely populated state in the nation (1.3 people per square mile). About 40% of Alaska's 733,391 residents live in a single city (Anchorage) and most development is centered in a narrow north-south "Railbelt" that parallels the Alaska Railroad route between the Kenai Peninsula, Anchorage, Matanuska-Susitna Valley, and Fairbanks. The state's capital, Juneau, is in Southeast Alaska. It is the state's third largest city, with about 32,000 residents, and is not connected directly to the road or rail system, except by marine ferry. Alaska's population increased by 3% between 2000 and 2020, with growth concentrated in the Southcentral region of the state, but has decreased in recent years.

In addition to urban centers, Alaska has a network of road-accessible rural communities and more than 200 small communities that are not connected to the road system. Most communities that are not connected to the road system are populated predominately by Alaska Natives living on ancestral lands used by their tribes. There are 229 federally recognized Alaska Native Tribes (40% of the total tribes in the United States). In 2023, Alaska Natives comprised nearly 16% of the state's total population (USCB 2024).

Landscapes

At 665,384 square miles, Alaska is one-fifth the size of the contiguous United States, hereafter the "Lower 48." (Figure 3.1).



Left: Figure 3.1. A map depicting the Lower 48 states overlayed with the State of Alaska.

Because of its remote northern location, Alaska has seen relatively little of the urbanization and land conversion (e.g., for farming, housing, flood control) common elsewhere in the United States. Approximately 60% of land in Alaska is owned and managed by the federal government, and 24.5% is managed by the State of Alaska. A relatively high percentage of the state has been managed under public ownership as state and federal parks, preserves, refuges, and national forests. These acres are largely under a conservation status that prohibits most development (e.g., National Park Service lands) and managed to conserve fish and wildlife populations in natural settings. Twelve regional Native corporations and dozens of local Native corporations own 10% of land in Alaska; less than 1% of the land is privately owned (State of Alaska 2023).

One-third of the state lies above the Arctic Circle, and Alaska is the only state with pack ice and a coastline on the Arctic Ocean. The large geographic and latitudinal extent of the state encompasses a wide range of climates, such as polar deserts in the north with cold temperatures, short summers, and low precipitation, continental climates in the interior with very cold winters and short but warm summers, and maritime climates along the southern coast with cool year-round temperatures and high precipitation. The vegetation is similarly varied. Alaska contains extensive Arctic tundra in the north, boreal forest in the interior, maritime tundra in the western deltas and islands, and temperate rainforest in the coastal regions of southcentral and southeast Alaska.

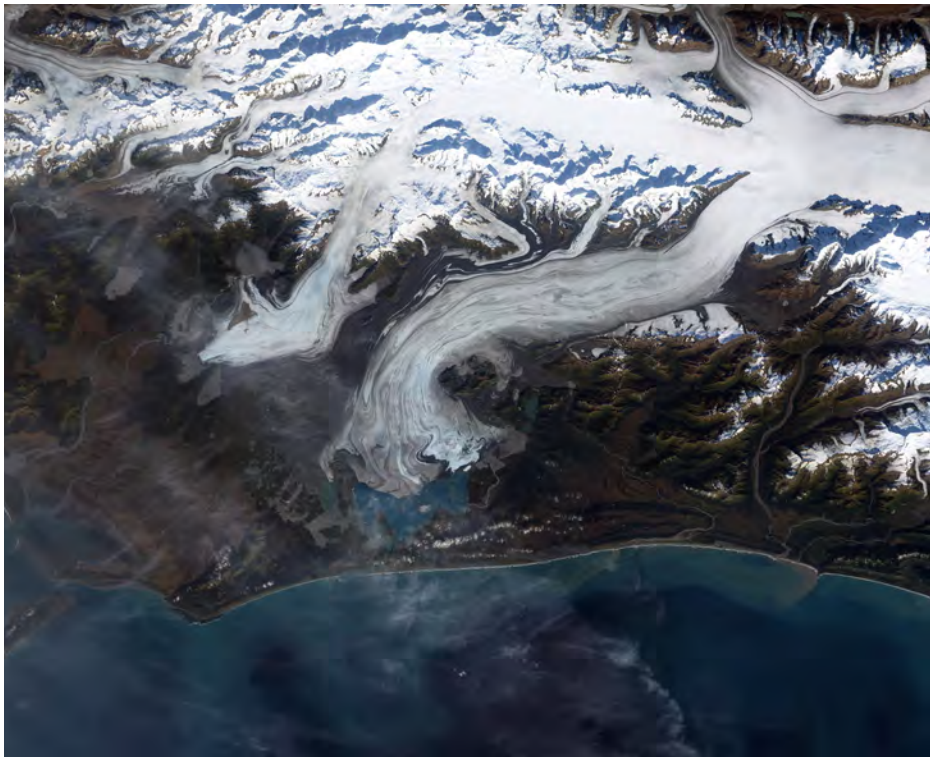
Alaska is one of the most geologically active regions in North America. Much of the state is marked by tectonic uplift and great vertical relief because it is situated where the northeast end of the Pacific Plate collides directly with the North American Plate. The megathrust boundary between the plates results in both the 2,500-mile-long Aleutian Trench and the arc of active volcanoes that parallel the trench. Along the trench, the rate of plate convergence is about a tenth of an inch per year. Convergence results in uplift and mountain building along Alaska's coasts. The St. Elias Mountains, along the Gulf of Alaska coast, rise from sea level to over 18,000 feet in just six miles, making it the steepest mountain belt in the world. Alaska boasts 39 mountain ranges, 17 of the 20 highest mountains in the United States, and the tallest mountain in North America (20,310 feet).

Mount Veniaminof is an active stratovolcano in the Aleutian Range. ADF&G.

Where tall mountains occur along the coast, orographic lifting of moisture-laden maritime air results in high snowfall, which develops into persistent ice and snow fields. The massive weight of accumulated snow and ice at high elevations creates immense "rivers" of ice that slowly flow seaward as glaciers. Not surprisingly, Alaska has more glaciers (664 named) and more glacial ice (33,000 square miles) than any other state. In fact, all the glaciers in the Lower 48 combined would be smaller than Alaska's Bering Glacier, North America's largest at 1,900 square miles.

North America's highest peak at 20,310 feet above sea level is located in the Alaska Range. ADF&G.

Currently, 25% of global ice loss from glaciers occurs in Alaska (Hugonnet et al. 2021). Most glaciers in Alaska are undergoing a rapid loss of mass due primarily to warming climatic conditions. Glacial runoff currently accounts for half the total freshwater input into the Gulf of Alaska, adding enough water to increase the global sea level by 0.006 inches per year (Berthier et al. 2010). Glacial melt plays an important and generally positive role in the dynamics and high productivity of nearshore systems (Timm 2020), such as adding habitat for Pacific salmon (Pitman et al. 2021). However, diminishment of glacial ice can have adverse impacts on several of Alaska's wildlife species, including the harbor seal, which pups and rests on ice floes calved from glaciers, and the Kittlitz's Murrelet, which nests on barren, newly exposed terrain near glaciers and feeds near tidewater glaciers.



The Bering Glacier terminates in Vitus Lake south of Alaska's Wrangell-St. Elias National Park. Combined with the Bagley Icefield, it is the largest glacier in North America. NASA, used with permission.

Ice in Endicott Arm. A. Carroll, ADF&G.

Arctic sea ice is a regular and important feature of the marine environment in both the Arctic Ocean and the Bering Sea. Alaska is the only state with permanent pack ice habitat. As the climate warms, however, the ice pack in the Arctic is diminishing. As of September 2023, Arctic sea ice extent (1.6 million square miles) was about 10% lower than the previous two years and overall the sixth lowest in the 45-year-long satellite record. All 17 of the lowest minimum sea ice extents have occurred in the 17 years since 2007. This translates to a 12.2% shrinkage of sea ice per decade since 1979 (Thoman et al. 2023). Since 2000, warmer summers have contributed to ice melt, so less multiyear ice (greater than four years) persists, resulting in younger, thinner ice than recorded in the 1980s and 1990s (Meier et al. 2022).

Fish and Wildlife

Alaska harbors populations of many northern species that occur in no other state, including beluga whales, ice seals, polar bears, muskoxen, Alaska blackfish, Kittlitz's Murrelets, Pribilof Rock Sandpipers, and McKay's Buntings, to name just a few.

Pack ice provides an important habitat for many marine mammals, including ice seals, polar bears, and Pacific walrus. As the pack ice grows during winter and shrinks during summer, the ice edge moves over hundreds of miles of shallow continental shelf. For walruses, which rest on the ice edge and dive to the seafloor to feed on benthic invertebrates, changes in the location of the pack ice edge continually carry them to new feeding areas. A problem arises if the ice edge retreats so far during summer that it occurs in deep, nonshelf waters. When walruses can no longer reach the bottom to feed, their only option is to leave the ice pack and swim to land. There, they face decreased access to food and increased risk of mortality from stampedes caused by disturbances from airplanes, people, or bears.

Walruses resting on an ice floe in the Chukchi Sea (USFWS permit #MA039386-2). J. Crawford, ADF&G.

One of Alaska's exceptional contributions to the world's avifauna is its seabirds. Alaska's coastal and offshore waters provide habitat for upwards of 100 million seabirds of more than 90 species (ASC 2024). Fifty of those species are nonbreeding residents, visitors, or species that only use marine habitats seasonally. Additionally, another 30 species, totaling 40

to 60 million individuals, breed in Alaska and spend most of their lives in U.S. territorial waters (Hatch and Piatt 1995). Alaska hosts over 95% of the breeding seabirds in the continental United States, with eight species nesting exclusively in Alaska and nowhere else in North America (Hatch and Piatt 1995), including the Red-faced Cormorant, Red-legged Kittiwake, and Whiskered Auklet. The Arctic Tern, which nests in Alaska, is considered the world's longest-distance migrant, traveling as much as 44,000 miles round-trip annually between the Arctic and the Antarctic (Hatch et al. 2020).

Red-legged Kittiwake. ADF&G.

Arctic Tern. A. Bankert, ABR, used with permission.

The global significance of Alaska's seabirds can be measured by the large number of globally important bird areas (IBAs; discrete areas with greater than 1% of the world's population) in the state. Based on breeding colony counts, biologists have identified 61 Alaska IBAs with globally significant populations of 22 species and 30 million birds (Smith et al. 2014). These areas, representing just 15% of all mapped breeding colonies in Alaska, contain 89% of its colonial nesting seabirds. Important areas for seabirds extend well beyond their nesting colony sites. They must also find their food (forage fish and krill) in highly ephemeral patches at sea. Biologists have identified 64 pelagic (open ocean) IBAs that provide habitat for 45 species and over 23 million seabirds (Smith et al. 2014). Although only 6% of the total water area is covered by IBAs, they contain about 38% of all pelagic seabirds in Alaska waters.

One of the most impressive IBAs is centered in Unimak Pass, in the Aleutian Islands. Upwards of 7 million seabirds use these waters, including globally significant populations of Short-tailed Shearwaters (3.4 million) and Sooty Shearwaters (1.1 million). These birds are drawn here by the upwelling waters and abundant food resources. Unimak Pass also lies along the great circle route between North America and Asia that is traveled by 3,000 tankers and cargo ships each year (8 to 9 per day). These ships, with a median bulk fuel load of 1.6 million gallons, pose a potential threat to these birds should an accident or grounding occur here (Transportation Research Board 2009).

Alaska has 33,904 miles of marine shoreline, which is 38% of the shoreline in the entire United States. This extensive shoreline, combined with its northern location and abundant breeding habitat, makes Alaska a particularly important place for shorebirds. Alaska annually hosts 7 to 12 million shorebirds, representing up to 50% of all the shorebirds in North America. Seventy-seven species of shorebird have been recorded in Alaska, representing fully one-third of the world's shorebird

Black-bellied Plover. A. Bankert, ABR, used with permission.

Western Sandpiper. A. Bankert, ABR, used with permission.

Black Turnstone. T. Bowman, USFWS, used with permission.

species (ASG 2019). Alaska contains most of the world's breeding population of three shorebird species (Bristle-thighed Curlew, Western Sandpiper, and Black Turnstone) and the entire global population of numerous species and subspecies, including Rock Sandpiper (*ptilocnemis* and *couesi*), Dunlin (*pacifica* and *arcticola*), Bar-tailed Godwit (*baueri*), Marbled Godwit (*beringiae*), and Black-bellied Plover. Regarding important habitat, Alaska has more than 50 shorebird migration staging or stopover sites that qualify as Western Hemisphere Shorebird Reserve Network sites (USFWS 2024a). At ten of these sites, concentrations exceed 1 million birds, with sites like the Copper River Delta hosting between 5 and 8 million shorebirds each spring.

Alaska has over 40% of the nation's surface water resources, including more than 12,000 rivers, 3 million lakes greater than five acres, and numerous creeks and ponds. Alaska has 174 million acres of wetlands, 63% of the nation's total. Most of these habitats are intact and free from development or water management. As a result, it is a prolific producer of waterfowl and other waterbirds as well as robust fisheries. For example, freshwaters of the Bristol Bay watershed support approximately half of the global abun-dance of wild sockeye salmon and is the location of the world's largest sockeye salmon fishery. Alaska is the breeding ground for approximately 20% of all waterfowl in the United States, including more than 60% of the world's population of Pacific Black

This sea cave is part of a columnar basalt formation. Some sea caves are used by nesting seabirds. S. Hillebrand, USFWS, used with permission.

Brant and 90% of the world's population of Emperor Geese (USFWS 2024b). Alaska supports 100% of the United States breeding populations of Greater White-fronted Geese, Cackling Geese, Dusky Canada Geese, Pacific Black Brant, Long-tailed Duck, Spectacled Eider, King Eider, Steller's Eider, Common Eider, Black Scoter, White-winged Scoter, and Surf Scoter.

Avian species dependent on terrestrial habitats (landbirds) constitute the largest and most ecologically diverse component of Alaska's avifauna (Handel et al. 2021). Notable groups include grouse and ptarmigan, raptors, woodpeckers, and passerines. Most landbird species are migratory, and four major global migration flyways merge in Alaska. Birds travel to breed in Alaska from all over the world, and reproductive success in Alaska affects populations in both North and South America. Alaska's largest area of landbird habitat is interior boreal forest, which comprises the westernmost portion of the Northern Forest Avifaunal Biome. Collectively with Canada, this biome is considered a "veritable Neotropical migrant factory" for species such as thrushes, warblers, and flycatchers (Rich et al. 2004). Alaska also supports 100% of the United States' breeding populations of Gyrfalcon, Rough-legged Hawk, and Snowy Owl, as well as large proportions of other raptor taxa.

Alaska's unique geography, climate, and intact ecosystems support 116 species of mammals (MacDonald and Cook 2009). Alaska's vast wilderness provides a home for many of North America's large mammals, including iconic species like the brown bear, wolf, lynx, caribou, and moose. The state's successful effort to introduce the American bison to Interior Alaska has provided hunting and viewing opportunities for Alaskans. Additionally, the state is in the process of reintroducing the wood bison, a species that

Pacific Black Brant near the Colville River delta, northern Alaska. R. Askren, USGS, used with permission.

Harlequin Ducks use clear, fast-flowing rivers and streams for breeding. ABR, used with permission.

Willow Ptarmigan in summer plumage on the Arctic tundra. D. Hejna, ABR, used with permission.

Northern collared lemming. ADF&G.

was previously extirpated from the state. Two wild herds have been established as of 2025, one near the Innoko River in Southwest Alaska and one at the Minto Flats State Game Refuge in the Interior. While large mammal species are not the primary focus of this plan, they are very important for ecological, cultural, recreational, and economic reasons, and research and conservation of harvested species is supported by license sales as well as federal Pittman-Robertson funds.

Alaska also hosts a high diversity of small mammals, which play important roles in the state's ecosystems as herbivores, carnivores, prey, seed dispersers, and nutrient cyclers (Droghini et al. 2022). For example, flying squirrels (see Northern Flying Squirrel vignette) and some voles are key dispersers of fungal spores associated with roots of seedling trees, leading to successful regeneration and mature trees that are more resilient to environmental change (Paragi et al. 2020). Alaska's unique geography and glacial history have produced a large number of endemic small mammal species, such as the Pribilof Island shrew and the Alaska hare (Cook et al. 2001).

Much of the marine area covered in the State Wildlife Action Plan (SWAP) lies over relatively shallow continental shelf waters, especially in the Bering Sea, and is highly productive for fish. State territorial waters extend to three miles offshore, and waters between three and 200 miles offshore represent an exclusive economic zone under federal management authority. For marine species, this plan will cover many fish and wildlife species that use marine waters out to the 200-mile limit, with a particular emphasis on species known to be at risk and those of high economic, cultural, or ecological importance. Commercially important species of seafood from Alaska include salmon, crab, scallops, herring, lingcod, and rockfish. In Alaska, important forage fish species include capelin, eulachon, and sand lance. These fish species constitute critically important food for larger predatory fish, seabirds, and marine mammals. Some of these fish have over 20% fat content (Iverson et al. 2002), making them particularly valuable for birds and marine mammals. Forage fish species are not harvested commercially in Alaska, but species like eulachon are of significant cultural and subsistence importance. Information about population status, trends, and ecology of forage fishes in Alaska is limited, and more baseline information on these species is needed.

Arctic graying. ADF&G

The variation in climate, physiography, and vegetation across the state, combined with a complex glacial history, has resulted in a

diverse assemblage of freshwater fishes in the state (Oswood et al. 2000). Many freshwater fish are anadromous, migrating short or long distances between marine feeding areas and freshwater spawning grounds. Alaska is famous for producing large numbers of Pacific salmon, which migrate from freshwater rivers to the ocean, where they spend most of their lives. They eventually return, often in the millions, to their natal streams to spawn, bringing important marine-derived nutrients into aquatic and terrestrial systems and supporting healthy wildlife populations. Other freshwater fish species, such as Dolly Varden, rainbow trout, and grayling, are important components of riverine and lacustrine ecosystems and are sought after by anglers.

Grizzly bear. G. Smith, ADF&G.

Three beluga whales. K. Frost, ADF&G.

Economy

Due to healthy habitats and well-managed use, Alaska has abundant populations of fish and wildlife that draw residents and visitors alike to outdoor activities. In 2022, 2.7 million visitors traveled to Alaska and spent nearly $3.9 billion during the summer and winter months, with a total economic impact of $5.6 billion. The tourism industry alone supports 56,711 jobs in Alaska during the peak season, and one-tenth of Alaska's workforce is employed in tourism, underscoring its vital role in the state's job market (ATIA 2024, AKRDC 2024a).

Wildlife viewing is a steadily growing industry in the state, with moose, marine mammals, birds, and brown (grizzly) bears being the most popular animals (ECONorthwest 2014). In 2019, 55 businesses and 187 vessels involved in whale watching tours in Alaska's coastal waters supported 1,105 jobs and $37.3 million in labor income, with the total economic impact of whale watching in Alaska estimated at $103 million (NOAA 2020). Similarly, bear viewing, particularly in Southcentral Alaska, generates $34 million annually, supporting an estimated 680 jobs and contributing $10 million in direct wages (Young and Little 2019).

Alaska's exceptional bird habitats offer unparalleled viewing opportunities to observe rare and threatened species. Across the expansive Alaska landscape, 545 species of birds have been recorded (Gibson et al. 2025). In a single year (2016), nearly 300,000 birdwatchers visited Alaska, spent $378 million, supported 4,000 jobs, and contributed to rural and remote economic communities (Schwoerer and Dawson 2022).

Commercial fishing. D. Smith, ADF&G.

The unparalleled hunting and fishing opportunities in Alaska provide important subsistence, cultural, recreational, personal use, and economic benefits for Alaskans. Nearly half a million Alaskans and tourists enjoyed recreational fishing in Alaska, contributing approximately $815 million to the state economy in 2021 and supporting 6,100 jobs (ASA 2021). In contrast to wildlife viewing, fishing and hunting license, tag, and permit sales directly support the management of fish and wildlife populations within the state. Over the years 2022–2025, the sale of hunting licenses, big game tags, and permit sales (e.g., draw hunt applications) contributed $19 million per year to ADF&G (ADF&G 2025). The guided hunting industry alone, including direct spending and wages, generated $91.8 million in economic activity in 2019 (MG 2021). Resident hunters also contribute tremendously to the Alaska economy through their expenditures to go hunting, including travel and purchases of equipment that includes ATVs, aircraft, boats, and outdoor gear.

Over the past decade, the utilization of natural resources, which are crucial to Alaska's economy, has increased by nearly 24%. Alaska's two largest natural resource sectors are oil and gas ($5.9 billion, 69,250 jobs; MRG 2023) and commercial fishing ($5.7 billion, 62,200 jobs; MRG 2024). Other industries are one-tenth the size or less and include mining ($1 billion, 11,400 jobs; AMA 2023) and farming (1,200 farms, $47.1 million; USDA 2022, UA 2022).

From 1959 to 2022, the State of Alaska collected nearly $274 billion in petroleum revenues, with 81% ($221 billion) in unrestricted funds available for use at the state's discretion. State government revenues from oil and gas have a broad impact across Alaska, funding programs like Medicaid, K-12 education, and various capital projects. In 2022, high oil prices led to an increase in petroleum revenues for the state, contributing 50% of all unrestricted state revenues (MRG 2023). In fact, Alaska's gross domestic product (GDP) reached its highest level in the past 20 years ($63.6 billion, USBEA 2023). However, North Slope oil and gas production in Alaska has declined steadily to less than 25% of its peak in 1988. The decline in production from existing fields is anticipated to continue over the next decade. Nevertheless, new projects currently under development or evaluation are expected to boost total North Slope production between 2023 and 2032 (MRG 2023). In addition, there are high expectations for increased production from the National Petroleum Reserve in Alaska (NPR-A) and offshore oil fields in the Arctic Ocean. Mining exploration and development in Alaska are also expected to increase over the next decade as the demand for critical minerals and precious metals increases.

Alaska accounts for 60% of the total commercial fishery harvest volume in the United States (MRG 2024), nearly four times more than the next largest seafood-producing state. From 2021 through 2022, the top three commercially harvested fish were salmon ($799 million ex-vessel value), pollock ($457 million), and crab ($233 million; MRG 2024). When all commercial fisheries were considered,

Alaska's seafood industry was worth $2 billion in 2022. Two-thirds of Alaska's seafood harvest is exported annually ($3.3 billion value annually), with Alaska's top exports being frozen sockeye salmon, pollock, surimi, and fillets (AKRDC 2024b).

Alaska's other significant sources of revenue come from investment earnings ($3.5 billion in fiscal year 2024 [FY24] and $3.7 billion in fiscal year 2025 [FY25] from the $77 billion in assets managed by the Alaska Permanent Fund), the federal government ($3 billion in FY24), and restricted nonpetroleum revenue ($831 million per year; ADR 2024).

Summary

Alaska is large, relatively pristine, and has intact fish and wildlife habitats with more conservation land than other states and territories. Its fish and wildlife populations are relatively abundant and healthy and do not face the same impacts from habitat loss and fragmentation as other states. Our challenges in this plan are to identify declining taxa that may be vulnerable to current and future threats and to identify what conservation and management actions Alaska can take to mitigate those threats and prevent the need for listings under the Endangered Species Act. While oil and gas, fishing, logging, and other economic activities can impact fish and wildlife and their habitats at local scales in Alaska, they are not the primary drivers of population loss for declining species in the state due to adequate existing regulations. For example, many migratory birds are threatened by activities outside of Alaska that affect populations that breed in the state. Once birds arrive on the breeding grounds, they encounter relatively pristine and intact habitat. However, monitoring at development sites is a potential tool to ensure that existing regulations continue to promote sustained yield of SGCN, especially as these species may face threats that are cumulative. Alaska has a wealth of fish and wildlife, including many species that exist nowhere else in the nation. The state recognizes its constitutional mandate to conserve and manage these resources for the public good according to the sustained yield principle and will use this plan to guide its efforts.

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4 | Species of Greatest Conservation Need

Ruddy Turnstones. B. Richard, ADF&G.

This chapter identifies how wildlife species[1] in Alaska were qualified as "species of greatest conservation need" (SGCN). State Wildlife Grant (SWG) funding received by the State of Alaska will be available only to projects that address SGCN and their habitats. While this chapter mentions some species to highlight our planning process, the complete list of SGCN and why each species was included is provided in Appendices A through C.

There are more than 1,200 named vertebrates in Alaska and its territorial waters, including 601 species of fishes (Mecklenberg et al. 2002), 545 species of birds (Gibson et al. 2025), 116 species of mammals (MacDonald and Cook 2009, UAF 2025), six native amphibians, and four marine reptiles (ADF&G 2025).

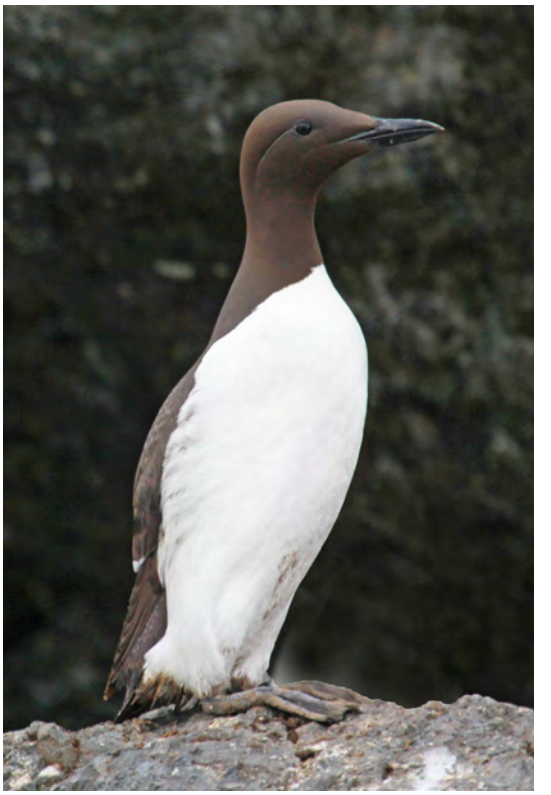
The number of species is not static. New species are still being discovered in Alaska, and as the climate changes, more species' ranges are expanding to the north (Parmesan and Yohe 2003). Between 1976 and 1991, 74 new avian taxa were documented in Alaska (Gibson and Kessel 1992). By 2007, there were 21 more avian taxa (Armstrong 2008), and another 127 have been added since then (Gibson et al. 2025). Although some of the increase may reflect a growing population of birders in Alaska with improved identification tools, there is a well-documented poleward shift of many

[1] The term *species* in this document encompasses subspecies, stocks, and distinct population segments (DPS) when referring to inclusion in the "species of greatest conservation need" (SGCN) list.

Snow crab. NOAA Fisheries, used with permission.

well-studied plant and animal species on all continents and in most major oceans (Perry et al. 2005, Parmesan 2006, Hitch and Leberg 2007, LaSorte and Thompson 2007). Subarctic seabirds, fishes, and marine mammals are shifting northward into Arctic regions in response to increased water temperatures, changes in water mass distributions, decreased extent and duration of ice cover, and altered prey communities (Stafford et al. 2022). Climate change in the Arctic exceeds the mean global rate (Sweeney et al. 2023, Zhou et al. 2024). It is expected to add conservation challenges to species and habitats (Moon et al. 2024).

In the decade since publication of the 2015 State Wildlife Action Plan (SWAP), marine heat waves (periods of unusually warm ocean temperatures) have occurred in the Gulf of Alaska and the Bering Sea. From 2014 through 2016, the Gulf of Alaska experienced harmful algal blooms, changes in phytoplankton and zooplankton communities, and decreased abundance and distribution of forage fish (Arimitsu et al. 2021, Van Hemert et al. 2020, McKinstry et al. 2022). Impacts at higher trophic levels included mass mortality, shifts in distribution, and colony-wide reproductive failures of Common Murres (Arimitsu et al. 2021, Piatt et al. 2020, Renner et al. 2024); mass mortality of fin and humpback whales (Savage 2017); and sharply reduced humpback whale reproductive success (Gabriele et al. 2022). In 2018 and 2019, a marine heat wave in the Bering Sea coincided with a record low extent of sea surface ice and collapse of the cold-pool barrier that had historically separated the northern and southern Bering Sea ecosystems (Siddon and Zador 2018). The changes precipitated a range of shifts in the zooplankton community (Kimmel et al. 2023, Overland et al. 2024); movement of predatory fish into the northern Bering Sea (Stevenson and Lauth 2019); and declines in juvenile snow crab, impacting the southeastern Bering Sea snow crab population (Fedewa et al. 2020, Szuwalski et al. 2023). In addition, die-offs of multiple species of seabirds (Kaler et al. 2022, Jones et al. 2024), an unusual mortality event of hundreds of ice seals (NOAA 2024), and harmful algal blooms have occurred, which will likely increase under future warming scenarios (Van Hemert et al. 2021). Ocean temperatures



Common Murre. ADF&G.

have since dropped in both the Gulf of Alaska and the Bering Sea following the heat wave events; however, the systems have been slow or unable to return to their pre-heat wave conditions. Overall trends point to continued warming and a possible transition of the rich and unique ecosystems to novel states rather than a return to past conditions (NOAA 2021, Overland et al. 2024, Renner et al. 2024).

The sections below describe the rules applied to exclude some taxa from the list of SGCN (e.g., plants, most invertebrate species, and many aquatic species). Additionally, the sections below define the criteria for inclusion of other taxa.

Excluded Species

Plants

Although some state wildlife action plans include rare or sensitive plant species, most focus on wildlife. Plant work can be incorporated into studies where wildlife species depend on vegetation as an important component of their habitat (e.g., eel-grass beds, old-growth forest, riparian willows, etc.) or where external factors, such as shifts in climate or disturbance, will cause significant changes in the composition, structure, and function of vegetation. In addition, if invasive plant species are determined to threaten SGCN, studies for monitoring or investigating control measures are appropriate.

Hunted and Trapped Species

Alaska is home to many iconic North American wildlife species, including caribou, moose, muskoxen, wolves, wolverines, brown bears, and polar bears. Many of these species are hunted or trapped and are of high cultural and economic importance to Alaskans. Most hunted and trapped species already receive funding for their management and conservation (e.g., through federal Pittman-Robertson funds and state sales of hunting licenses),[2] and the majority of Alaska Department of Fish and Game's (ADF&G's) funding is spent on managing harvested species for the beneficial use of all Alaskans. By contrast, conservation and management of SGCN using SWG and matching funds constitutes less than 2% of ADF&G's annual budget. Hunted and trapped species that typically do not receive sufficient funding from ADF&G, such as Alaska hare, are included in this plan, as are all species currently listed as endangered, threatened, or considered candidates for listing under the Endangered Species Act (ESA; e.g., bowhead whale, polar bear, Pacific walrus). Should significant conservation concerns be raised with other hunted species in the future, new work related to species not identified in this action plan can still be proposed and approved for SWG funding during the period covered by the plan. Adding an SGCN involves a brief letter to the U.S. Fish and Wildlife Service (USFWS) describing the emerging issue and conservation work needed on a particular species or habitat.

Marine Aquatic Species

Thousands of marine aquatic species could be included in this plan—diverse species of the intertidal zone, little-known life forms in the deep-sea trenches, and free-floating microzooplankton. By some estimates, at least 5,000 species of fishes are yet to be discovered in the world's oceans, more than all mammal species known today (Myers et al. 2000). Marine aquatic invertebrates pose a particular

[2] Pittman-Robertson funds are paid to each state from federal excise taxes to help manage and conserve game populations and their habitats. The fund is named for the chief sponsors of the 1937 Federal Aid in Wildlife Restoration Act that created the excise tax.

challenge. The Aleutian Islands alone harbor more echinoderm species than any place in the world, with more than 100 species named in 45 genera and another 25 species presently under description (Jaxshells 2025). The Aleutian Islands have among the highest diversity of coral species in the North Pacific Ocean (NOAA 2023), with up to 100 coral species found as deep as 5,000 feet beneath the surface (Carroll 2025). In state and federal waters along the Aleutian Islands, vast areas have been closed to bottom trawling, and several coral gardens have been closed to bottom contact by any commercial fishing gear to conserve the shallower coral species (Stone 2006, Stone and Rooper 2017).

We opted to include aquatic species for which at least some information on population sizes, trends, and importance is available. Most aquatic species included as SGCN are either used by Alaskans (culturally or economically important); have been recognized as having high ecological value (forage fish, some invertebrate orders) but have significant data deficiencies or are vulnerable to localized population declines; or are well-known species of concern (e.g., large whales, ice seals, polar bears, walrus). Because it was not feasible to consider individual marine invertebrate species for SGCN status, we added higher taxonomic at-risk groups to represent communities of interdependent species.

Rare, Casual, and Accidental Species

Identifying and excluding species that occur in Alaska in very small numbers can be challenging. The situation most often occurs when the edge of a species' normal range only touches or overlaps

Species of Conservation Need: Sunflower Sea Star *(Pycnopodia helianthoides)*

Sunflower sea star. J. Nichols, NOAA, used with permission.

The sunflower sea star is the only species of its genus and the second largest sea star in the world, with a maximum arm span of 3.3 feet. They occur in the northeastern Pacific Ocean, including Alaska. Adult sunflower sea stars usually have 16 to 24 limbs and range in color from bright orange to yellowish red, brown, and sometimes purple. Sunflower sea stars generally inhabit low subtidal and intertidal areas up to 435 meters deep, rich in seaweed, kelp, sand, mud, shells, gravel, or rocky bottoms. These sea stars are efficient hunters, moving at a speed of 1 meter per minute by using 15,000 tube feet that lie on their undersides. They feed mostly on sea urchins, clams, snails, and other small invertebrates. Sunflower sea stars can reproduce sexually through broadcast spawning. They breed from May through June and live for three to five years. Although the species was once widely distributed throughout the northeast Pacific, its population began rapidly declining in 2013 due to sea star wasting disease, which was associated with warming ocean temperatures. The sunflower sea star has nearly disappeared from coastal California and Oregon, and its population has been reduced by 99% in the waters off the coast of Washington. Alaska populations also experienced significant declines, although less severe compared to the southern portion of the species' range. Following the disease outbreak, increasing populations observed in some areas of Alaska demonstrate progress towards recovery. In March 2023, the National Marine Fisheries Service proposed listing the sunflower sea star as threatened under the Endangered Species Act throughout its range.

slightly with Alaska's geopolitical boundary. In other cases, such as migratory birds, an individual may be blown off course in a storm and appear temporarily in the state. In both situations, individuals are very uncommon, making it difficult to survey, monitor, or research in Alaska effectively. Further, no level of conservation effort can make such species persist continually or become more abundant.

Birds, in particular, have sufficient records in Alaska to be formally categorized as rare, casual, or accidental (Gibson et al. 2025). Rare species may be seen briefly each year, mostly as a few scarce residents at the perimeter of Alaska. Casual species are not detected annually and occur outside their normal range at irregular intervals. Accidental species occur as only one or two state records or no records in the last 30 years. Explicit definitions, combined with abundant bird knowledge in Alaska, enabled us to reliably exclude rare, casual, and accidental bird species unless it was already listed as a threatened, endangered, or candidate species under the ESA or met one or more criteria to qualify as an at-risk species (see the "Criteria for Inclusion" section below).

Black-legged Kittiwake nests, Shumagin Islands. S. Hillebrand, ADF&G.

Taxonomic Status

An important consideration in identifying SGCN was whether to recognize subspecies, stocks, and distinct population segments (DPSs) as valid taxonomic entities on our list. The best practice guidance for state wildlife action plans (AFWA 2012) encourages recognizing and planning for the conservation of any taxonomic entity that could be listed under the ESA, including valid subspecies, stocks, and DPSs. Subdivisions were treated as follows:

Subspecies—The inclusion of subspecies in the plan is complicated by disagreement among taxonomists over valid subspecies designations. To our knowledge, no universally accepted reference or source legally designates valid species or subspecies. For terrestrial vertebrates and marine mammals, the Alaska Species Ranking System (ASRS) was used to reflect taxonomic standing (Gotthardt et al. 2012). For birds and mammals, we also consulted taxonomic guidelines (Gibson and Withrow 2015, UAF 2025) and museum curatorial staff to ensure SGCN designations reflected currently accepted taxonomy. Aquatic and invertebrate species were included only at the species level and above. Information on genetic diversity and isolation varies greatly by species. Taxonomic

designation or recognition in the SWAP may be updated if warranted by new and compelling information.

Distinct population segment—*Distinct population segment* (DPS) is a term with specific legal meaning that is used for listing, delisting, and classification purposes under the federal ESA. Such designation involves not only distribution and level of genetic interchange, but also management and conservation regulation. These lines can follow political boundaries. Existing distinct population segments were included in this revised plan.

Stocks—The term *stock* is used by ADF&G and the National Marine Fisheries Service to manage separate populations of fishes, marine mammals, and some waterfowl. Although it has a similar meaning to DPS, it does not have a legal definition under the ESA. Instead, the term is legally recognized under other laws, such as the Marine Mammal Protection Act. Some distinct marine mammal stocks (e.g., western and eastern sea lion stocks) are recognized if the stock has legal DPS status. Different stocks of marine sea ducks that occur in the Pacific (western stock) versus the Atlantic (eastern stock) are also recognized as distinct.

Criteria for Inclusion as SGCN

Species qualified as SGCN if one or more of the following criteria were met:

- At-risk status (see "Alaska Species Ranking System" below)
- Stewardship status
- Cultural importance
- Economic importance
- Ecological importance

At-Risk Species

Generally, much more is known about terrestrial vertebrates and marine mammals than most aquatic vertebrates or invertebrates, and the criteria described below for inclusion as an SGCN reflect this difference. Typically, at-risk species are identified based on declining populations that may rely on habitats that are threatened. Small populations exhibiting small ranges can also be relatively vulnerable to decline.

An additional consideration for at-risk status involves data deficiencies. Data-deficient species may lack information important to conservation and management (e.g., unknown population trend, distribution, habitat needs). Knowledge gaps are particularly relevant to fish and wildlife populations in Alaska, which are among the least studied in North America. For example, an unexpected decline in a "keystone species," such as a widespread prey item (e.g., forage fish) or species that acts as an ecosystem engineer (e.g., small mammal), could negatively impact multiple SGCN at once (e.g., Mills et al. 1993, Power et al. 1996, Shukla et al. 2023).

The Alaska blackfish is the only air-breathing fish in the Arctic. ADF&G.

With one of the smallest populations of any shorebird species, the Bristle-thighed Curlew is considered vulnerable to extinction. G. Smith, ADF&G.

Including species with data deficien-cies helps make the SGCN list more comprehensive, reducing the need for listing under the ESA in three impor-tant ways. First, a comprehensive list enables detection of unanticipated declines, facilitating flexible and timely responses that can increase the likelihood of successful conservation because issues are assessed proactively before a species becomes imperiled. Second, addressing data gaps, when needed, provides opportunities for the best available science to inform ESA listing petitions unnecessarily applied to populations of Alaska's wildlife, thereby avoiding inappropriate, expensive, or prescriptive regulatory burdens of the ESA (e.g., Chapter 9, Table 9.1). Third, the need for timely conservation actions may also arise from unexpected environmental perturbations (e.g., the marine heat wave of 2014–2016) that impact a species across all or part of its range. Efficient management and understanding of these time-sensitive or spatially explicit threats requires a comprehensive SGCN list so that funds can be allocated to emerging research, monitoring, or management needs. Finally, it is important to note that data deficient species, while a key component of the SGCN list, typically do not rank as highly as those with known declines or vulnerabilities (see "Alaska Species Ranking System" below). Funding decisions always consider conservation need as a top factor when determining how to best allocate limited SWG dollars (Chapter 11).

Endangered Species Act

Given the purposes of the SWG program, primary weight was given to species at risk of becoming listed under the ESA. Species are considered at risk if they are currently listed as threatened or

Dungeness crab. A. Underwood, ADF&G.

endangered, proposed for listing under the ESA, or currently undergoing a status review for listing. All of these categories indicate the species, subspecies, DPS, or stock may have an increased need for conservation. Any species (fish, game, or nongame) was eligible for inclusion on the SGCN list based on its ESA status. Note that some game species were eligible for SGCN status in the 2015 SWAP, but are not included on the 2025 SGCN list because they are no longer being considered for ESA listing (e.g., Alexander Archipelago wolf).

Terrestrial Vertebrates and Marine Mammals

Alaska Species Ranking System

For terrestrial vertebrates and marine mammals, our primary tool for evaluating at-risk species was the Alaska Species Ranking System (ASRS; Gotthardt et al. 2012). The ASRS is a new tool implemented in the 2025 State Wildlife Action Plan revision for identifying SGCN. It was developed in partnership between the ADF&G Threatened, Endangered, and Diversity (TED) Program and the University of Alaska Anchorage, Alaska Center for Conservation Science (ACCS) to assist in setting wildlife conservation priorities for Alaska. The system provides a transparent and repeatable process for evaluating and ranking the status of Alaska's wildlife.

The ASRS evaluation process combines in-depth literature review with information provided by specialists and requires clear documentation for rankings while allowing for specialist opinion when some information is lacking. Rankings are updated with new information that can impact changes in status. Between 2017 and 2023, many ASRS rankings for terrestrial vertebrates and marine mammals were peer-reviewed and updated to complete a total of 263 Alaska taxa. Currently the ASRS does not include invertebrates or fish.

To rank risk levels for terrestrial vertebrates and marine mammals, we used a combination of two ASRS categories: Status and Biological. The Status category assigns a score to each species that quantifies current trends in population size and distribution in Alaska. The Biological category assigns a score that assesses a species' vulnerability based on population size, range size, and population concentration in Alaska. It also assesses life history characteristics, including reproductive potential and ecological specialization. Different combinations of Status and Biological categories provide the basis for ranking species at risk, and both are fundamental to understanding the level of conservation need.

The six possible rankings (I through VI) in decreasing order of risk are provided below. Taxa were considered at risk and included as an SGCN if its ASRS ranking falls between I and IV, as shown in bold, below. Ranks I and II are the highest priority categories because of known, decreasing trends

or vulnerabilities. Ranks III and IV address data-deficient species. Some species with low biological vulnerability (Ranks II and IV) may serve an important function as widespread prey (e.g., small mammals), akin to the Ecologically Important criterion described below to identify terrestrial and aquatic and invertebrate SGCN.

I: Decreasing population size and/or distribution AND high biological vulnerability.

II: Decreasing population size and/or distribution AND low biological vulnerability.

III: Unknown trends in population size and distribution AND high biological vulnerability.

IV: Unknown trends in population size and distribution AND low biological vulnerability.[3]

V: Stable or increasing population size and distribution (neither is decreasing) AND high biological vulnerability.

VI: Stable or increasing population size and distribution (neither is decreasing) AND low biological vulnerability.

Sandhill Crane. A. Underwood, ADF&G.

Species ranked as IV showed unknown trends in population size and distribution but were also relatively secure (low biological vulnerability). We therefore applied an additional prioritization process for any IV-ranked species to qualify as an SGCN. To understand the process, it is important to note that the original ASRS evaluation developed in 2012 included an Action category that comprehensively assessed each species' current state of knowledge based on existing survey, monitoring, research and management needs, including whether factors that may limit population growth were known (Gotthardt et al. 2012). Action scores were not used as a primary focus of the six rankings above, which instead emphasize Status (population trends, distribution) and Biological scores (population size, range, reproductive potential) to assess at-risk status.

Only a subset of IV-ranked species qualified as SGCN. We selected those with both above-average vulnerabilities (Biological scores) and data deficiencies (Action scores) relative to all taxa in the ASRS database. We specifically applied the median Biological and Action scores as "cut-off" values in a two-step sorting process. The first sort selected only IV-ranked species with Biological (vulnerability) scores above the median. The second sort identified as SGCN those species that also had Action scores above the median.

[3] Only a portion of species with ASRS ranks of IV were included as SGCN, given this rank had low biological vulnerability. See text for details on an additional sorting process.

Steller's Eiders and Long-tailed Ducks. ADF&G.

The ASRS should be considered a "living database" because the process of updating it is ongoing and iterative. ACCS updates rankings for a subset of Alaska taxa annually. Hence, there may be occasions when a species' ASRS rank does not yet reflect new information. However, other criteria we used for selecting SGCN, such as a species' inclusion on Avian Conservation Lists, act as a "fine filter" to catch recent declines of vulnerable species. In a few cases when an ASRS score was near the cut-off but new or urgent data had emerged since a species' last update, we deferred to input from Alaska species specialists to make necessary adjustments.

Avian Conservation Lists

We compared and supplemented the list of at-risk species described above (ASRS ranks I through III and a subset of IV) with taxa highlighted as conservation concerns in a select number of existing avian conservation lists, plans, and products. Although every list has its limitations, the overriding principles of each aligned well with ASRS, focusing on population status and trend, biological vulnerability, and peer review. Some were used to create the 2015 SGCN list and have been updated since. All are familiar, in wide use, and align with the efforts of our partners.

We specifically compared and supplemented the ASRS at-risk species list with the following: USFWS Birds of Conservation Concern (BCC; USFWS 2021), Alaska Shorebird Conservation Plan (ASG 2019), Boreal Partners in Flight (BPIF) Alaska Landbird Conservation Plan (Handel et al. 2021), and Partners in Flight Avian Conservation Assessment Database (ACAD; Partners in Flight 2024).

The BCC identified species likely to become candidates for listing under the ESA should additional conservation actions not be taken. The BPIF Landbird Conservation Plan and Alaska Shorebird Conservation Plan assessed population size, trends, life histories, and conservation issues in Alaska's

five Bird Conservation Regions to identify species of conservation concern. The ACAD database scored species vulnerability based on six factors related to population size, distribution, threats, and population trends. In cases where the ASRS differed from avian conservation lists, we consulted with ADF&G and other in-state species specialists before deciding whether to expand the SGCN list.

Aquatic and Invertebrate Species

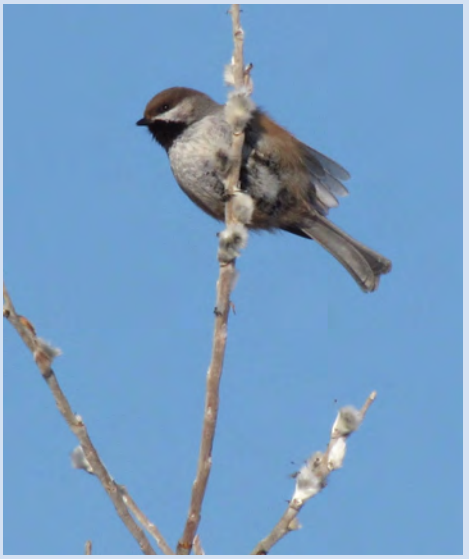
Information allowing rigorous and uniform at-risk assessment for aquatic and invertebrate species is lacking, because these groups are not yet part of the ASRS. Under the ASRS ranking process that we applied to terrestrial vertebrates and marine mammals, a species could be warranted for inclusion as an SGCN if it had unknown trends in population size and distribution (Rank IV; see "Alaska Species Ranking System" above). However, the ASRS Rank IV criterion alone would qualify unusually large numbers of aquatic and invertebrate species as SGCN. Other well-respected information sources on status, trend, and vulnerability, such as the IUCN Red List (IUCN 2024) and NatureServe (NatureServe 2023) ranking systems, did not adequately capture a majority of Alaska's aquatic and invertebrate taxa.

Thankfully, a great deal of information is available in population surveys, life history and habitat studies, harvest reports, and specialist knowledge of threats and ongoing environmental changes. ADF&G specialists conferred SGCN status to a range of species and higher-order taxa with known or suspected population declines, high vulnerability, or both, particularly as these relate to invasions of aquatic invasive species. We therefore included invertebrate and aquatic species as SGCN with known or anticipated local declines, or other key data deficiencies. The result collectively represents a broad range of guilds, habitats, and geographic locations. As such, research and management actions

Species of Conservation Need: Gray-headed Chickadee *(Poecile cinctus)*

The Gray-headed Chickadee, formerly known as the Siberian Tit, is a widespread resident breeder throughout subarctic Scandinavia and Northern Asia. They are also found in North America, where they are the rarest chickadee with a small, disjunct population occurring in Northern Alaska, northern Yukon, and the Northwest Territories. Gray-headed Chickadees were once considered widespread and common in parts of Alaska but are now rarely seen, with only a handful of observations over the past decade. They are likely vulnerable to increased icing events in the winter, and possibly vulnerable to range expansion by Boreal Chickadees. The small population, likely declining in population size and distribution, and lack of knowledge about its life history in Alaska or Canada, make it a species of conservation need.

Chickadees are specially adapted to endure Alaska's rugged winters. They have much denser, better-insulating plumage than other songbirds their size, and a special ability to put on fat quickly. Chickadees also drop their body temperature at night to conserve their winter fuel and "shiver" to keep their body temperature stable. The Gray-headed Chickadee is one of the few cavity nesters that range to the tree line in subpolar habitats, and it is speculated to use snow burrows to conserve body heat during the cold Arctic nights.



Gray-headed Chickadee. T. Booms, ADF&G.

Species of Conservation Need: Northern flying squirrel *(Glaucomys sabrinus yukonensis)*

Northern flying squirrel. J. Whitman, ADF&G.

The northern flying squirrel, a nocturnal gliding mammal, occurs in many of Alaska's forests. Unlike other squirrels in the state, flying squirrels have patagia (lateral skin folds between their front and hind legs) that enable them to glide short distances between trees at night. Their large eyes provide excellent night vision. These squirrels have a diverse omnivorous diet that includes nuts, berries, mushrooms, lichen, and spruce tips. They nest in tree cavities and witches' brooms (clusters of abnormal tree branches caused by tree rust diseases), using materials such as old foliage, lichen, and shredded bark. During Alaska's long and cold winters, flying squirrels enter torpor and hibernate in small groups within witches' brooms. Flying squirrel populations rely on dense, old, and closed-canopy forests with well-spaced corridors for gliding to evade predators such as owls and hawks. Flying squirrels, along with other small mammals, are key dispersers of fungal spores that form obligate associations with the roots of seedling trees, leading to successful regeneration and greater resilience of mature trees to environmental change. Squirrel inoculation of forest soils with fungal spores is an important consideration for reforestation and the functioning of forest ecosystems

directed towards these taxa will also be relevant to associated species not specifically identified as SGCN. The process of researching and modifying aquatic and invertebrate portions of Alaska's SGCN list is ongoing. In the coming decade, ADF&G aspires to add more taxa to the ASRS, such as fish, given existing knowledge of populations and trends.

Stewardship Species

A *stewardship* species is any taxon with a large percentage of its population or range in Alaska. This is particularly relevant to Alaska because 1) its large size makes it more likely to support a significant percentage of a taxon, 2) it has extensive island archipelagos (Aleutian Islands, Kodiak Archipelago, Alexander Archipelago, isolated Bering Sea islands) on which many endemic subspecies have evolved, and 3) many migratory bird species concentrate in Alaska to breed or stage before dispersing. More information is available on the population and range of vertebrates in Alaska, and stewardship designation reflects that pattern.

Stewardship can indicate continental responsibility (i.e., a substantial fraction of the North American population occurs in Alaska) or regional responsibility (i.e., species is endemic to Alaska). We adopted stewardship definitions present in both the shorebird and landbird conservation plans for SGCN status. For example, the Alaska Shorebird Conservation Plan defined an "Alaska Stewardship" species as one with equal to or greater than 50% of its North American population occurring in Alaska during any portion of its annual life cycle. We also applied

this definition to waterfowl and seabirds. The Alaska Landbird Conservation Plan defined a "Continental Stewardship" species as one in which equal to or greater than 10% of its global population occurs in North America and equal to or greater than 25% of its North American population occurs in Alaska. For mammals and fish, taxa that have relatively fewer population estimates than birds, we based stewardship on the proportion of the species' range occurring in Alaska (Baltensberger et al. 2024). Similar to the 2015 Alaska Wildlife Action Plan, stewardship status was warranted when more than 60% of a species' range occurred within Alaska.

Culturally Important Species

The best practices guide (AFWA 2012) recommends that action plans consider a species' cultural and economic importance when determining its status as an SGCN. A wide range of user groups were considered when determining cultural importance. Many culturally important species are hunted or trapped, but some of them are excluded from this plan because they receive adequate funding from other sources and are not listed under the ESA. All other culturally important species were considered eligible. Culturally important SGCN also include those that are economically important (defined below).

Information on important subsistence species from around the state was provided during development of the 2015 State Wildlife Action Plan by Dr. James Fall, program manager for the Division of Subsistence at ADF&G. These data include species harvested for subsistence, as well as selected species that provide subsistence harvest opportunities but do not receive substantial funding for management from other sources (e.g., some seabirds and sea ducks). Regional harvest reports of the Alaska Migratory Bird Co-Management Council (AMBCC 2025) were also used to identify culturally important species eligible for SGCN status. In 2025, additional information was provided by Dr. Lori Polasek, wildlife scientist for the Marine Mammals Program, Division of Wildlife Conservation at ADF&G.

Economically Important Species

Only aquatic species are categorized as economically important on the SGCN list. These include aquatic species harvested commercially, such as crabs and salmon. Among mammals, furbearers have commercial value but are excluded from the SGCN list because they are hunted or trapped and receive funding from other sources. Alaska's economically important SGCN are also considered to be culturally important.

Ecologically Important Species

For aquatic species and terrestrial invertebrates, ecological importance was considered for inclusion as SGCN. Most ecologically important species are important prey for some other species, whereas others may exert top-down control on community structure or provide key ecological functions (e.g., pollination). For example, under this category, select aquatic vertebrates species that are abundant and provide a critical source of food for species at upper trophic levels, such as forage fish (Cury et al. 2011), qualified as SGCN. For terrestrial vertebrates and marine mammals, any available information on this topic was part of the ASRS review and ranking process, so ecological importance was not considered as a separate criterion.

Results

Combined, our analysis resulted in qualifying 266 vertebrate species as SGCN in Alaska. The SGCN list also includes six orders of terrestrial arthropods, five classes of freshwater macroinvertebrates,

one species of freshwater mollusk, three orders and one subclass of marine zooplankton, two classes of deep-sea corals, and eight species of other marine invertebrates. Of the vertebrates, the SGCN list includes 12 fish species and one genus of rockfish, five amphibians, 183 birds, 42 terrestrial mammals, and 24 marine mammals. A complete list of all SGCN and the basis for their inclusion is shown in Appendices A through C.

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Researchers in a Zodiak navigating sea ice while surveying cliffs for seabirds. ADF&G.

5 | Distribution and Abundance of Wildlife in Alaska

Savannah Sparrow. A. Underwood, ADF&G.

Distribution of Species of Greatest Conservation Need

To describe the distribution and abundance of "species of greatest conservation need" (SGCN) in Alaska, a spatial framework of biogeographic regions was adopted (Figure 5.1). This framework largely follows Kessel and Gibson (1978), which others have used to describe the distribution of birds (Armstrong 2015) and mammals (MacDonald and Cook 2009) in the state. It also has the benefit of aligning closely with boundaries that define Bird Conservation Regions (NABCI 2000) and multiple state management boundaries in Alaska (ADF&G 2024, ADF&G 2022, ADF&G 2023).

There are six biogeographic regions for terrestrial species: Northern Alaska, Western Alaska, Central Alaska, Southwest Alaska, Southcentral Alaska, and Southeast Alaska (Figure 5.1). For marine species, there are three regions: Beaufort/Chukchi Seas, Bering Sea, and Gulf of Alaska (Kessel and Gibson 1978). For the 2025 revision of the Alaska State Wildlife Action Plan (SWAP), we adjusted the northern boundary of the Southcentral region northward to align with state management areas of aquatic species (ADF&G 2022). This change better delimits the natural distributions of aquatic species in the Southcentral region that were altered by late Pleistocene glaciation (e.g., Oswood et al. 2000).

This chapter provides an overview of the nine biogeographic regions in Alaska and describes in broad terms the primary environmental features in each region. The nine regions serve as a foundation for Chapter 6 "Key Habitats of Wildlife in Alaska," where available habitats and number of SGCN species in those habitats are described for each region.

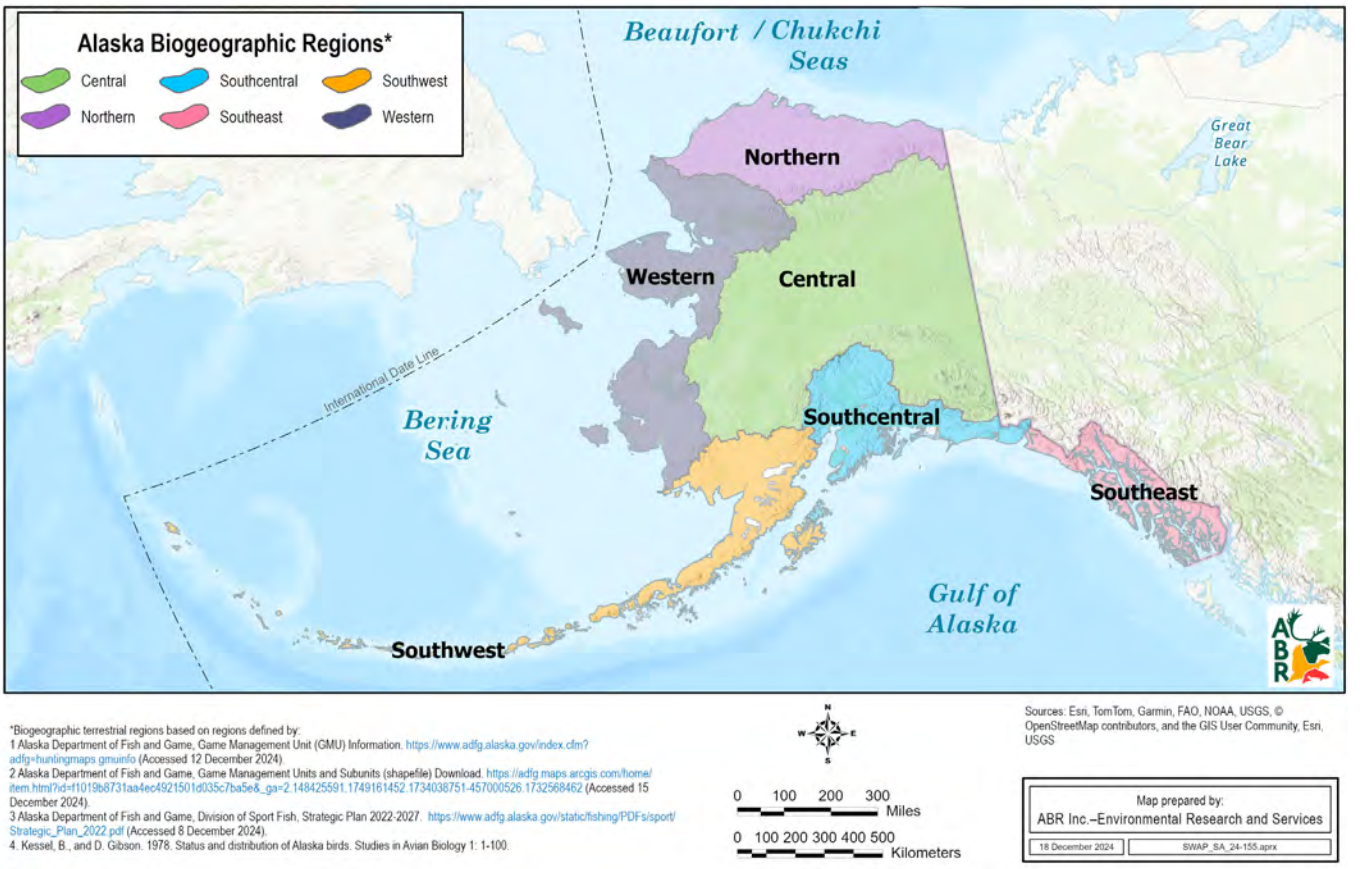


Figure 5.1. Map of the six terrestrial and three marine biogeographic regions in Alaska used in this wildlife action plan.

In this chapter, the following information is reported for each biogeographic region (Figure 5.1):

- Land or ocean area.
- Climate, including historical averages (1950–1999) compared to prevailing conditions (2000–2024).
- Physiography, including major mountain ranges and other significant landscape features.
- Typical vegetation and overview of important ecological attributes.
- Representative examples of vertebrate SGCN species present; distribution of each SGCN by biogeographic region is reported in Appendix D.

The presentation of climate data for each biogeographic region is a significant update, compared to previous versions of SWAP. Table 5.1 summarizes climate data for two time periods, 1950–1999 (historical) and 2000–2024 (recent), providing a comparison of recent change relative to historical averages. Further information on climate is provided in Chapter 7. Climate variables for each of the six terrestrial biogeographic regions and three marine regions were estimated using the ERA5 global reanalysis data set (Hersbach et al. 2020), with data downloaded from C3S (C3S 2017) to produce estimates of temperature, precipitation, snowfall, and sea surface temperature.

Northern Alaska

The Northern Alaska biogeographic region (Figure 5.1) is also referred to by some as the Arctic region. It encompasses 78,877 square miles and is bounded by the Beaufort Sea and Chukchi Sea to

Table 5.1. Average annual, winter, and summer air temperatures and average precipitation for historical (1950–1999) and more recent (2000–2024) time periods across Alaska's biogeographic regions. Comparison illustrates general patterns of relative change. Data comes from the updated ERA5 Land global dataset (Muñoz-Sabater et al. 2021) with grid cells of about 5.6 miles resolution used in each biogeographic region for the indicated time period and season. Sea surface temperatures are provided in parentheses for the three marine regions.

Region	Historical (1950–1999)					Recent (2000–2024)				
	Temperature (F)[1]			Precip[4] (in) Annual	Snowfall[5] (in) Oct–May	Temperature (F)			Precip[4] (in) Annual	Snowfall[5] (in) Oct–May
	Annual	DJF[2]	JJA[3]			Annual	DJF[2]	JJA[3]		
Northern	11.6	-16.5	45.7	14.7	5.4	15.4	-11.3	46.5	16.1	6.0
Western	23.1	-1.1	50.1	23.9	9.6	25.9	3.0	51.5	24.8	9.7
Central	22.7	-5.8	53.0	23.8	9.0	25.2	-1.4	54.1	24.5	9.0
Southwest	33.8	19.4	49.7	49.8	18.1	36.1	23.1	51.3	51.7	17.7
Southcentral	28.6	12.1	46.0	74.3	36.7	33.1	15.8	49.5	76.5	35.8
Southeast	36.3	23.6	49.2	114.8	44.4	39.4	28.5	52.0	119.0	42.4
Beaufort/Chukchi Sea	13.4 (30.5)	-8.8 (29.0)	35.3 (32.6)	12.0	6.2	18.3 (32.3)	-2.9 (29.0)	37.4 (36.3)	13.6	7.3
Bering Sea	34.5 (38.7)	25.4 (34.5)	44.5 (44.3)	34.1	12.0	36.4 (39.9)	27.8 (35.4)	45.9 (45.8)	35.2	11.2
Gulf of Alaska	44.3 (46.1)	38.4 (41.4)	51.2 (51.5)	48.9	3.7	45.2 (46.7)	39.6 (41.9)	52.4 (52.8)	50.3	3.1

[1] Average air temperature (or average sea surface temperature) is calculated by averaging the coldest month's average temperature and the warmest month's average temperature of each year, over the course of many years.

[2] DJF refers to the average air temperature for December, January, and February (i.e., meteorological winter)

[3] JJA refers to the average air temperature for June, July, and August (i.e., meteorological summer)

[4] Average annual total precipitation is calculated from yearly totals of precipitation, reported as the depth of water falling on the Earth's surface, averaged over many years.

[5] Snowfall is expressed in inches of water equivalent (i.e., liquid water produced when snow melts), not snow depth.

the north and the crest of the Brooks Range to the south. It includes the Arctic Coastal Plain as well as the northern foothills of the Brooks Range.

The Arctic Coastal Plain is a treeless, windswept landscape stretching across the Alaska coast of the Beaufort and Chukchi seas and into Canada. This region is characterized by abundant lakes (especially to the west), wetlands, and permafrost-related features such as pingos, ice-wedge polygon networks, peat ridges, and frost boils. Permafrost is nearly continuous across the region, resulting in typically saturated soils with thick organic horizons. The plain gradually ascends from the coast southward to the foothills of the Brooks Range.

Numerous large, braided rivers flow northward from the Brooks Range across the coastal plain. Thousands of shallow, rectangular thaw lakes that are aligned north-northwest due to prevailing summer winds cover up to 50% of the area, making it largely a wetland. In winter, small streams may run dry or freeze completely, while many larger rivers, often spring-fed, maintain flow year-round and create aufeis (layered ice deposits) that persist into summer. Just south of the coastal plain, the Brooks Range foothills feature long, linear ridges, gently rolling hills, glacial moraines, and mesas composed of tightly folded sedimentary rocks dividing narrow alluvial valleys. Unlike the coastal plain, the foothills have few lakes but are traversed by many swift streams and rivers, some freezing solid in winter while others braid across gravel flats, which results in large aufeis deposits.

A dry, polar climate dominates Northern Alaska, characterized by short, cool summers and long, cold, windy winters, with prevailing winds from the southwest. The coastal plain experiences cool and frequently foggy summers, given proximity to the abundant sea ice in the Beaufort and Chukchi seas. In contrast, the foothills experience somewhat warmer and wetter conditions.

Stream outflow from a lake on the Arctic Coastal Plain. S. Laske, USGS, used with permission.

Brooks Range near Anaktuvuk Pass. NPS, used with permission.

Annual average temperature (2000–2024) is 15°F with seasonal averages varying between -11°F and 47°F (Table 5.1). Average annual total precipitation is 16 inches, including an average of 6 inches of snowfall water equivalent. Recent conditions indicate an increase in both annual average temperature and total precipitation, relative to historical data (1950–1999; Table 5.1).

On the coastal plain, vegetation is dominated by wet sedge tundra in drained lake basins, swales, and floodplains; on gentle ridges, it is dominated by more well-drained tussock tundra and sedge-dryas tundra. Low willow thickets are common on well-drained riverbanks. The predominant vegetation in the foothills is mixed shrub-sedge tussock tundra with dryas tundra occurring on ridges. Vegetation along rivers is dominated by dwarf riparian willow near the coast and low and tall willow thickets in the foothills.

Northern Alaska provides globally important habitats for breeding waterfowl and shorebirds (e.g., American Golden-Plover, Dunlin, Pectoral Sandpiper), mesopredators (e.g., Snowy Owl, Arctic fox), raptors (e.g., Rough-legged Hawk, Gyrfalcon), and landbirds (e.g., Arctic Warbler, Lapland Longspur, Redpolls). Many species of waterbirds nest and breed on the Arctic Coastal Plain, including King Eider, Spectacled Eider, Steller's Eider, Long-tailed Duck, Red-throated Loon, Arctic Loon, and Yellow-billed Loon. One bird of particular note is the Gray-headed Chickadee, which is believed to inhabit Northern Alaska year-round. It needs further study, given its apparent decline and rarity on the landscape, and because little is currently known about its habits (Booms et al. 2020).

In the summer, many seabirds, including fulmars, auklets, guillemots, puffins, and murres, can be found in the marine waters of Northern Alaska. For shorebirds, most of the United States breeding populations of Long-billed Dowitcher, Dunlin, Semipalmated Sandpiper, Pectoral Sandpiper, and Buff-breasted Sandpiper occur in this region. In total, more than two dozen shorebird species breed in Northern Alaska, with more than six million birds estimated to breed in the National

Arctic ground squirrel. ABR, used with permission.

Petroleum Reserve in Alaska (NPR-A) alone. Many shorebird species also use the region's coastal areas for migration staging, creating localized concentrations, prior to migrating to southern parts of the western hemisphere, Southeast Asia, Oceania, Australia, and New Zealand. Some of these species include Black-bellied Plover, Whimbrel, Bar-tailed Godwit, Red Knot, Dunlin, Semipalmated Sandpiper, Western Sandpiper, Long-billed Dowitcher, Lesser Yellowlegs, and Red-necked Phalarope (ASG 2019). Smith's Longspur, a passerine SGCN, breeds on broad riverine terraces in the foothills of the Brooks Range, and Snowy Owls are common in the region, where they track populations of small mammals (Handel et al. 2021).

Small mammals common in Northern Alaska include singing, root, and northern red-backed voles; tundra and barren ground shrews; snowshoe hares; Alaska marmots; Arctic ground squirrels; and collared and brown lemmings. No land mammal species is restricted solely to the Northern bioregion of Alaska (MacDonald and Cook 2009). Offshore waters support the Pacific walrus, beluga, bearded seal, spotted seal, ringed seal, and polar bear. The Beaufort and Chukchi seas provide pack ice for polar bears in the winter and spring, whereas receding pack ice in summer and fall drives them to land to hunt for food. In the fall, the receding pack ice also provides open-water feeding grounds for bowhead whales.

Fish such as Dolly Varden, Arctic and Bering cisco, and Arctic grayling spawn and overwinter in the larger rivers. Additionally, small populations of pink, chum, and Chinook salmon spawn in small and large coastal rivers within the region.

Western Alaska

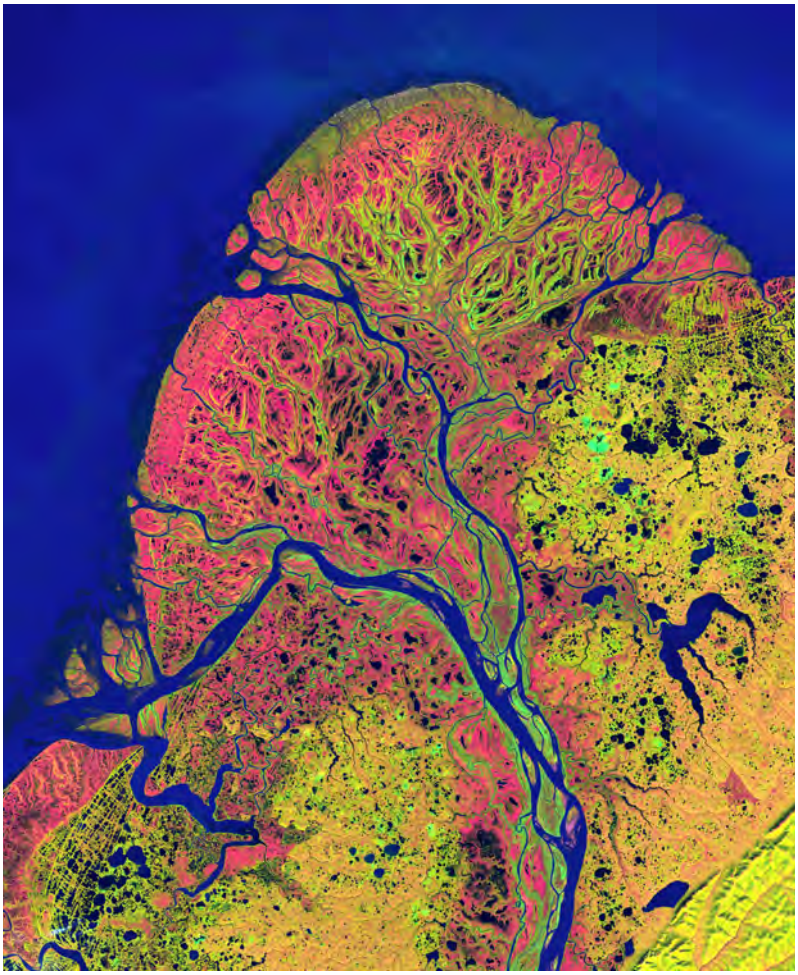
The Western Alaska biogeographic region (Figure 5.1) encompasses 109,183 square miles and is bounded by the Chukchi Sea to the north and the Bering Sea to the west. Various mountain ranges, such as the westernmost portion of the Brooks Range foothills, the Nulato Hills, and the Ahklun and Kilbuck mountains, define the eastern boundary of the region. The region's vast expanse encompasses 10 degrees of latitude and the region increases in elevation in the mountains that define the eastern boundary. It includes the Seward Peninsula in the north and the vast Yukon-Kuskokwim Delta in the south. Another feature of Western Alaska is the presence of the Bering Sea islands, including St. Lawrence, Nunivak, St. Matthew, Hall, and the two Pribilof Islands of St. George and St. Paul.

The coastal plains surrounding Kotzebue Sound are generally less than 330 feet in elevation and tend to be poorly drained. As in Northern Alaska, permafrost-related features dominate the landscape, with pingos around the Selawik River and many thaw lakes throughout the region. The low, rolling Nulato Hills occur between the Bering Sea and the Yukon River drainage in Central Alaska, while the

Ahklun and Kilbuck mountains separate the drainages into the Kuskokwim and Bristol bays; these mountains are steep and angular, with elevations reaching 4,950 feet. Past glaciers carved broad U-shaped valleys, and large finger lakes fill valleys on the south side of the mountains. Permafrost exists in most low-lying areas. The Yukon–Kuskokwim Delta is the result of deposition of heavy sediment loads from the glacial Yukon and Kuskokwim rivers. This flat coastal plain is characterized by abundant thermokarst lakes, meandering streams, highly productive brackish marshes, and wet meadows. Isolated basalt hills and volcanic cinder cones less than 400 feet high punctuate the landscape. Discontinuous permafrost impedes drainage and contributes to shallow organic soils. Large tidal fluctuations along the coast and occasional storm tide surges flood coastal areas with salt water, creating invertebrate-rich coastal marshes.

The region experiences cold, wind-swept winters, with prevailing winds blowing predominantly from the southwest. Precipitation varies geographically across the region and is influenced by elevation. Annual average temperature (2000–2024) is 30°F with seasonal averages varying between 15°F and 49°F (Table 5.1). Average annual total precipitation is 25 inches, with local averages ranging from 14 to 60 inches, including an average of 10 inches of snowfall water equivalent. Recent conditions indicate an increase in both annual average temperature and total precipitation, relative to historical data (1950–1999; Table 5.1).

The southern portion of Western Alaska is home to the expansive Yukon–Kuskokwim Delta, which is roughly the size of Oregon and ranks among the world's largest river deltas. This area is a crucial nursery for many of the nation's shorebirds and waterfowl, especially for Arctic-breeding geese such as Brant, Cackling, and Emperor Geese. In the region's mountainous areas, vegetation varies with elevation and terrain. At higher elevations, the landscape is either barren or covered by alpine tundra, featuring dryas-lichen or sedge-ericaceous shrub vegetation. At lower elevations, vegetation transitions to dwarf shrubs, tall shrubs (willow–birch–alder), or spruce and birch forests. Valleys often contain a mix of shrublands and wetlands interspersed with forests of white spruce, balsam poplar, or a combination of white spruce and paper birch. Upland areas, characterized by peat mounds,



An image from space of the low-lying Yukon River Delta, showing its many water features. Goddard Space Flight Center, used with permission.

sand dunes, and volcanic soils, support dwarf shrub communities of birch and ericaceous (heath) shrubs. Inland bogs contain tussock-forming sedges and sedge-moss communities. Willow thickets thrive along rivers and well-drained slopes, while alders and stunted spruce and birch grow along the major streams.

The Yukon–Kuskokwim Delta is classified as wet maritime tundra and features flat, treeless, and extremely wet coastal areas dominated by sedges and sedge tussocks. In better-drained areas upriver and to the east, vegetation transitions to white spruce, willows, alder, paper birch, and spruce-hardwood forests in drier microsites. The delta's diverse tundra plant life, influenced by its historical connection to Asia and varied geology, supports abundant wildlife. Over 20 species of waterfowl and 10 species of shorebirds, including Spectacled Eider, Bristle-thighed Curlew, and Bar-tailed Godwit, breed here.

Just as the climate of Western Alaska varies due to its expansive reach along the coast and elevation gradients, so do its fish and wildlife resources. In the northern part of this region, polar bears, spotted seals, bearded seals, ringed seals, beluga whales, bowhead whales, and Pacific walruses can be seen near the coast and on adjacent ice floes. The northern part of this region is also an important breeding area for two relatively rare Alaska bird species, Arctic Loon and Bristle-thighed Curlew. Common terrestrial mammals include singing voles and tundra shrews. All five species of Pacific salmon ascend area rivers to spawn. Dolly Varden spawn and overwinter in most rivers, and Arctic grayling are resident in larger streams. Bering cisco, Alaska blackfish, burbot, and sheefish are common residents of the freshwaters.

The Bering Sea islands are treeless, rocky, volcanic islands characterized by moist tundra meadows of sedges, grasses, low shrubs, and lichens. The shorelines are a mix of rocky sea cliffs and sand dunes. These islands provide important habitat for numerous marine mammals and seabirds. The

Iliamna Bay, Cook Inlet. ABR, used with permission.

Spectacled Eider. A. Bankert, ABR, used with permission.

Walrus Islands group in Bristol Bay gets its name from the large number of male walruses that haul out on the beaches each summer. The largest concentration occurs on Round Island, where Steller sea lions also haul out. Beluga whales feed along the coast. The Pribilof Islands provide habitat for approximately three million seabirds, including nearly the entire world population of Red-legged Kittiwakes. Other large breeding colonies of Crested Auklet and Red-faced Cormorants also exist on the islands. In many winters, polynyas (ice-free areas surrounded by ice) south of St. Lawrence Island attract virtually the entire global population of Spectacled Eiders. They forage on mollusks and other crustaceans found on the sea floor. The Pribilof Rock Sandpiper breeds only on the Bering Sea islands. McKay's Bunting, the only passerine species endemic to Alaska, breeds only on St. Matthew and Hall islands.

One of the richest pockets of invertebrate life in the Bering Sea is found near St. Lawrence Island, where extremely productive benthic communities, including mollusks and amphipods, support marine mammals and waterfowl. A diverse mix of marine fish, including pollock, halibut, salmon, and forage fish (e.g., herring and capelin), also contribute to the abundance of birds and mammals. Along with wintering bowhead whales, breeding and wintering walruses inhabit the area near St. Lawrence Island. The ice-associated seals—ringed, ribbon, bearded, and spotted—can be found on the northern islands. The Pribilof Islands provide critical breeding grounds for Steller sea lions and northern fur seals. Bowhead, beluga, sei, North Pacific right, gray, and humpback whales swim through the waters of the Bering Sea shelf. Dolly Varden and coho salmon spawn in rivers on St. Lawrence and Nunivak islands.

The Alaska hare, an unusually large lagomorph endemic to Western Alaska, is an important focal species because little is known about its vital rates, distribution, and population size or trends. Two species of shrew (the Pribilof Island shrew and the St. Lawrence Island shrew) and one vole (insular vole) occur only in this region, on islands in the Bering Sea. Other important land mammals include taiga and root voles, as well as Arctic ground squirrels.

Central Alaska

The Central Alaska biogeographic region (Figure 5.1), covering an area also known as Interior Alaska, encompasses 245,214 square miles and stretches from the crest of the Brooks Range in the north to the Yukon River in the west, to Canada in the east, and to the coastal mountain ranges in the south.

The Brooks Range occurs in the northernmost portion of Central Alaska and spans the entire state, east to west. It represents the northern extension of the Rocky Mountains. The range is characterized by steep mountains of uplifted sedimentary and metamorphic rock, with scattered glaciers above 5,940 feet. Within the Brooks Range, elevations range from 1,640 to 8,530 feet. Near the southern boundary of the Central Alaska region is the Alaska Range. The mountains of the Alaska Range are high, very steep, and covered with glaciers, rocky slopes, and ice fields. Elevations vary from broad

Koyukuk River in autumn. B. Raften, USFWS, used with permission.

valleys at 2,000 feet to peaks greater than 12,000 feet, with the tallest mountain in North America rising to 20,310 feet. Glaciers have shaped these mountains; therefore, cirques and U-shaped valleys are common features. Streams and rivers, heavy with sediment, run swiftly down mountain ravines and braid across valley bottoms. The Wrangell and Kuskokwim mountains are found in the southern portion of Central Alaska. While the Wrangell Mountains are steep and covered with ice fields and glaciers, the Kuskokwim Mountains are rolling mountains with elevations generally below 4,000 feet.

Lowlands in Central Alaska are shaped by large rivers, including the Yukon, Tanana, Kuskokwim, Copper, Porcupine, and Old Crow rivers. Permafrost tends to be discontinuous and is retreating in extent due to climate change. Thawing results in thaw lakes, collapse-scar bogs, and fens. Glacial moraines and kettle lakes across the lowlands are evidence of past glaciation, and oxbow lakes exist where river routes have changed.

The prevailing climate in Central Alaska is continental and is characterized by long, cold winters and short, warm summers. Some upland areas experience dry, warm summers, contributing to a higher frequency of wildfires. Annual average temperature (2000–2024) is 25°F with seasonal averages varying between -1°F and 54°F (Table 5.1). Average annual total precipitation is 25 inches, including an average of 9 inches of snowfall water equivalent. Recent conditions indicate an increase in both annual average temperature and total precipitation, relative to historical data, but no change in snowfall water equivalent (1950–1999; Table 5.1).

Vegetation in Central Alaska is diverse. In the north, it includes shrub-sedge tussock tundra with willow thickets along rivers and streams and sparse spruce-birch forests at lower elevations. Steep slopes and slopes at higher elevations are largely barren, while upper and intermediate slopes support alpine heath communities. When vegetation is present, it features shrub birch, dwarf shrub communities, or dryas-lichen tundra. In the southern part of the region, boreal forest is extensive, and it features stands of black and white spruce. Floodplains are dominated by black spruce and tamarack. On more well-drained slopes and uplands, white spruce, paper birch, and quaking aspen occur.

Areas affected by forest fires typically regenerate to tall willow, birch, and alder shrubs. In lowland areas, vegetation varies with soil drainage. Highly productive stands of white spruce and balsam poplar dominate on riverine terraces along the major rivers. Where meandering streams have left oxbows or cut-off sloughs, wet sedge meadows, grass marshes, shrub swamps, and aquatic vegetation occur. Tall alders, birch, and willows dominate active floodplains and river bars.

Small mammals in Central Alaska include snowshoe hares; brown and northern bog lemmings; meadow, tundra, and taiga voles; and little brown bats. Common, dusky, and tundra shrews can be found in the wide valley floors of this region. The woodchuck is restricted to this region in Alaska.

Rivers and lakes throughout Central Alaska support northern pike, burbot, whitefish, and grayling. Headwater streams in the mountains support resident populations of Dolly Varden. All five species of Pacific salmon migrate up the Yukon and Kuskokwim rivers to spawn in tributary streams and commonly occur throughout the region.

Rusty Blackbird. A. Underwood, ADF&G.

Wonder Lake and the Alaska Range. © M. Emery, used with permission.

This boreal forest-dominated region supports a large variety of birds, including Surfbirds that breed in rocky areas above tree line. Open, mixed deciduous-conifer forests support a large variety of birds, including Boreal Chickadees, Northern Flickers, and Boreal Owls. Landbirds inhabiting this area across a diversity of habitats include Golden Eagles, Olive-sided Flycatchers, Blackpoll Warblers, Great Gray Owls, and Rusty Blackbirds. The rich aquatic habitats attract millions of waterbirds, including breeding species such as Lesser Scaup, Northern Pintail, Surf and Black Scoters, and Red-throated Loon.

Southwest Alaska

The Southwest Alaska biogeographic region (Figure 5.1) encompasses 61,799 square miles and includes the Alaska Peninsula, the Aleutian Islands, and the lowlands around Bristol Bay. The lowlands are dominated by moraines and other glacially influenced landforms, and elevations range from sea level to 500 feet. The Alaska Peninsula separates the Gulf of Alaska from the Bering Sea, and its dominant feature is the Aleutian Range, the peninsula's volcanic spine that reaches elevations of 8,580 feet above sea level. Extensive glaciers historically covered this area, and because glaciers remain on some high peaks, many lakes and rivers contain suspended glacial flour comprised of sediment from glacial erosion of rock and gravel. Many lakes and large river basins occur in the lowlands of the peninsula, which terminate in broad estuarine areas on the Bering Sea. Much of the shoreline of Bristol Bay and the Bering Sea is characterized by mixed sand and gravel beaches and exposed mudflats. The protected bays and lagoons often have eelgrass beds, which provide food for waterfowl and are the base of the food chain for many fish species. Izembek Lagoon contains one of the largest eelgrass beds in the world, a critical food source for Pacific Black Brant. The rugged Gulf Coast has intertidal habitats and subtidal kelp forests on rocky substrates.

Arcing 1,200 miles westward from the Alaska Peninsula to the island of Attu, the Aleutian Islands are a chain of volcanic islands formed by the Pacific tectonic plate being forced beneath the Bering Sea plate. Fog often shrouds the steep, rubble-covered peaks, which rise to 6,000 feet above sea level. Icecaps or small glaciers occur on many of the volcanoes, and past glaciation is evident. The archipelago's location over an active seismic fault results in frequent volcanic and seismic activity. Out of the 76 volcanoes in the chain, 40 have been active in the past 250 years.

A maritime climate dominates the Alaska Peninsula and the Aleutian Islands, whereas the climate transitions from maritime to continental in the lowlands around Bristol Bay. Rain, fog, and persistent winds are common throughout Southwest Alaska. Annual average temperature (2000–2024) is 36°F with seasonal averages varying between 23°F and 51°F (Table 5.1). Average annual total precipitation is 52 inches, including an average of 18 inches of snowfall water equivalent. Recent conditions indicate increases in annual average temperature and total precipitation, relative to historical data (1950–1999; Table 5.1).

In the lowlands around Bristol Bay and the Alaska Peninsula, moist and wet tundra dominates the landscape. Low and dwarf shrub communities of willow, birch, and alder, as well as mosses and tussock-forming sedges, characterize these wetlands. Spruce and birch forests occur along major rivers and streams, and sand dunes are present along bluffs on the coast and riverbanks. Most of the Alaska Peninsula and the Aleutian Islands are treeless. Tundra vegetation predominates below the barren ice-covered peaks. The alpine tundra is a semiarid habitat that supports low shrubs, lichens, mosses, and grasses. Moist tussock tundra of mosses, lichens, and tufted hair grass occurs in mountain valleys and along plateaus. Tall shrub communities of alder and willow dominate floodplains. The flora of the Aleutian Islands is a blend of species from the North American and Asian continents. Alpine tundra is characterized by species not found to the north or in Central Alaska, including Alaska arnica, Siberian spring beauty, caltha-leaved avens, western buttercup, and Kamchatka rhododendron. Low shrub communities of willow, birch, and alder dominate mountain flanks and coastlines, interspersed with ericaceous-heath, dryas-lichen, and grass communities. Uplands are characterized by peat and mats of heath tundra with sedges. Shallow, nearshore marine waters support eelgrass beds.

Alaska Peninsula, National Wildlife Refuge. © M. Emery, used with permission.

All five species of Pacific salmon spawn in this region, as do other anadromous species (e.g., Dolly Varden). The Kvichak River may be one of the world's most productive sockeye salmon systems, and the Nushagak River supports the third-largest Chinook salmon run in the world. Over

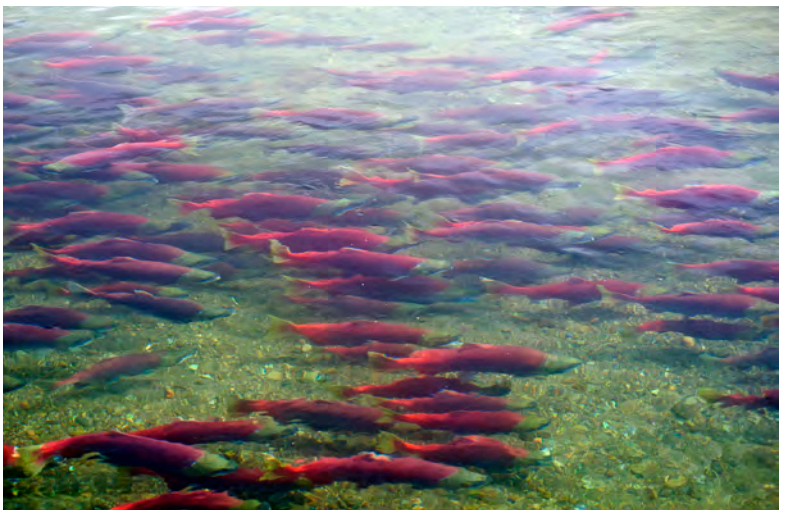
Vulcan Dome and volcanic springs near the headwaters of Surpise Lake below Aniakchak Caldera. NPS, used with permission.

the last 30 years, the annual harvest of salmon in Bristol Bay has exceeded 25 million fish, of which over 95% were sockeye salmon, making this the most valuable commercial fishery in Alaska. The streams and rivers of Bristol Bay also support healthy populations of resident rainbow trout and Arctic grayling. The Aleutian Islands unit of the Alaska Maritime National Wildlife Refuge is thought to have more salmon spawning streams than any other refuge in the country, providing a rich food resource for birds as well as terrestrial and marine mammals.

Common small mammals include Arctic, red, and ground squirrels; collared and brown lemmings; singing, root, and meadow voles; collared pikas; Alaska and snowshoe hares; dusky and tundra shrews; and little brown bats.

Nushagak and Egegik bays host large concentrations of migrant shorebirds annually, including Dunlin, Rock Sandpipers, and Western Sandpipers. Up to one-third of the global population of Bar-tailed Godwits (*baueri* subspecies only) uses Egegik Lagoon in the fall. Lowlands around Bristol Bay host roughly 10% of the breeding population of Red-throated Loons. The productive estuaries of Nushagak and Kvichak bays are used during spring migration by thousands of sea ducks, including King Eiders, Black Scoters, Long-tailed Ducks, and Steller's Eiders. Other coastal wetlands, lagoons, and bays in Southwest Alaska provide staging areas for large seasonal aggrega-tions of waterfowl and shorebirds. Izembek and Moffet lagoons support concentrations of more than 500,000 shorebirds each spring, including Marbled Godwits, Rock Sandpipers, and nearly 100% of the global populations of Pacific Black Brant and Emperor Geese. Aleutian Terns, Red-faced Cormorants, Cassin's Auklets, and Kittlitz's Murrelets also breed here. Nelson Lagoon is the primary molting area for the Steller's Eider, which is currently listed as threatened under the ESA (62 FR 31748). The Alaska Peninsula and the Aleutian Islands support endemic species of both birds and mammals. Landbirds,

including Blackpoll Warblers and Rusty Blackbirds, breed in the forests and wetlands. McKay's Buntings and Sanderlings overwinter in terrestrial and intertidal habitats, respectively, in Southwest Alaska.



School of sockeye salmon. ADF&G.

Southwest Alaska supports a diverse assemblage of marine species, including the beluga whale, northern sea otter, and Pacific walrus. Rookeries and haulouts for Steller sea lions are distributed primarily along the Gulf Coast and the Aleutian Islands. Northern sea otters inhabiting this region belong to the Southwest Distinct Population Segment (DPS) and have been listed as threatened under the ESA since 2005 (74 FR 52010). Fin and humpback whales feed in the nearshore and offshore waters in the summer.

Southcentral Alaska

The Southcentral Alaska biogeographic region (Figure 5.1) encompasses 51,116 square miles from Kamishak Bay and the southern tip of the Kenai Peninsula in the south to the Alaska Range in the north. This region includes Cook Inlet, Prince William Sound, and the Chugach and St. Elias mountain ranges. Approximately 500 miles of this region is coastline.

McKay's Bunting. J. Dau, ADF&G.

Elevation in Southcentral Alaska ranges from sea level to 14,750 feet. Gently sloping lowlands were extensively glaciated during the Pleistocene epoch. Hundreds of small lakes, swamps, fens, and bogs occur on glacial moraine deposits. Several large rivers, including the Susitna, Kenai, and Copper rivers, originate in the surrounding mountains and produce extensive floodplains in the lowlands. The Copper River Delta is the largest contiguous wetland on the Pacific Coast of North America at 700,000 acres. The rugged, ice-covered Chugach and St. Elias mountains serve as the backdrop for these lowlands, forming a crescent behind the Gulf of Alaska coastline and reaching from the southern tip of the Kenai Peninsula eastward around to the Fairweather Range in Southeast Alaska. These rugged mountains have the largest area of ice fields and glaciers outside the polar region. Fjords and archipelagos are common, and small lakes occur high in glacier-carved valleys. Glacial outburst floods, land subsidence, isostatic rebound, and localized high-wind events continue to dominate and influence landscape patterns.

The marine environments in Southcentral Alaska vary from exposed coastlines to sandy barrier islands and deep fjords. In Prince William Sound, water depths reach greater than 2,500 feet, and icebergs calve directly into marine waters at the base of tidewater glaciers. Tides here are large, and numerous freshwater rivers and streams flow into the ocean creating high-value estuarine habitats. During early summer, meltwater from snow and ice flows from the terminus of glaciers and forms swift, short streams in valleys that can temporarily inundate coastal flats. Nutrient and mineral contributions from ice-melt into glacial fjords make them some of the most productive marine habitats in the world.

Glacier in College Fjord, Prince William Sound. NOAA, used with permission.

The climate in Southcentral Alaska is a mix of continental and maritime. Annual average temperature (2000–2024) is 31°F, with seasonal averages varying between about 16°F to 50°F (Table 5.1). Annual average total precipitation is 77 inches, with wetter areas averaging 187 inches annually. Annual average snowfall water equivalent is approximately 36 inches, but varies widely, from five to 107 inches. Recent conditions indicate increases in temperature and precipitation but a decrease in snowfall water equivalent, relative to historical data, (1950–1999; Table 5.1).

In the westernmost part of Southcentral Alaska in the Gulf of Alaska, Sitka spruce and black cottonwood have only recently become established on islands; the dominant vegetation consists of willow and alder thickets or wet and moist sedge meadows. Barrens or alpine tundra occurs at higher elevations. From Afognak Island moving eastward, spruce and hardwood forests dominate the landscape, but the varying climatic conditions, discontinuous permafrost, and rolling

Dunlins and Ruddy Turnstones. B. Richard, ADF&G.

topography support a diverse set of vegetation types. Lowlands with wet, organic soils support black spruce stands, and ericaceous shrubs are dominant in open bogs. Plant communities of tall shrubs, wet graminoids (grasses and sedges), and wet forbs (broad-leaved herbs) also occur. Uplands have mixed forests of white and Sitka spruce, aspen, and birch. Tall shrub communities, dominated by willow and alder, occur in floodplains. Farther east, a lush temperate rain forest dominated by western hemlock and Sitka spruce grows along the shoreline and on mountain slopes. Cottonwood and alder stands occur in river valleys. At the highest elevations, thin, rocky soils support alpine tundra composed of sedges, grasses, and low shrubs.

The diverse habitats and relatively mild climate in Southcentral Alaska result in a great diversity of vertebrate fish and wildlife species, ranging from amphibians to marine mammals. For instance, this region is the northernmost range of the western toad. Small mammals include the northern flying squirrel; Arctic ground and red squirrels; singing, root, and meadow voles; collared pika; snowshoe hare; and dusky and tundra shrews. The endangered Cook Inlet beluga whale population occurs only within the region and is isolated from other beluga whale populations. Northern sea otters, Steller sea lions, and humpback whales occur in high numbers.

Numerous lakes, ponds, and wetlands in Southcentral Alaska attract large numbers of shorebirds and waterfowl. The Copper River Delta is one of North America's most important shorebird stopover sites. Along with nearby Controller Bay (Bering River Delta), the area supports the largest spring concentration of shorebirds in the Western Hemisphere (Bishop et al. 2016). Thirty-six species of migrating shorebirds have been recorded in the Copper River Delta alone, with the two most

abundant species being Dunlin and Western Sandpiper. Recent work has documented that Red Knots (*roselarii* subspecies) also stage in Controller Bay during their spring migration (Bishop et al. 2016). Significant numbers of Western Sandpipers, Dunlin, Rock Sandpipers, Short-billed Dowitchers, and Hudsonian Godwits also use Cook Inlet during migration, breeding, or wintering.

Other waterfowl and shorebird species of importance in the region include the entire breeding population of Dusky Canada Geese and sizable populations of Aleutian Terns, Red-throated Loons, and Black Oystercatchers. Prince William Sound supports a large concentration of migrating surfbirds each spring, and high nesting concentrations of Bald Eagles and Marbled Murrelets also occur in the region. Cassin's Auklets and other seabirds nest in cliff colonies along the rocky shorelines, and Kittlitz's Murrelets breed in rocky areas in the mountains. Yellow-billed Loons and many species of sea ducks winter along the coast in Prince William Sound. Sensitive landbirds in the region include Olive-sided Flycatchers and Blackpoll Warblers.

The Matanuska and Susitna River drainages are home to all five species of Pacific salmon, rainbow trout, Dolly Varden, Arctic grayling, and whitefish. Northern pike and Alaska blackfish are not native to this region, but numerous populations occur now due to illegal human introductions and subsequent dispersal of each species. The Kenai River has a unique run of the world's largest Chinook salmon. Dolly Varden, rockfish, halibut, and lingcod occur throughout Prince William Sound.

Southeast Alaska

The Southeast Alaska biogeographic region (Figure 5.1) encompasses 33,513 square miles and includes the entire Alaska Panhandle. It spans from Yakutat Bay in the north to the southern tip of Prince of Wales Island in the south and encompasses the Alexander Archipelago and the North Coast Mountain range. Other major islands besides Prince of Wales Island include Admiralty, Baranof, Chichagof, Kuiu, and Kupreanof. The region's islands are interlaced with coastal inland waters, including Icy Strait, Lynn Canal, Stephens Passage, Chatham and Clarence straits, and Frederick Sound.

Alexander Archipelago. NOAA, used with permission.

Southeast Alaska rain forest. ADF&G.

The Coast Mountains straddle the border between Alaska and British Columbia, with elevations ranging from sea level to 9,840 feet. During the Pleistocene, massive ice sheets covered these mountains. Winter snows feed ice fields and glaciers in this ecoregion, but steep, rugged peaks are exposed and retreating glaciers have left U-shaped valleys. During the summer, melting ice feeds swift streams and rivers to the coast. Several interior rivers pass through these mountains, including the Taku, Stikine, Unuk, and Whiting rivers. This area includes the southernmost extent of tidewater glaciers on the North American continent (LeConte Glacier, near Wrangell).

The Alexander Archipelago consists of thousands of islands, including Prince of Wales, the third largest island in the United States. Past glaciers carved deep U-shaped valleys that filled with seawater when the glaciers retreated. Elevation in the archipelago ranges from sea level to over 3,280 feet. Rolling moraine landforms dominate the hills and valley bottoms. Tectonic movement and the forces of isostatic rebound after glacier retreat have raised and lowered marine terraces, forming rich coastal lowlands and estuaries. Glacial inputs of nutrients and minerals strongly influence the nearshore marine environment, particularly where glaciers flow into bays and fjords. Limestone underlies parts of the ecoregion, and karst topography of sinkholes, caves, underground streams, and fractured bedrock fosters high levels of endemism in plants. With many narrow passages for tidewaters to transit, tidal range and currents can be extreme.

The primarily maritime climate in the region results in significant precipitation and relatively warm temperatures compared to the rest of Alaska (Table 5.1). Annual average temperature (2000–2024) is about 39°F, with seasonal averages varying between about 28°F to 52°F. Annual average total precipitation is 199 inches and ranges from 96 to 134 inches per year, with wetter areas receiving nearly 215 inches in some years. Annual average snowfall water equivalent is about 42 inches, but varies widely, with some areas averaging as little as 1.5 inches annually, while others receive up to 108 inches annually. Recent conditions indicate an increase in annual temperature and precipitation relative to historical data, including a decrease in the average snowfall water equivalent (1950–1999; Table 5.1).

The temperate rain forest, consisting primarily of western hemlock and Sitka spruce, reaches from the shoreline to 1,200 feet elevation on mountain slopes. Salal and western red cedar are also found in the southern parts of the archipelago. Mixed conifer, black cottonwood, and lodgepole pine occur on drier sites. Where bedrock is not exposed, the forest gradually transitions with elevation gain into shrublands, followed by alpine tundra. Water-tolerant plants such as sphagnum moss, sedges, and shore pine occur in peatlands. Poorly drained soils support open muskeg and forested wetlands.

The natural fragmentation of the archipelago has influenced species distribution and promoted a high level of endemism in Southeast Alaska. As a result of the region's unique island biogeography and variable glaciation through time, populations of many endemic birds, invertebrates, and mammals occur here. This biogeographic region is also rich in species compared to more northerly regions of the state. For example, it is home to amphibians, including northwestern salamanders, long-toed salamanders, wood frogs, spotted frogs, and western toads. The region supports multiple taxa found in no other region of the state, many of which are SGCN, but six resident species of bats, southern red-backed vole, root and meadow voles, meadow jumping mouse, and northwestern deer mouse.

Northern sea otter. M. L. Baird, ADF&G.

Marine mammal life is abundant in Southeast Alaska and includes many species, such as northern sea otter, humpback whale, and Steller sea lion. The Forrester Island complex supports the largest Steller sea lion rookery in Alaska.

The coastal streams, headwater lakes, and rivers support large runs of all five Pacific salmon species. These species transport important, marine-derived nutrients back to freshwater and terrestrial ecosystems and draw Bald Eagles and other scavengers. Other resident and anadromous fish species in these watersheds include Dolly Varden, steelhead, and cutthroat trout. Large spawning concentrations of eulachon occur during spring near the mouths of some rivers, attracting large numbers of Bald Eagles and Steller sea lions. In fact, Southeast Alaska holds the highest nest density of Bald Eagles in the world.

Marine and estuarine waters of the Southeast biogeographic region support large seasonal concentrations of sea ducks, particularly during winter and spring migration and staging. For example, during the spring staging period, thousands of Surf Scoters congregate in Lynn Canal to take advantage of Pacific herring spawning sites. Sheltered waters around the islands of the Alexander Archipelago support many sea duck species during migration, molting, staging, and wintering periods. These include Harlequin Ducks, Surf and White-winged scoters, and Long-tailed Ducks.

Other birds of interest in this region include Red-breasted Sapsuckers, Varied Thrush, Rufous Hummingbirds, Black Oystercatchers, Marbled Murrelets, Kittlitz's Murrelets, Western Screech-Owls, and American Goshawks (inclusive of its subspecies, the Queen Charlotte Goshawk).

Southeast Alaska supports the largest breeding Marbled Murrelet population in the world. Additionally, Glacier Bay, in northern Southeast Alaska, holds the largest known breeding population of Kittlitz's Murrelets.

Beaufort and Chukchi Seas

The Beaufort and Chukchi seas biogeographic region (Figure 5.1) encompasses about 415,000 square miles. It includes all marine waters, coastline, and ocean floor between Cape Prince of Wales and Demarcation Point, including the Chukchi Sea, Kotzebue Sound, and the western portion of the Beaufort Sea that occurs in Alaska. The Alaska tidal coastline of the region is approximately 4,500 miles long and consists primarily of low topographic features and shallow coastal waters. Much of the northern coastline is characterized by shallow barrier islands which form productive lagoons and estuaries. In the Beaufort Sea, the continental shelf is relatively narrow, extending between 30 and 60 miles offshore, whereas the Chukchi Sea is shallow throughout, with depths less than 200 feet.

The Beaufort and Chukchi seas are ice-covered for much of the year, resulting in relatively low overall productivity. Annual average air temperature (2000–2024) is 18°F, with seasonal averages ranging from -3°F in winter to 37°F in summer (Table 5.1). Annual average sea surface temperature is 32°F and rises to 36°F in summer. Annual average total precipitation is about 14 inches, including seven inches of snow water equivalent (Table 5.1). Average annual wind speed for the region is about six mph to the southeast (northwesterly winds), but average winter wind speeds within the region exceed 23 mph.

Recent conditions (2000–2024) indicate increases in temperature and precipitation relative to historical data (1950–1999; Table 5.1). These changes are associated with a marked decline in sea ice extent in the region. During September, the month of minimum sea ice coverage, sea ice extent

Ice floes in the Chukchi Sea. J. Rose, ABR, used with permission.

has declined by approximately 30,800 square miles per decade in the Beaufort Sea, and 27,000 square miles per decade in the Chukchi Sea between 1957 and 2021 (Ballinger et al. 2023). The decrease in sea ice extent and the shortening of the ice-covered period are related to rising sea surface temperatures, which, in turn, amplify air temperatures and increase precipitation.

The Chukchi Sea is more productive than the Beaufort Sea because it mixes with nutrient-rich North Pacific waters that flow through the Bering Strait. It receives warmer, low-salinity water that flows from the Yukon River up through the Bering Strait; water circulation is primarily wind-driven from south to north during the ice-free season. In comparison, water circulation in the Beaufort Sea is generally westerly, with a subsurface undercurrent flowing to the east. Spring sea ice melt creates a productive nearshore corridor used by marine and anadromous fish and migrating shorebirds and waterfowl. Most marine mammals in the Beaufort Sea generally remain with the sea ice as it retreats northward. Kotzebue Sound is a large, shallow, productive bay fed by nutrient-rich waters of the Kobuk and Noatak rivers. It serves as an overwintering area for a large population of sheefish.

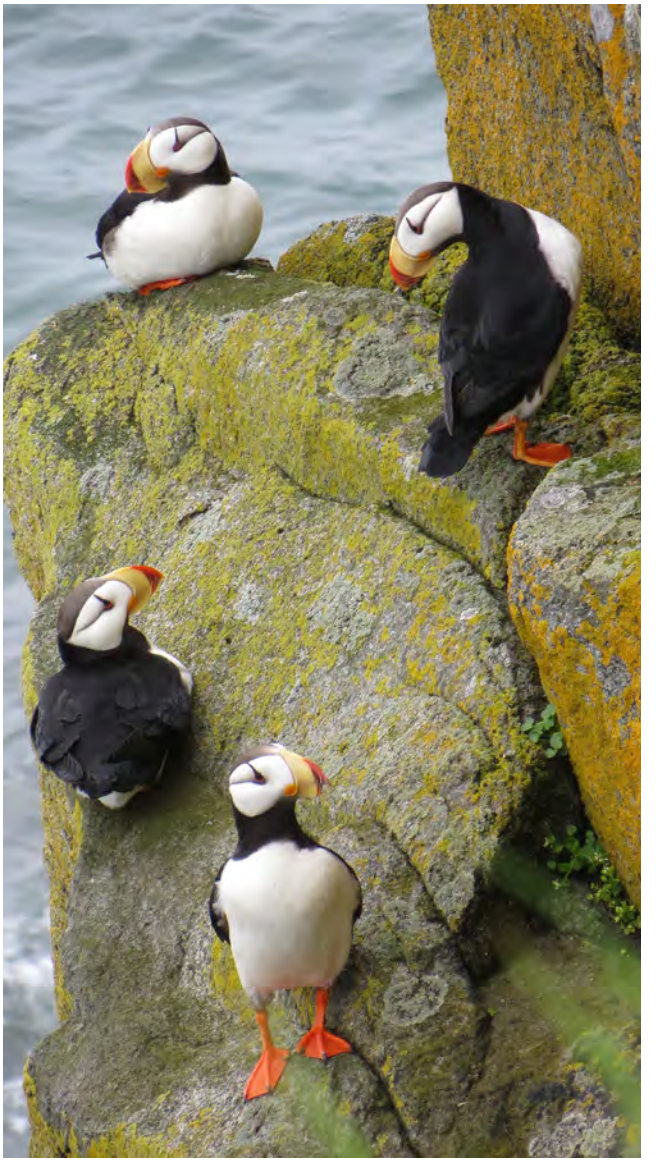
The Beaufort and Chukchi seas region supports populations of several marine mammals, including Pacific walruses; bowhead and beluga whales; bearded, ringed, ribbon, and spotted seals; and polar bears. This region is a summer home to many marine birds, including Red-throated and Yellow-billed Loons, auklets, Northern Fulmars, Black Guillemots, Thick-billed and Common Murres, Tufted and Horned Puffins, Black-legged Kittiwakes, Ross's and Glaucous Gulls, jaegers, Arctic Terns, and Red-necked and Red Phalaropes, and a large portion of sea ducks that breed in northern Alaska use the Beaufort and Chukchi seas for migration, molting, and staging. The barrier islands of the Beaufort Sea in particular provide important molting and staging areas for sea ducks, especially Long-tailed Ducks and Pacific Common Eiders. In the Chukchi Sea, Ledyard Bay is used during the molting period by likely all female Spectacled Eiders that breed on Alaska's Arctic Coastal Plain, as well as a significant number of males from both the Alaska and Russia breeding populations. Characteristic marine invertebrate species include snow crab, Pacific blue mussel, squid, sea cucumber, and sea stars. Characteristic fish species include salmon (Chinook, chum, and pink), pond and rainbow smelt, capelin, Pacific sand lance, Pacific herring, Arctic and saffron cod, stickleback (ninespine and threespine), cisco (broad, Arctic, and Bering), Dolly Varden, and Arctic lamprey.

Bering Sea

The Bering Sea biogeographic region (Figure 5.1) encompasses approximately 770,000 square miles. It includes all marine waters and ocean floor (i.e., United States territorial waters) from Cape Prince of Wales south to the Alaska Peninsula and encompasses both sides of the Aleutian Islands west of Unimak Pass. Approximately 44% of the region is a continental shelf, 13% is a continental slope, and 43% is in a deep-water basin. Offshore of the Aleutian Islands, the continental shelf is very narrow, and most of it is a deep-water

Female and male Steller sea lions with pup. ADF&G.

basin. The Aleutian Basin contains several deep-water marine canyons, ocean-floor ridges, and seamounts. The broad continental shelf of the Bering Sea is highly productive, and there are also extremely productive regions near the slopes of some major ridges, oceanic canyons, and seamounts. Productivity is strongly related to the Alaska Stream and Alaska Coastal Current, fed partly by the Kuskokwim and Yukon rivers and upwelling from the Bering Sea Gyre.



Horned Puffins. ADF&G.

The region includes Norton Sound, Kuskokwim and Bristol bays, St. Lawrence and St. Matthew islands, and waters north of the Aleutian Islands. The Alaska coastline of the Bering Sea and the Aleutian Islands biogeographic region is approximately 7,000 miles long, most of which is within National Conservation Units, including the Yukon Delta National Wildlife Refuge, Togiak National Wildlife Refuge, and Izembek National Wildlife Refuge.

Weather and climate in the Bering Sea are highly variable and influenced in part by the region's wide latitudinal span. Annual average air temperatures (2000–2024) are approximately 28°F in winter and 46°F in summer (Table 5.1). Annual average sea surface temperatures range from about 35°F in winter to 46°F in summer. In colder areas, sea surface temperatures are 42°F in summer, and warmer areas can reach 50°F. Annual average total precipitation is 35 inches, including 11 inches of snow water equivalent during colder months. Average annual wind speed for the region is about three mph to the southeast (northwesterly winds), but average winter wind speeds within the region exceed 24 mph.

Recent conditions (2000–2024) indicate increases in winter and summer air temperature, sea surface temperature, and average annual precipitation, compared to historical data (1950–1999; Table 5.1), along with reduced sea ice extent. Much of the northern Bering Sea was historically ice-covered for most of the year, with the annual formation and subsequent melting of sea ice strongly influencing salinity and water temperature. However, in recent decades, the March sea-ice extent (i.e., maximum ice coverage) has declined by approximately 19,300 square miles per decade from 1957–2021, with record lows in 2018 and 2019 (Ballinger et al. 2023).

The region is home to about 300 species of fishes, many of which are commercially and ecologically important, along with hundreds of species of crustaceans and mollusks, some 50 species of seabirds,

Species of Conservation Need: Northern Fur Seal *(Callorhinus ursinus)*

Northern fur seals have dense fur, stocky bodies, and long flippers. Adult females can weigh up to 140 pounds, reach lengths of five feet, and have dark gray or brown dorsal coloration with light gray or cream ventral coloration; males can weigh up to 600 pounds, reach lengths of seven feet, and have dark brown or black coloration. Northern fur seals spend approximately 80% of their time in the open ocean, ranging across areas of the North Pacific Ocean, Bering Sea, and Okhotsk Sea. The remainder of their time (summer and fall) is spent at breeding colonies on rocky beaches of Alaska's islands, such as St. Paul, Bogoslof, St. George, and Sea Lion Rock. The eastern Pacific stock is estimated at 626,618 fur seals as of 2019, while the estimated population in the 1950s was approximately 2.1 million fur seals. Threats to this species include changes in marine ecosystems, entanglement in marine debris, and contaminants.

Northern fur seal. J. Hyde, ADF&G.

and 26 species of marine mammals. Marine mammals found in the region include the Pacific walrus; Steller sea lion; bowhead, sei, fin, sperm, North Pacific right, humpback, and beluga whales; six species of seals; harbor porpoise; northern sea otter; and polar bear. Many seabirds feed in these waters during the breeding season, including Red-throated and Yellow-billed Loons; Laysan, Black-footed, and Short-tailed Albatrosses; Fork-tailed Storm-Petrel; cormorants; auklets; murrelets; guillemots; murres; puffins; kittiwakes; gulls; jaegers; and Arctic and Aleutian Terns. The world's population of Spectacled Eiders winters in the sea ice south of St. Lawrence Island in most winters. Aquatic species in the region include crab, scallop, abalone, mussel, clam, shrimp, five species of Pacific salmon, steelhead, salmon shark, sablefish, halibut, flounder, smelt, capelin, eulachon, cod, stickleback, rockfish, whitefish, sheefish, and Dolly Varden.

Gulf of Alaska

The Gulf of Alaska biogeographic region (Figure 5.1) is a relatively open marine system encompassing approximately 592,000 square miles (within United States territorial waters). It includes all shorelines, marine waters, and ocean floor areas off the coast of southern Alaska between the southernmost point in Alaska at Cape Muzon on Dall Island in the east and Unimak Pass in the west. The area includes the marine waters of the Alexander Archipelago, Prince William Sound, Cook Inlet, Kodiak Island, and the southern shoreline of the Alaska Peninsula.

The region's coastline is approximately 24,700 miles long and includes many glacially carved fjords and estuaries. Much of the adjoining lands lie within National Conservation Units, including the Alaska Peninsula National Wildlife Refuge, Kodiak National Wildlife Refuge, Katmai National Park and Preserve, Lake Clark National Park and Preserve, Kenai National Wildlife Refuge, Kenai Fjords National Park, the Chugach National Forest, Wrangell-St. Elias National Park and Preserve, Glacier Bay National Park and Preserve, and the Tongass National Forest.

The Gulf of Alaska region consists primarily of deep ocean basins, with a narrow continental shelf comprising only 10% of the total area (approximately 62,000 square miles). The region is strongly influenced by the Alaska Current, which is part of a huge counterclockwise gyre in the Gulf of Alaska. Almost the entire Gulf of Alaska remains ice-free year-round. The region's weather is dominated by winds and the gulf is well known for generating significant storm events, which drive precipitation patterns across much of Alaska, the west coast of Canada, and the contiguous United States.

Annual average sea surface temperature is about 47°F, ranging from 42°F to 53°F (2000–2024; Table 5.1). Annual average air temperature is 45°F; with winter averaging 40°F and summer 52°F. Recent conditions indicate increases in average sea surface temperatures, annual average air temperatures, and total precipitation, relative to historical data (1950–1999; Table 5.1). Annual average total precipitation across the region is about 50 inches, while the wettest areas average between 103 and 133 inches per year. The region's annual average snow water equivalent is three inches, ranging from less than one to seven inches. In areas with predominantly northeasterly winds, sustained wind speeds range from seven to 16 mph, with autumn being the windiest season. In areas with predominantly southwesterly winds, sustained speeds range from four to 17 mph and winter is the windiest season, with average wind speeds exceeding 20 mph in some areas.

The region supports populations of hundreds of fish species, marine invertebrates, marine mammals, and many species of seabirds. Mammals on the SGCN list that are commonly found in the region include the Steller sea lion; sei, fin, North Pacific right, humpback, sperm, and beluga whales; northern fur and Pacific harbor seals; harbor porpoise; and northern sea otter. Seabirds in the region include loons, albatrosses, Fork-tailed Storm-Petrel, cormorants, auklets, murrelets, Pigeon Guillemot, Thick-billed and Common Murres, Tufted and Horned Puffins, kittiwakes, gulls, jaegers, and terns. The Kodiak Archipelago is of particular importance to wintering sea ducks, including Black Scoters, White-winged Scoters, Harlequin Ducks, and Barrow's Goldeneye, and its nearshore waters provide ample foraging areas and shelter from high winds and rough seas. More than 5% of the continental populations of Black Scoters, White-winged Scoters, and Harlequin Ducks inhabit these waters during winter months. The region is also used as a fall migratory corridor for passerines. The Gulf waters are home to many invertebrate and fish species, including crab, scallops, abalone, mussels, clams, shrimp, all five species of Pacific salmon, salmon shark, sablefish, halibut, flounder, smelt, capelin, eulachon, cod, stickleback, and many species of rockfish.

Species Richness of Terrestrial Vertebrate SGCN

The 2015 SWAP lacked a comprehensive, spatially explicit treatment of SGCN distributions at the landscape scale. ADF&G partnered with the University of Alaska Fairbanks in 2022 to create statewide, multispecies "heatmaps" depicting hotspots of species richness for 211 vertebrate SGCN in the terrestrial environment (Figure 5.2); this work was funded by a Competitive State Wildlife Grant (SWG) SWAP Improvement Grant. This mapping work provides the first overview of areas of species richness of wildlife SGCN across Alaska's terrestrial landscape.

Distributional hotspots are areas where multiple SGCN taxa co-occur. Identifying species-rich areas can help managers understand and predict landscape patterns of biodiversity, prioritize where to focus limited funds for future research and management efforts, and help inform future decisions about state wildlife resources (e.g., Underwood et al. 2011, Gary et al. 2019). Research and monitoring within SGCN hotspots also provide a cost-effective means to collect data on multiple SGCN taxa

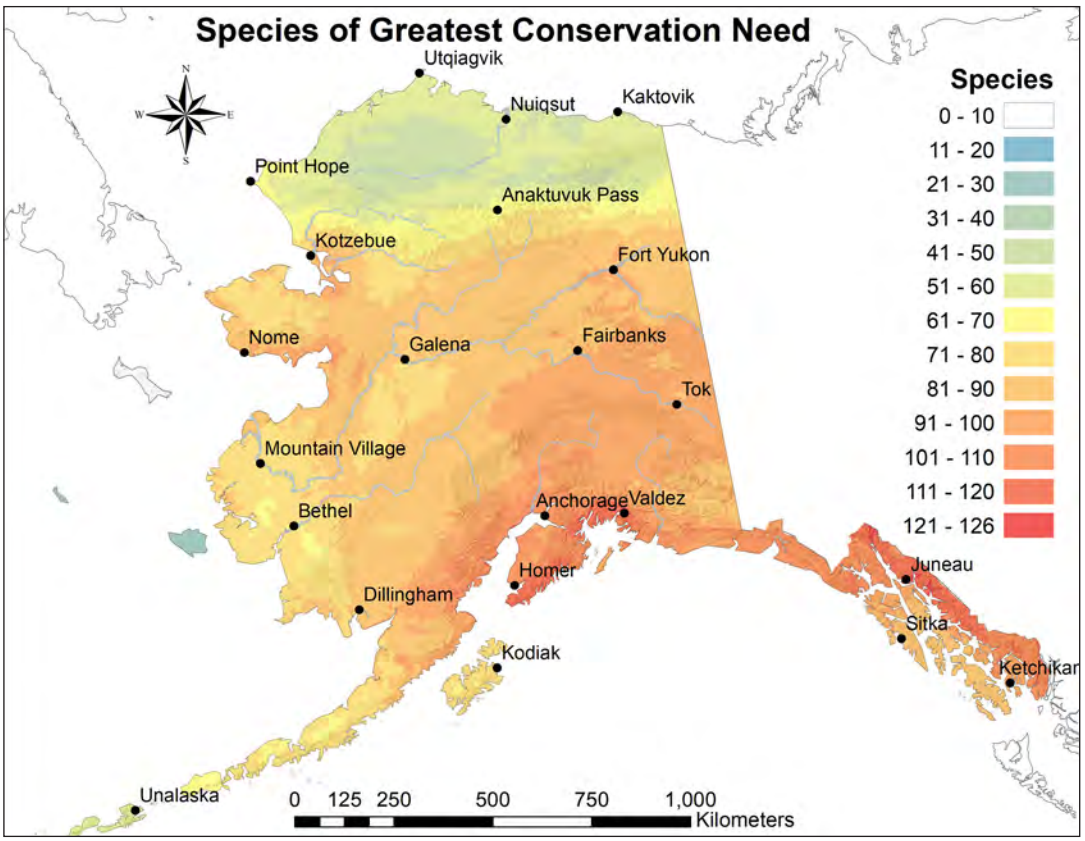


Figure 5.2. Statewide heatmap of "species of greatest conservation need" (SGCN) in Alaska, including the predicted distribution of 211 vertebrates (amphibians, birds, and mammals) across terrestrial environments. The color scale indicates the predicted number of overlapping SGCN taxa. Species range and distribution maps used to generate this figure were created by the U.S. Geological Survey Alaska Gap Analysis Project (ACCS 2024).

at once and provides opportunities to collaborate with partners. Finally, scientific work in SGCN-rich areas can help identify common drivers of decline, determine applied solutions, and pinpoint environmental factors that produce high levels of wildlife diversity, such as unique ecological features that support productive habitats for a variety of taxa.

Data used to create heatmaps came from 211 species range maps of vertebrate SGCN listed in the 2015 SWAP (7 amphibians, 159 birds, and 45 mammals). Range maps for Alaska were based on spatially explicit models (12-digit hydrologic unit code watershed scale) used to predict each species' distribution on land, developed as part of the U.S. Geological Survey Gap Analysis Project (GAP; Gotthardt et al. 2014, Aycrigg et al. 2015, ACCS 2024). Individual species range maps were overlaid to determine areas with the highest numbers of SGCN. Over 90% of the 211 species used in the heatmap exercise in 2022 are retained on the 2025 SGCN list; therefore, the output and patterns described below remain broadly applicable until further updates become available. Results and predicted species-specific distribution layers are available at the University of Alaska Fairbanks' Scenarios Network for Alaska + Arctic Planning (SNAP) GeoNetwork portal (SNAP 2024).

It is important to note that the maps are intended to provide a broad, landscape-level overview only. Species ranges in the Alaska GAP were modeled and extrapolated from the best available, but sometimes limited data, making the maps unsuitable for use or interpretation at finer, local scales.

General Patterns of Vertebrate Richness

A statewide heatmap of all vertebrate SGCN indicated that species richness is greatest in the Southcentral Alaska and Southeast Alaska biogeographic regions (Figure 5.2). The highest overall SGCN richness occurred along some coastal areas of Prince William Sound (126 species). Over 80% of the 126 species were also present near Juneau, Haines, and in the coastal region of Norton Sound (Figure 5.2).

Species Richness by Taxonomic Group

Spatial patterns of species richness also vary by taxonomic group. We created separate heatmaps for amphibian, bird, and mammalian groups. The greatest SGCN amphibian richness occurs in the Southeast Alaska region (Figure 5.3a), including the northern end of Sitka Island and the area surrounding Ketchikan. Only a single amphibian (the wood frog) is predicted to occur across much of the rest of the state.

SGCN bird richness is greatest in the Southcentral Alaska region (104 of 159 species), including the eastern Kenai Peninsula and Prince William Sound area (Figure 5.3b). Over 80% of the 104 avian SGCN are also predicted to co-occur in northern portions of the Southeast Alaska region, along the Gulf of Alaska coastline, and in coastal areas of northeastern Norton Sound (Figure 5.3b). The greatest mammalian SGCN richness is expected to occur across portions of the Seward Peninsula and Northwest Arctic coast. Other diverse areas for mammals included the eastern Central Alaska region, especially in the Upper Koyukuk River Valley, Yukon-Tanana Uplands, and the central Alaska Range (Figure 5.3c).

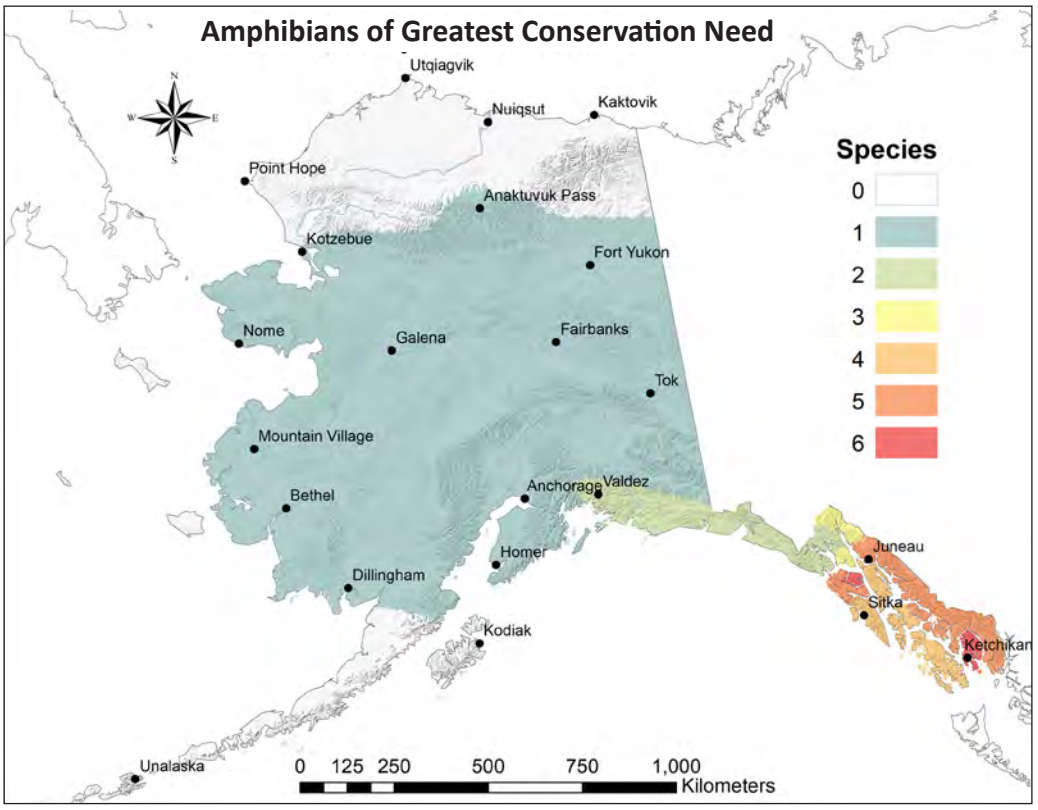


Figure 5.3a. Vertebrate species richness heatmaps by taxonomic group across Alaska (amphibian "species of greatest conservation need").

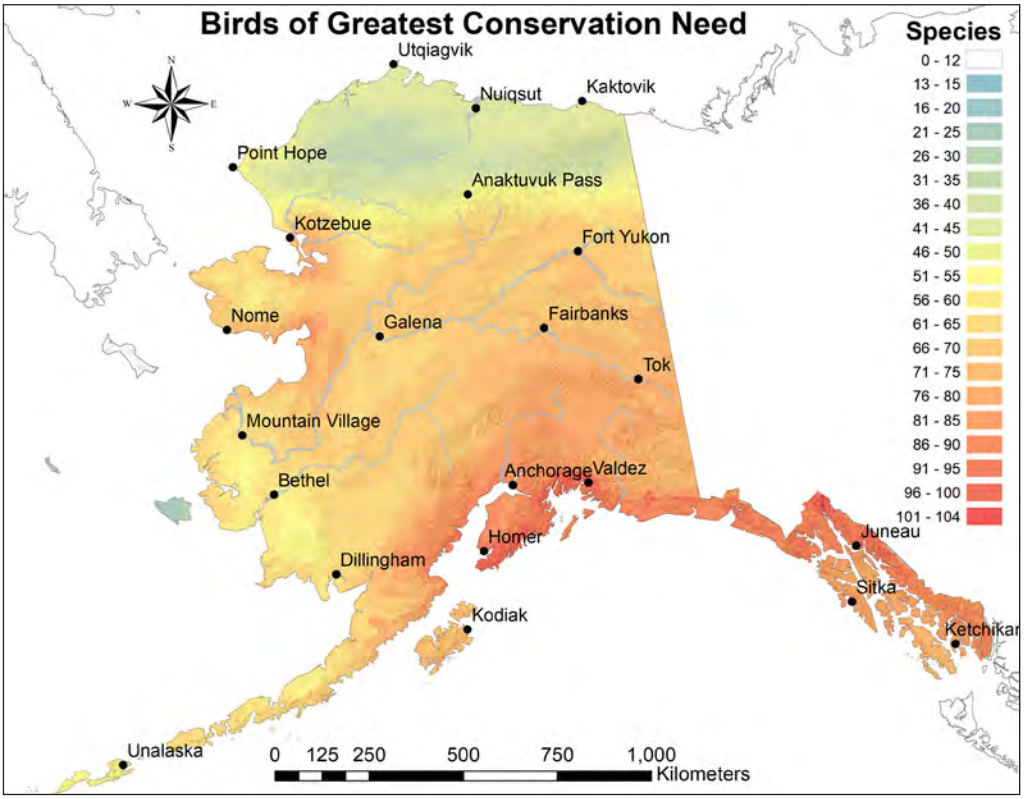


Figure 5.3b. Vertebrate species richness heatmaps by taxonomic group across Alaska (bird "species of greatest conservation need").

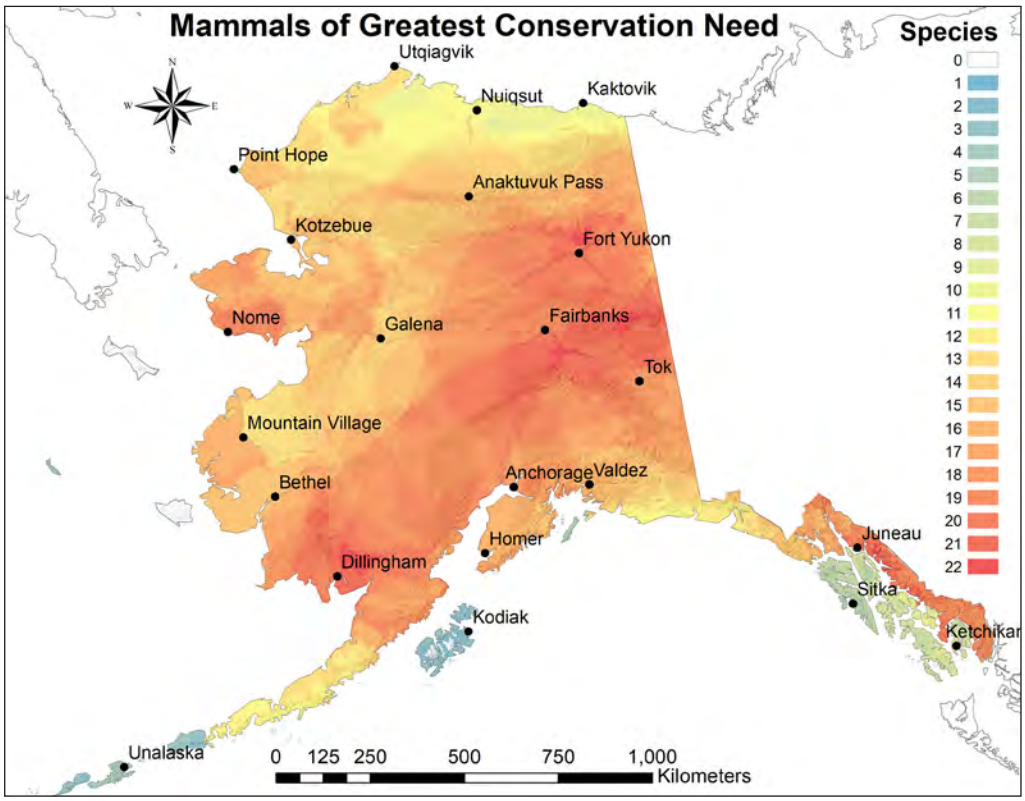


Figure 5.3c. Vertebrate species richness heatmaps by taxonomic group across Alaska (mammal "species of greatest conservation need").

Abundance of SGCN

Given the large size and remoteness of Alaska, abundance estimates for most nonexploited species are unknown. All available Alaska population estimates for SGCN are given in Appendix E.

In cases where populations are suspected of being small or declining, more work has been conducted to arrive at credible population estimates. Where species have been proposed for Endangered Species Act (ESA) listing, or are already listed, relatively good population estimates are also available. It is safe to assume that some less-studied species, such as forage fish and many marine and freshwater invertebrates, are very abundant, numbering in the tens of millions to hundreds of billions. Many small mammals are also abundant, numbering in the millions to tens of millions.

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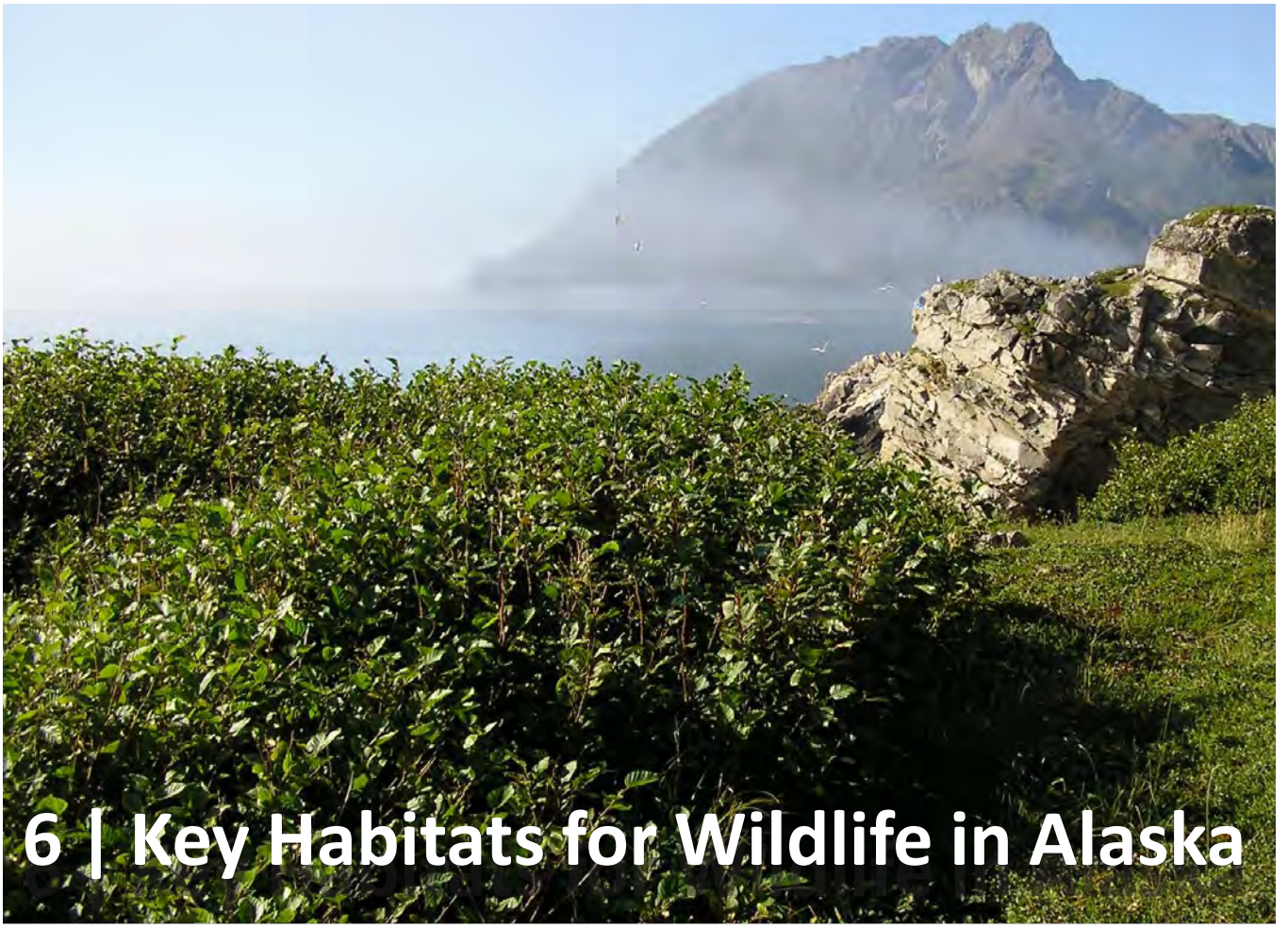


6 | Key Habitats for Wildlife in Alaska

Iliamna Bay, lower Cook Inlet. G. Frost, ABR, used with permission.

Alaska provides a diversity of terrestrial habitats for wildlife due to gradients of elevation, latitude, continentality, and glacial history. These often floristically rich and structurally complex habitats support a diversity of vertebrate wildlife "species of greatest conservation need" (SGCN). The state also hosts extensive freshwater aquatic habitats and surrounding marine waters used by wildlife, fish, and aquatic SGCN.

In the six terrestrial biogeographic regions developed for this State Wildlife Action Plan (SWAP; Figure 6.1), 33 broad-scale terrestrial, freshwater, and coastal habitats were assessed for the occurrence of vertebrate wildlife SGCN. Habitat relationships for SGCN (see Wildlife Species Richness by Habitat, below) were assessed at the Ecological Systems level in the classification of U.S. Terrestrial ecosystems (Comer et al. 2003), which describes mid-scale units of vegetation and land cover. The occurrence and extent of Ecological Systems in each biogeographic region was based on an unpublished update to the Landfire 2020 Existing Vegetation Types map for Alaska (Nawrocki et al. 2024; for the most current Alaska Vegetation Map, see: https://akveg.org/). Because of the large number of Ecological Systems types (roughly 50–70) that occur in each biogeographic region, the habitats used by SGCN were aggregated to a smaller set of broader Macrogroup classes described in the U.S. National Vegetation Classifiction (USNVC Version 3.0). This resulted in the 33 habitat types discussed in this chapter. The USNVC provides a standard methodology for classifying vegetation in North America, the use of which is mandated in federally funded projects (FGDC 2008). This alignment with the USNVC habitat classes for Alaska represents a new approach compared to the 2015 SWAP, which summarized habitat types at a much coarser level. Further aggregation

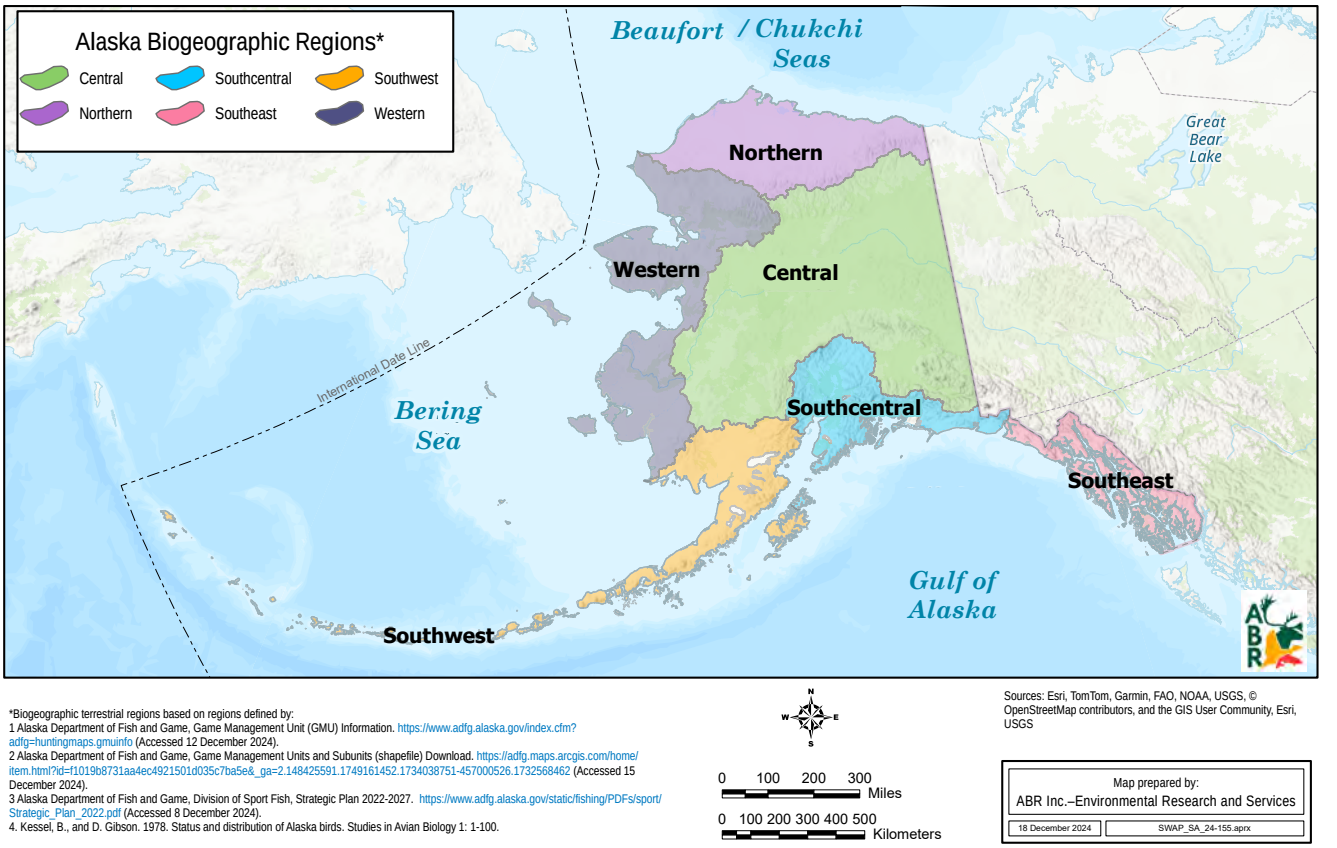


Figure 6.1. Map of the six terrestrial biogeographic regions and three oceanic regions in Alaska used in this wildlife action plan. D. Dissing, ABR.

and simplification of the 33 Macrogroup classes presented in this SWAP can be conducted to support the needs of specific habitat conservation or habitat management projects for SGCN.

Distribution maps of the Macrogroup habitats described in this chapter were prepared using an unpublished draft of the Alaska Vegetation Map (Nawrocki et al. 2025; for more the most current map, see: https://akveg.org/). Using Nawrocki et al. (2025), the areal coverage and percent of Alaska occupied by each habitat type was determined (Table 6.1). The exceptions are rivers and streams, lakes and ponds, and aquatic vegetation at waterbody margins. These freshwater aquatic habitats are not mapped separately from open water in the draft Alaska Vegetation Map. If higher resolution images of the maps and photos presented in this chapter are desired, the reader can download the separate, higher resolution copy of Chapter 6 provided as an online supplement.

Alaska is the only place in North America where Arctic Warblers breed, preferring streamside willow thickets in arctic, central, and western regions of the state. Osado, used with permission.

In the three oceanic regions used in this SWAP (Figure 6.1), we described a set of eight broad-scale marine and intertidal habitat types known to be used regularly by marine birds and mammals (Table 6.1). As with freshwater aquatic habitats noted above, marine habitats are also

Table 6.1. Terrestrial, freshwater, and marine habitats in Alaska. Areal coverage of terrestrial and freshwater habitats (USNVC Macrogroup classes) mapped across Alaska in the draft Alaska Vegetation Map (Nawrocki et al. 2025). Marine habitats described for this State Wildlife Action Plan (SWAP) were not mapped.

Habitat type	Square miles	Percent area in Alaska
Forest and woodlands		
Temperate coastal rainforest	16,731	2.88
Temperate subalpine woodland	7,733	1.33
Boreal forest	51,847	8.94
Boreal subalpine and subarctic woodland	21,607	3.73
Floodplain forests		
Temperate floodplain forest	1,533	0.26
Boreal floodplain forest	25,693	4.43
Freshwater wetlands		
Temperate forested wetland	193	0.03
Boreal forested wetland	57,850	9.98
Temperate marsh, wet meadow, and shrubland	291	0.05
Temperate fen	966	0.17
Boreal marsh, wet meadow, and shrubland	8,902	1.54
Boreal bog	27,904	4.81
Arctic marsh, wet meadow, and shrubland	17,104	2.95
Shrublands and grasslands		
Temperate shrubland and grassland	12,194	2.10
Aleutian heath and meadow	13,321	2.30
Boreal shrubland and grassland	79,342	13.69
Tundra		
Temperate alpine tundra	6,624	1.14
Boreal alpine tundra	10,211	1.76
Arctic tundra	149,496	25.79
Cliff, scree, and rock		
Temperate cliff, scree, and rock vegetation	11,158	1.92
Boreal cliff, scree, and rock vegetation	14,225	2.45
Arctic cliff, scree, and rock vegetation	12,005	2.07
Coastal habitats		
Temperate salt marsh	244	0.04
Temperate intertidal vegetation	68	0.01
Arctic salt marsh	2,856	0.49
Temperate coastal beach and dune	65	0.01
Temperate coastal cliff and bluff	20	<0.01
Arctic coastal shore	191	0.03
Freshwater aquatic habitats		
Rivers and streams	Not mapped	Not mapped
Lakes and ponds	Not mapped	Not mapped
Glacial habitats		
Perennial snow, ice, and glacial outwash	26,279	4.531.33

Table 6.1. Terrestrial, freshwater, and marine habitats in Alaska, continued.

Habitat type	Square miles	Percent area in Alaska
Human-modified habitats		
Recently disturbed or modified	7,039	1.21
Agricultural and developed lands	912	0.16
Marine		
Mudflats and island mudflats	Not mapped	Not mapped
Mainland and island rocky shores	Not mapped	Not mapped
Mainland and island cliffs and bluffs	Not mapped	Not mapped
Mainland and island cobble and sand beaches	Not mapped	Not mapped
Nearshore waters	Not mapped	Not mapped
Offshore shelf waters	Not mapped	Not mapped
Offshore marine waters	Not mapped	Not mapped
Estuarine waters	Not mapped	Not mapped

not mapped in the draft Alaska Vegetation Map, so there were no data available to determine areal coverage numbers for marine habitats. More detailed descriptions of the terrestrial and freshwater habitat types discussed in this chapter, except for the human-modified habitats, are provided in Appendix F. Appendix G provides a comprehensive list of the plant species referenced in the summary and detailed habitat descriptions. The detailed information in Appendices F and G is a resource that can be used by researchers and interested members of the public to get a better understanding the wealth of wildlife habitats that exist in Alaska and their occurrence on the landscape.

Plant taxonomy in this chapter follows the *Checklist of Vascular Plants, Bryophytes, Lichens, and Lichenicolous Fungi of Alaska* (Nawrocki et al. 2020), and common plant names follow the U.S. Department of Agriculture plants database (NRCS 2025). The common and scientific names of all SGCN discussed in this chapter are presented in Chapter 4 and Appendices A through C.

As defined in this chapter, terrestrial habitats include upland, wetland, and freshwater aquatic habitats on the mainland and islands of Alaska. These habitats are described in decreasing order of vegetation structural complexity (i.e., forests, shrublands, herbaceous, sparsely vegetated, aquatic). Marine habitats include coastal and intertidal areas along the mainland and islands, as well as nearshore and offshore waters.

Wildlife Species Richness by Habitat

In a novel approach for Alaska, species richness for vertebrate wildlife SGCN was assessed for 33 coarse-scale terrestrial, freshwater aquatic, and coastal habitats, many of which were mapped across the state, and in eight coarse-scale marine and intertidal habitats (Table 6.1). Species richness (the number of species occurring within a region or habitat area) was assessed by first conducting a matrix habitat evaluation procedure (Johnson and O'Neil 2001, Morrison et al. 2006) to identify the important Ecological Systems (Nawrocki et al. 2024) and USNVC Macrogroup (Nawrocki et al. 2025) habitat classes for each wildlife SGCN. Categorical habitat-value rankings for wildlife SGCN were used to define those habitats consistently used by SGCN and these were identified as the important habitats for each species. In this approach, based on habitat-use information in the scientific literature and extensive field experience in Alaska, habitats were ranked for each SGCN and habitat type as high, moderate, low, or negligible value (Table 6.2). In practice, the combination of high- and

Table 6.2. Categorical habitat-value classes used to calculate species richness for birds, mammals, and amphibians in each terrestrial, freshwater, and marine habitat.

Value class	Description
High	High-value habitats are frequently used during the migration and breeding season for nesting and/or foraging/hunting by nonresident species or for shelter, breeding, denning, overwintering, foraging, and/or hunting by resident species.
Moderate	Moderate-value habitats may be used regularly during the breeding, migration, or wintering seasons for foraging/hunting or as travel corridors but less so than high-value habitats.
Low	Low-value habitats would see little use by the species under consideration and in very low numbers.
Negligible	The species is not expected to occur or would occur very rarely in negligible-value habitats.

Table 6.3. Statewide species richness values for wildlife "species of greatest conservation need" (SGCN) by habitat type (the total number of species that were considered to regularly use each habitat), richness rankings, and percent areal coverage of the 41 coarse-scale terrestrial, freshwater, and marine habitats assessed in Alaska. Richness ranks reflect only the total number of species that can consistently use each habitat; the rankings do not address species richness per unit area because not all habitat sizes are known (some are not mapped in the draft Alaska Vegetation Map [Nawrocki et al. 2025]).

Habitat group	Habitat type	Statewide species richness	Richness rank	Percent area in Alaska
Freshwater wetlands	Boreal marsh, wet meadow, and shrubland	114	1	1.54
Freshwater wetlands	Boreal bog	112	2	4.81
Tundra	Arctic tundra	110	3	25.79
Freshwater wetlands	Arctic marsh, wet meadow, and shrubland	109	4	2.95
Forest and woodlands	Boreal forest	91	5	8.94
Freshwater wetlands	Temperate marsh, wet meadow, and shrubland	90	6	0.05
Freshwater aquatic habitats	Lakes and ponds	86	7	Not mapped
Freshwater wetlands	Boreal forested wetland	81	8	9.98
Floodplain forests	Temperate floodplain forest	75	9	0.26
Coastal habitats	Arctic salt marsh	74	10	0.49
Shrublands and grasslands	Boreal shrubland and grassland	70	11	13.69
Coastal habitats	Temperate coastal beach and dune	69	12	0.01
Human-modified habitats	Recently disturbed or modified	67	13	1.21
Floodplain forests	Boreal floodplain forest	66	14	4.43
Coastal habitats	Temperate salt marsh	66	14	0.04
Forest and woodlands	Temperate coastal rainforest	63	15	2.88
Forest and woodlands	Boreal subalpine and subarctic woodland	62	16	3.73
Marine	Offshore shelf waters	62	16	Not mapped
Shrublands and grasslands	Aleutian heath and meadow	61	17	2.30
Marine	Nearshore waters	58	18	Not mapped
Marine	Estuarine waters	55	19	Not mapped

Table 6.3. Categorical habitat-value classes, continued.

Habitat group	Habitat type	Statewide species richness	Richness rank	Percent area in Alaska
Freshwater aquatic habitats	Rivers and streams	53	20	Not mapped
Human-modified habitats	Agricultural and developed lands	53	20	0.16
Coastal habitats	Arctic coastal shore	52	21	0.03
Freshwater wetlands	Temperate fen	52	21	0.17
Forest and woodlands	Temperate subalpine woodland	49	22	1.33
Freshwater wetlands	Temperate forested wetland	49	22	0.03
Tundra	Boreal alpine tundra	51	23	1.76
Shrublands and grasslands	Temperate shrubland and grassland	50	24	2.10
Coastal habitats	Temperate intertidal vegetation	46	25	0.01
Tundra	Temperate alpine tundra	45	26	1.14
Coastal habitats	Temperate coastal cliff and bluff	42	27	<0.01
Marine	Offshore marine waters	42	27	Not mapped
Marine	Mainland and island cobble and sand beaches	39	28	Not mapped
Cliff, scree, and rock	Arctic cliff, scree, and rock vegetation	34	29	2.07
Marine	Mainland and island rocky shores	33	30	Not mapped
Marine	Mudflats and island mudflats	33	30	Not mapped
Marine	Mainland and island cliffs and bluffs	23	31	Not mapped
Cliff, scree, and rock	Boreal cliff, scree, and rock vegetation	19	32	2.45
Cliff, scree, and rock	Temperate cliff, scree, and rock vegetation	16	33	1.92
Glacial habitats	Perennial snow, ice, and glacial outwash	7	34	4.53

moderate-value rankings for both resident and migratory SGCN represents those habitats that can be consistently used by wildlife SGCN (see also Marcot et al. 2015). These habitat-ranking data for high- and moderate-value habitats were then used to develop species richness numbers by habitat type for wildlife SGCN in the six terrestrial biogeographic and three oceanic regions used in this SWAP (Figure 6.1).

The statewide species richness values and rankings for each habitat (Table 6.3) were developed only for vertebrate wildlife SGCN, for which distribution and habitat-use information is relatively well known. Because of a lack of comprehensive data on the distribution of aquatic species in Alaska, a similar assessment of species richness for fish and aquatic invertebrate SGCN in freshwater and marine habitats was not conducted; however, notes on the occurrence of those aquatic SGCN are provided in the following habitat descriptions.

Our assessment of wildlife species richness occurred before public comment on the 2025 SWAP, and any subsequent changes involving the inclusion or exclusion of SGCN in the SWAP are not reflected here. However, given the large number of SGCN occurring within the habitat types in each biogeographic region, it is unlikely that the addition or subtraction of small numbers of SGCN would substantially alter the species richness calculations. This possibility was assessed by comparing

species richness values calculated from an early version versus a later version of the SGCN list (a process in which seven SGCN were added and 12 SGCN were removed). The results indicated minimal change to species richness numbers in each habitat type (an average change of 2.4 species or 3.7%).

These species richness data are most useful when comparing richness among different habitats, either at the local or regional scale. They are less appropriate for comparing species richness among entire regions encompassing multiple habitat types, such as the nine biogeographic regions used in this SWAP. This is because, across all available habitats, there would generally be at least one or more habitats that are classified as high or moderate value for each SGCN. This is the result of habitat partitioning among species and when the data are summarized across multiple habitats and multiple species, each habitat on the landscape becomes classified as important for one or more SGCN. In this entire-region assessment scenario, there would be little to no difference between species richness derived from high and moderate habitat-value data and a simple list of the species that occur in each region. In contrast, the "heatmaps" presented in Chapter 5, showing hotspots of occurrence of SGCN across the state (based on range map data), are better at illustrating broad, regional patterns of occurrence of SGCN in Alaska.

At the statewide scale, the most wildlife species-rich habitats are freshwater wetlands (Table 6.3). These marsh, wet meadow, bog, and wet shrublands represent the 1st, 2nd, and 4th most species-rich types. Other forested freshwater wetlands rank 6th and 8th in species richness. These habitats provide a diversity of wetland areas suitable for waterbird, shorebird, seabird, passerine, raptor, and small mammal SGCN. They also provide shrub and forested wetlands that are transitional to more well-drained forests. These edge habitats are attractive to additional species of passerines, shorebirds, seabirds, and raptors.[1]

Other species-rich habitats at the statewide scale include Arctic tundra, which ranks as the 3rd most species-rich habitat, boreal forest (ranked 5th), and lakes and ponds (ranked 7th). Arctic tundra is a widespread, diverse habitat, which at the Macrogroup scale used in this chapter encompasses nine different moderate-scale habitats, ranging from mesic meadows, mesic dwarf shrub tundra, tussock tundra, and alder shrubland, to well-drained upland dwarf shrub and lichen tundra and sparsely vegetated montane tundra. Statewide, as with freshwater wetlands, the wide diversity of habitat types including Arctic tundra provides suitable habitat for a large number of bird and mammal SGCN. Similarly, boreal forest at the Macrogroup scale includes six moderate-scale forest types with notable differences in landscape position, vegetation structure, and species composition. As a group, these different forest types are attractive to a large number of bird and mammal SGCN. Lakes and ponds and the transitional littoral zones from lacustrine to adjacent terrestrial habitats are known to attract a large number of waterbirds, shorebirds, seabirds, and their predators (raptors), as well as small mammals and furbearers. Other relatively species-rich terrestrial and primarily freshwater habitats include temperate floodplain forest (ranked 9th), Arctic salt marsh (ranked 10th), and boreal shrubland and grassland (ranked 11th).

[1] At more localized scales (e.g., for possible State Wildlife Grant-funded habitat projects), the high species richness numbers in freshwater wetlands would decrease. This is because at local scales there would not be multiple subspecies of small mammals present, for example, and a reduced set of bird and mammal species would occur, when compared to the large number of species expected to use these habitats statewide. For the same reasons, to varying degrees, similar reductions in species richness at local scales would occur for all the other broad-scale habitats assessed in this chapter.

Old beaver pond near Koktuli River in southwestern Alaska. ABR, used with permission.

In the most species-rich terrestrial habitat (boreal marsh, wet meadow, and shrubland), the highest species richness values were tied or differed by a single species in three biogeographic regions (Southeast, Central, and Southcentral). In the second-most species-rich habitat (boreal bog), the highest species richness values were very similar in the Central and Western regions, differing by just two species. In the third-most species-rich habitat (Arctic tundra), species richness was greatest, by far, in the Western region.

Across all 33 terrestrial habitats assessed, some regional patterns in species richness are evident. The Southeast region had the highest species richness for nine of the 33 habitats (27%), and the Western region had the highest species richness for six habitats (18%). Outside of those two regions, the Southwest and Southcentral regions had the highest species richness for three and two habitats (nine and six percent), respectively. The Central region had the highest species richness in a single habitat (three percent). For 12 additional habitats, the highest species richness values were tied or very similar for groups of two to four regions, which included the Southeast, Southwest, Southcentral, Western, and Central regions in various combinations. The Northern region did not have the highest species richness for any habitat and was not included in any combination of two to four regions with similarly high levels of species richness.

Of the marine habitats, offshore shelf waters is considered to be the most species-rich habitat (ranked 16th, tied with boreal subalpine and subarctic woodland), followed by nearshore waters (ranked 18th) and estuarine waters (ranked 19th). As with freshwater lakes and ponds, these marine areas are well known to provide habitat for a wide diversity of marine birds and mammals. In both offshore shelf waters and nearshore waters, the highest species richness values occur in the Bering Sea region. In estuarine waters, the highest species richness values were tied between the Bering Sea and Gulf of Alaska regions.

Across all eight marine habitats assessed, the highest species richness values for five habitats (63 percent) were found in the Bering Sea region. The Gulf of Alaska had the highest species richness for one habitat and the region was tied with the Bering Sea for the highest species richness in two habitats. The Beaufort-Chukchi Seas region did not have the highest species richness for any marine habitat.

For each of the habitats described in this chapter, its occurrence and development on the landscape or in the marine environment is discussed, along with the composition and structure of characteristic plant or algal communities. Notes on the areal coverage of each habitat in Alaska (when mapped), the wildlife species richness number and ranking among all 41 habitats assessed, and the characteristic SGCN that contribute to the species richness numbers in each habitat are also presented. The characteristic SGCN noted as regularly occurring in each habitat described in the following sections are the wildlife species and subspecies that were assigned high- or moderate-value habitat rankings for each habitat in the habitat evaluation procedure.

Terrestrial, Freshwater, and Coastal Habitats

Forest and Woodlands

Temperate Coastal Rainforest

USNVC Synonym: Vancouverian Coastal Rainforest

ACCS.

Biogeographic region	Species richness
Central	20
Northern	0
Southcentral	35
Southeast	52
Southwest	21
Western	0

The temperate coastal rainforest forms a near-continuous band through the Southeast and Southcentral biogeographic regions, bordering the Gulf of Alaska and extending to the upper islands of the Kodiak Archipelago (Figure 6.2). This habitat has also been mapped sparingly in the Southwest and Central regions. These are productive forests dominated by full-stature, needleleaf trees with stands present over a broad elevational gradient from sea level to the subalpine. Canopy cover ranges from open with a well-developed deciduous shrub understory to closed with a species-poor understory that includes pocket wetlands and bryophyte (mosses, liverworts, and hornworts) carpets. Forest canopies consist of Sitka spruce and western hemlock with understory shrubs such as blueberry, huckleberry, rusty menziesia, and devil's club. The main large-scale disturbance to this habitat is timber harvest. At the local scale, windthrow (trees uprooted by wind) affects plant succession, avalanches and landslides influence the habitat extent, and pests and pathogens affect overall forest health.

Temperate coastal rainforests cover 16,731 square miles (2.9%) of Alaska (Table 6.1). The large elevational range and vegetation structure complexity of coastal rainforests can provide high- or moderate-habitat value for 63 wildlife SGCN statewide. Across all terrestrial and marine habitats evaluated, this species richness number is moderate to moderately high and ranks 15th among the 41 habitats assessed (Table 6.3). By far, the highest wildlife species richness in temperate coastal rainforests occurs in the Southeast Alaska biogeographic region, with a richness value of 52 (see table above). The next most species-rich region for coastal rainforests is Southcentral, with a much lower richness value of 35. Species richness then drops in the Southwest and Central regions to 21 and 20, respectively. These rainforests have not been mapped in the Northern and Western regions.

In temperate coastal rainforests statewide, five amphibian SGCN can occur regularly: Columbia spotted frog, long-toed salamander, northwestern salamander, western toad, and wood frog. Nineteen mammal SGCN can consistently occur in this habitat, including five species of bat (little brown myotis, California myotis, long-eared myotis, long-legged myotis, and silver-haired bat) and other characteristic mammal species including northwestern deermouse, root vole, southern red-

backed vole, northern flying squirrel, and five subspecies of dusky shrew. A total of 39 avian SGCN can also regularly use this habitat type; commonly occurring species include Sooty Grouse, Marbled Murrelet, dozens of passerines (e.g., Brown Creeper, Chestnut-backed Chickadee, Hermit Thrush, Golden-crowned Kinglet, Pacific Wren, Ruby-crowned Kinglet, Townsend's Warbler, Varied Thrush), Rufous Hummingbird, Vaux's Swift, American Three-toed Woodpecker, Hairy Woodpecker, and Red-breasted Sapsucker. Several raptors (e.g., Bald Eagle, Boreal Owl, Northern Saw-whet Owl, Queen Charlotte Goshawk) can also occur.

Figure 6.2. Distribution of temperate coastal rainforest in Alaska. M. Geist, ACCS.

Temperate Subalpine Woodland

USNVC Synonym: Vancouverian Subalpine-High Montane Forest

ACCS.

Biogeographic region	Species richness
Central	20
Northern	0
Southcentral	30
Southeast	39
Southwest	0
Western	0

Temperate subalpine woodlands occur in montane settings throughout the Southeast biogeographic region and westward through Southcentral to Cook Inlet and the Kenai Peninsula (Figure 6.3). The habitat has also been mapped sparingly in the Central region. These are treeline forests and woodlands dominated by needleleaf trees interspersed with thickets of tall deciduous shrubs, dwarf shrub heaths, and herb meadows. This habitat is commonly found at higher elevations exposed to cold temperatures and desiccating winds but may also develop at lower elevations in colder

microclimates. As exposure increases, trees become dwarfed, and the canopy thins to form isolated stands of mountain hemlock skirted by thickets of low shrubs such as copperbush, blueberry, and rusty menziesia. Dwarf ericaceous and crowberry shrub heaths and herb meadows grow among the tree-shrub islands. Avalanches and landslides tend to control the extent of this habitat at upper elevations, with small-scale windthrow affecting lower elevation forests with more continuous canopies.

Temperate subalpine woodlands cover 7,733 square miles (1.3%) of Alaska (Table 6.1). These treeline forests in the temperate zone can provide high- and moderate-value habitat for 49 wildlife SGCN statewide. Across all terrestrial and marine habitats evaluated, this species richness number is moderate to moderately low and ranks 22nd (tied with temperate forested wetland) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in temperate subalpine woodlands occurs in Southeast Alaska, with a richness value of 39 (see table above). Much lower species richness values occur in the Southcentral and Central regions, 30 and 20, respectively, and the habitat has not been mapped in the other three terrestrial biogeographic regions.

The vegetation structure complexity in temperate subalpine woodlands can support a diversity of species, including several habitat generalists. Statewide, three amphibian SGCN (Columbia spotted frog, long-toed salamander, and northwestern salamander) can occur, along with 11 mammal SGCN including American marten, snowshoe hare, two species of voles, five subspecies of dusky shrew, and cinereus shrew. Thirty-five avian SGCN can also occur regularly in this habitat, including these characteristic species: American Three-toed Woodpecker, Black Merlin, Brown Creeper, Canada Jay, Cedar Waxwing, Chestnut-backed Chickadee, Hermit Thrush, Olive-sided Flycatcher, Rufous Hummingbird, Spruce Grouse, Vaux's Swift, and White-crowned Sparrow.

Figure 6.3. Distribution of temperate subalpine woodland in Alaska. M. Geist, ACCS.

Boreal Forest

USNVC Synonym: Alaskan-Yukon North American Boreal Forest

Mike Flemming, ACCS.

Biogeographic region	Species richness
Central	46
Northern	10
Southcentral	46
Southeast	52
Southwest	39
Western	34

The boreal forest type occurs primarily in the Central and Southcentral biogeographic regions, and in the Western and Southwest regions to the longitudinal limit of trees (Figure 6.4). This habitat has also been mapped sparingly in the Southeast and Northern regions. These are mixed needleleaf-broadleaf forests and woodlands where canopy and understory species composition follow a moisture and productivity gradient. The warmest and driest sites tend to be dominated by quaking aspen with an open understory of dry-site shrubs, including kinnikinnick, prickly rose, and buffaloberry. More mesic sites of moderate productivity tend to be dominated by a mix of white spruce, black spruce, and Alaska birch. Characteristic shrubs of mesic sites include deciduous species such as Siberian alder, resin birch, dwarf birch, prickly rose, and shorter stature ericaceous shrubs. Lichens and feathermosses provide important ground cover on dry and mesic sites, respectively. Colder, low-productivity sites are often dominated by black spruce with a dwarf and low shrub understory of crowberry, bog blueberry, and dwarf birch. Wildland fire is a major, landscape-scale disturbance, while insect infestation and blowdown impact forests at smaller scales.

Boreal forests are quite common and cover 51,847 square miles (8.9%) of Alaska (Table 1.1). Boreal forests statewide can provide high- and moderate-value habitat for a large number (91) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is high and ranks fifth among the 41 habitats assessed (Table 6.3), making it the most biologically diverse forest habitat in Alaska in terms of wildlife species richness. Boreal forests in Southeast Alaska have the greatest wildlife species richness value (52), while the Southcentral and Central regions have moderately lower richness values of 46 each (see table above). Notably lower richness values for boreal forests, ranging from 39 to 10, were determined for the other three biogeographic regions.

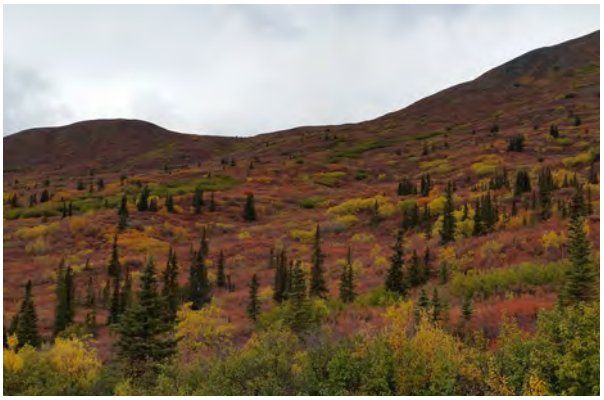
Three amphibian SGCN (Columbia spotted frog, long-toed salamander, and northwestern salamander) use boreal forests in the Southeast region, while one amphibian SGCN (wood frog) can routinely use this habitat across the state. Twenty-seven mammal SGCN can occur regularly in boreal forests statewide including these characteristic small mammals: seven subspecies of Arctic ground squirrels, five species of voles, and nine species and subspecies of shrews (e.g., Holarctic least shrew, pygmy shrew, tundra shrew). A total of 60 avian SGCN can be found in boreal forest habitats, with regular use by these characteristic species: Spruce Grouse, Sooty Grouse, American Three-toed Woodpecker, Boreal Chickadee, Brambling, Canada Jay, Gray-headed Chickadee, Gray-

cheeked Thrush, Hermit Thrush, Olive-sided Flycatcher, Northern Shrike, Western Wood-Pewee, Yellow-rumped Warbler, Boreal Owl, American Goshawk, Great Gray Owl, Red-tailed Hawk, Northern Hawk-Owl, and Western Screech-Owl.

Figure 6.4. Distribution of boreal forest in Alaska. M. Geist, ACCS.

Boreal Subalpine and Subarctic Woodland

USNVC Synonym: North American Northern Boreal Woodland



ADF&G.

Biogeographic region	Species richness
Central	36
Northern	12
Southcentral	36
Southeast	29
Southwest	37
Western	31

Boreal subalpine and subarctic woodlands form at treeline throughout all six biogeographic regions but primarily in the Central, Western, and Southwest regions (Figure 6.5). These woodlands are dominated by short-stature needleleaf and broadleaf trees and a low to dwarf shrub understory with herbs, lichens, and bryophytes. In areas of treeline expansion, trees are evenly distributed and display normal growth forms. In contrast, trees and shrubs may be stunted or contorted at the limit of a species' climatic tolerance or treeline regression. Where more developed tree canopies or terrain provide protection from desiccating winds and insulation from low temperatures, broadleaf deciduous trees (e.g., Alaska birch) and shrubs (e.g., grayleaf willow, Richardson's willow, Bebb willow, resin birch) are more common. Understories tend to be more forb- and bryophyte-rich in these relatively productive stands. In less-protected sites, shorter stature dwarf birch and ericaceous species (e.g., marsh labrador tea, crowberry, bog blueberry, lingonberry) are common. In

these comparatively less-productive sites, understories tend to be more graminoid (sedges, rushes, and grasses) dominated and lichen-rich. The expression of boreal woodlands on the landscape is largely dependent on climate and the presence of permafrost. Because of this, regional changes in temperature and precipitation can cause the expansion or contraction of this habitat type. As with other forested habitats, wildland fire can be a major, landscape-scale disturbance.

Boreal subalpine and subarctic woodlands cover 21,607 square miles (3.7%) of Alaska (Table 6.1). These treeline forests in the boreal zone statewide can provide high- and moderate-value habitat for 62 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 16th (tied with offshore shelf waters) among the 41 habitats assessed (Table 6.3. The highest wildlife species richness values for boreal subalpine and subarctic woodlands occur in the Southwest, Southcentral, and Central regions, with richness values of 37, 36, and 36, respectively (see table above). Notably lower richness values ranging from 31 to 12 were determined for the other three biogeographic regions.

Statewide, the mix of trees and shrubs in boreal subalpine and subarctic woodlands can provide food, cover, and breeding resources for a range of animal species, including one amphibian SGCN (long-toed salamander) and 20 mammal SGCN of different groups, such as little brown myotis, snowshoe hare, and long-tailed vole. Boreal subalpine woodlands can provide habitat for 41 avian SGCN, including these characteristic species: American Tree Sparrow, Black-backed Woodpecker, Blackpoll Warbler, Boreal Chickadee, Redpoll, Fox Sparrow, Gray-headed Chickadee, Golden-crowned Sparrow, Varied Thrush, and White-crowned Sparrow.

Figure 6.5. Distribution of boreal subalpine and subarctic woodland in Alaska. M. Geist, ACCS.

Floodplain Forests

Temperate Floodplain Forest

USNVC Synonym: Vancouverian Flooded & Swamp Forest

ACCS.

Biogeographic region	Species richness
Central	0
Northern	0
Southcentral	50
Southeast	62
Southwest	0
Western	0

Temperate floodplain forests occur in settings prone to riverine flooding in the Southeast biogeographic region and westward through Southcentral to Cook Inlet and the Kenai Peninsula (Figure 6.6). Forest structure and species composition are largely dependent on flooding regime. Glacially fed rivers are characterized by frequent, large-scale flood events with high sediment input driven by glacial runoff and snowmelt. Forests associated with these glacial rivers form broad mosaics of needleleaf and broadleaf trees dominated by black cottonwood, red alder, and Sitka spruce. Forests associated with nonglacial rivers and streams experience smaller-scale and less frequent overbank flooding driven by precipitation events. Here, riparian forests form narrow corridors dominated by red alder and Sitka spruce. In both floodplain settings, deciduous broadleaf shrub understories dominated by Sitka alder, devil's club, and salmonberry are associated with frequently disturbed substrates. On more stable substrates, various forbs, including threeleaf foamflower, enchanter's nightshade, twisted stalk, and false lily of the valley are common. Flooding and the associated erosion and redeposition of sediment are the primary disturbances.

Temperate floodplain forests cover a relatively small area (1,533 square miles, 0.3%) of Alaska (Table 6.1). These forests provide high- and moderate-value habitat for a relatively large number (75) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is relatively high and ranks 9th among the 41 habitats assessed (Table 6.3). By far, the highest wildlife species richness in temperate floodplain forests occurs in the Southeast biogeographic region, with a richness value of 62 (see table above). The only other region in which these floodplain forests were mapped (Southcentral Alaska) has a substantially lower richness value of 50.

Temperate floodplain forests statewide can be consistently used by five amphibian, 26 mammal, and 44 avian SGCN. The five amphibians that can occur in this habitat are Columbia spotted frog, long-toed salamander, northwestern salamander, western toad, and wood frog. Among the mammals that use this habitat are five species of bats (little brown myotis, California myotis, long-eared myotis, long-legged myotis, and silver-haired bat), American marten, North American river otter, muskrat, northern flying squirrel, and several species of mice, voles, and shrews. Characteristic avian SGCN that can regularly use floodplain forests include American Three-toed Woodpecker,

Blackpoll Warbler, Golden-crowned Kinglet, MacGillivray's Warbler, Pine Siskin, Varied Thrush, Queen Charlotte Goshawk, Western Screech-owl, Short-billed Gull, and Harlequin Duck.

Figure 6.6. Distribution of temperate floodplain forests in Alaska. M. Geist, ACCS.

Boreal Floodplain Forest

USNVC Synonym: North American Boreal Flooded & Rich Swamp Forest

ACCS.

Biogeographic region	Species richness
Central	49
Northern	0
Southcentral	56
Southeast	0
Southwest	46
Western	39

Boreal floodplain forests occur in settings prone to riverine flooding, primarily in the Central, Western, and Southwest biogeographic zones; this habitat has also been mapped sparingly in the Southcentral region (Figure 6.7). Forest structure and species composition are largely dependent on flooding regime, which ranges from narrow extents driven by precipitation events along low-volume streams to broad-scale seasonal floods driven by glacial runoff, snowmelt, and the breakup of river ice. Forests associated with glacial rivers form broad mosaics of balsam poplar and white spruce with deciduous broadleaf shrub understories of feltleaf willow, thin-leaf alder, and Siberian alder. On more stable substrates, the understory transitions to mesic shrubs and forbs such as prickly rose, highbush cranberry, and twinflower. Bluejoint reedgrass is an abundant and common component of the herbaceous stratum. Flooding and the associated erosion and redeposition of sediment are the

primary disturbances; however, ice dams and ice scour can cause catastrophic damage, particularly along larger rivers. Due to the presence of water, fire frequency and severity in floodplain systems are typically lower than that of the surrounding boreal forest.

Boreal floodplain forests cover 25,693 square miles (4.4%) of Alaska (Table 6.1). Floodplain forests in the boreal zone statewide can provide high- and moderate-value habitat for 66 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate to moderately high and ranks 14th (tied with temperate salt marsh) among the 41 habitats assessed (Table 6.3). Wildlife species richness in boreal floodplain forests is greatest in the Southcentral region, with a richness value of 56 (see table above). Notably lower species richness in these floodplain forests occurs in the Central and Southwest regions, with richness values of 49 and 46, respectively. Species richness drops to 39 in the Western region and the habitat has not been mapped in the other two regions.

These boreal floodplain forests statewide can be consistently used by two amphibians (western toad and wood frog) and 19 mammal SGCN such as these characteristic species: little brown myotis, American marten, North American river otter, snowshoe hare, Alaska hare, three species of voles, and seven species and subspecies of shrews. This habitat can also support 45 avian SGCN, including Spruce Grouse, Willow Ptarmigan, Short-billed Gull, Harlequin Duck, and a diversity of passerines (e.g., Alder Flycatcher, Fox Sparrow, Orange-crowned Warbler, Ruby-crowned Kinglet, Yellow-rumped Warbler). The following raptor species occur in this habitat type: American Goshawk, Boreal Owl, Great Gray Owl, Red-tailed Hawk.

Figure 6.7. Distribution of boreal floodplain forests in Alaska. M. Geist, ACCS.

Freshwater Wetlands

Temperate Forested Wetland

USNVC Synonyms: North Pacific Bog

ACCS.

Biogeographic region	Species richness
Central	0
Northern	0
Southcentral	35
Southeast	43
Southwest	0
Western	0

Temperate forested wetlands occur in peatland settings in the Southeastern biogeographic region and westward through Southcentral to Cook Inlet and the Kenai Peninsula (Figure 6.8). Forested wetlands develop as dwarf needleleaf woodlands in bog and fen settings and as full-stature, closed canopy stands of needleleaf trees. For all variants of this habitat type, conifers capable of growing in saturated conditions, such as shore pine, western hemlock, mountain hemlock, Alaska cedar, and Sitka spruce, dominate the canopy. Woodland bogs and fens, known colloquially as muskeg, are characterized by a mosaic of trees, low shrubs, herbs, mosses, and standing water across hummocky topography. As woodland bogs are precipitation-fed and typically nutrient-poor, they are characterized by slow-growing dwarf ericaceous shrubs such as bog labrador tea, bog blueberry, and crowberry; *Sphagnum* moss blankets much of the ground cover. By contrast, woodland fens are groundwater-fed and typically more nutrient-rich, supporting low deciduous shrubs (e.g., crab apple, redosier dogwood, sweetgale, alpine laurel) underlain by a diversity of forbs and graminoids. Mature wetland forests are characterized by tall needleleaf trees and a discontinuous broadleaf shrub understory that includes species of tall blueberries, rusty menziesia, devil's club, and salal punctuated by pockets of obligate wetland species and bryophytes. The saturated and inundated soils in this habitat type slow soil decomposition such that organic matter accumulates as woody, *Sphagnum*, or sedge peat.

Temperate forested wetlands cover only 193 square miles (<0.1%) of Alaska (Table 6.1) but provide high- and moderate-value habitat for 49 species of SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate to moderately low and ranks 22nd (tied with temperate subalpine woodland) among the 41 habitats assessed (Table 6.3). By far, the highest wildlife species richness in temperate forested wetlands occurs in the Southeast region, with a richness value of 43 (see table above). Notably lower species richness occurs in the Southcentral region, with a value of 35, and the habitat has not been mapped in the other four regions.

Many wetland-obligate and some generalist wildlife species can use temperate forested wetlands for breeding. Statewide, Columbia spotted frog, northwestern salamander, western toad, and wood frog are the four amphibian SGCN that can regularly use this habitat. The 10 mammal SGCN that occur

consistently in this habitat type are American marten, snowshoe hare, long-tailed vole, root vole, southern red-backed vole, cinereus shrew, and four subspecies of dusky shrew. There are 35 avian SGCN that can be found regularly in these forested wetlands, including these characteristic species: Sooty Grouse, Rufous Hummingbird, Vaux's Swift, Hairy Woodpecker, Chestnut-backed Chickadee, Dark-eyed Junco, Lincoln's Sparrow, Rusty Blackbird, Song Sparrow, White-crowned Sparrow, Bald Eagle, and Merlin.

Figure 6.8. Distribution of temperate forested wetland in Alaska. M. Geist, ACCS.

Boreal Forested Wetland

USNVC Synonym: North American Boreal Conifer Poor Swamp

ACCS.

Biogeographic region	Species richness
Central	54
Northern	15
Southcentral	48
Southeast	40
Southwest	38
Western	36

Boreal forested wetlands occur in peatland settings across the Central and Southcentral biogeographic regions, extending into the Western and Southwest regions to the limits of continuous forest (Figure 6.9). This habitat has also been mapped sparingly in the Northern and Southeast regions. These wetlands have woodland to open forest canopies dominated by needleleaf trees. Where saturation results from the presence of shallow permafrost, the growth of trees is stunted, and slow-growing dwarf shrubs and bryophytes are common in the understory. Black spruce bogs are a good example of this common and widespread type of boreal forested wetland. Where saturation results from

high groundwater levels unrelated to permafrost, soils and water are warmer, and needleleaf trees are more likely to reach full stature. In these more productive settings, broadleaf shrubs and herbs characterize the understory. Tamarack fens are a good example of this less common type of boreal forested wetland. The expression of boreal forested wetlands on the landscape is largely dependent on climate and the presence of permafrost. Where a regional increase in temperature results in permafrost degradation and improved drainage, sites may transition out of the wetland condition. Wildland fire is a common disturbance in boreal ecosystems, including forested wetlands.

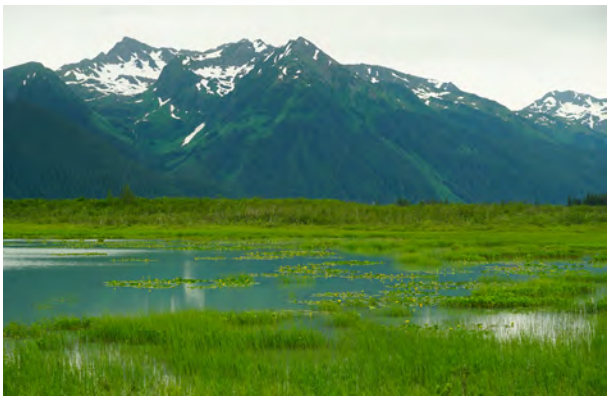
Boreal forested wetlands are quite common and cover 57,850 square miles (10.0%) of Alaska (Table 6.1). Forested wetlands in the boreal zone statewide can provide high- and moderate-value habitat for 81 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is high and ranks 8th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness for boreal forested wetlands occurs in the Central region, with a richness value of 54 (see table above). Species richness drops to 48 in the Southcentral region and declines further from 40 to 36 in the other three boreal forest regions.

Boreal forested wetlands can provide cover for many species of small mammals and breeding habitat for many tree-nesting birds, shorebirds, and wetland-obligate amphibians. All five amphibian SGCN (Columbia spotted frog, long-toed salamander, northwestern salamander, western toad, and wood frog) can be found in this habitat type, although the majority of species occur in Southeast Alaska. Nineteen mammal SGCN can regularly use boreal forested wetlands, including these characteristic species: snowshoe hare, Nearctic brown lemming, northern bog lemming, five species of voles (e.g., meadow vole, root vole, taiga vole), and eight species and subspecies of shrews (e.g., barren ground shrew, tundra shrew). There are 57 avian SGCN that can consistently use boreal forest wetlands, including these characteristic species: Spruce Grouse, American Three-toed Woodpecker, Black-backed Woodpecker, and dozens of passerines (e.g., Blackpoll Warbler, Bohemian Waxwing, Boreal Chickadee, Canada Jay, Fox Sparrow, Gray-cheeked Thrush, Golden-crowned Kinglet, Lincoln's Sparrow, Olive-sided Flycatcher, Rusty Blackbird, White-crowned Sparrow). Raptors (e.g., American Goshawk, Boreal Owl, Great Gray Owl, Northern Hawk-Owl), Short-billed Gulls, and shorebirds (e.g., Greater Yellowlegs, Hudsonian Godwit, Lesser Yellowlegs, Solitary Sandpiper, Wilson's Snipe) also use this habitat type.

Figure 6.9. Distribution of boreal forested wetland in Alaska. M. Geist, ACCS.

Temperate Marsh, Wet Meadow, and Shrubland

USNVC Synonym: Vancouverian Lowland Marsh, Wet Meadow & Shrubland



ACCS.

Biogeographic region	Species richness
Central	30
Northern	0
Southcentral	60
Southeast	64
Southwest	42
Western	0

Temperate marshes, wet meadows, and shrublands occur in wetland settings primarily in the Southeast, Southcentral, and Southwest biogeographic regions (Figure 6.10). These habitats have also been mapped sparingly in the Central region. These are freshwater systems that form in areas of regular inundation (mudflats), saturation (wet meadows), slow-moving water (emergent marshes), or standing water (wet shrublands). Plant communities are dominated by annual herbs, emergent, rhizomatous graminoids and forbs, and low deciduous broadleaf shrubs. Vegetation may occur as a near monoculture in permanently flooded basin sites or as a combination of herbaceous and woody types in sites with more varied topography. Riparian or otherwise wet shrublands are typically dominated by thin-leaf and Sitka alder in disturbed or nutrient-poor settings. Barclay's, grayleaf, and tealeaf willow occur in sites with better-developed soils and available nutrients. Rhizomatous graminoids such as common spikerush, softstem bulrush, water sedge, beaked sedge, and Northwest Territory sedge are common emergents. Characteristic forbs include horsetails, common marestail, water arum, buckbean, and purple marshlocks. Disturbances that alter natural hydrologic conditions may impact these wetland systems.

Temperate marsh, wet meadow, and shrubland habitats cover only 291 square miles (<0.1%) of Alaska (Table 6.1). These wetlands statewide, however, can provide high- and moderate-value habitat for a relatively large number (90) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is high and ranks 6th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness, by far, in temperate marsh, wet meadow, and shrubland habitats occurs the Southeast and Southcentral regions, with richness values of 64 and 60, respectively (see table above). Substantially lower richness values of 42 and 30, respectively, were determined for the Southwest and Central regions and these wetland habitats have not been mapped in the other two regions.

These temperate wetlands can provide breeding habitat for many seabirds, shorebirds, waterfowl, amphibians, and shrub-nesting passerines, and foraging habitat for mammals such as bats, voles, and shrews. Statewide, all five amphibian SGCN can occur in this habitat along with 27 mammal SGCN, including five species of bat (little brown myotis, California myotis, long-eared myotis, long-legged myotis, and silver-haired bat) and these other characteristic species: muskrat, Alaska hare, snowshoe hare, meadow jumping mouse, collared lemming, root vole, five subspecies of dusky shrew, western water shrew, and Glacier Bay water shrew. A total of 58 avian SGCN can use these

wetland habitats for nesting and foraging, including numerous passerines (e.g., Alder Flycatcher, Blackpoll Warbler, Redpoll, Fox Sparrow, Gray-cheeked Thrush, Lincoln's Sparrow, Orange-crowned Warbler, Red-winged Blackbird, Rusty Blackbird, Song Sparrow, Varied Thrush, White-crowned Sparrow, Wilson's Warbler), seabirds (e.g., Aleutian Tern, Herring Gull, Short-billed Gull), shorebirds (e.g., Greater Yellowlegs, Lesser Yellowlegs, Red-necked Phalarope, Solitary Sandpiper, Wilson's Snipe), and waterbirds (e.g., Blue-winged Teal, Dusky Canada Goose, Horned Grebe, Lesser Scaup, Northern Pintail, Red-necked Grebe, Trumpeter Swan). Of the aquatic SGCN, Alaska blackfish are common in the marsh habitats in these freshwater wetlands.

Figure 6.10. Distribution of temperate marsh, wet meadow, and shrubland in Alaska. M. Geist, ACCS.

Temperate Fen

USNVC Synonym: North Pacific Fen

ACCS.

Biogeographic region	Species richness
Central	23
Northern	0
Southcentral	31
Southeast	34
Southwest	33
Western	0

Temperate fens are small in extent and uncommon on the landscape, occurring in peatland settings primarily in the Southeast, Southcentral, and Southwest biogeographic regions (Figure 6.11). This habitat has also been mapped sparingly in the Central region. Vegetation cover is continuous in this habitat type and characterized by a species-rich assemblage of graminoids, forbs, and bryophytes where, typically, no single species is dominant. Species composition is driven by the chemical

qualities of the water and soil, with fens categorized as poor (low pH) or rich (circumneutral to high pH). Poor fens resemble bogs and are more likely to support low and dwarf shrubs, but they lack ericaceous shrubs and have little to no *Sphagnum* moss. Rich fens support a diversity of herbs, many well-adapted to lime-rich soil. Species characteristic of both poor and rich fens include forbs (e.g., buckbean, purple marshlocks, deercabbage, and burnet) and graminoids (e.g., water, rock, and mud sedges). As shallow and flowing groundwater is requisite for the formation and maintenance of fens, they typically develop across gentle slopes or in areas of groundwater discharge. In some locations, high precipitation can overcome the drainage afforded by terrain, allowing fens to develop on relatively steep slopes. Fens are slow-developing systems that are difficult to restore following disturbance.

Temperate fens cover only 966 square miles (0.2%) of Alaska (Table 6.1). Fens in the temperate zone statewide can provide high- and moderate-value habitat for 52 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 21st (tied with Arctic coastal shore) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in temperate fens occurs in the Southeast, Southwest, and Southcentral regions, with richness values of 34, 33, and 31, respectively. Species richness is substantially lower in the Central region, with a value of 23, and these fens have not been mapped in the other two regions.

Temperate fens can support amphibians, several small mammals, ground-nesting birds, and species that use the species-rich understory for foraging. All five amphibian SGCN (Columbia spotted frog, long-toed salamander, northwestern salamander, western toad, and wood frog) can be found in this habitat type, although the majority of species occur in Southeast Alaska. Fens can also support 11 mammal SGCN, including these characteristic species: Alaska hare, muskrat, meadow jumping mouse, Nelson's collared lemming, Nearctic brown lemming, and root vole. Thirty-six avian SGCN can occur regularly in these wetlands, including these characteristic species: Savannah Sparrow, Short-billed Gull, Greater Yellowlegs, Hudsonian Godwit, Least Sandpiper, Lesser Yellowlegs, Marbled Godwit, Red-necked Phalarope, Semipalmated Sandpiper, Spotted Sandpiper, Solitary Sandpiper, Wilson's Snipe, Aleutian Tern, and Sandhill Crane.

Figure 6.11. Distribution of temperate fen in Alaska. M. Geist, ACCS.

Boreal Marsh, Wet Meadow, and Shrubland

USNVC Synonym: North American Boreal Marsh, Wet Meadow & Shrubland

M. Flemming, ACCS.

Biogeographic region	Species richness
Central	65
Northern	19
Southcentral	65
Southeast	66
Southwest	59
Western	61

Boreal marshes, wet meadows, and shrublands occur in wetland settings primarily in the Central and Western biogeographic regions (Figure 6.12). These habitats have also been mapped sparingly in the other four terrestrial regions. These are freshwater systems that form in areas of regular inundation (floodplains), saturation (wet meadows), or slow-moving or standing water (emergent marshes and wet shrublands). The plant communities are dominated by emergent, rhizomatous graminoids, forbs, and low deciduous broadleaf shrubs. Vegetation can form a near monoculture in permanently flooded basin sites or as a mosaic of herbaceous and woody plants in sites with more heterogenous topography. Riparian or otherwise wet shrublands are typically dominated by thin-leaf and Sitka alder in disturbed or nutrient-poor settings and tealeaf and Richardson's willow in sites with more mature soils and available nutrients. Rhizomatous graminoids such as water sedge, Northwest Territory sedge, softstem bulrush, and pendant grass are common emergent plants in this habitat. Characteristic forbs include horsetails, common marestail, buckbean, and purple marshlocks. These wetland systems will likely be impacted by any alterations to their natural hydrology.

Boreal marsh, wet meadow, and shrubland habitats cover a relatively small area (8,902 square miles, 1.5%) of Alaska (Table 6.1). These wetlands statewide, however, have the highest species richness of all 41 terrestrial and marine habitats assessed in this SWAP and can provide high- and moderate-value habitat for 114 wildlife SGCN (Table 6.3). Wildlife species richness in boreal marsh, wet meadow, and shrubland habitats is strikingly similar in the Southeast, Central, and Southcentral biogeographic regions, with richness values of 66, 65, and 65, respectively (see table above). In the Western and Southwest regions, species richness drops slightly to 61 and 59 SGCN, respectively. Richness then drops further to 19 in the Northern region where this boreal habitat is not common.

The vegetation structure complexity in these boreal wetland habitats can provide cover, foraging habitat, and breeding habitat for a diverse set of wildlife species. Statewide, this includes all five amphibian SGCN (Columbia spotted frog, long-toed salamander, northwestern salamander, western toad, and wood frog) and 30 mammal SGCN such as these characteristic species: muskrat, snowshoe hare, meadow jumping mouse, Nearctic brown lemming, northern bog lemming, meadow vole, root vole, western water shrew, and Glacier Bay water shrew. A total of 79 avian SGCN can also occur regularly in this habitat, including numerous passerines (e.g., Alder Flycatcher, American Tree

Sparrow, Arctic Warbler, Bluethroat, Blackpoll Warbler, Fox Sparrow, Gray-cheeked Thrush, Lincoln's Sparrow, Olive-sided Flycatcher, Orange-crowned Warbler, Red-winged Blackbird, Rusty Blackbird, Savannah Sparrow, Song Sparrow, Tree Swallow, Varied Thrush, White-crowned Sparrow, Wilson's Warbler). These wetland habitats are also routinely used by raptors (e.g., Boreal Owl, Great Gray Owl, Northern Hawk Owl), seabirds (e.g., Aleutian Tern, Herring Gull, Short-billed Gull), shorebirds (e.g., Greater Yellowlegs, Least Sandpiper, Lesser Yellowlegs, Red-necked Phalarope, Semipalmated Sandpiper, Solitary Sandpiper, Upland Sandpiper, Wilson's Snipe), and waterbirds (e.g., Dusky Canada Goose, Horned Grebe, Lesser Scaup, Northern Pintail, Red-necked Grebe, Red-throated Loon, Sandhill Crane, Surf Scoter, Trumpeter Swan, White-winged Scoter, Yellow-billed Loon). Of the aquatic SGCN, Alaska blackfish are common in the marsh habitats in these freshwater wetlands.

Figure 6.12. Distribution of boreal marsh, wet meadow, and shrubland in Alaska. M. Geist, ACCS.

Boreal Bog

USNVC Synonym: North American Boreal & Subboreal Bog & Acidic Fen

ACCS.

Biogeographic region	Species richness
Central	53
Northern	36
Southcentral	43
Southeast	35
Southwest	45
Western	55

Boreal bogs occur in peatland settings primarily across the Central, Western, Southwest, and Southcentral biogeographic regions; however, the habitat has also been mapped sparingly in the other two terrestrial regions (Figure 6.13). These bogs form as mosaics of low to dwarf shrubs, graminoids, and bryophytes. Ericaceous shrubs (e.g., bog blueberry, lingonberry, bog and marsh

labrador tea, crowberry, bog rosemary, small cranberry) and *Sphagnum* mosses are consistently present. Dwarf trees encroach on the drier margins and ridges but do not gain dominance. Precipitation is the primary water source for bogs, and soils are acidic and nutrient-poor, with a thick accumulations of peat. The expression of boreal wetlands on the landscape largely depends on climate and the associated presence of permafrost. Where regional increases in temperature results in permafrost degradation and improved drainage, sites may no longer function as wetlands. Wildland fire is a common disturbance in boreal ecosystems. Through their dam-building activities, beavers can cause substantial hydrologic change to peatland systems.

Boreal bogs cover 27,904 square miles (4.8%) of Alaska (Table 6.1). Bogs in the boreal zone statewide can provide high- and moderate-value habitat for a large number (112) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is high and ranks 2nd among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in boreal bogs occurs in the Western and Central regions, with richness values of 55 and 53, respectively (see table above). Richness drops to 45 and 43 in the Southwest and Southcentral regions, respectively, and drops again to 36 and 35 in the Northern and Southeast regions, respectively.

While plant species diversity is low, the patchwork of shrubs, graminoids, and bryophytes in boreal bogs can support breeding and foraging habitat for numerous wildlife species. Three species of amphibian SGCN occur in this habitat type, although two of them (Columbia spotted frog and western toad) are limited to Southeast Alaska. Twenty-eight mammal SGCN also occur in this habitat including these characteristic species: meadow jumping mouse, Nearctic brown lemming, northern bog lemming, meadow vole, root vole, southern red-backed vole, barren ground shrew, western water shrew, and Glacier Bay water shrew. A total of 81 avian SGCN can consistently occur in boreal bog habitats including a diversity of shorebirds (e.g., Bar-tailed Godwit, Black-bellied Plover, Black Turnstone, Greater Yellowlegs, Hudsonian Godwit, Least Sandpiper, Lesser Yellowlegs, Pacific Golden-plover, Red Phalarope, Red-necked Phalarope, Rock Sandpiper, Semipalmated Sandpiper, Solitary Sandpiper, Spotted Sandpiper, Stilt Sandpiper, Western Sandpiper, Whimbrel, Wilson's Snipe). Several species of seabirds (e.g., Parasitic Jaeger, Sabine's Gull, Short-billed Gull, Glaucous Gull, Aleutian Tern), waterbirds (e.g., Black Brant, Emperor Goose, Taverner's Cackling Goose, Tule Greater White-fronted Goose, Northern Pintail, Sandhill Crane), passerines (e.g., Bohemian Waxwing, Fox Sparrow, Lapland Longspur, Lincoln's Sparrow, Rusty Blackbird, Savannah Sparrow, White-crowned Sparrow), and raptors (e.g., Boreal Owl, Great Gray Owl, Northern Hawk Owl, Rough-legged Hawk) can also breed and forage in this habitat type.

Figure 6.13. Distribution of boreal bog in Alaska. M. Geist, ACCS.

Arctic Marsh, Wet Meadow, and Shrubland

USNVC Synonym: Arctic Freshwater Marsh & Wet Meadow

A. Underwood, ADF&G.

Biogeographic region	Species richness
Central	57
Northern	54
Southcentral	0
Southeast	0
Southwest	51
Western	80

Arctic marshes, wet meadows, and shrublands occur in wetland settings primarily in the Northern and Western biogeographic regions; the habitat has also been mapped sparingly in the Central and Southwest regions (Figure 6.14). These habitats are well-vegetated areas dominated by emergent graminoids, broadleaf shrubs, and aquatic mosses. The plant community composition follows a gradient of water depth and persistence mainly driven by permafrost. Deep and permanently flooded permafrost basins often support monocultures of pendant grass, with shallower waters supporting creeping sedge, water sedge, and tall cottongrass. Shrubs tend to be shorter in poorly drained areas underlain by shallow, ice-rich permafrost and taller on substrates where seasonal thaw is deep and drainage is better. Arctic wetland shrublands are dominated by tealeaf willow, bog willow, and dwarf birch, with diverse sedges occurring in the wettest areas. Floodplain shrublands support taller willows such as littletree, grayleaf, barrenground, and Richardson's willow on regularly flooded terrain, and by mats of the prostrate shrub entireleaf mountain-avens in regularly inundated terrains. The dynamics of these habitats are influenced by seasonal cycles of freezing, thawing, and flooding. In areas of fine-grained, ice-rich sediment, periglacial (freeze-thaw) processes

such as permafrost degradation and aggregation, cryoturbation (frost churning), and solifluction (movement of wet soil) influence the habitat. The cyclical development of patterned ground, such as polygon tundra, thaw lakes, and string and flark fens is ongoing at the landscape scale.

Arctic marsh, wet meadow, and shrubland covers 17,104 square miles (3.0%) of Alaska (Table 6.1). These wetlands in the Arctic regions of the state can provide high- and moderate-value habitat for a large number (109) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is high and ranks 4th among the 41 habitats assessed (Table 6.3). By a substantial margin, the highest wildlife species richness in Arctic marsh, wet meadow, and shrubland habitats occurs in the Western biogeographic region, with a richness value of 80 (see table above). Richness drops in the Central, Northern, and Southwest regions, with values of 57, 54, and 51, respectively and the habitat has not been mapped in the other two regions.

These Arctic wetland habitats can provide shrublands for nesting birds as well as marshes and wet meadows for foraging waterbirds, shorebirds, and mammals. Statewide, one amphibian SGCN (wood frog) can regularly use this habitat type along with 22 mammal SGCN, including these characteristic species: Arctic fox, Alaska hare, muskrat, meadow jumping mouse, Nearctic brown lemming, northern bog lemming, meadow vole, root vole, and barren ground shrew. A total of 86 avian SGCN can occur consistently in this habitat, including seabirds (e.g., Glaucous Gull, Long-tailed Jaeger, Parasitic Jaeger, Pomarine Jaeger, Sabine's Gull, Steller's Eider), shorebirds (e.g., American Golden-plover, Black-bellied Plover, Dunlin, Long-billed Dowitcher, Pacific Golden-plover Pectoral Sandpiper, Red Phalarope, Red-necked Phalarope, Semipalmated Sandpiper, Stilt Sandpiper, Western Sandpiper), and waterbirds (e.g., Arctic Loon, Black Brant, Black Scoter, Canvasback, Emperor Goose, King Eider, Long-tailed Duck, Red-necked Grebe, Red-throated Loon, Sandhill Crane, Spectacled Eider, Surf Scoter, Taverner's Cackling Goose, White-winged Scoter, Trumpeter Swan, Yellow-billed Loon). Willow Ptarmigan, Lapland Longspur, and Snowy Owl can also occur in this habitat. Of the aquatic SGCN, Alaska blackfish are common in the aquatic marsh habitats in these Arctic wetlands.

Figure 6.14. Distribution of Arctic marsh, wet meadow, and shrubland in Alaska. M. Geist, ACCS.

Shrublands and Grasslands

Temperate Shrubland and Grassland

USNVC Synonym: Northern Vancouverian Lowland-Montane Grassland & Shrubland

ACCS.

Biogeographic region	Species richness
Central	28
Northern	0
Southcentral	32
Southeast	42
Southwest	19
Western	0

Temperate shrublands and grasslands occur in upland settings primarily in the Southeast, Southcentral, and Southwest biogeographic regions, and the habitat has been mapped sparingly in the Central region as well (Figure 6.15). These habitats form as open to closed thickets of low to tall deciduous shrubs and herbaceous meadow openings or combinations of the types. Herbaceous species either establish as an understory to the shrub layer or as species-rich meadows. Characteristic shrubs include Sitka alder, salmonberry, devil's club, copperbush, and blueberry, with willows also occurring in wetter sites. In meadows, a mixture of ferns, forbs, and graminoids is characteristic, including species such as ladyfern, bluejoint reedgrass, fireweed, cowparsnip, false hellebore, and Sitka valerian. Shrublands and grasslands tend to develop where tree growth is precluded by either disturbance or climate, such as on mountain sideslopes steep enough to produce frequent avalanches, along coastal headlands, and above the elevational treeline.

Temperate shrubland and grassland covers 12,194 square miles (2.1%) of Alaska (Table 6.1). These mixtures of shrub and meadow habitat in temperate zones statewide can provide high- and moderate-value habitat for 50 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate to moderately low and ranks 24th among the 41 habitats assessed (Table 6.3). By far, the highest wildlife species richness in temperate shrubland and grassland occurs the Southeast region, with a richness value of 42 (see table above). Richness values drop in the Southcentral, Central, and Southwest regions to 32, 28, and 19, respectively, and the habitat has not been mapped in the other two regions.

Temperate shrublands and grasslands can provide cover and foraging habitat suitable for a diverse set of amphibian, mammal, and bird species. Statewide, four amphibian SGCN (Columbia spotted frog, long-toed salamander, western toad, and wood frog) can occur regularly along with 17 mammal SGCN, including these characteristic species: little brown myotis, silver-haired bat, northern bog lemming, meadow vole, and root vole. Twenty-nine avian SGCN can also regularly use this habitat type including these characteristic species: Willow Ptarmigan, Alder Flycatcher, American Tree Sparrow, Fox Sparrow, Gray-cheeked Thrush, Golden-crowned Sparrow, Northern Shrike, Orange-crowned Warbler, Redpoll, Savannah Sparrow, Song Sparrow, Varied Thrush, White-crowned Sparrow, Wilson's Warbler, Short-eared Owl, Semipalmated Sandpiper, and Spotted Sandpiper.

Figure 6.15. Distribution of temperate shrubland and grassland in Alaska. M. Geist, ACCS.

Aleutian Heath and Meadow

USNVC Synonym: North Pacific-Bering Maritime Heath & Meadow

ACCS.

Biogeographic region	Species richness
Central	15
Northern	0
Southcentral	25
Southeast	0
Southwest	41
Western	33

Aleutian heaths and meadows occur primarily in the Southwest biogeographic region from the lower Alaska Peninsula and lower Kodiak Archipelago, extending through the Aleutian Islands to the Kamchatka Peninsula (Figure 6.16). These habitats with Aleutian Island floristic affinities have also been mapped sparingly in the Western, Southcentral, and Central regions. These habitats develop as open canopies of short-stature deciduous shrubs, herbaceous meadows, or mosaics of vegetation types. When dominated by ericaceous dwarf shrubs, this habitat is referred to as heath. Shrub stature generally decreases as maritime influence increases. Graminoids, ferns, and forbs may dominate the shrub understory or be interspersed as patches of meadow. As this habitat typically spans an area of plant species exchange between the Russian Far East and western Alaska, its floristics are somewhat unique. Common low shrubs include Sitka alder, a variety of willow species, salmonberry, and bog blueberry. Common dwarf shrubs include crowberry, Aleutian mountainheath, Alaska bellheather, and partridgefoot. Common graminoids, ferns, and forbs include Pacific reedgrass, dunegrass, bluejoint reedgrass, ladyfern, seacoast angelica, cowparsnip, and Kamchatka aconite. Volcanism

and deglaciation are primary agents of landscape-scale disturbance. Otherwise, exposure to strong coastal winds affects plant distributions and community composition.

Aleutian heath and meadow covers 13,321 square miles (2.3%) of Alaska (Table 6.1). Heaths and meadows with Aleutian Islands floristic affinities statewide can provide high- and moderate-value habitat for 61 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 17th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness value in Aleutian heath and meadow (41) occurs in the Southwest region where the habitat is most common. Species richness drops in the Western, Southcentral, and Central regions to 33, 25, and 15, respectively, and the habitat has not been mapped in the other two regions.

Aleutian heath and meadow habitats can support many ground-nesting birds and small mammal species, while low and dwarf shrubs can provide cover for other species. Statewide, two amphibian SGCN (western toad and wood frog) can regularly use these habitats along with 19 mammal SGCN, including these characteristic species: six subspecies of Arctic ground squirrels, snowshoe hare, meadow jumping mouse, collared lemming, Nearctic brown lemming, northern collared lemming, root vole, and Pribilof Island shrew. Forty avian SGCN can also consistently use this habitat type, including Aleutian Cackling Goose, Rock Ptarmigan, Willow Ptarmigan, passerines (e.g., American Pipit, Horned Lark, Gray-crowned Rosy Finch, Lapland Longspur, Northern Wheatear, Savannah Sparrow, Snow Bunting, White-crowned Sparrow), seabirds (e.g., Fork-tailed Storm-petrel, Kittlitz's Murrelet, Leach's storm-petrel, Long-tailed Jaeger, several auklet species), and shorebirds (e.g., Black-bellied Plover, Pacific Golden-plover, Surfbird, Wilson's Snipe).

Figure 6.16. Distribution of Aleutian heath and meadow in Alaska. M. Geist, ACCS.

Boreal Shrubland and Grassland

USNVC Synonym: North American Boreal Shrubland & Grassland

ACCS.

Biogeographic region	Species richness
Central	39
Northern	17
Southcentral	36
Southeast	32
Southwest	37
Western	42

Boreal shrublands and grasslands occur in upland settings throughout the Central biogeographic region, extending into the Western, Southwest, and Southcentral regions (Figure 6.17). The habitat has also been mapped sparingly in the Northern and Southeast regions. The habitat type develops as shrublands, grasslands, herbaceous meadows, or mosaics of the three. Shrubland cover ranges from open to closed. Shrub stands may be dominated by deciduous or evergreen shrubs and can include or be co-dominated by dwarf shrubs. Herbaceous communities tend to be dominated by graminoids on dry, wind-exposed sites, with the proportion of forbs increasing in more protected sites that are better able to retain moisture. Shrub stands are characterized by one or more deciduous shrub species: Siberian alder, tealeaf willow, grayleaf willow, Richardson's willow, resin birch, and dwarf birch. Young or disturbed sites tend to be alder-dominated and typically support an herb-rich understory. In contrast, older, more stable sites tend to be dominated by willow and birch and are characterized by an understory of ericaceous dwarf shrubs. In an uncommon setting, boreal shrublands and grasslands develop on inland dunes and steppe bluffs. Here, vegetation is characterized by dry, open low shrub and herb associations. Boreal shrublands and grasslands develop where extreme site conditions, such as recent deglaciation, wildland fire, cold air drainage, avalanche, or unstable substrates, preclude the establishment of trees.

Boreal shrublands and grasslands are quite common and cover 79,342 square miles (13.7%) of Alaska (Table 6.1). Shrublands and grasslands in the boreal zone statewide can provide high- and moderate-value habitat for 70 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderately high and ranks 11th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in boreal shrublands and grasslands occurs in the Western biogeographic region, with a richness value of 42 (see table above). Richness values drop in the Central, Southwest, Southcentral, and Southeast regions, to 39, 37, 36, and 32, respectively, and then drop further to 17 in the Northern region.

Four species of amphibian SGCN occur in this habitat type (long-toed salamander, northwestern salamander, western toad, and wood frog) although the majority are limited to Southeast Alaska. Twenty-eight mammal SGCN also occur in this habitat, including these characteristic species: Alaska hare, snowshoe hare, meadow jumping mouse, Nearctic brown lemming, northern bog lemming, five species of voles, seven species subspecies of Arctic ground squirrel, and 10 species and subspecies of shrews (e.g., tundra shrew, dusky shrew). Thirty-eight species of birds including Willow Ptarmigan, a

large number of passerines (e.g., Alder Flycatcher, American Tree Sparrow, Arctic Warbler, Blackpoll Warbler, Bluethroat, Fox Sparrow, Golden-crowned Sparrow, Gray-cheeked Thrush, Lincoln's Sparrow, Northern Shrike, Orange-crowned Warbler, Redpoll, Savannah Sparrow, Varied Thrush, White-crowned Sparrow, Wilson's Warbler), raptors (e.g., American Kestrel, Northern Hawk Owl, Short-eared Owl), shorebirds (e.g., Upland Sandpiper, Wilson's Snipe), and waterbirds (e.g., Sandhill Crane, Black Scoter) can regularly use this habitat for nesting and foraging.

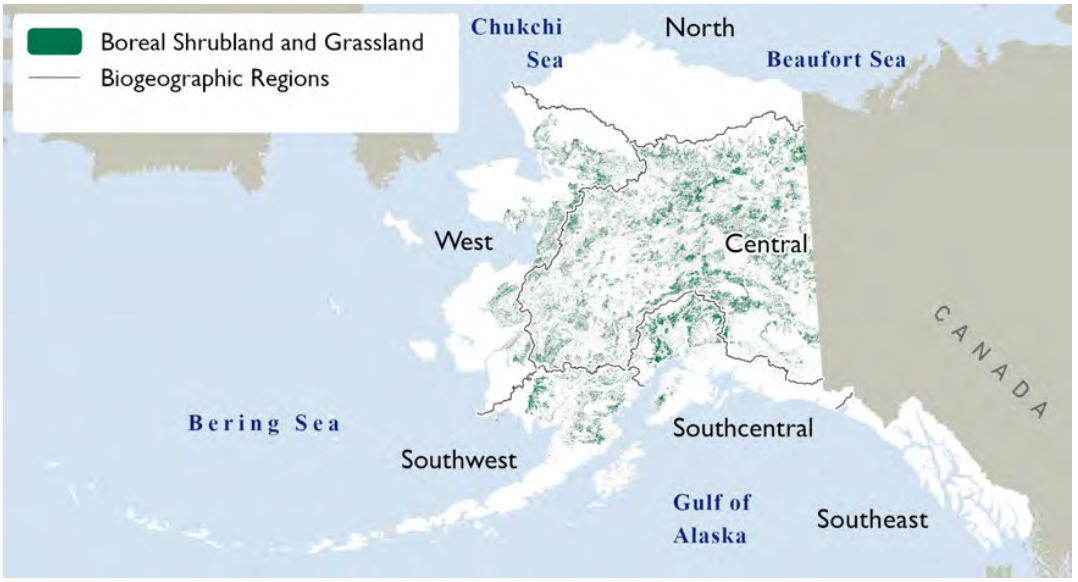


Figure 6.17. Distribution of boreal shrubland and grassland in Alaska. M. Geist, ACCS.

Tundra

Temperate Alpine Tundra

USNVC Synonym: Vancouverian Alpine Tundra

ACCS.

Biogeographic region	Species richness
Central	18
Northern	0
Southcentral	24
Southeast	21
Southwest	27
Western	0

Temperate alpine tundra occurs in montane settings throughout the Southeast and Southcentral biogeographic regions, extending into the Central and Southwest regions where these regions overlap with the Alaska Range (Figure 6.18). This habitat type is found at high elevations or on exposed sites where it develops as treeless, sparsely to well-vegetated patches of dwarf shrubs, graminoids, and forbs. In the most wind-exposed and rocky sites, tundra vegetation develops in protected microsites as a sparse cover of prostrate shrubs, graminoids, forbs, and lichens. Prostrate

shrubs in the mountain-avens genus and graminoids (e.g., longawn sedge, alpine fescue) are common species. In more protected areas, tundra forms a semicontinuous cover of dwarf ericaceous or willow shrub. Common ericaceous shrubs include western moss heather, yellow mountainheath, Alaska bellheather, bog blueberry, dwarf bilberry, and crowberry. Common willow species include arctic, sprouting leaf, and netleaf willows. In the most wind-protected sites, tundra may develop as lush herbaceous meadows with forbs (e.g., larkspurleaf monkshood, burnet, Sitka valerian, Kamchatka fritillary, Alaska Indian paintbrush, wooly geranium, Nootka lupine). Disturbances include wind, soil and snow creep, and freeze-thaw action; steeper sites may be prone to avalanches. On mountain summits where treeline is advancing due to a warming climate, the extent of alpine tundra will be reduced.

Temperate alpine tundra covers 6,624 square miles (1.1%) of Alaska (Table 6.1). Alpine tundra in the temperate zone statewide can provide high- and moderate-value habitat for 45 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderately low and ranks 26th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in temperate alpine tundra occurs in the Southwest and Southcentral regions, with richness values of 27 and 24, respectively (see table above). Richness values drop to 21 and 18 in the Southeast and Central regions, respectively, and these alpine habitats have not been mapped in the other two regions.

The low-stature vegetation in temperate alpine tundra provides ideal habitat for obligate high-elevation mammals and ground-nesting birds. Statewide, three amphibian SGCN (Columbia spotted frog, long-toed salamander, and western toad) can occur regularly in this habitat, as well as 18 mammal SGCN. Characteristic mammal SGCN include hoary marmot, collared pika, root vole, and five subspecies of Arctic ground squirrel. A total of 24 avian SGCN can occur consistently in this habitat type, including these characteristic species: Rock Ptarmigan, American Pipit, Horned Lark, Northern Wheatear, Savannah Sparrow, Snow Bunting, American Golden-plover, Black-bellied Plover, Surfbird, and Aleutian Cackling Goose.

Figure 6.18. Distribution of temperate alpine tundra in Alaska. M. Geist, ACCS.

Boreal Alpine Tundra

USNVC Synonym: Western Boreal Alpine Tundra

ACCS.

Biogeographic region	Species richness
Central	20
Northern	20
Southcentral	25
Southeast	20
Southwest	22
Western	18

Boreal alpine tundra occurs in montane settings primarily in the Central, Southcentral, and Western biogeographic regions, although the habitat has been mapped in all six terrestrial regions (Figure 6.19). This habitat type is found at high elevations or on exposed sites where it develops as treeless, sparsely to well-vegetated patches of dwarf shrubs, graminoids, and forbs. In the most wind-exposed and rocky sites, tundra develops in protected microsites as a sparse cover of prostrate shrubs, graminoids, forbs, and lichens. Prostrate shrubs include dry-site species such as mountain-avens, pincushion plant, and alpine bearberry. Graminoids include Altai fescue, alpine sweetgrass, Bigelow's sedge, spike trisetum, and smallawned sedge. A variety of forbs with cushion or creeping growth forms may also occur. In more protected areas, tundra forms a semicontinuous cover of dwarf ericaceous or willow shrub. Common ericaceous species include crowberry, alpine azalea, bog blueberry, and white Arctic mountain heather. Common willow species are Arctic, polar, skeletonleaf, and netleaf willow. In the most wind-protected sites, lush herbaceous meadows with herbs (e.g., larkspurleaf monkshood, longawn sedge, Altai fescue, wooly geranium, forget-me-not, fringed grass of Parnassus, Canadian burnet, arrowleaf ragwort, Sitka valerian) establish. Disturbances include wind, soil and snow creep, and freeze-thaw action; steeper sites may be prone to avalanches. The extent of alpine tundra is likely to be reduced on mountain summits where treeline is advancing due to a warming climate.

Boreal alpine tundra covers 10,211 square miles (1.8%) of Alaska (Table 6.1). Alpine tundra in the boreal zone statewide can provide high- and moderate-value habitat for 51 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate to moderately low and ranks 23rd among the 41 habitats assessed (Table 6.3). Wildlife species richness values in boreal alpine tundra are strikingly similar in each of the six terrestrial biogeographic regions in Alaska, with values spanning a narrow range from 25 to 18 (see table above).

Three amphibian SGCN (northwestern salamander, western toad, and wood frog) can occur regularly in boreal alpine tundra, although the majority of species are restricted to Southeast Alaska. The habitat can also support 20 mammal SGCN including these characteristic species: collared pika, tundra shrew, St. Lawrence Island shrew, five subspecies of dusky shrew, and seven subspecies of Arctic ground squirrels. A total of 28 avian SGCN can occur regularly in this habitat, including the

following characteristic species: Rock Ptarmigan, American Pipit, Horned Lark, Northern Wheatear, Savannah Sparrow, Smith's Longspur, Snow Bunting, White-crowned Sparrow, American Golden-plover, Surfbird, and Upland Sandpiper.

Figure 6.19. Distribution of boreal alpine tundra in Alaska. M. Geist, ACCS.

Arctic Tundra

USNVC Synonym: Arctic Dry-Moist Tundra

ACCS.

Biogeographic region	Species richness
Central	52
Northern	53
Southcentral	32
Southeast	0
Southwest	57
Western	78

Arctic tundra occurs in treeless settings primarily in the Northern, Western, and Southwest biogeographic regions; the habitat has also been mapped in the Central and Southcentral regions (Figure 6.20). This habitat type develops as sparsely to well-vegetated areas of shrubs, graminoids, and forbs. Mosses and lichens are important components of the understory. Generally, the stature and cover of vegetation and the abundance of woody species increases as sites gain protection from wind, insulation from freezing temperatures, or have a sustained water source through the growing season. Because of this, tundra communities range in structure and composition from sparse assemblages of prostrate shrubs, low-stature herbs, mosses, and lichens in the most exposed, often high-elevation sites, to a continuous cover of low and dwarf shrubs interspersed with tussock forming-sedges, forbs, and a diversity of nonvascular species across the more protected, low elevation coastal plains. Tussock tundra is widespread and characterized by a high abundance of

tussock-forming sedges in combination with low and dwarf shrubs. Shrub-dominated tundra without tussocks tends to be dominated by either mountain-avens, willow, or ericaceous species. Mountain-avens prostrate shrub tundra occurs in dry, windswept areas with little retention of snow; dwarf willow shrub tundra occurs in small patches on moderately exposed sites; and ericaceous shrub tundra commonly occurs on moderately protected mesic to moist sites. Mesic herbaceous tundra is an uncommon habitat type occupying small patches in areas of late-lying snow, seeps, and stream margins. Much of the Arctic is underlain by continuous permafrost, and where soils are ice-rich, periglacial processes are common. These range in scale from cryoturbation and solifluction to thaw slumping (down-slope debris slides) and the development of patterned ground. Where sediment is well-drained with low interstitial ice volumes, the effects of permafrost are negligible.

Arctic tundra is the most abundant terrestrial habitat statewide covering 149,496 square miles (25.8%) of Alaska (Table 6.1). These tundra habitats can provide high- and moderate-value habitat for a large number (110) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is high and ranks 3rd among the 41 habitats assessed (Table 6.3). By far, the Western region has the greatest wildlife species richness, with 78 SCGN (see table above). Species richness values drop in the Southwest, Northern, and Central regions to 57, 53, and 52, respectively, and drop again in the Southcentral region to 32. Arctic tundra does not occur in the Southeast region.

Statewide, the single amphibian SGCN that can regularly occupy Arctic tundra is the wood frog. Thirty-four mammal SGCN can routinely occur in these habitats, including these characteristic species: Alaska hare, Alaska marmot, hoary marmot, seven subspecies of Arctic ground squirrels, and a suite of lemming, mice, vole, and shrew species. A total of 75 avian SGCN can consistently use Arctic tundra habitats, including Willow Ptarmigan, Rock Ptarmigan, dozens of passerines (e.g., American Pipit, Arctic Warbler, Bluethroat, Golden-crowned Sparrow, Horned Lark, Lapland Longspur, Northern Wheatear, Red-throated Pipit, Smith's Longspur, Snow Bunting, White-crowned Sparrow), and raptors (e.g., Gyrfalcon, Short-eared Owl, Snowy Owl). Several seabirds (e.g., Kittlitz's Murrelet, Long-tailed Jaeger, Parasitic Jaeger), a large number of shorebirds (e.g., American Golden-plover, Bar-tailed Godwit, Buff-breasted Sandpiper, Long-billed Dowitcher, Pectoral Sandpiper, Red Knot, Red-necked Stint, Semipalmated Sandpiper, Surfbird, Upland Sandpiper, Wilson's Snipe, Western Sandpiper, Whimbrel) and waterbirds (e.g., Taverner's Cackling Goose, King Eider, Long-tailed Duck, Northern Pintail, Sandhill Crane) can also breed and forage in Arctic tundra.

Figure 6.20. Distribution of Arctic tundra in Alaska. M. Geist, ACCS.

Cliff, Scree, and Rock

Temperate Cliff, Scree, & Rock Vegetation

USNVC Synonym: Western North American Cliff, Scree, & Rock Vegetation

ACCS.

Biogeographic region	Species richness
Central	11
Northern	0
Southcentral	15
Southeast	10
Southwest	16
Western	0

Temperate cliff, scree, and rock vegetation occurs in exposed settings throughout the Southeast and Southcentral biogeographic regions and extends into the Central and Southwest regions where they overlap with the Alaska and Aleutian ranges (Figure 6.21). These sparsely vegetated habitats develop on scree, talus, outcrops, cliffs, and bedrock shields. Plants establish in protected microsites, and communities range from lichen-encrusted bedrock to a sparse cover of graminoids, dry-site mosses, and fruticose lichens. Prostrate shrubs and wind- and cold-adapted forbs are occasional components. Sites are regularly exposed to the disturbances of wind, substrate and snow creep, and freeze-thaw action. On mountain summits where woody vegetation is advancing due to a warming climate, the extent of high-alpine rocky habitat is expected to be reduced.

Temperate cliff, scree, and rock vegetation covers 11,158 square miles (1.9%) of Alaska (Table 6.1). Cliff, scree, and rock vegetation in the temperate zone statewide can provide high- and moderate-value habitat for only a small number (16) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is low and ranks 33rd, which is second to last in richness

among the 41 habitats assessed (due to seven tied ranks; Table 6.3). The Southwest and Southcentral regions have the greatest wildlife species richness in temperate cliff, scree, and rock habitats, with richness values of 16 and 15, respectively (see table above). Richness values drop in the Central and Southeast regions to 11 and 10, respectively, and these rocky habitats have not been mapped in the other two biogeographic regions.

The terrestrial species that can use these harsh rocky environments have adapted to survive in difficult conditions with limited vegetation and cover. Statewide, collared pika and hoary marmot are the two characteristic mammal SGCN that can be regularly associated with this habitat. A total of 14 avian SGCN can also occur consistently in this habitat type, including these characteristic species: Rock Ptarmigan, Northern Wheatear, Snow Bunting, Golden Eagle, Gyrfalcon, Peregrine Falcon, Rough-legged Hawk, Surfbird, and Kittlitz's Murrelet. The Black Swift is another avian SGCN that can use this habitat type in Southeast Alaska.

Figure 6.21. Distribution of temperate cliff, scree, and rock vegetation in Alaska. M. Geist, ACCS.

Boreal Cliff, Scree, and Rock Vegetation

USNVC Synonym: North American Boreal Cliff, Scree, & Rock Vegetation

A, Underwood, ADF&G.

Biogeographic region	Species richness
Central	34
Northern	11
Southcentral	15
Southeast	0
Southwest	13
Western	12

Boreal cliff, scree, and rock vegetation occurs primarily in exposed settings throughout the Central, Southcentral, and Southwest biogeographic regions; this habitat has also been mapped in the Western and Northern regions (Figure 6.22). The nature of this sparsely vegetated habitat and the factors driving its establishment and maintenance in rocky terrain are the same as described above under the "Temperate Cliff, Scree, and Rock Vegetation" section.

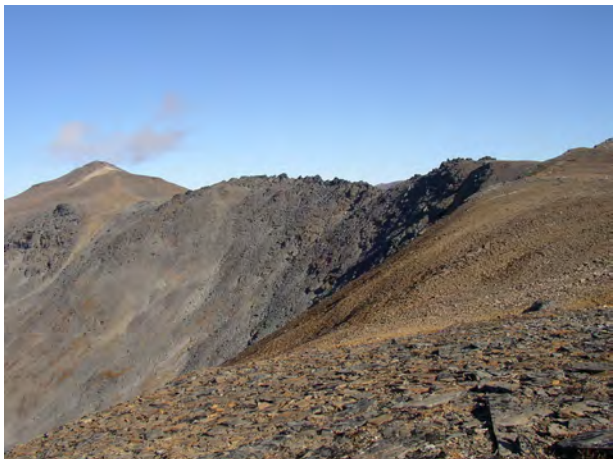
Boreal cliff, scree, and rock vegetation covers 14,225 square miles (2.5%) of Alaska (Table 6.1). Cliff, scree, and rock vegetation in the boreal zone statewide can provide high- and moderate-value habitat for 19 wildlife SGCN that have adapted to harsh conditions with limited vegetation and cover. Across all terrestrial and marine habitats evaluated, this species richness number is low and ranks 32nd (3rd from last) among the 41 habitats assessed (due to seven tied ranks; Table 6.3). The Southcentral and Central regions have the greatest wildlife species richness in boreal cliff, scree, and rock habitats, with richness values of 15 and 14, respectively (see table above). The richness numbers in the Southwest, Western, and Northern regions, however, are only slightly lower (13, 12, and 11, respectively). These boreal rocky habitats have not been mapped in the Southeast region.

Statewide, the three characteristic mammal species that can occur regularly in boreal cliff, scree, and rock vegetation are collared pika, little brown myotis, and Alaska marmot. This habitat type also can also be used regularly by 16 avian species, such as these characteristic species: Rock Ptarmigan, Snow Bunting, Northern Wheatear, Horned Lark, Golden Eagle, Gyrfalcon, Rough-legged Hawk, Peregrine Falcon, Gray-crowned Rosy Finch, and Kittlitz's Murrelet. Wandering Tattler is also considered to use this habitat regularly in the Western region.

Figure 6.22. Distribution of boreal cliff, scree, and rock vegetation in Alaska. M. Geist, ACCS.

Arctic Cliff, Scree, and Rock Vegetation

USNVC Synonym: Arctic Scree, Rock, & Cliff Barrens



ACCS.

Biogeographic region	Species richness
Central	17
Northern	17
Southcentral	13
Southeast	0
Southwest	19
Western	26

Arctic cliff, scree, and rock vegetation occurs in exposed settings north of the latitudinal treeline in the Northern biogeographic region and beyond the longitudinal extent of treeline in Western and Southwest Alaska (Figure 6.23). The type has also been mapped sparingly in the Southcentral and Central regions. The nature of this habitat and the factors driving the establishment and maintenance of these sparsely vegetated habitats in rocky terrain are the same as described above under the "Temperate Cliff, Scree, and Rock Vegetation" section. Where permafrost is ice-rich in Arctic settings, soils in this habitat are susceptible to solifluction and cryoturbation.

Arctic cliff, scree, and rock vegetation covers 12,005 square miles (2.1%) of Alaska (Table 6.1). Cliff, scree, and rock habitats in Arctic settings in all regions combined have higher terrestrial species richness than similar rocky habitats in temperate and boreal areas. These Arctic rocky habitats can provide high- and moderate-value habitat for 34 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is low and ranks 29th among the 41 habitats assessed (Table 6.3). The Western region has notably greater wildlife species richness in Arctic cliff, scree, and rock habitats than the other biogeographic regions, with a richness value of 26 (see table above). Richness numbers drop in the Southwest, Central, Northern, and Southcentral regions to 19, 17, 17, and 13 SGCN, respectively. Arctic rocky habitats do not occur in the Southeast region.

Statewide, 11 characteristic mammal SGCN such as Alaska marmot, hoary marmot, six subspecies of Arctic ground squirrels, singing vole, and St. Lawrence Island shrew can occur regularly in these rocky habitats. Twenty-three avian SGCN can also consistently occur in this habitat, including these characteristic species: Rock Ptarmigan, Northern Wheatear, American Pipit, Horned Lark, Snow Bunting, Long-tailed Jaeger, American Golden-plover, and in the Southwest and Western regions, Kittlitz's Murrelet. In the Western region, other species, such as McKay's Bunting and Red Knot can regularly use this habitat type. Several raptor species use this habitat during the breeding season, including Golden Eagle, Rough-legged Hawk, Gyrfalcon, and Peregrine Falcon.

Figure 6.23. Distribution of Arctic cliff, scree, and rock vegetation in Alaska. M. Geist, ACCS.

Coastal Habitats

Temperate Salt Marsh

USNVC Synonym: North American Pacific Coastal Salt Marsh

Alaska ShoreZone.

Biogeographic region	Species richness
Central	0
Northern	0
Southcentral	43
Southeast	39
Southwest	40
Western	34

Temperate salt marshes occur in coastal settings primarily in the Southeast, Southcentral, and Southwest biogeographic regions (Figure 6.24). This habitat has also been mapped sparingly in the Western region. Tides regularly inundate these gently sloping areas, which are consequently vegetated by salt-tolerant forbs and graminoids. Low marsh areas are subject to twice-daily tidal inundation and often support a sparse cover of herbaceous species on mudflats. At the seaward margin of vegetation, the salt-loving creeping alkaligrass colonizes bare mud. Moving inland, dominance transitions to Nootka alkaligrass and succulent, annual forbs (e.g., Danish scurvygrass, saltmarsh starwort, seaside arrowgrass, goose tongue). The mid-marsh occupies the reach of land inundated only at the highest tides. It typically supports dense swards of Lyngbye's or Ramensk's sedge with largeflower speargrass occupying higher or more well-drained ground. The high marsh ranges from the level of seasonal high tides to the maximum reach of storm surges and salt spray.

Accordingly, there is a general shift to species with minimal tolerance of saline conditions, such as dunegrass, Bering's tufted hairgrass, red fescue, and low shrubs (e.g., sweetgale, dune willow). Due to their landscape position, salt marshes are highly susceptible to impacts from development, oil spills, sea level rise, and earthquake-induced slides and tsunamis.

Temperate salt marsh covers only 244 square miles (<0.1%) of Alaska (Table 6.1). Salt marshes in the temperate zone statewide can provide high- and moderate-value habitat for 66 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderately high and ranks 14th (tied with boreal floodplain forest) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in temperate salt marshes occurs in the Southcentral, Southwest, and Southeast regions, with richness values of 43, 40, and 39 respectively (see table above). Richness drops to 34 SGCN in the Western region. Temperate salt marshes do not occur in Central and Northern regions.

Salt marshes can provide high-quality foraging habitat for shorebirds, seabirds, and some mammals and are available in early spring when other habitats are still snow covered. Statewide, 10 mammal SGCN can regularly use temperate salt marshes, including these characteristic species: little brown myotis, silver-haired bat, muskrat, North American river otter, and various small mammal species. A total of 56 avian SGCN can forage or nest in salt marsh habitats including a large number of shorebirds (see below), passerines (e.g., Black Swift, Savannah Sparrow, Song Sparrow), raptors (e.g., Short-eared Owl, Northern Hawk-owl), seabirds (e.g., Aleutian Tern, Glaucous Gull, Glaucous-winged Gull, Herring Gull, Short-billed Gull), and waterbirds (e.g., Tule Greater White-fronted Goose, Northern Pintail, Sandhill Crane). Twenty-seven shorebird SGCN can occur consistently in this habitat type, including these characteristic species: American Golden-Plover, Black-bellied Plover, Black Turnstone, Dunlin, Greater Yellowlegs, Hudsonian Godwit, Least Sandpiper, Lesser Yellowlegs, Long-billed Dowitcher, Marbled Godwit, Pectoral Sandpiper, Red Knot, Red-necked Phalarope, Rock Sandpiper, Semipalmated Sandpiper, Sharp-tailed Sandpiper, Short-billed Dowitcher, Western Sandpiper, and Whimbrel. Of the aquatic SGCN, crabs are prevalent in temperate salt marshes.

Figure 6.24. Distribution of temperate salt marsh in Alaska. M. Geist, ACCS.

Temperate Intertidal Vegetation

USNVC Synonym: Temperate Pacific Seaweed Intertidal Vegetation and Temperate Pacific Seagrass Intertidal Vegetation

Alaska ShoreZone.

Biogeographic region	Species richness
Central	0
Northern	0
Southcentral	33
Southeast	25
Southwest	33
Western	25

Temperate intertidal vegetation occurs in coastal settings primarily in the Southeast, Southcentral, and Southwest biogeographic regions. This habitat has also been mapped sparingly in the Western region (Figure 6.25). This habitat type is dominated by seaweed, vascular plants, and lichens that are tolerant of periodic inundation by saltwater. The vertical distribution of vegetation is influenced by tidal regime, with species establishing in relation to their saltwater tolerance. The low intertidal zone, which may only be exposed once a day, is often vegetated with a band of scouler's surfgrass or eelgrass, which is an important source of food for species such as Emperor and Pacific Black Brant Geese during migration and the nonbreeding season. The mid-intertidal zone commonly supports brown kelps, brown rockweed, and green and red seaweeds. Marine lichens form bands in the high-intertidal to supratidal zone. Black seaside lichen forms the lowest band, indicating the wave break zone. White and orange seaside lichens may form bands in the higher, supratidal zone (above the mean high-water level), which is exposed to storm surge and salt spray. Intertidal vegetation is exposed to daily inundation of saline water, wave action, and, at times, extreme wind and cold. Herbivory by invertebrates can strongly impact intertidal areas; for example, sea urchin grazing on kelp can completely depopulate an area of macroalgae. In some protected inlets of Southeast Alaska, oyster and kelp mariculture occur in the subtidal but may impact the adjacent intertidal zone. Due to their topographic position, intertidal zones are highly susceptible to impacts from oil spills, sea level rise, and earthquake-induced slides and tsunamis. They can also be impacted by coastal infrastructure.

Temperate intertidal vegetation covers only 68 square miles (<0.1%) of Alaska (Table 6.1). Intertidal zones in the temperate zone statewide can provide high- and moderate-value habitat for 46 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderately low and ranks 25th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness for temperate intertidal vegetation occurs in the Southcentral and Southwest regions, with a richness value of 33 for both regions (see table above). Richness values drop in the Southeast and Western regions to 25 SGCN in both regions. Temperate intertidal vegetation does not occur in the Central and Northern regions.

Statewide, two subspecies of North American river otter and 44 avian SGCN can routinely use this habitat. Avian SGCN that can use intertidal vegetation include Glaucous-winged Gull, Herring Gull,

Short-billed Gull, Peregrine Falcon, and Black Merlin in the Southeast region and Emperor Goose in the Southwest region. The intertidal habitats of coastal Alaska provide important food resources in the form of mollusks, crustaceans, worms, and biofilm for large numbers of shorebirds during spring and fall migration. Shorebird SGCN that can regularly use these intertidal habitats include these characteristic species: Black Oystercatcher, American Golden-Plover, Black-bellied Plover, Pacific Golden-Plover, Marbled Godwit, Hudsonian Godwit, Bar-tailed Godwit, Whimbrel, Black Turnstone, Ruddy Turnstone, Red Knot, Semipalmated Sandpiper, Western Sandpiper, Pectoral Sandpiper, Rock Sandpiper, Dunlin, Long-billed Dowitcher, Short-billed Dowitcher, Greater Yellowlegs, and Lesser Yellowlegs. Additional avian species that can use this habitat include American Pipit, Snow Bunting, Black Scoter, Dusky Canada Goose, and Tule Greater-white Fronted Goose. Of the aquatic SGCN, crabs and sea stars are commonly found in intertidal zones.

Figure 6.25. Distribution of temperate intertidal vegetation in Alaska. M. Geist, ACCS.

Arctic Salt Marsh

USNVC Synonym: Arctic Tidal Salt Marsh

M. Flemming, ACCS.

Biogeographic region	Species richness
Central	0
Northern	43
Southcentral	0
Southeast	0
Southwest	45
Western	57

Arctic salt marsh occurs in coastal settings primarily in the Northern and Western biogeographic regions, and this habitat has also been mapped sparingly in the Southwest region (Figure 6.26). Salt marshes are subject to regular tidal inundation and are dominated by salt-tolerant forbs

and graminoids. Vegetation communities vary depending on the frequency and duration of tidal inundation. Along coastlines that are not rising or falling, the vegetation pattern is zonal, with plants establishing according to their tolerance to salinity and inundation. Along coastlines experiencing subsidence and erosion due to thermokarst, the vegetation pattern can be a relict of the preexisting, nontidal habitat type. In the low marsh, mudflats are dominated by the clonal, halophytic graminoids creeping alkaligrass and Hoppner's sedge, along with the halophytic, succulent forbs saltmarsh starwort and Danish scurvygrass. In sheltered lagoons and brackish estuaries, the mid-marsh may support a continuous cover of emergent vegetation with the salt-tolerant herbs pendantgrass, Fisher's tundragrass, fourleaf mare's tail, and Ramensk's sedge. Along higher ground exposed only to storm surge and salt spray, prostrate oval-leaf willow and herbs with minimal salt tolerance are common. Arctic salt marshes are regularly inundated by storm surges, which flood low-lying inland tundra. Permafrost degradation and an increase in ice-free days have exposed the coastline to coastal erosion, ice-rafting, and storm surges for a greater period of time, thereby exacerbating the cumulative impacts of these processes.

Arctic salt marsh covers only 2,856 square miles (0.5%) of Alaska (Table 6.1). Salt marshes in the Arctic, however, can provide high- and moderate-value habitat for a relatively large number (74) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is relatively high and ranks 10th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness for Arctic salt marsh habitats occurs in the Western region, with a richness value of 57 (see table above). Richness numbers drop in the Southwest and Northern regions to 45 and 43 SGCN, respectively. Arctic salt marshes do not occur in the other three biogeographic regions.

Arctic salt marshes can provide breeding and foraging habitats for a diversity of wildlife species, particularly shorebirds, seabirds, and waterbirds. Statewide, 63 avian SGCN can use this habitat type to forage and nest during the short snow-free season in Alaska. Characteristic bird taxa include passerines (e.g., Lapland Longspur, Savannah Sparrow), raptors (e.g., Peregrine Falcon), seabirds (e.g., Aleutian Tern, Arctic Tern, Glaucous Gull, Long-tailed Jaeger, Parasitic Jaeger, Pomarine Jaeger, Glaucous-winged Gull, Sabine's Gull, Short-billed Gull), and shorebirds. This highly productive coastal habitat is important to many of Alaska's shorebirds (e.g., Black-bellied Plover, Pacific-Golden Plover, Whimbrel, Bar-tailed Godwit, Black Turnstone, Ruddy Turnstone, Dunlin, Rock Sandpiper, Pectoral Sandpiper, Semipalmated Sandpiper, Western Sandpiper, Long-billed Dowitcher, Red-necked Phalarope, Red Phalarope, Wilson's Snipe). Additional bird species that use Arctic salt marshes include waterbirds (e.g., Black Brant, Cackling Goose, Emperor Goose, King Eider, Long-tailed Duck, Northern Pintail, Red-throated Loon, Spectacled Eider, Yellow-billed Loon). The wood frog along with 10 mammal SGCN can also regularly use this habitat type, including these characteristic species: Alaska hare, Arctic fox, muskrat, Nearctic brown lemming, and barren ground shrew. Of the aquatic SGCN, crabs are prevalent in Arctic salt marshes.

Figure 6.26. Distribution of Arctic salt marsh in Alaska. M. Geist, ACCS.

Temperate Coastal Beach and Dune

USNVC Synonym: Pacific Coastal Beach & Dune

A. Underwood, ADF&G.

Biogeographic region	Species richness
Central	0
Northern	0
Southcentral	45
Southeast	41
Southwest	50
Western	0

Temperate beaches and dunes occur in coastal settings in the Southeast and Southcentral biogeographic regions and extend into the Southwest region through Bristol Bay (Figure 6.27). These habitats are sparsely vegetated grasslands and herbaceous meadows occupying the elevational range from the upper intertidal zone to the inland extent of salt spray. Plant species diversity tends to increase with substrate stability and distance from the tideline. Mobile, lower beach substrates are commonly vegetated by seaside sandplant, dunegrass, seaside ragwort, oysterleaf, and beach pea. Along the upper beach, there are additional grasses, such as red fescue, meadow barley, largeglume bluegrass, largeflower speargrass, Pacific reedgrass, and Bering's tufted hairgrass. Stable beach meadow communities are complimented by a diversity of herbs, including cowparsnip, Scottish licorice-root, Pacific hemlock parsley, seacoast angelica, and salt-tolerant sedges (e.g., largehead sedge, Gmelin's sedge, Mackenzie's sedge, longawned sedge). Sitka spruce saplings may establish in meadows that are out of the range of storm surges and salt spray due to isostatic rebound or regional tectonics. Owing to their topographic position, dunes and beaches are highly susceptible to impacts from oil spills and human use.

Temperate coastal beach and dune covers only 65 square miles (<0.1%) of Alaska (Table 6.1). Beaches and dunes in the temperate regions statewide can provide high- and moderate-value habitat for 69 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderately high and ranks 12th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in temperate coastal beach and dune habitats occurs in the Southwest region, with a richness value of 50 (see table above). Richness is notably lower in the Southcentral and Southeast regions, with values of 45 and 41, respectively. Temperate beaches and dunes do not occur in the Western, Central, and Northern regions.

Statewide, 50 avian SGCN can regularly use these coastal habitats, including shorebirds, seabirds, waterfowl, passerines, and raptors. Shorebird species that can occur in this habitat include these characteristic species: American Golden-Plover, Black-bellied Plover, Pacific-golden Plover, Killdeer, Marbled Godwit, Hudsonian Godwit, Whimbrel, Black Turnstone, Ruddy Turnstone, Red Knot, Surfbird, Sanderling, Semipalmated Sandpiper, Western Sandpiper, Spotted Sandpiper, Least Sandpiper, Rock Sandpiper, Dunlin, Short-billed Dowitcher, Wilson's Snipe, Greater Yellowlegs, and Lesser Yellowlegs. Many gulls and terns (e.g., Aleutian Tern, Glaucous-winged Gull, Short-billed Gull, Herring Gull) depend on beaches and dunes for primary nesting and foraging habitat. Waterbird species that can regularly use this habitat include Black Brant, Aleutian Cackling Goose, Emperor Goose, Northern Pintail, and Sandhill Crane. Several passerines (e.g., Bank Swallow, Lapland Longspur, Savannah Sparrow) and raptors (e.g., Bald Eagle, Short-eared Owl, Snowy Owl) can use this habitat type regularly. All five amphibian SGCN (Columbia spotted frog, long-toed salamander, northwestern salamander, western toad, and wood frog) can also use these habitats. Fifteen mammal SGCN can also regularly use this habitat type including these characteristic species: root voles, little brown myotis, silver-haired bat, North American river otter, Arctic ground squirrel, and cinereus shrew.

Figure 6.27. Distribution of temperate coastal beach and dune in Alaska. M. Geist, ACCS.

Temperate Coastal Cliff and Bluff

USNVC Synonym: Pacific Coastal Cliff & Bluff

A. Underwood, ADF&G.

Biogeographic region	Species richness
Central	0
Northern	0
Southcentral	30
Southeast	22
Southwest	40
Western	0

Temperate coastal cliff and bluff habitat occurs in the Southeast and Southcentral biogeographic regions and extends into the Southwest region through the Kodiak Island Archipelago and the southern coast of the Alaska Peninsula (Figure 6.28). See also the description of "Marine Habitat, Mainland and Island Cliffs and Bluffs," which occurs in all three oceanic regions. This habitat type forms sparse yet diverse plant communities on sea cliffs, bluffs, scree slopes, and rocky coastlines exposed to salt spray and ocean wave action. Vascular plants typically have some salt tolerance, and communities consist of creeping and succulent forbs, low grasses, dwarf shrubs, and stunted trees. These plants are restricted to small cracks in rock or slight, sheltered depressions. Lichen and moss cover tends to be high in this habitat type. Sitka spruce tolerates salt spray, and stunted individuals may grow from cracks in rocky headlands. Exposure to wave, wind, and sheet erosion may create unstable substrates subject to failure.

Temperate coastal cliff and bluff covers only 20 square miles (<0.1%) of Alaska (Table 6.1). Coastal cliffs and bluffs in the temperate zone are the least species-rich of the coastal habitats and can provide high- and moderate-value habitat for 42 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderately low and ranks 27th (tied with offshore marine waters) among the 41 habitats assessed (Table 6.3). By far, the highest wildlife species richness in temperate coastal cliff and bluff habitats occurs in the Southwest region, with a richness value of 40 (see table above). Richness numbers are dramatically lower in the Southcentral and Southeast regions, with values of 30 and 22, respectively. Temperate coastal cliffs and bluffs do not occur in the Central region and have not been mapped in the Western and Northern regions.

Coastal cliffs and bluffs provide important nesting habitat and protection from predators for numerous seabirds that are obligate breeders in this habitat type. Statewide, these cliffs and bluffs provide habitat for one mammal SGCN (North American river otter) and 41 avian SGCN. Seabirds that can be regularly associated with this habitat include several species of auklets, murres, puffins, kittiwakes, gulls, storm-petrels, and cormorants, as well as Aleutian Tern, Pigeon Guillemot, and Northern Fulmar. Shorebird SGCN that can use temperate coastal cliff and bluff include these characteristic species: Black Oystercatcher, Black Turnstone, Rock Sandpiper, Ruddy Turnstone, Semipalmated Sandpiper, Sanderling, Surfbird, and Wandering Tattler. Several passerines (e.g., Gray-crowned Rosy Finch, Snow Bunting, Bank Swallow), geese (Aleutian Cackling Goose and Emperor Goose), and raptors (e.g., Gyrfalcon, Peregrine Falcon) can also use this habitat type.

Figure 6.28. Distribution of temperate coastal cliff and bluff in Alaska. M. Geist, ACCS.

Arctic Coastal Shore

USNVC Synonym: North American Arctic Coastal Shore

A. Underwood, ADF&G.

Biogeographic region	Species richness
Central	0
Northern	10
Southcentral	35
Southeast	0
Southwest	36
Western	26

Arctic coastal shore habitats occur in the Northern and Western biogeographic regions and extend into the Southwest region through Bristol Bay (Figure 6.29). The habitat has also been mapped sparingly in the Southcentral region. These habitats are sparsely vegetated grasslands and herbaceous meadows above the maximum reach of high tides. While not regularly inundated, these habitats are exposed to wind, salt spray, storm surges, and rafted ice. Plant species diversity tends to increase with substrate stability and distance from the tideline. Mobile, lower beach substrates are commonly vegetated by seaside sandplant, dunegrass, beach pea, and oysterleaf. More stable upper beach and dune communities may include grasses (e.g., Lapland reedgrass, red fescue, Bering's tufted hairgrass) and forbs (e.g., boreal yarrow, boreal sagebrush, Tilesius' wormwood, Pacific hemlock parsley, Lake Huron tansy). Permafrost degradation and an increase in ice-free days in Northern and Western regions of Alaska have exposed the coastline to coastal erosion, ice-rafting, and storm surges for a greater period of time, thereby exacerbating the cumulative impacts of these processes. Off-road vehicle use along beaches is frequent near villages and towns.

Arctic coastal shore covers only 191 square miles (<0.1%) of Alaska (Table 6.1). Arctic coastal shore habitats statewide can provide high- and moderate-value habitat for 52 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 21st (tied with temperate fen) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in Arctic coastal shore habitats occurs in the Southwest and Southcentral regions, with richness values of 36 and 35, respectively (see table above). Richness numbers drop in the Western region to 26 SGCN and drop again to 10 in the Northern region. Arctic coastal shore habitats do not occur in the Central and Southeast regions.

Arctic coastal shore habitats provide important foraging and breeding grounds for seabirds, shorebirds, and waterbirds. Statewide, the 47 avian SGCN that can regularly use this habitat include several species of gulls and terns (e.g., Glaucous Gull, Glaucous-winged Gull, Short-billed Gull, Aleutian Tern), shorebirds (e.g., Dunlin, Sanderling), and waterbirds (e.g., King Eider, Pacific Common Eider, Long-tailed Duck). McKay's Bunting, Song Sparrow, Gyrfalcon, Snowy Owl, and several other species of passerines and raptors can also occur regularly in this habitat. Five mammal SGCN can be associated with this habitat type, including Arctic fox, Arctic ground squirrel, root vole, barren ground shrew, and in the Western region, Pribilof Island shrew.

Figure 6.29. Distribution of Arctic coastal shore in Alaska. M. Geist, ACCS.

Freshwater Aquatic Habitats

Rivers and Streams

ACCS.

Biogeographic region	Species richness
Central	24
Northern	22
Southcentral	25
Southeast	29
Southwest	24
Western	31

Alaska's flowing waters range from small, ephemeral streams to intermittent or groundwater-fed channelized rivers, as well as large, braided glacial and meandering systems. Perennial rivers and streams support numerous aquatic species, including both anadromous and resident fish. Mainstems and tributaries provide critical spawning, rearing, and overwintering habitats, with the type and ratio of substrate materials determining habitat suitability for aquatic species during different life stages. Rivers and streams can be broadly categorized as glacial and nonglacial. Glaciers feed into nearly all major rivers in Alaska and provide the headwaters to some of the state's largest rivers. In these rivers, the glacial input determines the chemical and physical characteristics of the water, depending on the extent of glacial input relative to other inputs, such as snowmelt and groundwater. Glacial meltwater has high levels of bioavailable nutrients, which fuel high, sustained levels of primary productivity. These waters also have seasonally variable levels of instream flow and channel adjustments from erosional and depositional processes are common. Nonglacial, or clearwater rivers and streams exhibit low turbidity, high clarity, and flow derived primarily from groundwater and precipitation. Different from glacial waterways, clearwater systems have less variable interannual flow, relatively narrower channel widths, stable and well-defined beds and banks, low sediment loads, and increased habitat complexity in the form of pools, riffles, runs, and large woody debris. Overwintering habitat for anadromous fish in clearwater streams can be reduced due to the smaller volume of water available; however, upwelling in groundwater-fed streams and perennial spring pools provide some of Alaska's most important winter habitats for freshwater aquatic species.

Although rivers and streams are not mapped in the Alaska Vegetation Map data (Nawrocki et al. 2025) used to determine the areal coverage of wildlife habitats in Alaska, these are important habitats for wildlife. Statewide, rivers and streams can provide high- and moderate-value habitat for 53 amphibian, bird, and mammal SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 20th (tied with agricultural and developed lands) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in rivers and streams occurs in the Western and Southeast regions, with richness values of 31 and 29, respectively (see table above). The notably lower species richness numbers in rivers and streams in the other four biogeographic regions are strikingly similar, ranging from 25 to 22.

Statewide, the three species of amphibians that can regularly use rivers and streams are Columbia spotted frog, western toad, and wood frog. Thirty-two avian species can consistently occur in or forage above this habitat type, including Bank Swallow, Black Swift, Tree Swallow, Bald Eagle, and obligate riverine species (e.g., Harlequin Duck). Numerous species of gulls, terns, shorebirds, and waterbirds also depend on flowing waters. The 18 mammal species that can regularly use flowing waters or the aerial space occupied by insects above streams include bats (e.g., little brown myotis, California myotis, long-eared myotis, long-legged myotis, silver-haired bat), muskrat, North American river otter, and several small mammals (e.g., taiga vole, cinereus shrew, tundra shrew, western water shrew, Glacier Bay water shrew). Because of a lack of comprehensive distribution data for all rivers in the state, fish and aquatic invertebrate SGCN were not included in the species richness assessment of this habitat; however, Alaska's rivers are teeming with aquatic life and provide habitat for almost all freshwater SGCN for at least part of their life cycles. Salmon and trout are prevalent throughout Alaska rivers and streams. Aquatic life stages of insects such as mayflies, stoneflies, caddisflies, and midges also occur in Alaska's rivers and are important food items for juvenile anadromous salmon and resident juvenile and adult trout.

Lakes and Ponds

ACCS.

Biogeographic region	Species richness
Central	33
Northern	34
Southcentral	41
Southeast	42
Southwest	46
Western	53

Alaska's lakes and ponds range from small alpine ponds underlain by bedrock to Arctic thermokarst lakes, as well as large bodies of water occupying glacial troughs carved during the Pleistocene. Lake and pond habitats vary with substrate, bathymetry, and shoreline contour. In the relatively still waters of lakes and ponds, flow regimes of inlets and outlets and basin contours influence nutrient cycling, hydraulic retention time, and biological productivity. Glacially carved lakes tend to be deep and bedrock-bound, with permanent surface water connections. Most of the state's larger lakes, particularly those in the Southwest and Southcentral regions, resulted from glaciation and are important to both resident and anadromous fish species for overwintering. For example, while Kenai Lake and Iliamna Lake differ in their glacial and nonglacial inputs, both are connected to rivers supporting large and valuable runs of salmon.

Unlike glacial lakes, lakes and ponds of thermokarst, fluvial, and volcanic origin generally lack connecting tributaries. These isolated waterbodies may instead be connected by seasonal surface or subsurface flow. For example, thermokarst ponds are often connected by the subsurface flow of groundwater over perennially frozen soil (permafrost) and through connections to deeper aquifers via taliks (areas of unfrozen ground in an otherwise frozen landscape). In the north, the depth of lakes and ponds is important for the survival of aquatic species. In general, waterbodies less than six feet deep will freeze to the bottom, leaving no free water for the survival of resident fish.

Although lakes and ponds are not mapped in the Alaska Vegetation Map data (Nawrocki et al. 2025) used to determine the areal coverage of wildlife habitats in Alaska, these are important habitats for wildlife. Lakes and ponds in Alaska can provide high- and moderate-value habitat for a relatively large number (86) of wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is relatively high and ranks 7th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in lakes and ponds occurs in the Western region, with a richness value of 53 (see table above). Richness numbers drop in the Southwest, Southeast, and Southcentral regions, with values of 46, 42, and 41, respectively. Richness numbers drop again in the Northern and Central regions to 34 and 33 SGCN, respectively.

Statewide, all five amphibian SGCN can use these habitats for foraging or breeding. Numerous seabirds (e.g., terns, gulls), waterbirds (e.g., geese, eiders, ducks, grebes, scoters, loons), and passerines (e.g., swallows, blackbirds) can heavily use lakes and ponds or the aerial space above them for foraging during the breeding season. Several bat species (e.g., little brown myotis, California myotis, long-eared myotis, long-legged myotis, silver-haired bat), and other mammals including muskrat, North American river otter, and small mammals (e.g., taiga vole, western water shrew, Glacier Bay water shrew) can also use lakes and ponds for foraging, breeding, or year-round habitat. Because of a lack of comprehensive distribution data for all Alaska lakes, fish and aquatic invertebrate SGCN were not included in the species richness assessment of this habitat. That said, while species assemblages differ by watershed, all freshwater aquatic SGCN can be found in Alaska lakes at least for part of their life cycles.

Freshwater Aquatic Vegetation

USNVC Synonym: Western North American Freshwater Aquatic Vegetation and Boreal Freshwater Aquatic Vegetation

ACCS.

Freshwater aquatic vegetation occurs in standing and slow-moving water throughout the state and occurs in the margins of lakes and ponds and rivers and streams. This habitat type consists of rooted, submerged, and free-floating herbaceous plants. Common species of plants, listed in order of increasing water depth preference from the littoral (nearshore) to limnetic (open water) zone include aquatic mosses, duckweed, buttercups, mare's tails, quillwort, water starwort, water mudwort, water alwort, bur-reeds, bladderworts, pondweeds, pond lilies, and watermilfoil. Shallow lakes and small ponds freeze to the bottom in the winter, while vegetation in larger lakes with sufficient fetch may be damaged by scour from wind-blown and rafted ice. In developed areas, increased concentrations of nitrogen and phosphorus may prompt a shift to eutrophic conditions and a subsequent change in plant community composition towards fast-growing plant and algal species. Such lakes are particularly susceptible to the establishment of the invasive aquatic waterweed *Elodea canadensis*. Although freshwater aquatic vegetation is not mapped in the Alaska Vegetation Map data used to delineate wildlife habitats in Alaska (Nawrocki et al. 2025) and wildlife species richness was not assessed for this habitat, many of the wildlife SGCN listed for lakes, ponds, and slow-moving rivers and streams are likely to use the vegetation resources this habitat provides.

Glacial Habitats

Perennial Snow, Ice, and Glacial Outwash

USNVC Synonyms: North American Glacier & Ice Field and North American Glacial Outwash

ACCS.

Biogeographic region	Species richness
Central	4
Northern	0
Southcentral	4
Southeast	4
Southwest	6
Western	0

Glaciers and perennial snow fields occur on mountain slopes and valleys in the Southeast, Southcentral, Southwest, and Central regions (Figure 6.30). Crevasses, seracs, and moulins are common glacial features. Ice fields are broad, ice-covered areas high in the mountains, typically on nearly level to strongly sloping gradients. Soils are generally nonexistent; however, on the lower reaches of glaciers, there is often a relatively thin veneer of very to extremely cobbly, stony, or bouldery glacier sediment over glacier ice. Vegetation is absent except in low-elevation ablation zones, where early-successional species can become established on thick till overlying glacial ice. Glacial outwash consists of recently deglaciated material at the terminus of and downstream of a receding glacier. Surface organics are typically absent or very thin and extremely patchy. Mineral soils are deep, rocky, and excessively drained. Vegetation is sparsely distributed but can include patches of early successional plants such as alder shrubs, Drummond's mountain avens, lichens, and bryophytes.

Perennial snow, ice, and glacial outwash covers 26,279 square miles (4.5%) of Alaska (Table 6.1). These glacial habitats statewide can provide high- and moderate-value habitat for only seven wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number ranks 34th and is the lowest among the 41 habitats assessed (due to seven tied ranks; Table 6.3). The wildlife species richness numbers in perennial snow, ice, and glacial outwash are highest in the Southwest, Southcentral, Southeast, and Central regions, with values ranging from six to four (see table above). These glacial habitats have not been mapped in the Western and Northern regions.

The sparse terrestrial vegetation associated with glacial habitats provides limited resources for wildlife. Statewide, the wildlife SGCN that can regularly use these glacial habitats includes two mammals (Alaska and hoary marmots) and five birds (Kittlitz's murrelet, Spotted Sandpiper, Wandering Tattler, Bank Swallow, and Gray-crowned Rosy Finch). Kittlitz's murrelets and harbor seals can forage regularly in the glacially influenced marine waters adjacent to freshwater glacial habitats.

Figure 6.30. Distribution of perennial snow, ice, and glacial outwash in Alaska. M. Geist, ACCS.

Human-Modified Habitats

Recently Disturbed or Modified

ACCS.

Biogeographic region	Species richness
Central	32
Northern	0
Southcentral	39
Southeast	44
Southwest	31
Western	16

Recently disturbed or modified habitats are broadly categorized as lands that have experienced wildland fire or logging within the last five years, which removes or reduces forest cover and resets plant succession (Figure 6.31). The structure and species composition of habitats following fire depends on the initial habitat type as well as the extent and severity of the most recent burn. Sites with severely burned substrates tend to support a greater density of herbaceous plants, broadleaf shrubs, seedlings, and trees that differ from the species that were dominant before fire. Sites with less severely burned substrates tend to be recolonized by resprouting from rootstocks of shrub and tree species that survived the burn. Herbs such as bluejoint reedgrass, Altai fescue, fireweed, and fire-associated liverworts and mosses are characteristic of the lower strata. Shrubs and trees capable of basal suckering (e.g., willow, birch, aspen, cottonwood) comprise the mid-level strata. Standing dead and downed trees can be common and may overtop live vegetation. Soils generally have a thin layer of surface organic material. Recently logged habitats are similar to recently burned habitats as they also represent an early successional phase in which the removal of the tree canopy allows colonization of ruderal forbs and graminoids. Similar to a severe wildfire, physical disturbance

associated with logging can result in removal of surface organic material and excessive erosion on sloped terrain.

Recently disturbed or modified areas cover 7,039 square miles (1.2%) of Alaska (Table 6.1). Disturbed areas statewide can provide high- and moderate-value habitat for 67 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderately high and ranks 13th among the 41 habitats assessed (Table 6.3). Wildlife species richness in recently disturbed or modified areas is highest in the Southeast region, with a richness value of 44 (see table above). Richness values are slightly lower in the Southcentral region (39) and then drop further in the Central, Southwest, and Western regions to 32, 31, and 16, respectively. These disturbed habitats have not been mapped in the Northern region.

Recently burned and logged areas provide various resources for wildlife with coarse woody debris and varying levels of overstory cover, depending on the degree of disturbance. Statewide, four amphibians, 42 birds, and 21 mammals can be regularly found in disturbed or modified areas. Columbia spotted frog, long-toed salamander, western toad, and wood frog are the amphibians that can use recently burned and logged habitats. Bird species that can consistently use these early successional habitats with standing dead trees include upland gamebirds (e.g., Sooty Grouse, Spruce Grouse, Willow Ptarmigan), woodpeckers (American Three-toed Woodpecker, Black-backed Woodpecker), passerines (e.g., American Tree Sparrow, Dark-eyed Junco, Savannah Sparrow, Western Wood Pewee), raptors (e.g., American Kestrel, Red-tailed Hawk, Short-eared Owl), and shorebirds (e.g., Killdeer, Greater Yellowlegs, Upland Sandpiper, Wilson's Snipe). Mammals that can be found in disturbed areas are silver-haired bat, American marten, snowshoe hare, and several species of mice, lemmings, voles, and shrews.

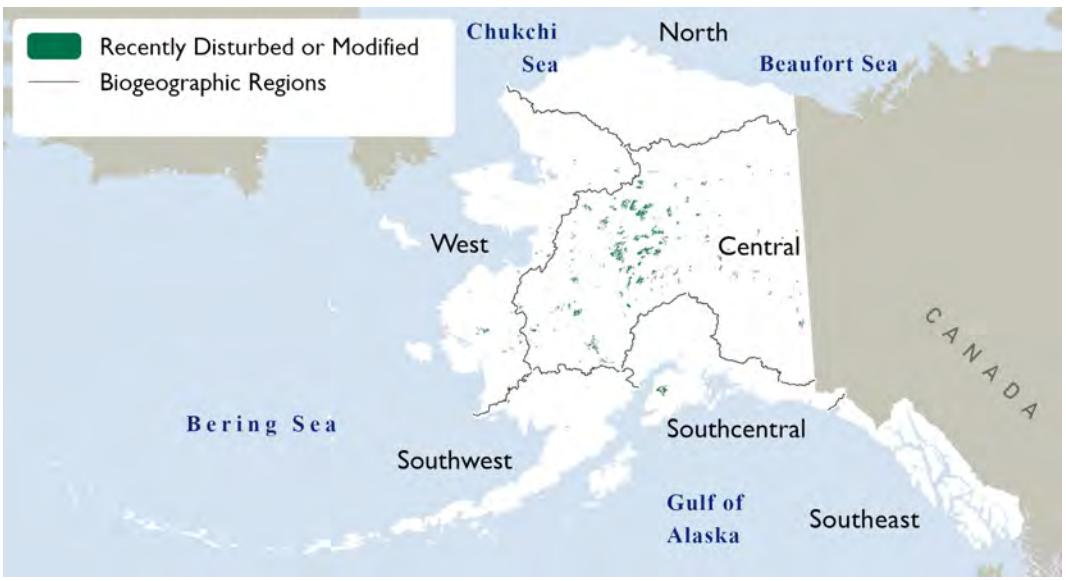


Figure 6.31. Distribution of recently disturbed or modified habitat in Alaska. M. Geist, ACCS.

Agricultural and Developed Lands

ACCS.

Biogeographic region	Species richness
Central	21
Northern	6
Southcentral	30
Southeast	36
Southwest	22
Western	17

Herbaceous agricultural vegetation includes areas of pasture, hay, or crops cultivated for livestock grazing or the production of annual or perennial crops (Figure 6.32). This class also includes all land being actively tilled. Developed lands are categorized by intensity of use and proportion of impervious substrates. High-intensity developed areas are where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial and industrial developments. In these areas, impervious surfaces account for 80% to 100% of the total land cover. Low-intensity developed areas have a mixture of constructed materials and vegetation. These areas most commonly include single-family housing units where impervious surfaces account for 20% to 49% of total cover. Moderately developed areas are characterized by a mixture of constructed materials and vegetation. These areas include single-family housing units where impervious surfaces account for 50% to 79% of the total land cover. Developed open spaces are characterized by vegetation in the form of lawn grasses with some constructed materials. Impervious surfaces account for less than 20% of the total land cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetics. Roads include improved and unimproved corridors designed for vehicle traffic. Impervious surfaces such as asphalt, concrete, or gravel account for 80% to 100% of the total land cover. Human-modified barrens are areas of bedrock, volcanic material, strip mines, gravel pits, and other accumulations of earthen material. In these areas, vegetation generally accounts for less than 15% of the total land cover.

Agricultural and developed lands cover only 912 square miles (0.2%) of Alaska (Table 6.1). Statewide, these lands can provide high- and moderate-value habitat for 53 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 20th (tied with rivers and streams) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in agricultural and developed lands occurs in the Southeast and Southcentral regions, with richness values of 36 and 30, respectively (see table above). Richness values drop in the Southwest, Central, and Western regions to 22, 21, and 17, respectively, and then drop further to six SGCN in the Northern region.

Agricultural lands provide habitat for many avian and mammal species that can use these areas during migration or the breeding season. Development intensity affects the wildlife use of these developed lands, but they can still support a number of wildlife SGCN. Statewide, all five of Alaska's amphibian SGCN can occur in agricultural and developed areas. A total of 34 avian SGCN can

regularly use these habitats, including these characteristic species: Barn Swallow, Boreal Chickadee, Common Raven, Lapland Longspur, Pine Siskin, Savannah Sparrow, Snow Bunting, Song Sparrow, Tree Swallow, Yellow-rumped Warbler, American Kestrel, Bald Eagle, Western Screech-Owl, Killdeer, Upland Sandpiper, Sandhill Crane, and five species of gulls. Fourteen mammal SGCN can occur consistently in these human-modified habitats including five species of bats and these characteristic and adaptable species: Arctic fox, northwestern deermouse, meadow jumping mouse, northern bog lemming, voles, and shrews.

Figure 6.32. Distribution of agricultural and developed lands in Alaska. M. Geist, ACCS.

Marine Habitats

As noted above, the eight broad-scale marine and intertidal habitat types described in this chapter were not mapped, but they were assessed for habitat-value and species richness for marine birds and mammals in the three oceanic regions surrounding Alaska.

Mainland and Island Mudflats

Alaska ShoreZone.

Oceanic region	Species richness
Beaufort-Chukchi Sea	24
Bering Sea	27
Gulf of Alaska	28

Mudflats develop along low-energy coastlines of Alaska's mainland and islands. Substrates are typically fine-grained sands and subject to regular tidal inundation. The sparse vegetation associated with mudflats is described in the "Arctic Salt Marsh" and "Temperate Salt Marsh" sections above.

In the three Alaska oceanic regions combined, intertidal mudflats can provide high- and moderate-value habitat for 33 wildlife SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is low and ranks 30th (tied with mainland and island rocky shores) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness for intertidal mudflats occurs in the Gulf of Alaska, with 28 SGCN (see table above). Species richness is similar in the Bering Sea and Beaufort-Chukchi Seas regions, with values of 27 and 24, respectively.

Statewide, mudflats can provide important migration staging areas during spring and fall and/or foraging habitat during the breeding season for 25 shorebird SGCN, including Whimbrel, Surfbird, Red Knot, Gray-tailed Tattler, eight species of sandpipers, four species of plovers, three species of godwits, two species of dowitchers, both species of turnstones, and both species of yellowlegs. Seven seabird and waterbird SGCN can occur in mainland and island mudflat habitats, including Aleutian Tern, Glaucous Gull, Glaucous-winged Gull, Herring Gull, Short-billed Gull, Parasitic Jaeger, and Steller's Eider. Mudflats (at high tide) can provide important foraging habitat for one marine mammal SGCN (Pacific harbor seal).

Mainland and Island Rocky Shores

Alaska ShoreZone.

Oceanic region	Species richness
Beaufort-Chukchi Sea	13
Bering Sea	30
Gulf of Alaska	26

Rocky shores develop along high-energy coastlines of Alaska's mainland and islands. Substrates are subject to regular tidal inundation and are characterized by boulders, pebbles, and pools of salty water. The vegetation associated with rocky shores is described in the "Temperate Intertidal Vegetation" section above.

In the three Alaska oceanic regions combined, rocky shores can provide high- and moderate-value habitat for 33 SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is low and ranks 30th (tied with mainland and island mudflats) among the 41 habitats assessed (Table 6.3). The highest wildlife species richness in rocky shore habitats is associated with the Bering Sea region, with a richness value of 30 (see table above). Richness drops slightly to 26 SGCN in the Gulf of Alaska and then drops to 13 SGCN in the Beaufort-Chukchi Seas region.

Statewide, 20 seabird and waterbird, eight shorebird, and five marine mammal SGCN can be regularly found using rocky shore habitats. Breeding seabird and waterbird SGCN that can consistently use rocky shores on islands include Cassin's Auklet, Dovekie, Fork-tailed Storm-petrel, Horned Puffin, Glaucous-winged Gull, Leach's Storm Petrel, Least Auklet, Pacific Common Eider, Parakeet Auklet, Pigeon Guillemot, Red-faced Cormorant, Tufted Puffin, and Whiskered Auklet. Two marine mammal species (northern fur seal and Steller sea lion) also consistently use rocky shore habitats on islands. Additional seabird and marine mammal SGCN that can inhabit rocky shore habitats include Black-legged Kittiwake, Common Tern, Glaucous Gull, Herring Gull, Pelagic Cormorant, Short-billed Gull, Parasitic Jaeger, northern sea otter, Pacific harbor seal, and Pacific walrus. Eight shorebird SGCN can consistently use rocky shore habitats, including Black Oystercatcher, Whimbrel, Surfbird, Rock Sandpiper, the 2 turnstone species, and both tattler species.

Mainland and Island Cliffs and Bluffs

Alaska ShoreZone.

Oceanic region	Species richness
Beaufort-Chukchi Sea	11
Bering Sea	22
Gulf of Alaska	18

Cliffs and bluff habitats are located immediately adjacent to the beach along the coastlines of Alaska's mainland and islands. While these habitats are subject to coastal processes such as wind, storm wave erosion, and salt spray, they are not subject to regular tidal inundation. The sparse yet diverse plant communities are described in the "Temperate Coastal Cliff and Bluff" section above.

These near-vertical habitats in the three Alaska oceanic regions combined provide protected nesting habitat for many species of seabirds. Coastal cliff and bluff habitats can provide high- and moderate-value habitat for 23 avian SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is low and ranks 31st among the 41 habitats assessed (Table 6.3). The highest wildlife species richness for coastal cliffs and bluffs occurs in the Bering Sea region, with a richness value of 22 (see table above). Richness drops slightly to 18 SGCN in the Gulf of Alaska region and drops further to 11 SGCN in the Beaufort-Chukchi Seas region.

Statewide, seabirds that can routinely use cliffs and bluffs for breeding on the mainland include Black-legged Kittiwake, Common Murre, Glaucous Gull, Glaucous-winged Gull, Herring Gull, Short-billed Gull, Horned Puffin, Kittlitz's Murrelet, Marbled Murrelet, Northern Fulmar, Pelagic Cormorant, Thick-billed Murre, and Tufted Puffin. Seabirds that can commonly nest on cliffs and bluffs on offshore islands include Black Guillemot, Cassin's Auklet, Crested Auklet, Dovekie, Least Auklet, Parakeet Auklet, Pigeon Guillemot, Red-faced Cormorant, Red-legged Kittiwake, and Whiskered Auklet.

Mainland and Island Cobble and Sand Beaches

Alaska ShoreZone.

Oceanic region	Species richness
Beaufort-Chukchi Sea	25
Bering Sea	34
Gulf of Alaska	25

Cobble and sand beaches develop along moderate-energy coastlines of Alaska's mainland and islands. Substrates are subject to regular tidal inundation and are characterized by cobbles and sand. The upper vegetated areas of cobble and sand beaches is described in the "Temperate Coastal Beach and Dune" section above.

Cobble and sand beaches in the three Alaska oceanic regions combined can provide high- and moderate-value habitat for 39 marine SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is low and ranks 28th among the 41 habitats assessed (Table 6.3). Wildlife species richness for cobble and sand beaches is highest in the Bering Sea region, with a richness value of 34 (see table above). Richness drops in the Gulf of Alaska and Beaufort-Chukchi Seas regions, with values of 25 SGCN in each region.

Statewide, 18 shorebird, 14 seabird and waterbird, and seven marine mammal SGCN can be regularly found using these beach habitats. Shorebird SGCN that can consistently use cobble and sand beaches include Black Oystercatcher, Marbled Godwit, Whimbrel, Surfbird, Red Knot, Red Phalarope, both species of turnstones, both species of tattlers, three species of plovers, and five species of sandpipers. Seabird and waterbird SGCN that can be found in this habitat include Black Guillemot, Parasitic Jaeger, Cassin's Auklet, Dovekie, both species of kittiwakes, three species of eiders, three species of gulls, and two species of terns. Cobble and sand beaches can provide important habitat for marine mammals such as the Pacific harbor seal, spotted seal, northern fur seal, Pacific walrus, Steller sea lion, and polar bear.

Nearshore Waters

ACCS.

Oceanic region	Species richness
Beaufort-Chukchi Sea	34
Bering Sea	53
Gulf of Alaska	48

Nearshore waters are relatively shallow marine waters that range from mean low tide to an average of approximately 65 feet deep. Nearshore waters generally extend from the shoreline to three nautical miles offshore and are under state management. Nearshore areas have greater variability in salinity, temperature, suspended sediment concentrations, and ice scouring than shelf or oceanic habitats. Wave energy is generally higher in nearshore waters than in deeper waters due to wave break. Winds, freshwater input, ice current patterns, and tides drive seasonal cycles of mixing and turnover in the water column. Depending on environmental conditions, the column may be strongly stratified during one season and strongly mixed during another. Freshwater from glacial rivers carries a heavy load of fine sediments that decrease light penetration and biological productivity in turbid areas.

Where waters with contrasting density, salinity, and other characteristics meet, floating debris and kelp may mark a ripline. Such boundary areas often support greater abundance of fish, birds, and marine mammals. Kelp forests growing in the nearshore habitat provide habitat structure, living substrate, cover, microhabitats, and primary productivity. Some kelp species are perennials; however, many are annuals that die back during the winter. Although the extent of these forests varies yearly, kelp contributes substantial primary productivity and habitat complexity to the marine ecosystem. The seasonal die-off contributes a strong pulse of detritus to the ecosystem during low-light winter months, supporting detritivores and upper trophic levels when primary productivity in the water column wanes. Lower intertidal eelgrass beds, which may also be considered part of the nearshore habitat, are discussed in the "Temperate Intertidal Vegetation" section above.

In the three Alaska oceanic regions combined, nearshore waters can provide high- and moderate-value habitat for 58 SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 18th among the 41 habitats assessed (Table 6.3). Nearshore waters in the Bering Sea and Gulf of Alaska have the highest marine wildlife species richness, with 53 and 48 SGCN, respectively (see table above). Marine species richness drops in the Beaufort-Chukchi Seas region, with a value of 34 SGCN.

Statewide, 41 avian and 17 marine mammal SGCN can be regularly found using nearshore waters. Nearshore waters can provide habitat for many seabird SGCN, such as Black-legged Kittiwake, Parasitic Jaeger, Black Guillemot, Pigeon Guillemot, Least Auklet, Crested Auklet, Whiskered Auklet, Red-faced Cormorant, Pelagic Cormorant, Aleutian Tern, Common Murre, Thick-billed Murre,

Glaucous Gull, Glaucous-winged Gull, Herring Gull, Short-billed Gull, Kittlitz's Murrelet, and Marbled Murrelet. Waterbird SGCN that can regularly use nearshore waters include Yellow-billed Loon, Red-throated Loon, Common Loon, Surf Scoter, King Eider, Pacific Eider, Common Eider, Spectacled Eider, Steller's Eider, Western Grebe, Red-necked Grebe, and Horned Grebe. Some of the marine mammal SGCN that can use nearshore waters include beluga, common minke whale, Dall's porpoise, harbor porpoise, humpback whale, northern sea otter, Pacific harbor seal, ringed seal, spotted seal, Steller sea lion, northern fur seal, Pacific walrus, and polar bear. Because of a lack of comprehensive distribution data, fish and aquatic invertebrate SGCN were not included in the species richness assessment of this habitat; however, nearshore waters are habitat for a variety of marine fishes such as herring, smelt, and salmon.

Species of Conservation Need: Polar bear *(Ursus maritimus)*

Polar bear (USFWS Permit #MA80164B-0). J. Crawford, ADF&G.

Polar bears are the largest of all bear species and can be found in and around the seasonally ice-covered waters of the circumpolar Arctic. Adult males can weigh up to 1,200 pounds, while females can weigh up to 700 pounds. There are 19 subpopulations of polar bears worldwide, two of which—the Chukchi Sea and Southern Beaufort Sea populations—are found in Alaska. Approximately 26,000 polar bears exist among these 19 subpopulations, with roughly 2,000 bears in the Chukchi Sea and 900 bears in the Southern Beaufort Sea. Except for females with dependent cubs, polar bears live solitary lives with an average lifespan of 25 years. Female polar bears den in snow drifts in the late fall and give birth to one to three cubs approximately two months later. Polar bear diet consists primarily of ringed seals (*Pusa hispida*) and bearded seals (*Erignathus barbatus*). The primary threat to this species is the loss of sea ice habitat. The species is listed as threatened under the Endangered Species Act. ADF&G has conducted multiple studies on polar bears to understand and monitor their status, help ensure continued opportunities for subsistence, and ensure that federal regulations and permitting of activities in polar bear habitat are appropriate.

Offshore Shelf Waters

ACCS.

Oceanic region	Species richness
Beaufort-Chukchi Sea	35
Bering Sea	54
Gulf of Alaska	50

Offshore shelf waters are marine waters that are generally 65–650 feet deep, including the shelf break zone. Shelf waters are generally located greater than three nautical miles from the shoreline and are under federal management. Continental shelves slope very gently toward the ocean basin along gradients of varying widths. Shelves are typically broad along passive or spreading continental margins where there is little seismic or volcanic activity and narrower along margins of active convergence or subduction. Because of its location along an active tectonic plate margin, the continental shelf rimming the Gulf of Alaska is relatively narrow. Conversely, the continental shelves tapering to the passive basins of the Bering, Chukchi, and Beaufort seas are comparatively wide.

Shelf habitats are high-productivity environments that support a wide range of animals. Sublittoral substrates can be soft-bottomed (mud, sand, shell, and gravel), shell debris, or rocky. The benthic communities that reside here include infauna, organisms that live within sediments, and epifauna, organisms that live on sediments. In general, benthic communities contain a diversity of deposit and suspension feeders, as well as predators and scavengers, but suspension feeders dominate. Prominent species include barnacles, king crabs, bryozoans and other hydroids, shrimp, ascidians, anemones, sea pens, sea whips, brittle stars, sea cucumbers, sponges, gastropods, urchins, and shrimp. Soft-bottom communities recycle nutrients from the water column and rocky habitats. Cold-water corals form important benthic habitat in the Gulf of Alaska and off the coast of the Aleutian Islands. These coral gardens include more than 100 species of coral and are comparable in size and structure to tropical coral reefs. The Aleutian Islands have the highest coral diversity of Alaska's waters. Some of these corals have a tree-like structure and can reach heights of 10 feet and widths of 23 feet.

Offshore shelf waters in the three Alaska oceanic regions combined can provide high- and moderate-value habitat for 62 marine SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate to moderately high and ranks 16th (tied with boreal subalpine and subarctic woodland) among the 41 habitats assessed (Table 6.3). Wildlife species richness in offshore shelf waters is highest in the Bering Sea and Gulf of Alaska regions, with richness values of 54 and 50, respectively (see table above). Marine species richness drops in the Beaufort-Chukchi Seas region, with a value of 35 SGCN.

Statewide, 40 avian and 22 marine mammal SGCN can be regularly found using offshore shelf waters. Shelf waters can provide habitat for many seabird SGCN including Fork-tailed Storm-petrel, Thick-

billed Murre, Northern Fulmar, Kittlitz's Murrelet, Horned Puffin, Dovekie, Black-footed Albatross, Short-tailed Albatross, Laysan Albatross, Red-legged Kittiwake, Black-legged Kittiwake, Short-tailed Shearwater, Buller's Shearwater, Sooty Shearwater, Pink-footed Shearwater, Least Auklet, Crested Auklet, Parakeet Auklet, Cassin's Auklet, Ivory Gull, Sabine's Gull, Ross's Gull, Long-tailed Jaeger, and Pomarine Jaeger. Waterbird and shorebird SGCN that can regularly use shelf waters include Yellow-billed Loon, Common Loon, King Eider, Spectacled Eider, Red Phalarope, and Red-necked Phalarope. Some of the marine mammals that occur in offshore shelf waters include polar bear, bearded seal, Northern fur seal, ribbon seal, ringed seal, spotted seal, Steller sea lion, Pacific walrus, beluga, bowhead whale, common minke whale, Dall's porpoise, humpback whale, North Pacific right whale, Pacific white-sided dolphin, and sperm whale. Because of a lack of comprehensive distribution data, fish and aquatic invertebrate SGCN were not included in the species richness assessment of this habitat. Offshore shelf waters, however, are habitat for rockfish, lingcod, king crab, and sea stars.

Offshore Marine Waters

ACCS.

Oceanic region	Species richness
Beaufort-Chukchi Sea	19
Bering Sea	31
Gulf of Alaska	34

Offshore marine waters refer to waters beyond the continental shelf break, greater than 650 feet deep, and are under federal management. Oceanic habitats begin at the continental slope, which marks the seaward boundary of the continental shelf. Oceanic habitats include several layers of water, each with distinct characteristics of salinity, temperature, and light intensity. The epipelagic zone, which extends between the surface and 650 feet deep, is the only area where food can be directly produced by photosynthesis in the open ocean. Below this, the source of food is primarily from detritus falling from the epipelagic zone. Minor additional food sources include vertically migrating animals and chemosynthesis at hydrothermal vents. Unlike shelf and nearshore corals, deep-sea corals do not require light to grow; instead, they acquire the nutrients they need directly from the water column. Deep-sea coral reefs primarily consist of cold-water corals, black coral, gorgonian corals, stony corals, sea whips, sea pens, and sponges.

Offshore marine waters in the three Alaska oceanic regions combined can provide high- and moderate-value habitat for 42 SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is relatively low and ranks 27th (tied with temperate coastal cliff and bluff) among the 41 habitats assessed (Table 6.3). The highest marine wildlife species richness for offshore marine waters is associated with the Gulf of Alaska and Bering Sea regions, with richness values of 34 and 31, respectively (see table above). Marine species richness drops in the Beaufort-Chukchi Seas region, with a value of 19 SGCN.

Statewide, 24 seabird and 18 marine mammal SGCN can be regularly found in offshore marine waters. These deeper, offshore waters are inhabited by characteristic seabird SGCN such as Northern Fulmar, Fork-tailed Storm-petrel, Mottled Petrel, Pomarine Jaeger, Parakeet Auklet, Ivory Gull, Ross's Gull, Horned Puffin, Tufted Puffin, Laysan Albatross, Short-tailed Albatross, Buller's Shearwater, Pink-footed Shearwater, Short-tailed Shearwater, and Sooty Shearwater. Some of the marine mammals in offshore waters include northern fur seal, Baird's beaked whale, beluga whale, bowhead whale, common minke whale, Cuvier's beaked whale, Dall's porpoise, fin whale, humpback whale, North Pacific right whale, Pacific white-sided dolphin, sei whale, sperm whale, and Stejneger's beaked whale. Because of a lack of comprehensive distribution data, fish and aquatic invertebrate SGCN were not included in the species richness assessment of offshore marine waters; however, many species of deep-sea corals are found in offshore waters.

Estuarine Waters

Alaska ShoreZone.

Oceanic region	Species richness
Beaufort-Chukchi Sea	24
Bering Sea	46
Gulf of Alaska	46

Estuaries are defined as waters where rivers meet the sea. Here, freshwater from inland rivers and streams mixes with saltwater from the ocean, forming brackish conditions. These waters fill the mouths of tidal rivers and protected bays and lagoons. The mixing of fresh and salt waters at the transition from terrestrial to marine environments results in highly productive ecosystems supporting plants and animals adapted to these unique conditions. The vegetation associated with estuaries is described in the "Temperate Salt Marsh" and "Arctic Salt Marsh" sections above.

In the three Alaska oceanic regions combined, estuarine waters can provide high- and moderate-value habitat for 55 SGCN. Across all terrestrial and marine habitats evaluated, this species richness number is moderate and ranks 19th among the 41 habitats assessed (Table 6.3). The highest wildlife species richness for estuarine waters occurs in the Gulf of Alaska and Bering Sea regions, with richness values of 46 in both regions (see table above). Marine species richness drops in the Beaufort-Chukchi Seas region, with a value of 24 SGCN.

Statewide, 27 shorebird, 13 seabird, 10 waterbird, and five marine mammal SGCN can be regularly found using estuarine waters. Shorebird SGCN that can consistently use intertidal areas in estuarine waters include Whimbrel, Red Knot, both turnstone species, both tattler species, both yellowlegs species, eight sandpiper species, four plover species, three godwit species, two dowitcher species, and two phalarope species. Seabird SGCN that can use estuarine waters consistently include Kittlitz's Murrelet, Marbled Murrelet, six gull species, two jaeger species, two cormorant species, and two

tern species. Waterbird SGCN that can regularly use estuarine waters include Surf Scoter, Common Eider, Spectacled Eider, Steller's Eider, Common Loon, Red-throated Loon, Yellow-billed Loon, and three grebe species. Marine mammal SGCN that can use these habitats include bearded seal, harbor porpoise, Pacific harbor seal, beluga, and polar bear. Because of a lack of comprehensive distribution data, fish and aquatic invertebrate SGCN were not included in the species richness assessment of this habitat; however, estuaries are used regularly by salmon smolt and crabs.

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7 | Threats to Wildlife

Pacific walrus. A. Underwood, ADF&G.

This chapter outlines the potential threats that could affect fish and wildlife populations in Alaska at local, regional, or statewide scales. The threats described in this chapter are generally not expected to have population-level impacts on "species of greatest conservation need" (SGCN) due to the availability of undisturbed and intact fish and wildlife habitats, the small spatial scale of human-associated threats, and the large areas of land already managed for fish and wildlife conservation across the state. Importantly, Alaska has adequate regulatory mechanisms to ensure that development and other human activities are compatible with fish and wildlife conservation.

Both the Alaska Constitution (Art. VIII) and Alaska Department of Fish and Game's (ADF&G) mission prioritize the long-term sustainable use of all natural resources, guiding ADF&G to manage fish and wildlife populations in a way that supports both conservation and public use. The state's approach is not to eliminate all potential threats, but to ensure that threats are managed to maintain healthy, viable populations of fish and wildlife. This reflects a balanced strategy—supporting the beneficial use of resources while safeguarding the long-term sustainability of fish and wildlife populations, recognizing that there may be impacts from resource use at a local scale. Using this strategy, ADF&G already addresses many of the threats described in this chapter through current regulations that support its constitutional mandates.

The 11 primary threat categories outlined in this chapter use standardized terminology from the Classification of Direct Threats to Ecosystems and Species, version 4.0, created by the International Union for the Conservation of Nature (IUCN) and Conservation Measures Partnership (CMP; Salafsky et al. 2024). Version 4.0 updates version 1.0 (Salafsky et al. 2008), which was used in the 2015 Alaska State Wildlife Action Plan (SWAP). The presentation of the primary threat categories and

subcategories below follows the standardized order used by Salafsky et al. (2024); however, some modifications to the subcategories in the climate change section were made to reflect conditions unique to Alaska ecosystems and wildlife. Because the SWAP undergoes a major revision at least once a decade, this version focuses on the extent of threats over the next one to two decades. Though our discussion about threats to Alaska's wildlife are organized into discrete categories, interactions among multiple threat types may occur, resulting in compounded or intensified impacts on wildlife and their habitats.

Waterfront houses, Ketchikan. ADF&G.

Residential, Commercial, and Recreation Areas

Alaska's human population is small (740,133 people; U.S. Census 2025) compared to the state's large size (586,412 square miles). As of 2019, over half of Alaskans live in the three major cities of Anchorage, Fairbanks, and Juneau, and most live in communities of over 2,500 people (DOLWD 2024). The State's population declined during 2016–2019 for the first time since the late 1980s but is projected to increase slightly until 2033 (DOLWD 2024). Population expansion has occurred in the Southcentral biogeographic region, particularly in the Matanuska-Susitna Borough.

While the number of Alaska residents has declined, the number of visitors to Alaska has increased dramatically. Between May 2022 and April 2023, the state hosted over 2.7 million visitors (Destination Analysts 2023). Most arrived by cruise ship (57%) to the Southeast, Southcentral, and Central regions. A majority of tourists also visited Alaska's national parks (NPS 2022).

Residential Areas

Alaska's small population makes housing an unlikely threat to wildlife at the statewide or regional level during the coming decade. However, given the uneven distribution and growth of population centers, localized impacts are possible. Housing developments can impact aquatic habitats for many fish and wildlife species via the draining and filling of wetlands, the diversion of small water bodies or streams, or the development of high-value riverfront, lakefront, and oceanfront properties. Point source pollution may be associated with failed septic systems or lack of functional sewer or septic systems in some areas of Alaska. Housing expansion into undeveloped areas increases the potential for human-wildlife conflict. It can also lead to increases in populations of non-native and nuisance species that thrive in urbanized areas.

Commercial and Industrial Areas

As with housing, the extent of habitat affected by commercial and industrial development is small relative to Alaska's size. Commercial development often occurs on or adjacent to land already modified by people and is therefore unlikely to affect population viability of most species. Landfills serving

larger population centers are required to meet modern standards (e.g., lined pits, effluent recovery systems) to reduce contamination of nearby habitats. Still, those in rural areas may pose local risks if they are unlined or uncovered. Landfills can attract and concentrate predators (e.g., ravens, gulls, foxes, and bears), increasing predation of nearby species (Weiser 2010). Contaminants from solid waste and incineration may spread into surrounding habitats, affecting terrestrial, freshwater, or marine ecosystems.

Recreation and Tourism Areas

Development of tourism-related infrastructure has mostly occurred in Alaska's population centers and nearby areas. On most state and federal public lands, commercial tourism activities such as sport fishing, river rafting, kayaking, heliskiing, and flightseeing are regulated by permit. Cruise ships, recreational fishing boats, whale watching vessels, and jet ski tours in marine waters, as well as wildlife viewing by boat, plane, and helicopter, all present potential localized, transient impacts to wildlife (see "Human Intrusions and Disturbance: Recreational Activities" below).

Alaska's outdoor recreation economy is larger than its construction economy and has grown in recent years (USBEA 2023). The infrastructure associated with recreational activities (e.g., viewing platforms and visitor centers) at wildlife viewing sites on state or federal lands is modest in extent and unlikely to have significant effects on wildlife habitats or species viability. However, open-topped pipes associated with recreational facilities (e.g., outhouse vents, pipe gates) are a well-documented

Downtown Juneau with Mount Juneau in the background. ADF&G.

threat to birds that investigate and become trapped inside. This threat is easily mitigated by installing covers or grates over open pipes (Hathcock and Fair 2014, Braxton Little 2015).

Agriculture and Aquaculture

Agriculture and aquaculture are not expected to be threats to SGCN at statewide or regional scales due to the relatively small geographic areas in which these activities occur and state regulations that minimize impacts of aquaculture on fish and wildlife. Most agricultural land development in Alaska took place between 1920 and 1980 (Stevenson et al. 2014), though there are recent efforts to increase food production and security (Alaska Food Policy Council 2025). As of 2022, Alaska has 1,173 farm operations, most of which are located in the Southcentral and Central biogeographic regions.

Annual and Perennial Nontimber Crops

Only a very small percentage (approximately 0.2%) of all land in Alaska is currently used for crop production. Top commodity crops include floriculture, sod and hay crops, and barley. Current threats to wildlife populations and habitats are limited but may result from habitat loss, habitat alteration, or pesticide exposure.

Terrestrial Animal Farming, Ranching, and Herding

Livestock production in Alaska is limited in scope, involving approximately 20,500 dairy and beef cattle, pigs, and nearly 11,000 poultry. These animals primarily occupy the same land as that in the annual and perennial nontimber crops category. The majority of the land used for farming and ranching livestock is located in the Southwest, Central, and Southcentral biogeographic regions (USDA 2024). Approximately 688,977 acres of land in Alaska are used for livestock production, though few individual ranching operations exist. Large ranches are present on Umnak and Unalaska islands.

Threats to wildlife related to livestock production in the state include disease transmission from domestic animals (Cleaveland et al. 2001) and habitat loss or alteration. Zoonotic diseases could affect populations of moose, caribou, sheep, and bears (ADF&G 2025a), and many avian species could be affected by pathogens from domestic birds. Additionally, livestock grazing may significantly change the vegetation by foraging, trampling, or enabling invasive or noxious plants to spread. Although livestock production is not a significant threat regionally or statewide, it can be an acute problem for endemic species on islands, particularly those in the Western biogeographic region. Abandoned livestock (e.g., cattle on Chirikof Island) or free-range livestock (e.g., reindeer on Kodiak and St. Paul islands) may enter and damage sensitive wetland habitats or disturb ground nesting birds.

Marine and Freshwater Aquaculture

Aquaculture is regulated by state law to prevent adverse effects on fish, wildlife, and their habitats (AS 16.05.105). Aquaculture is a growing industry in Alaska and can consist of farms or hatcheries for shellfish, finfish, or seaweed. Shellfish aquaculture production sales in Alaska totaled $1.9 million in 2022. There has been an increase in aquaculture farming applications and the quantity of aquatic farm acreage applied for in recent years (NOAA 2024a). The state recently received $100 million in funding to support the growth of the aquaculture industry. In 2023, Alaska was designated as

the next region to begin identification of Aquaculture Opportunity Areas, which will help advance sustainable aquaculture in areas that are environmentally, socially, and economically appropriate (NOAA 2024b).

Although Alaska banned finfish farming in 1990 (AS 16.240.210), the practice is common in China, Korea, Chile, Norway, Japan, and Canada, and products from those countries compete with Alaska's wild-reared salmon on global markets. Hatchery production from Pacific Rim nations, primarily Russia, the U.S., Japan, Canada, and South Korea, increased substantially from the 1970s to about 1990 and since then has remained relatively stable (NPAFC 2024). Atlantic salmon are extensively farmed in British Columbia and Washington state and are occasionally reported in Alaska waters.

In contrast, Alaska's private nonprofit hatcheries rear salmonids (Pacific salmon and trout) from eggs and release juveniles that feed in the ocean for one to four years before being harvested in marine waters or near the hatchery release site. The original broodstocks for hatcheries in Alaska are required to be from local salmon populations. In 2023, Alaska hatcheries released 1.9 billion juvenile salmon (primarily pink and chum salmon), and hatchery salmon accounted for 35% of the salmon harvest (Wilson 2024). ADF&G also stocks many rivers and lakes, primarily to provide sport fishing opportunities. The majority of these stocking programs use triploid fish that cannot reproduce (ADF&G 2025b).

Oysters, blue mussels, and kelp are also grown in Alaska (NOAA 2024a). The majority of permitted aquaculture operations in Alaska are located in the Southeast region, where operations are dedicated to seaweed and shellfish farming. Southcentral and Western Alaska also support shellfish, kelp, and oyster farms.

Alaskan seaweed farmers examine their crop. NOAA Fisheries, used with permission.

Potential threats from shellfish and finfish aquaculture include alteration of marine habitat, disturbance to other marine organisms, disease, invasive species introductions (McLaughlin et al. 2005), potential increased food competition with native aquatic species (Ruggerone et al. 2023), and genetic effects from hybridization of stray hatchery-origin salmon with wild stocks (Grant 2012). ADF&G implements policies to manage threats to wild stocks from hatcheries and aquaculture (Wilson 2024), including sourcing hatchery stocks locally so that any stray hatchery returns will be genetically similar to the wild stocks from nearby streams. Alaska hatcheries do not selectively breed salmon, and there is extensive planning, permitting, and monitoring to prevent the spread of infectious diseases. Shellfish and kelp farms require little or no input in the form of water, feed, or fertilizer, and they can improve water quality by removing excess nutrients, buffering ocean acidification exacerbated by climate change, and creating habitat for marine life (NOAA Fisheries 2022). However, shellfish farms also may negatively impact marine wildlife through direct disturbance (i.e., from boat and vehicular traffic), habitat alteration, or changes in the movement and availability of phytoplankton, nutrients, and organic materials in the water column, resulting in localized changes to coastal areas (Ahmed and Solomon 2016). For example, on-bottom shellfish aquaculture near eelgrass beds can lead to habitat destruction and degradation. Shellfish farming structures also may interfere with roosting, feeding, and nesting behavior of birds and may exclude marine mammals. Other potential threats to marine mammals include entanglement with aquaculture gear such as kelp longlines, behavior altered by the noise or positioning of farming operations, and food conditioning (Bath et al. 2023).

Active claim within Independence Mine State Historical Park. ADF&G.

Energy Production and Mining

Natural resource extraction and renewable energy projects in Alaska are regulated by state, federal, and local agencies through an extensive permitting process to ensure compliance with environmental laws and standards and to minimize impacts on fish, wildlife, and their habitats. Alaska's economy is highly dependent on natural resource extraction, particularly oil and natural gas. Income from the oil and gas sector accounted for 81% of Alaska's unrestricted general revenue from 1959 to 2022 (MRG 2023). Taxation of oil and gas property assets has contributed significant revenue to local governments, particularly those in the Northern and Southcentral biogeographic regions (MRG 2023). Renewable energy projects, including hydroelectric,

Dalton Highway, Alaska. ADF&G.

wind, and solar power, are an emerging industry in Alaska and are predicted to increase in the coming years (Bernton 2024). Global demand for critical minerals including graphite, cobalt, and rare earth elements (e.g., lanthanum, cerium, ytterbium) is increasing. This demand, in part, has led to increased mining exploration in Alaska since 2015 (Szumigala 2024). As demand increases, existing regulations will continue to ensure development is compatible with fish and wildlife conservation, as mandated by the Alaska Constitution (Art. VIII). Overall, the effects of oil and gas exploration and extraction, mining and quarrying, and renewable energy development on fish and wildlife in Alaska are well-managed and do not put the long-term viability of SGCN at risk. As new projects are developed across Alaska during the next 10 years, opportunities may arise for ADF&G to partner with industry and, where needed, conduct additional monitoring, mitigation, and conservation actions.

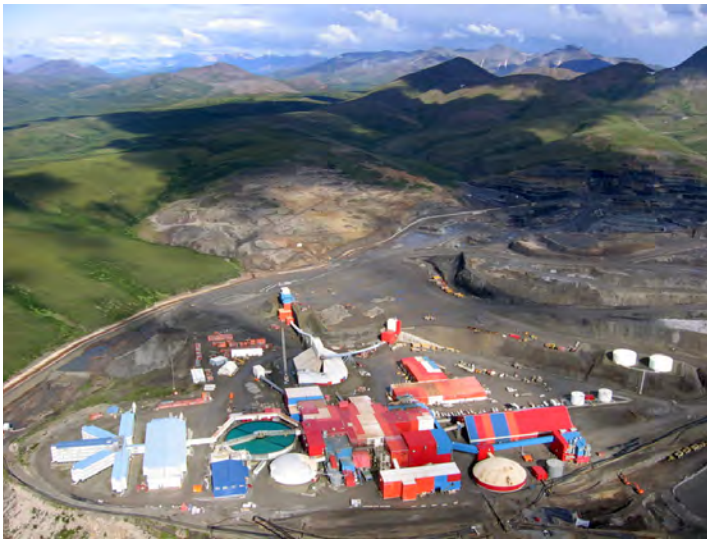
Oil and Gas Exploration and Extraction

Oil and gas drilling primarily occurs in the Northern biogeographic region, which produces approximately 95% of Alaska's crude oil (USEIA 2024). Oil and gas drilling also occurs in Cook Inlet on state and federally managed onshore and offshore leases. Several offshore oil and gas lease sales were held in the Beaufort and Chukchi seas during 2007–2012, but these were later canceled, and a new leasing program has not yet been implemented (BOEM 2016, BOEM 2023).

While oil production in Alaska's existing fields has declined in recent decades, new projects are forecasted to increase North Slope oil production and represent 51% of total production by 2032 (MRG 2023). Overall, the total amount of habitat directly affected by these new projects is small, but the indirect effects of their development can extend beyond the actual footprint of the project. Direct effects include habitat loss and alteration due to winter exploration, gravel mining, construction and operation of drill pads, roads (including ice roads), processing facilities, and employee housing. Spills or pollutant releases, such as oil, saltwater, drilling fluids, and gas flaring from drill sites and production facilities, may also negatively impact habitats.

Indirect effects of oil and gas exploration and extraction include attraction of predators and scavengers to human activity or facilities, habitat alteration or contamination from fugitive dust

and gravel spray, and impacts to prey populations. Increased predator numbers (e.g., gulls, ravens, foxes) associated with camps and infrastructure have been found to decrease nesting success of birds in the surrounding area (Liebezeit et al. 2009). Anthropogenic food sources have led to red foxes displacing Arctic foxes from dens closest to oil field facilities in Prudhoe Bay (Stickney et al. 2014).



Red Dog Mine, Alaska. ABR, used with permission.

If development of unconventional oil sources (e.g., shale formations, coal-bed methane, methane hydrates) increases in the future, these activities may also impact wildlife via drilling, transportation, and infrastructure construction and operation. However, the costs of developing unconventional oil resources on the North Slope are high, given the remoteness and lack of infrastructure, so this type of development may not occur for some time.

Mining and Quarrying

Alaska has large deposits of minerals, including gold, copper, zinc, silver, cobalt, and graphite, as well as other resources, such as coal, gravel, and sand. Currently, across the state, there are seven large mines and eight large exploration projects (DNR 2024a), over 200 placer gold mines, and approximately 120 active rock, sand, and gravel operations (AMA n.d.). The level of impacts to wildlife and habitat from current and future mineral development varies depending on the size, location, and type of mine (i.e., placer, surface, underground, or in-situ), and they may be short-term or long-term in nature. Mining exploration and development will likely intensify as the demand for critical minerals needed to produce renewable energy and computing technology increases (BLM 2021). In Alaska, small-scale mining activities require permits, while large-scale mining operations undergo extensive review and oversight by several state and federal resource agencies. Without this management and mitigation, mining can negatively impact fish, wildlife, and their habitats.

The stages of mineral extraction (e.g., exploratory drilling, construction, tailings disposal, water withdrawal, water impoundment, and water operation) can directly impact fish and wildlife through habitat loss or alteration, reduction of water in aquatic ecosystems, and the release of contaminants. The overall percentage of wildlife habitats affected statewide is small and unlikely to result in population-level effects on Alaska's wildlife, except where mineral extraction activities occur on or very near specific important habitats of at-risk species or when they have the potential to affect a species that exists in very small numbers or has low genetic diversity.

Aquatic habitats and species can be impacted through the emission of toxic contaminants, stream channel burial, and changes to the flow regime (Sergeant et al. 2022). Landscape-scale watershed alterations from large-scale mineral development can be detrimental, and the effects of widespread small placer mines on fish and wildlife can be additive. These effects include increased erosion

and sediment transport, transport of contaminants from dust, mine waste, and mine drainage. Mining can reduce hydrological buffering, resulting in periodic high-water flow, followed by longer periods of decreased flows; these fluctuations can reduce habitat quality for aquatic organisms. Mineral extraction and coal mining typically require the use and disposal of significant amounts of water. Withdrawals of freshwater from rivers and streams can lead to reduced depths and flows (Bjerklie and LaPerriere 1985) and increased water temperatures, all of which can negatively affect fish and wildlife.

Renewable Energy

As of 2023, Alaska generates about one-quarter of its total electricity from renewable energy sources, primarily hydropower (USEIA 2024), and the number of renewable energy projects in Alaska is expected to increase over the next decade. Several large wind power projects are currently in the planning stages. Additionally, solar, tidal, in-stream, and geothermal projects are proposed, under construction, or already operated across Alaska. Potential wildlife impacts associated with renewable energy projects include direct habitat loss and collision with structures such as wind turbines, solar panels, in-water turbines, and associated transmission equipment. Except for possible large hydropower development, threats to wildlife from renewable energy production in Alaska are relatively small, localized, and unlikely to impact most species on a population level. Large hydropower development in Alaska would require significant review and oversight by several state and federal resource agencies to manage and mitigate the impacts on fish and wildlife.

Wind turbines behind the U.S. Coast Guard base, Kodiak, Alaska. ADF&G.

The amount of wind-generated power in Alaska is extremely small in relation to the landscape, and wind generation is unlikely to lead to population-level conservation concerns for any wildlife species. In certain locations, these systems could pose localized threats to concentrations of migratory birds and possibly bats. Wind generation in the United States results in a relatively minor direct loss of birds through collisions with rotors (approximately 140,000 to 328,000 birds annually; Loss et al. 2013). Some bird taxa such as raptors (i.e., hawks, eagles, and falcons) are more susceptible to collisions with turbines than others. Bats, particularly those that make long-distance seasonal migrations, are also susceptible to collisions with wind turbines, and data suggests that millions die every year at wind power facilities (BCI 2024). Minimizing the potential impacts of wildlife collisions with wind turbines will involve primarily working with project proponents to develop project-specific mitigation measures, as described in Chapter 10.

Trans-Alaska oil pipeline crossing on South Fork, Koyukuk River. S. Hillebrand, ADF&G.

Offshore wind is likely the most feasible option for renewable energy production on Alaska's Outer Continental Shelf but has not yet been implemented. Wave and tidal energy projects are still in the early stages of development and implementation. A hydrokinetic project in Igiugig was launched in 2019, and another has been proposed in Cook Inlet as of 2024. Potential effects on wildlife from wave or tidal energy development could involve disruptions in migration patterns of marine fishes and mammals, increased disturbance, and potentially increased mortality. Based on project monitoring elsewhere, risks of collision are low for salmon and small, agile cetaceans; however, risks may be greater for large cetaceans and pinnipeds. These energy developments could affect marine mammals if sited in places where large numbers of marine mammals pass through annually, such as the Bering Strait and Unimak Pass.

Transportation, Service, and Security Corridors

Alaska's existing transportation network is mostly contained within a fairly narrow north–south corridor spanning the Northern, Central, and Southcentral biogeographic regions, where other development infrastructure in the state is centered. Alaska has a far lower density of transportation, service, and security corridors than any other state. While all of these are potential threats to fish and wildlife at local scales, they are not expected to impact SGCN at regional or statewide levels due to the large undeveloped expanse of fish and wildlife habitat across the state.

Roads, Trails, and Railroads

Alaska's existing road system is very small relative to the size of the state, comprising nearly 18,000 miles total, most of which are local roads. Fewer than 1,100 miles are classified as interstate highways, and 3,200 miles are classified as arterial and major collector roadways (DOT&PF 2024b). Alaska also has one railroad system, a single line that runs 656 miles from Fairbanks to Seward (AKRR 2024). Alaska's Department of Natural Resources has identified hundreds of public trails across the state, primarily accessible from the road system (DNR 2023).

Roads can have negative effects on fish and wildlife (Bennett 2017). The construction of roads and railroads results in direct habitat loss and habitat alteration within the road prism. Roads, perched culverts, and railroads may block terrestrial and aquatic migration corridors and have been shown to impede salmon spawning and displace other species (Sergeant et al. 2022). However, the impacts of roads on anadromous waters are regulated under Alaska statute (AS 16.05.871), which reduces potential conservation challenges associated with transportation corridors and helps ensure movement of anadromous fish is not blocked. Roads, trails, and railroads have also been implicated in introducing and spreading invasive plant species. Vehicle collisions are a source of direct mortality of wildlife. Compared with roads, railroads may have less severe impacts on wildlife because traffic is relatively infrequent; however, because of the volume and types of products carried, potential threats from spills may be higher.

Recent initiatives, such as the state's Roads to Resources and the proposed Alaska Long Trail project, could extend the current transportation network into undeveloped areas (DOT&PF 2024a, BLM 2025). New roads and trails can lead to increased hunting, trapping, fishing, recreational activities, resource extraction, and industrial and residential development. However, even with the addition of several new roads or trails, Alaska will still have the lowest density of transportation corridors of any state.

Utility lines under construction at Delta Junction, Alaska. ABR, used with permission.

Utility and Service Lines

The total land area directly affected by utility and service lines in Alaska is small; however, alteration of habitat structure and vegetation can change which species use these corridors for breeding, movement, and migration and increase the risk of predation for some species.

Impacts to wildlife from utility lines and corridors primarily consist of direct mortality (Bevanger 1998), habitat alteration, and changes in wildlife use and patterns of movement. An estimated 12–64 million birds are killed annually through collisions with or electrocution by powerlines in the rest of the United States (Loss et al. 2013). However, the density of utility lines and their corresponding risk to birds is substantially lower within Alaska. Towers associated with utility lines provide artificial structures for nesting and perching by raptors and ravens. Any resulting artificial increase

Shipping in the Inside Passage. ADF&G.

in predators may depress the nesting success of breeding birds, as well as populations of small mammals, along utility corridors. Similarly, pipelines and utilidors can alter habitat and vegetation composition (McDonald et al. 2020) and affect wildlife movement (Charlebois et al. 2023). In a recent 12-year study, factors such as pipeline height, pipeline corridor width, and vegetation type played a role in how likely boreal mammal species were to cross above-ground pipeline corridors during winter months (Charlebois et al. 2023).

Shipping Lanes

Aside from oil spills (see "Pollution: Water-borne and Other Effluent Pollution" below), threats to wildlife from shipping in Alaska are primarily related to marine shipping and vessel travel (Humphries and Huettmann 2014), although there is also substantial barge shipping on large river systems. For example, the North Pacific Great Circle Route is a globally important shipping corridor between North American and Asian ports, with around 1,000–3,000 vessel transits per year that cut through the ecologically rich Aleutian Islands (Sullender et al. 2021). In addition, approximately 57% of the 2.7 million tourists visiting Alaska each year use the cruise ship industry (Destination Analysts 2023), and the numbers of passengers and vessels have increased in recent years.

Snowy Owl resting on fishing vessel at sea. ABR, used with permission.

Increases in shipping in the Bering and Beaufort and Chukchi Sea biogeographic regions, which historically have experienced low levels of shipping activity, are occurring due to the reduction in sea ice in the Arctic. Between 2013 and 2023, there was a 37% increase in the number of ships entering Arctic waters worldwide, primarily due to a large increase in the number of gas tankers (PAME 2024). During the same time period, marine tourism in Arctic waters increased

from 58 vessels in 2013 to 96 in 2023 (PAME 2024). As the length of the ice-free season increases, shipping vessels traveling the Northern Route (between Europe and Asia along the northern coast of Russia) may be able to access the Great Circle Route (between western North America and Asia) via the Bering and Chukchi Seas. This could lead to increases in vessel traffic along the Aleutian Island chain and through Unimak Pass (Arctic Council 2021), an important migration corridor for wildlife (Sydeman et al. 2023). Voluntary measures, such as the designation of Areas To Be Avoided (ATBA) along shipping routes, can decrease the risk of impacts from shipping to fish and wildlife (Sullender et al. 2021).

Shipping activities and the maintenance of shipping lanes can result in habitat alteration and changes to water quality, which, in turn, can affect the numbers and types of wildlife using affected areas. Dredging and construction, as well as maintenance of boat docks and harbors, can degrade sensitive nearshore and intertidal marine habitats. Offshore dredging can degrade benthic habitats and result in the mortality of sessile marine invertebrates, such as bivalves, corals, and sponges.

Species of Conservation Need: Cook Inlet Beluga *(Delphinapterus leucas)*

Beluga whales are known as the "canaries of the sea" for their impressive repertoire of vocalizations. Adults can reach lengths of up to 16 feet and are bright white in coloration, whereas calves are born with a dark grey coloration that lightens as they mature. Belugas lack a prominent dorsal fin and instead have a dorsal ridge, which allows them to swim under sea ice more easily. There are five recognized stocks of beluga whales that inhabit Alaska waters. Of these, the Cook Inlet stock, recognized as a Distinct Population Segment (DPS), is the only stock listed under the Endangered Species Act (ESA). Surveys conducted by ADF&G in 1979 estimated that there were approximately 1,300 whales in Cook Inlet at that time. After decades of decline, the population was listed as endangered under the ESA. As of 2022, the abundance estimate for the Cook Inlet beluga stock was 331 animals. Many potential threats to the population have been identified, including catastrophic events (e.g., oil spills and mass strandings), noise, disease agents (e.g., harmful algal blooms, pathogens, and parasites), reductions in prey availability, habitat loss and degradation, predation, and pollution and contaminants. Cumulative effects, resulting from all or some of these impacts, may be responsible for the slow recovery of the species. Cook Inlet belugas appear to have some stark differences compared to other stocks that could be contributing to their decline. Their lifespan appears to be shorter than that of other Alaska populations; their age of first reproduction or calving is older than in other stocks; and strandings of calves are higher than expected. Reproduction is likely a limiting factor for the recovery of the population.

An adult Cook Inlet beluga (white) and a juvenile (gray) swim in silty water (NOAA permit #20465). H. Europe and J. Barbaro, NOAA Fisheries, used with permission.

These benthic animals provide habitat for other wildlife, including commercially harvested fish species. Ballast water exchange and hull fouling of ships and barges are potential vectors for aquatic invasive species, especially in the Arctic.

Vessel collisions and propeller strikes cause mortalities and injuries to marine mammals and birds. In Alaska waters, the number of vessel strikes for marine mammals is thought to be generally low, but many incidents likely go undetected or unreported, especially in remote areas (Neilson et al. 2012). The number and speed of vessels relate to collision severity for whales (Jensen and Silber 2003) and potentially other marine wildlife. Sea ducks, such as Spectacled and Steller's Eiders, typically fly low over the water at relatively high speeds and are at risk of collisions during periods of bad weather and impaired visibility. Some vessel lighting configurations, such as red steady-state lights and lighting that shines upward and outward from the vessel, are particularly disorienting to marine birds (USFWS 2025).

Atmospheric and Space Activities (Flight Paths)

In-state and international air traffic between Asia and North America commonly use numerous civilian and military flight paths over Alaska. The overall quantity of in-state civil air traffic is low relative to more populous states; however, the Ted Stevens International Airport in Anchorage is the most active cargo hub in the country (FAA 2024a). Within Alaska, the highest airport traffic rates occur in Anchorage, Fairbanks, Juneau, Bethel, and Ketchikan (FAA 2024b). The use of unmanned aerial systems (UAS; i.e., drones) for both civilian and military purposes has increased over the past decade, and the University of Alaska Fairbanks operates a national UAS test site (ACUASI 2024). Military flight paths are discussed in the "Human Intrusion and Disturbance" section.

Impacts of air traffic on wildlife include direct mortality due to collisions, disturbance from excess noise, and air pollution generated during low-elevation flight, take-off, and landing. Bird strikes are most common near major airports and areas of high air traffic. Collisions and other impacts associated with industry, military, and civilian aircraft activities in nonurban parts of the state are unlikely to have population-level effects on wildlife. Still, they can lead to localized effects, particularly for large congregations of individuals, such as resting walruses and staging or molting waterfowl and shorebirds.

Biological Resource Use and Control

The harvests of fish, wildlife, and all other replenishable resources in Alaska are managed for the beneficial use of all Alaskans and future generations under the sustained yield principle as required under the Alaska Constitution (Art. VIII, § 4). This mandate helps ensure that both the direct harvest of SGCN and the management of the indirect impacts of biological resource use on SGCN are conducted in a way that supports the long-term conservation of SGCN. The state supplies 60% of the wild seafood consumed in the United States, and the seafood industry contributed approximately $6 billion to the Alaska economy during 2021–2022 (MRG 2024). Hunting, fishing, and trapping are important practices for many Alaskans for consumption and recreation, and they are a particularly important source of food, cultural connection, and income for rural communities. While logging used to be a top contributor to the economies of Southeast Alaska communities, the industry has declined in recent decades.

Hunting, Collecting, and Controlling Terrestrial Animals

Hunting ptarmigan in the Kenai Mountains. ADF&G.

The harvest of wildlife is important to many Alaskans and occurs broadly across the state. A commonality shared by Alaskans in every community is the pleasure of putting a meal of wild game on the table. The highest levels of wild food harvest per capita in Alaska occur in rural communities in the Northern, Western, and Central biogeographic regions (ADF&G 2018). The State of Alaska is the primary manager of wildlife in Alaska and sets the harvest regulations across the state for all harvested wildlife, except marine mammals and migratory birds. Through the Federal Subsistence Board, the federal government can restrict harvest by nonrural residents in certain instances when a harvest limitation is necessary to safeguard subsistence uses. Subsistence harvests are the customary and traditional uses of fish and wildlife. Because of the importance of fish and wildlife to the people of Alaska, the sustainable management of renewable resources was incorporated into the Alaska Constitution (Art. VIII, § 4), which has resulted in management that is generally conservative. Therefore, hunting is unlikely to be a current threat to the sustainability of game populations, as evidenced by Alaska's successful management of game populations for more than a half-century, since statehood in 1959.

Hunting and trapping result in direct mortality of wildlife. Some of Alaska's bird species listed as SGCN are regularly harvested, particularly in rural communities. Species undergoing population declines, that are concentrated in small areas during various life stages, or that have a limited range can be vulnerable to overharvesting if their harvest is not adequately managed. When combined with other threats (e.g., climate change, resource development, and new infrastructure), hunting and trapping can potentially have an additive effect on local wildlife population mortality. Although hunting pressure in Alaska is generally low for migratory birds listed as SGCN, many species face threats outside the state from unregulated hunting and trapping practices at migratory stop-over sites and wintering grounds. This is particularly true for shorebirds migrating through and wintering in the Caribbean and northern South America (ASG 2019).

The use of lead ammunition and fishing tackle may result in the accidental poisoning of wildlife. For example, scavenger species, including eagles, may inadvertently consume lead fragments left behind in gut piles and carcasses harvested by hunters who used lead bullets, which has led to population-level impacts for eagles (Slabe et al. 2022). In 2024, ADF&G and partner organizations initiated a public education and incentive program to reduce the use of lead ammunition across the state to minimize the threat of accidental lead poisoning on wildlife (AK Copper Ammo Challenge 2025).

Logging, Harvesting, and Controlling Trees

Logging can impact SGCN by eliminating habitat for forest-dependent species; however, the limited geographic scope of current logging activities in Alaska, relative to the vast amount of available

habitat, is unlikely to result in population-level impacts. Additionally, the Alaska Forest Resources Protection Act (AS 41.17) ensures that impacts of logging to fish and wildlife are minimized in sensitive riparian areas, and ADF&G has proposed best practices for timber and wildlife in interior boreal forests (Paragi et al. 2020).

Logging and wood harvesting for commercial purposes occur in the Central, Southcentral, and Southeast biogeographic regions and target two major forest types: the interior boreal and coastal forests (DNR 2024c). Between 1990 and 2019, statewide timber harvest declined by 67.6% (Simmons et al. 2024). Historically, most logging and wood harvesting occurred in the Southeast region, particularly in the Tongass National Forest. Logging in the Central region's boreal forests targets productive stands of white spruce, found in both upland and riparian settings, for lumber, while birch, found in upland settings, is primarily harvested for fuelwood, including fuel pellets.

Most of the past logging in the Southeast region occurred on highly productive old growth sites, at lower elevations, in riparian areas, and near the coastline, resulting in disproportionate impacts to habitats of highest importance to fish and wildlife (Albert and Schoen 2013). Regionally, 11.9% of productive old growth forests have been logged. Within this logged proportion, large-tree stands were reduced by 28.1%, karst forests by 37%, and continuous old growth forests by 66.5% (Albert and Schoen 2013). Logging can affect terrestrial wildlife by causing habitat loss. Aquatic species may be impacted by increased sediment loads and changes to water quality and riparian habitat structure that result from logging operations. While levels of logging have declined substantially in the past decade and are not expected to return to historical levels, the impacts of historical logging will continue to affect wildlife habitat for decades, as forest stands take many years to resume their old growth characteristics. ADF&G will continue to monitor SGCN that may be affected by the 2025 reversal of the Roadless Rule. However, we are not aware of any resulting changes in timber development plans that could have population-level effects on SGCN.

Clearcut on Dall Island. ADF&G

The harvest of timber for biomass energy has the potential to impact boreal forests, particularly in the Central region. The Alaska Energy Authority's Biomass Energy Program has been developing wood-fired heating systems in Alaska, and there are currently 50 systems operating across the state (AEA 2024). Material for biomass systems can come from residual sawmill waste, slash from standard logging or thinning operations, or timber sales specifically targeting whole trees. When wood waste from mills is used, there is no additional impact on wildlife or wildlife habitat; however, logging activity does change the structure and habitat value of these stands for wildlife. These changes may be positive or negative, depending on the wildlife species considered (Paragi et al. 2020).

Species of Conservation Need: Yelloweye Rockfish *(Sebastes ruberrimus)*

Yelloweye rockfish. ADF&G.

Yelloweye rockfish are among the most well-known of Alaska's 33 rockfish species. Named for the color of their eyes, these fish are most often found near rocky reef structures at depths exceeding 300 feet. Young yelloweye rockfish feed on algae, zooplankton, and crustaceans, but as adults, they are primarily piscivorous and can grow up to 36 inches, making them highly sought after by anglers. Yelloweye rockfish do not become sexually mature until they are between 20 and 30 years old. They commonly live to be over 100 years old and spend their entire lives on the same reef. Females give birth to live young between May and August. Their lengthy developmental period and very small home ranges make yelloweyes and other demersal rockfish extremely vulnerable to overfishing, requiring careful management efforts. Populations of yelloweye rockfish on the United States west coast (i.e., off the coasts of Washington, Oregon, and California) were declared overfished by the National Marine Fisheries Service in 2002. In 2010, the population in Puget Sound was listed as threatened under the Endangered Species Act. A contributing factor to rockfish vulnerability is a lack of swim bladder vents. This results in barotrauma injuries (bulging eyes or stomach protruding from the mouth) when fish are reeled up from depth, inhibiting them from resubmerging upon release. ADF&G has conducted extensive research to develop best practices for rockfish release, and anglers are now required to carry deep-water release mechanisms to safely return all unretained rockfish species to depth. In recent years, fishing restrictions for yelloweye rockfish have become more common to help ensure the conservation of this species.

Fishing and Harvesting Aquatic Species

Large harvests of fish occur in Alaska in commercial, subsistence, sport, and personal use fisheries throughout the state. All Alaska fisheries are managed to provide harvestable surpluses because of the constitutional requirement to ensure sustained yield. Subsistence and personal use fisheries are limited to Alaska residents. In contrast, sport and commercial fisheries include both in-state and out-of-state residents who purchase a sport fishing license or a commercial fishing permit. The most common fish harvested commercially are Alaska pollock and salmon species, which accounted for 75% of the ex-vessel volume during 2021–2022 (MRG 2024). For the most part, commercial fisheries in state-managed waters target salmon, groundfish, herring, and crabs; however, there are fisheries that target many other species of finfish and shellfish. Federally managed marine fisheries primarily target pollock, Pacific cod, Pacific halibut, and other groundfish species, as well as king, tanner, and snow crab under joint federal-state management structures in the Bering Sea and Aleutian Islands.

Subsistence fisheries harvest an estimated 28 million pounds of all species of fish annually, and sport fisheries harvested an estimated 2.9 million fish annually between 2004 and 2013. Subsistence and sport fisheries are managed by ADF&G to provide beneficial use for all Alaskans. These fisheries primarily target salmon, but many species of shellfish, groundfish, and resident freshwater species

of finfish are also harvested (ADF&G 2018). Traditional harvest of marine mammals, including seals, sea lions, walruses, and whales, by Alaska Natives accounts for 14% of all wild food harvested by local residents (ADF&G 2018).

Alaska salmon fisheries are managed by ADF&G, first to ensure adequate spawning escapement levels and then to provide harvestable surpluses (under the sustained yield principle). However, reduced run sizes in recent years, especially for Chinook and Western Alaska chum salmon, have resulted in considerable restrictions for commercial, recreational, personal use, and subsistence fisheries. The reasons for the decline of some aquatic species and species groups are complex. Warming ocean temperatures, changes in currents, invasive species, parasites, and disease possibly play a role in stock abundances to varying degrees. Other species groups, such as rockfish, may be impacted by incidental catch when targeting halibut and lingcod, resulting in conservation concerns and additional management measures (Hochhalter and Reed 2011, Hochhalter 2012).

Impacts from Bycatch and Trawl Gear in Commercial Fisheries

Alaska has large-scale federally managed commercial groundfish fisheries for pollock, Pacific cod, and flatfish. Comprehensive science and management programs have been established to minimize the impacts of these fisheries on other marine species and habitats. Minimizing the impacts of bycatch is a key focus area for the North Pacific Fishery Management Council, which has established bycatch limits and other incentives for fishing fleets to avoid bycatch (NPFMC 2025). Bycatch is defined as fish that are harvested in a fishery but not sold or kept. Fish are discarded in commercial fisheries because they are prohibited by regulation from being retained or are simply not wanted due to being a nonpreferred size, a less desirable species, or a lower value or unmarketable species. Alaska fisheries bycatch is relatively low compared to commercial groundfish fisheries in other areas. Of the 2,058,816 tons of fish caught in the Alaska halibut and groundfish fisheries in 2021, 97,083 tons (4.7%) were discarded (Witherell and Fey 2023). To ensure continued low levels of bycatch, federal fishery managers count and monitor all catch and bycatch using human observers and electronic technologies, and all bycatch accrues towards the annual catch limits for groundfish stocks and established bycatch limits for salmon, crab, halibut, and herring.

While bycatch in Alaska fisheries has not been identified as the primary cause of conservation concerns for specific species, fishery managers recognize the importance of continued work to further minimize bycatch in commercial fisheries. The Alaska Bycatch Review Task Force was formed in 2021 to evaluate fisheries bycatch and provide recommendations for continued work on incentives and methods to avoid and reduce bycatch (Alaska Administrative Order no. 326; November 18, 2021). The task force published a final report on December 8, 2022, containing recommendations on research, state engagement, and management measures related to bycatch (ABRT 2022). ADF&G uses these recommendations to support science and management priorities at the North Pacific Fishery Management Council. In addition, the Alaska Bycatch Advisory Council was formed in 2023 to maintain a focus on improving bycatch management by advising the ADF&G Commissioner on implementation of Alaska Bycatch Review Task Force recommendations (ADF&G 2025c).

The North Pacific Fishery Management Council also focuses effort on minimizing the impacts of trawl gear on other marine species and habitats. A large portion of Alaska's federally managed commercial harvest occurs on vessels that catch fish by towing a bottom or pelagic trawl net. As the name implies, bottom trawls are designed to catch fish at or near the seafloor. Pelagic trawls,

also known as mid-water trawls, are designed to fish higher than bottom trawls and are typically used to target a single species, primarily pollock in Alaska's fisheries. The best available information indicates that bottom trawls have a greater impact on seafloor habitat than pelagic trawls, and federal management programs have already closed large areas of the ocean off Alaska's coast to bottom trawling to minimize these impacts. Most trawling in Alaska fisheries occurs with pelagic trawl nets, which are designed to tow the net through the water column rather than on the seafloor. However, pelagic trawl gear is known to have contact with the seafloor, and efforts are underway to better estimate the impacts to benthic habitat and sensitive species (Rijnsdorp et al. 2016). This work is expected to inform the North Pacific Fishery Management Council's ongoing evaluation of the impacts of fishing on essential fish habitat for all managed marine species.

Human Intrusions and Disturbances

Recreational Activities

Alaska is known for its abundant recreational opportunities, and both residents and many of the approximately 2.7 million tourists who visit Alaska each year take advantage of these opportunities (Destination Analysts 2023). Outside of human population centers, most recreational activity in Alaska generally occurs at a low level of intensity. In addition, because Alaska has a limited road system, recreationists do not access much of the wildlife habitat in the state. Because of these factors, recreational activities are unlikely to have population-level effects on wildlife. Areas with greater localized impacts include popular river corridors, some accessible ocean shorelines, areas near population centers, and popular fish and wildlife viewing areas where human activity is often concentrated and can affect riparian and shoreline habitats important to some bird and aquatic species. Recreational vehicles can cause localized disruption of wildlife behavior and damage to habitats. However, these impacts are not likely to affect fish and wildlife at the population level. Recreation vehicles are also a potential pathway for spreading invasive aquatic and terrestrial species into remote ecosystems, where the costs of surveillance and eradication are high. However, there are regulations and a public outreach campaign designed to minimize this threat.

Fishing the Copper River. ADF&G.

Conflict, Civil Unrest, and Security Activities

The Joint Pacific Alaska Range Complex (JPARC) includes all land, air, and sea space used for military training in Alaska. The overall JPARC training area encompasses 65,000 square miles of airspace, 2,500 square miles of land space, and 42,000 square miles of ocean surface. Each year, JPARC hosts three to four major military exercises, such as RED FLAG, that involve thousands of personnel and hundreds of vehicles, aircraft, and facilities (JPARC n.d.). Ongoing military training occurs daily on a much smaller scale at home stations.

Paratroopers descend over the Donnelly drop zone near Fort Greely. M. S. Berry, U.S. Army, used with permission.

Potential effects of military activity on wildlife include localized direct mortality from munitions training and aircraft and vehicle collisions, alteration or elimination of habitat, increased air and water pollution from munitions and transportation (Racine et al. 1992), and behavioral effects related to noise pollution, particularly from low-level aerial training exercises (Lawrence et al. 2015). Large military exercises result in temporary increases in aircraft overflights (sometimes at low elevation and supersonic speeds), vehicle traffic, and live fire exercises in the training areas utilized. These activities may affect local wildlife populations, and with renewed focus on Arctic engagement by the military, the potential for wildlife disturbance is likely to increase (Bye 2024). While the total amount of land, water, and air space designated for military training is large, for most of the area, the overall percentage of time that activity takes place at a significant scale is quite low and unlikely to have population- or landscape-level effects on fish or wildlife.

Other Human Disturbances

Scientific research and other nonrecreational and nonmilitary activities occur at a small scale across Alaska, and their effects on fish and wildlife are expected to be localized. However, small populations of animals that are frequently studied have experienced impacts from this threat (Meixell and Flint 2017). Possible impacts of researcher disturbance on fish and wildlife include injury or mortality, disturbance, displacement, and attraction of predators.

Natural System Management and Modifications

Fire and Fire Management

Wildfire plays an important role in the life history of many wildlife species in Alaska. It is one of many factors that maintain biological diversity (Smith et al. 2000): the natural cycle of habitat change caused by wildfire generally leads to more productive and diverse landscapes. However, fires can result in the immediate loss of individuals and the short-term loss of suitable habitat over large areas. Alaska has seen several major wildfire seasons over the past 20 years, including 2015, when 5.1 million acres burned (IARC 2025). As human recreation in nonurban areas increases, so does the potential for accidental wildfires. The frequency and intensity of wildfires have increased over the past few decades as a result of climate change and changing fire management strategies in Alaska.

Kanuti River and burned area. S. Hillebrand, USFWS, used with permission.

Dams and Water Management/Use

Alaska is fortunate to have relatively few water impoundments, and much of the state has abundant surface and groundwater availability. There are approximately 184 named dams in the state, primarily in the Southcentral, Southwest, and Southeast biogeographic regions. Of these, 50 dams are integral to utility-scale hydroelectric projects, whereas the remaining dams are relatively small and were built for community water storage or the treatment of water at mining operations (ASCE 2021). Potential impacts on wildlife from future dams and water withdrawals are most likely to come from large, utility-scale hydroelectric dams or those associated with large-scale mineral or oil and gas development.

Potential impacts of dams and water withdrawals on wildlife include permanent habitat loss and alteration, changes to water flow and characteristics, and blocking fish passage. Upstream of any river dam, large-scale flooding alters riparian and forest habitats important to wildlife, including forest birds and mammals. Dewatering of stream channels downstream of the dam or withdrawal results in reduced water flows, reduced transport of sediment and nutrients, and increased water temperature, all of which can degrade downstream wetland or estuarine habitats. Changes to habitat structure and function may alter wildlife communities that depend on these habitats and are most likely to affect fish, aquatic invertebrates, and bird species. Without fish passage structures, dams may prevent migrating salmonids from swimming upstream to spawn, and these fish may become the targets of predators who prefer slow-moving water.

Blue Lake Dam in Sitka. ADF&G.

In Alaska, the Anadromous Fish Act (AS 16.05.871–.901) and the Fishway Act (AS 16.05.841) both require consultation with ADF&G for any project that may have an impact on anadromous fish habitat or may obstruct fish passage. ADF&G evaluates project components and works with a project applicant to minimize the possible impacts on anadromous fish habitat and fish passage, which could include stipulations such as construction and operation timing windows, minimum flow releases, and project design, among other things. These statutes provide a mechanism for responsible management of anadromous waterways in Alaska that helps to mitigate impacts to these waters.

Invasive and Other Problematic Species, Genes, and Pathogens

As of 2024, an estimated 132 non-native animal species (fish, amphibians, reptiles, birds, mammals, invertebrates, parasites, and pathogens) have been reported in Alaska, and 24 of these are designated as highly invasive (USGS 2025, ADF&G 2025d). Potential invaders arriving by human-mediated pathways, including ships and cargo vessels, trailered watercraft, and fouled infrastructure, or through intentional or inadvertent introduction, are not included in that number. Some of these invasive and problematic species can have significant ecological and economic effects. Managing invasive, problematic, and pathogenic species is a priority because they can have significant negative impacts on habitat and native fish and wildlife. Due to the potential threat of invasive or problematic species introductions, Alaska has state laws and regulations aimed at preventing the introduction of potential invasive species. With diligent effort and sufficient resources, the introduction of these harmful organisms can be prevented or controlled.

Invasive Non-native and Alien Species

For this plan, an invasive species is defined using the language of the State of Alaska's Executive Order 13112: "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Following Salafsky et al. (2024), this section also includes information on native species that have been transplanted outside their natural range, which can result in harm to SGCN, their habitats, or both.

The most serious effects of terrestrial invasive species, so far, have been felt on individual Aleutian Islands in the Southwest biogeographic region, where the establishment of exotic foxes, rats, livestock, and mice have wreaked havoc on some bird populations (ASG 2019, BPIF 2021). Efforts to eradicate these species have been successful on Hawadax Island, where rat eradication has resulted in recovery of terrestrial and marine birds (Croll et al. 2016; see "Invasive Species" in Chapter 8).

Aquatic habitats are especially vulnerable to threats from invasive species due to their rapid transport by flowing water or ocean currents (Gotthardt and Walton 2011). Marine colonial tunicates, including the didemnid tunicate *(Didemnum vexillum)*, are easily transported on vessel hulls, infested aquatic farm infrastructure, or in ballast water, and aquatic plant species such as *Elodea* are typically spread by floatplane or boat traffic. These organisms can spread rapidly, enabling them to outcompete native species, altering the habitat and reducing or concealing available fish or wildlife forage species (ADF&G 2024). *Elodea* can completely choke slow-moving river channels, slowing currents and increasing water temperatures. It can outcompete native aquatic plants and cover the entire bottom of shallow lakes, altering habitat structure. Additionally, it could pose a threat to several fish species and other aquatic organisms (DNR 2024b).

A number of invasive terrestrial plants can disrupt native plant communities by directly competing for resources, displacing native vegetation, and ultimately degrading natural habitats that Alaska wildlife depend on (DNR 2011). European bird cherry *(Prunus padus)* contains cyanogenic glycosides and has, in rare circumstances, resulted in cyanide poisoning of moose. European bird cherry also outcompetes native vegetation and supports fewer terrestrial insects, reducing prey availability for salmon (Roon et al. 2016). Other plants, such as Japanese knotweed *(Fallopia japonica)*, can outcompete willow and native grasses, which are food and habitat for wildlife. When introduced to estuarine habitats, cordgrasses (*Spartina* spp.) fill in mudflats important to bivalves, crabs, and fish species, transforming them into dense meadows (DNR 2025).

While Alaska's remoteness and challenging physical environment were once thought to prevent many potential invasive species from becoming established, the state's relatively low level of natural biodiversity actually increases the risk that an invasive species could cause the decline of a native species or destroy important habitats. Invasive species can negatively impact fish, wildlife, and their habitats through predation and competition for resources, and they can serve as potential vectors for novel animal and plant pathogens. Landscape-scale changes caused by climate change, including rising ocean temperatures, are increasing habitat suitability for many non-native species. This has been the case with the detection of invasive European green crabs *(Carcinus maenas)* in the Southeastern region in 2022 (Lutto 2022). The European green crab has depleted shellfish beds and affected aquaculture in other states and is capable of causing widespread and rapid damage to eelgrass beds, which are important to many marine species. Dreissenid (zebra and quagga) mussels are aquatic invasive species that are not currently present in Alaska but potentially will be within the

European green crab. E. Grason, NOAA, used with permission.

next decade. Dreissenid mussels are filter feeders that have had extreme impacts on food webs outside of Alaska (Miller and Watzin 2007), and resources to control their spread in Alaska are currently scarce.

Increases in human travel and development, particularly new roads and other transportation corridors, may facilitate the spread and establishment of invasive species in otherwise remote areas. Higher rates of interstate and international shipping traffic could result in accidental introductions of invasive species. Both the state and federal governments and nongovernmental organizations (NGOs) have engaged in public education efforts regarding the dangers of introducing non-native species.

Desirable native fish, furbearer, and game species such as northern pike and mink have been intentionally transplanted in Alaska, including to islands and waters outside their native range, and have thrived (Paul 2009, Sepulveda et al. 2013). Intentional transplants may have been done to augment an existing wildlife population, create economic, hunting, and angling opportunities, reduce human-wildlife conflicts, increase food security, or rebalance predator and prey levels (Paul 2009). For example, invasive northern pike illegally released in lakes of the Southcentral region have caused population declines of salmonids due to predation (Dunker et al. 2022). Managing invasive species through methods such as netting, trapping, or pesticides can also have bycatch and nontarget effects on some SGCN species; however, precautions are taken to minimize this bycatch during pike removal. Mink were transplanted to some islands in the early twentieth century for ranching, and these populations have had significant negative effects on breeding seabirds, such as Pigeon Guillemots in Prince William Sound (USFWS 2024). Successful removal of mink from the Naked Islands group in Prince William Sound by 2017 led to population rebounds by Pigeon Guillemots.

Problematic Native Species

Native species in terrestrial or aquatic environments can become harmful to other wildlife and their habitats when they become overabundant or spread beyond their natural ranges due to human activities (Salafsky et al. 2024). They can also become overabundant without human translocation and negatively affect other native wildlife and their habitats. For example, warmer temperatures and milder winters have led to an increase in the severity of spruce beetle *(Dendroctonus rufipennis)* outbreaks (Dell and Davis 2019), negatively impacting habitat quality and suitability for some forest-dwelling species but possibly benefitting wildlife species that prefer early successional habitats. As of 2024, at least 2.3 million acres of forest have been affected by spruce beetle outbreaks in the Southcentral region (Spruce Beetle in Alaska's Forests 2025). Due to the availability of artificial nest structures in the oilfields, Common Ravens have become more common in Alaska's Northern region, where they prey on tundra-nesting birds, their eggs, and their young (Backensto 2010).

Introduced Genetic Material

Unlike hatchery development practices used elsewhere in North America, Alaska has always prioritized conserving local salmon populations in the vicinity of hatcheries (Evenson et al. 2018). A few studies have indicated that hatchery salmon can effectively spawn with wild salmon in streams (McConnell et al. 2018, Shedd et al. 2022), which may decrease genetic diversity of wild populations (Jasper et al. 2013). A key research question is whether potential effects are transitory (short-term) or heritable (long-term).

Pathogens

Disease-causing microorganisms such as bacteria, viruses, fungi, and prions can cause injury and mortality of Alaska's fish and wildlife. Much of the research and surveillance conducted in Alaska has centered around pathogens found in fish and wildlife species that may pose a risk to human health. Additionally, in recent decades, several pathogens have been detected in wild bird, mammal, and marine invertebrate populations that have the potential to impact some species on a population level. Some emerging infectious diseases in wildlife are linked to climate change, and there is evidence that the spread and prevalence of some diseases is increasing (Van Hemert et al. 2014). Warming ocean waters and marine heat waves, such as the one that affected the North Pacific Ocean during 2014–2016, have facilitated the spread of diseases. For example, a Sea Star Wasting Syndrome pandemic began in 2013 and led to population crashes of several species of sea stars. This outbreak decimated most populations of the sunflower sea star in the southern portion of its range, while in Alaska, the largest portion of the species' range, declines were less severe, and there has been some evidence of recovery (Lowry et al. 2022).

Migratory bird and mammal species play an important role in the spread of diseases, and increased monitoring efforts are needed in Alaska (Van Hemert et al. 2014, Droghini et al. 2022). For example, Highly Pathogenic Avian Influenza (HPAI) has been detected in both domestic and wild bird populations as well as in some mammals in Alaska (ADF&G 2022). Waterfowl and raptors appear to be particularly susceptible to HPAI (ADF&G 2022); waterfowl and seabirds constitute the majority of reported cases in Alaska (APHIS 2024).

Avian keratin disorder, a recently described disease that may be caused by a novel picornavirus, has been detected in Alaska landbird populations, particularly Black-capped Chickadees and American Crows (BPIF 2021). The disease causes abnormal beak growth, which prevents infected birds from feeding and properly maintaining their feathers, often leading to death. Currently, the prevalence of this virus is low, and it is not having population-level impacts on Alaska's birds.

White-nose syndrome (WNS), a disease caused by the fungus *Pseudogymnoascus destructans*, has not yet been detected in Alaska. This disease has been decimating bat populations in eastern North America since at least 2006 and was first detected in a western state in 2016. WNS is highly contagious and lethal for bats that congregate in large numbers, as they do in the East and Midwest, where bats hibernate in caves and mines. It has resulted in the deaths of more than six million bats outside of Alaska, and mortality at individual caves and mines can be as high as 90–100% of the colony (Cheng et al. 2021). In Alaska, western little brown myotis hibernate in small groups in dispersed hibernacula on talus slopes rather than in large groups in caves and mines (Neubaum 2018, Blejwas et al. 2021). Their different hibernation strategy, habitat use, and greater genetic

Species of Conservation Need: Little Brown Bat *(Myotis lucifugus)*

Little brown bat. ADF&G.

The little brown bat is the most common and widespread bat species in Alaska and the only one found outside Southeast Alaska. Bats sleep during the day and hunt and feed at night, using echolocation to navigate and catch their prey. Little brown bats mate in the fall, but fertilization does not occur until the following spring, after the females emerge from hibernation. Females give birth to a single pup in June or July, clustering together in large, warm roosts to speed the growth and development of their young. Most known maternity roosts in Alaska are located in buildings, but such roosts have also been found in trees and even at hot springs in Southeast Alaska. Male bats and nonreproductive females usually roost singly or in small groups in various roost types, including snags, live trees, rock crevices, caves, logs, stumps, and buildings. The little brown bat hibernates for the winter, usually entering hibernation in September or October and emerging in April or May. Little brown bats east of the Rocky Mountains hibernate in caves and mines, where they often cluster in large groups. This has made them vulnerable to a deadly fungal disease called white-nose syndrome, which has killed millions of bats in the eastern and midwestern United States. In the western United States, little brown bats hibernate locally in small groups in the spaces between rocks on talus slopes or boulder fields, which has slowed the spread of the disease and resulted in much lower levels of mortality. White-nose syndrome has not been detected in Alaska, where bats are likely at lower risk of the disease than bats in the continental United States due to their use of dispersed hibernacula, among other variables.

structure suggest that western bats may not experience the same high levels of mortality as their eastern counterparts (Blejwas et al. 2023). Furthermore, based on the current rate of spread in Washington State, it could take decades for WNS to reach Alaska, although accidental translocation of infected bats remains a possibility.

Pollution

The quantity of human-caused pollution that enters Alaska's waters and air from in-state sources is low relative to the state's size and is typically associated with localized development (e.g., military bases, airports, oil and gas fields, mines, household sewage). Pollution (not limited to in-state sources) has been identified as a top conservation threat for some species groups, such as shorebirds (ASG 2019) and marine mammals, as well as sensitive marine ecosystems that directly and indirectly support large numbers of fish and wildlife.

Water-borne and Other Effluent Pollution

Household Sewage and Urban Wastewater

Excess nutrients, toxic substances (e.g., pharmaceuticals, heavy metals, and household chemicals), and sediments from waterborne sewage and nonpoint runoff can impact the health and survival of wildlife and alter wildlife habitats. Most wastewater in larger urban areas in Alaska is collected and

treated in sewage treatment plants before being discharged into rivers or directly into the ocean; however, sparsely populated and small villages in rural areas often lack this infrastructure. An estimated 3,300 houses in Alaska lack water and sewer service, most occurring in rural, underserved communities in the Western and Northern biogeographic regions. In addition, approximately 4,500 rural homes are connected to community-wide piped systems that have surpassed or are nearing the end of their design life (ADEC 2023).

Household sewage and the unregulated dumping of effluent from large cruise ships can be detrimental to nearshore ecosystems such as eelgrass beds; high nutrient input from waste streams can result in excess growth of algae and other epiphytes on eelgrass blades, blocking light and interfering with photosynthesis. Regulations now require cruise ships in Alaska waters to maintain approved wastewater treatment systems and limit where discharges can occur. These effluents are generally regulated under the requirements of the federal Clean Water Act and require permitting and monitoring for compliance.

Pollution from roads is also part of the urban wastewater stream and may impact fish and wildlife at a local scale. Salt brine (a solution composed of sodium chloride and water) is frequently used in urban areas in Alaska to prevent and remove ice on roadways (DOT&PF 2014). Bird mortalities associated with salted roads may be more widespread and frequent than indicated by documented reports alone (Mineau and Brownlee 2005). Applying calcium chloride to unpaved roads for dust control has been shown to alter soil chemistry and, subsequently, plant health (Stehn and Roland 2018). Runoff from calcium chloride application, as well as other contaminants such as road salt, tire residue, and vehicle fluids, is toxic to fish (Barnes and Conner 2014) and wood frog larvae (Harless 2012) and may have other direct and indirect effects on aquatic invertebrate and fish species. When sedimentation and water quality in nearshore marine environments are altered due to runoff or other pollution sources, overgrowth of native epibenthic algae can be a problem (Hughes et al. 2004).

Industrial and Military Effluents

Contaminated sites are present at discrete locations across Alaska, and hazardous materials that have been released into the environment include oil, fertilizers, heavy metals, polychlorinated biphenyls (PCBs), and polyfluoroalkyl substances (PFAS), as well as short-lived climate pollutants such as black carbon and methane. During 2015–2024, the Alaska Department of Environmental Conservation recorded 645 spills of at least 500 gallons, the majority of which originated from oil production, mining operations, military installations, and vessels (ADEC 2024). Of these, most spills occurred in the Northern, Central, and Western biogeographic regions. The Department of Defense has over 500 Formerly Used Defense Sites (FUDS) in Alaska (USACE 2024) and seven active Superfund sites (EPA 2024), all of which are polluted with a variety of toxic contaminants. There are nine active military installations in the state, portions of which are contaminated by used munitions and other toxic materials. Alaska currently has a limited manufacturing industry (i.e., 4% of state gross domestic product [GDP]), but there are ongoing efforts to expand this sector. Alaska's seafood processing industry, with over 166 shore-based plants, 49 catcher-processor vessels, and 10 large floating processors, accounts for 70% of Alaska's manufacturing employment (ARC 2021). Additionally, Alaska has several oil refineries and one fertilizer plant (not currently operating).

Spills and releases of oil, gas, produced water, and other contaminants can destroy habitat, contaminate groundwater aquifers and surface water, and introduce dissolved metals and

Species of Conservation Need: Spectacled Eider *(Somateria fischeri)*

Male Spectacled Eiders. T. Bowman, USFWS.

The Spectacled Eider is a large sea duck with distinctive plumage—both males and females have eye patches resembling spectacles. It is an Arctic and subarctic species found only in Alaska and Russia. In Alaska, Spectacled Eiders breed in marshy tundra, most commonly in the Yukon-Kuskokwim Delta and along the Beaufort Sea coast. The entire population has been known to winter south of St. Lawrence Island in the Bering Sea. They are currently listed as threatened under the Endangered Species Act—in 1993, researchers found a 96% decline in the breeding population along Alaska's western coast. Lead poisoning from ingestion of lead shotgun pellets was considered an important threat, but lead shotgun pellets are now banned for waterfowl hunting by ADF&G regulations. Decreased winter sea ice cover in the Bering Sea due to climate change is likely to affect populations of these eiders over the next two decades. ADF&G and partners are conducting research to understand the effects of the changing climate on this SGCN. Spectacled Eiders feed primarily on invertebrates; during the breeding season, they feed on plentiful insect life and larvae, and in the winter, they will dive up to 250 feet underwater to feed on marine invertebrates such as clams, snails, and crustaceans.

radio-active elements to surface waters. Effects from small spills are generally limited to direct damage to local fish and wildlife populations and their habitats. PFAS, known as "forever chemicals," do not naturally degrade in the environment but must be incinerated at very high temperatures to remove them from soils and other substrates (Verma et al. 2023). Live fire exercises for military purposes, as well as fire and airport trainings, are of concern because they use Aqueous Film Forming Foam (AFFF), a substance containing PFAS, to put out fires.

Oil spills in or near marine or freshwater habitats, especially in flowing water, can spread more easily and have an increased impact because spilled oil is much more difficult to control and recover in these environments. Such spills can have much broader impacts on wildlife, particularly invertebrates (Miller et al. 1986), fish (Moles et al. 1979), and other aquatic species that depend on the impacted system. Of particular concern is the potential for spills in remote areas where oil is difficult to contain and remove, such as Arctic waters with sea ice and locations critical to large numbers of marine animals.

The risk of a large marine oil spill has been reduced to some extent by the use of double-hulled tankers and real-time monitoring of cargo and other vessels; however, even small marine oil spills can cause mortality of seabirds, shorebirds, marine mammals, fish, and marine invertebrates. Depending on the size of the spill (Peterson 2001) and the location, mortality can be widespread and can potentially have population-level effects on fish and wildlife. An oil spill affecting important coastal and nearshore areas, such as Izembek Lagoon, the Copper River Delta, or Ledyard Bay, could expose millions of birds and marine mammals, fish, and other aquatic species to harm. In addition

to the immediate effects of oil spills on wildlife, long-term oil exposure has been shown to decrease reproductive success in seabirds for up to 10 years after a spill event (Barros et al. 2014).

The potential failure of containment dams holding tailings and effluents from mineral processing could expose a large downstream area to toxic pollutants, resulting in direct mortality of fish and other aquatic organisms; contamination of wildlife that depend on aquatic organisms for food; and alteration of habitat through toxin exposure, sedimentation, and channel modification. In January 2024, a pipeline leak at a mine near Juneau spilled over 105,000 gallons of tailings slurry containing sediments and elevated concentrations of heavy metals into a nearby creek and marine waters (Canny 2024). Disposal of water used in leaching or other ore reduction operations generally requires treatment, which requires impoundment facilities. These facilities can alter habitats and negatively affect fish and wildlife on a local scale. Wet impoundments may also leak or fail over time, sometimes resulting in catastrophic failure, which can impact fish and wildlife (Davies 2002).

Oiled birds from the Exxon Valdez oil spill in Prince William Sound. NOAA, used with permission.

Acid mine drainage has long been recognized as detrimental to wildlife (Hoffert 1947, Higman et al. 2019). Mineral extraction often results in the exposure of metal sulfides to oxygen and water, leading to the formation of sulfuric acid, which can leach metals from rocks that come in contact with the acid. This runoff can be toxic to aquatic organisms (Koryak et al. 1972; Jennings et al. 2008) in both freshwater and marine environments (Grout and Levings 2001). These threats can be a significant concern, given the persistence of such runoff over time and the difficult, often prohibitive mitigation costs. Unremediated, abandoned mine sites can continue to have localized negative effects on fish and wildlife decades after mine operations have ceased. For example, ongoing acid mine drainage into the Taku River in Southeast Alaska continues to be a risk to the river's important fish and wildlife populations, despite a nearby mine being closed since 1957.

Agricultural and Forestry Effluents

Because there is so little agricultural land in the state, there is very little risk that agricultural effluents would cause any population-level effects on wildlife. Discharges from the forest products industry in the state currently include increases in natural runoff from clearcutting and sedimentation due to landslides. Sedimentation from road building and logging-related operations is monitored and regulated by the Alaska Department of Natural Resources and by the Department of Environmental Conservation under the Alaska Forest Resources Protection Act (FRPA; AS 41.17). There are no longer any pulp mills operating in the state. Herbicide use for right-of-way maintenance has the potential to impact both terrestrial and aquatic habitats through runoff; this is most likely to be problematic in urban areas of Alaska. Pesticides used in mariculture operations have the potential

This Laysan Albatross chick died from ingesting plastic garbage picked up while foraging. Claire Fackler, NOAA, used with permission.

for localized impacts to nearshore and intertidal habitats such as eelgrass beds and salt marshes.

Garbage and Solid Waste

Unsecured garbage in developed areas is an attractant to wildlife, such as bears (Peirce and Van Daele 2006). Garbage can provide a nutritional subsidy to avian and mammalian predators, potentially skewing the population balance among some species (Weiser 2010, Ripple et al. 2014).

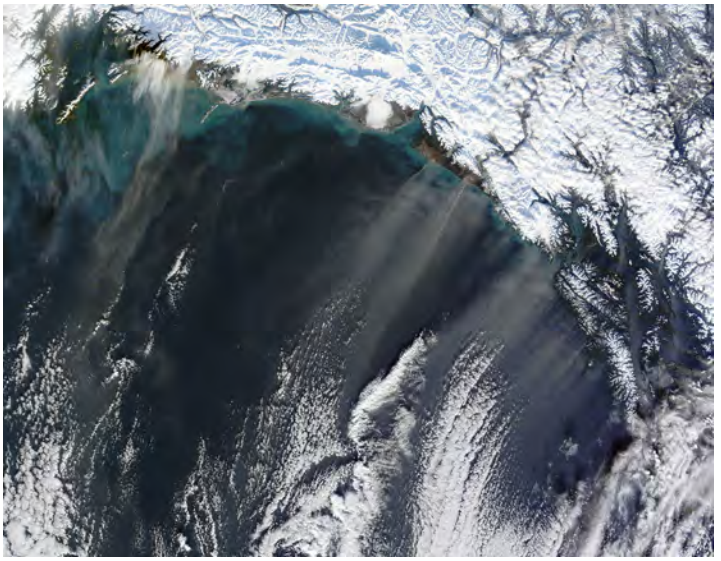
Plastic waste pollution primarily threatens developed terrestrial areas and the marine environment, though the magnitude of impacts on individual fish and wildlife species is unclear. Worldwide, improperly disposed of plastic waste affects all terrestrial, freshwater, and marine habitats and has been implicated as a driver of biodiversity loss and ecosystem degradation (IUCN 2024). The majority of plastic waste consists of macroplastics, much of which is from single-use containers. Discarded fishing gear is particularly problematic in marine environments and can result in entanglements and ingestion, with associated harmful effects on seabirds and marine mammals (Manville 1990; Raum-Suryan et al. 2009). Microplastics and nanoplastics, as well as synthetic textile fibers, can enter living organisms and, in the case of nanoplastics, cross cell walls (IUCN 2024). Microplastics have been found in the blubber of many marine mammal species, including a subsistence-harvested bearded seal from Alaska, suggesting translocation throughout the body (Merrill et al. 2023). Ongoing studies (unpublished) are finding microplastics in other marine mammal tissues (i.e., muscle, liver, kidney, placenta) and in amniotic fluid and fetal tissue.

Alaska lacks adequate facilities and infrastructure to manage plastic waste. The most noticeable impact of plastic waste on wildlife is mortality from ingestion, entanglement, or suffocation; however, floating plastics can also be a transport mechanism for invasive species. In addition, contaminants may leach from plastics or be deposited from airborne sources into surrounding habitats, where they may affect soil processes and plant production (IUCN 2024).

Airborne Pollutants

The Alaska Department of Environmental Conservation regulates airborne pollutants under the federal Clean Air Act. Airborne pollutants from point and nonpoint sources, such as vehicle emissions, wood smoke, and industrial development emissions, may impact the health and survival of Alaska wildlife. Air pollution from vehicle exhaust, electricity generation, and the heating of buildings (e.g., wood, coal, natural gas, and heating oil) is more common around urban population centers in the Southcentral and Central biogeographic regions. Due to prevailing wind patterns and ocean currents, the Northern biogeographic region and other parts of the global Arctic act as a sink for airborne pollutants from distant sources, which degrade very slowly in cold temperatures. Heavy metals (e.g.,

mercury) and persistent organic pollutants (e.g., PCBs) can bioaccumulate, as observed in Alaska birds (Evers et al. 2014, Kaler et al. 2014, Perkins et al. 2016), whales (Hoguet et al. 2013), and fish (Kenney et al. 2014).



Strong offshore winds carry sand and dust from beaches out across the Gulf of Alaska. Photo by Jeff Schmaltz, NASA.

Energy Emissions

Artificial light has been shown to alter the behavior and movement of wildlife in terrestrial, freshwater, and marine environments and can ultimately impact an animal's productivity, movement, and survival (Rich and Longcore 2006). Behavioral changes in aquatic invertebrates can alter their population dynamics and ultimately cause changes to an ecosystem's structure and function, affecting wildlife at higher trophic levels (Ganguly and Candolin 2023). Artificial light can cause collisions with human structures such as residential and commercial buildings, communication towers, wind turbines, fishing vessels, offshore oil rigs, and others (Day et al. 2015, Cabrera-Cruz et al. 2018). Emission of artificial light is generally restricted to developed areas and transportation corridors and therefore is not expected to have population level impacts on SGCN.

Noise pollution from traffic, industrial and urban sources, seismic exploration, SONAR use, and human recreation can make it difficult for wildlife to communicate, forage, mate, and avoid predators. It may also deflect and deter wildlife from using particular areas (Shannon et al. 2016). Sound transmission decreases with distance, and the effects of loud, stationary sources are typically confined to developed areas and transportation corridors. However, in-water noise is typically transmitted over much longer distances, resulting in a larger disturbance area than terrestrial sources of noise. Seismic airguns used in oil and gas exploration emit high-energy, low-frequency bursts of sound that can travel long distances, disrupt marine mammal behaviors, and, at close range, cause physical injury (MMC 2021). Changes to the acoustic landscape in marine environments can impact foraging success and cause mortalities of marine mammals (Bejder et al. 2006, Blair et al. 2016). For example, in Cook Inlet, one study found that daily anthropogenic noise sources may be masking beluga whale communication and hearing (Castellote et al. 2018).

Natural Disasters

Geologic Events

Threats to wildlife populations in Alaska from geologic events, including volcanoes, earthquakes, tsunamis, avalanches, and landslides, are unpredictable and have the potential to significantly alter fish and wildlife habitats. The state is located in the most tectonically active region of the country, with a significant portion of its coastline located at the intersection of two major tectonic plates.

Volcanoes

A major volcanic eruption would likely cause some direct loss of wildlife and habitat in the immediate area of the volcano, but widespread ash fall is the most common volcanic hazard (USGS 2000). Volcanic ash can harm wildlife health, causing direct mortality from inhalation, increased sedimentation, radical change of the pH of waterbodies, and the death of vegetation that wildlife depend on. These effects can last for months to years or more.

Mount Redoubt. ADF&G.

Earthquakes and Tsunamis

Earthquakes and associated tsunamis can cause widespread damage to coastal, marine, and inland habitats, as well as habitat loss or alteration from uplift or subsidence. Breaches of industrial facilities, such as pipelines, mining ponds, holding facilities, or similar infrastructure, could also threaten wildlife and habitats by discharging toxic substances. Shallow, nearshore marine habitats are extremely productive and are important for seabirds, juvenile fish, and shellfish. Catastrophic damage from earthquakes and tsunamis could impact wildlife on a regional population level.

Avalanches and Landslides

In recent decades, there have been an increasing number of landslides, avalanches, and coastal tsunamis in Alaska due to warming temperatures, thawing permafrost, glacial retreat, and high levels of precipitation. Many recent events have occurred in the Southeast biogeographic region, including Icy and Glacier bays, Haines, Sitka, Juneau, Wrangell, and Ketchikan. Landslides are becoming more frequent in Alaska's other biogeographic regions as well. In addition to human and economic costs, debris flows may cause localized mortality and habitat loss for wildlife in the area.

Climate Change

Climate change is a potential threat to fish and wildlife in Alaska at regional and statewide scales. Adequate planning for the future of fish and wildlife management in Alaska will require consideration of future changes in climate and resulting impacts on species and habitats. As this plan guides Alaska conservation efforts over the next decade, this section focuses on climatic changes occurring presently and predicted changes within the next two decades. Robust monitoring will be essential during this time period to identify which species are likely to be resilient to climate change and which will require additional management to support their resilience.

Owing to the high connectivity of habitats, wildlife in Alaska may be more resilient to climate change than wildlife in other parts of the United States where habitat fragmentation by human activities is more extensive (Vynne et al. 2021). For example, wildlife in Alaska may be able to more easily move to higher elevations or latitudes (e.g., Tape et al. 2016, 2018, Mizel et al. 2016) as their habitats change

because there are fewer anthropogenic barriers to dispersal. Climate-related shifts in distribution or abundance may have ecosystem-wide effects, especially as new species immigrate or emigrate. Wildlife managers, therefore, need to adapt management strategies to account for the effects of a changing climate, combining past experience and knowledge with new information to assess or modify management strategies. While climate change may have neutral or even positive effects on some species, this section focuses on SGCN that are currently—or are projected to be—negatively impacted, since supporting resilience of these species will avoid the need to list additional species under the ESA.

Alaska Wildlife and Fish in a Changing Climate

Climate dynamics strongly affect terrestrial, aquatic, coastal, and marine species and environments in Alaska (Markon et al. 2018, Huntington et al. 2023). Climate can directly impact wildlife by influencing species' ranges, seasonal timing (phenology), or productivity. Complex or indirect effects of climate on wildlife and fish include habitat changes, disturbances (such as fire, wind, or insect outbreaks), and influences on competition, predator-prey interactions, community structure, and food webs. As a result, changes in climate are expected to affect fish and wildlife species in complex ways.

Wood frog. NPS, used with permission.

Changes in global and regional climate, such as increasing temperature and altered precipitation patterns, can trigger a series of processes that may ultimately affect wildlife and fish in both positive and negative ways. In northern systems, changes in temperature and precipitation interact to affect characteristic patterns of snowpack, permafrost, glaciers, and sea ice (Figure 7.1). For example, throughout much of the Southwest, Southcentral, and Southeast biogeographic regions, cold season temperatures typically hover around freezing. As a result, small temperature changes can have large effects on snow accumulation and melting, even if the amount of precipitation does not change. In these places, hydrologic and habitat changes that are important to fish and wildlife species can thus be disproportionate to air temperature changes.

Current Climate Trends

Temperature and Precipitation

Alaska's climate is characterized in part by its inherent variability, both in terms of expected conditions across the large geographic span of the state and the interannual and interdecadal variability stemming from the region's position in Arctic and North Pacific climates. Climate change in Alaska is driven by global trends, but Alaska is warming at two to three times the global average (Markon et al. 2018, Ballinger et al. 2023), and the Arctic is warming at four times the global average (Rantanen et al. 2022). Annual average temperatures since 1971 have increased by approximately 2.4°F in the Southeast biogeographic region to approximately 6.2°F in the Northern biogeographic region (Ballinger et al. 2023).

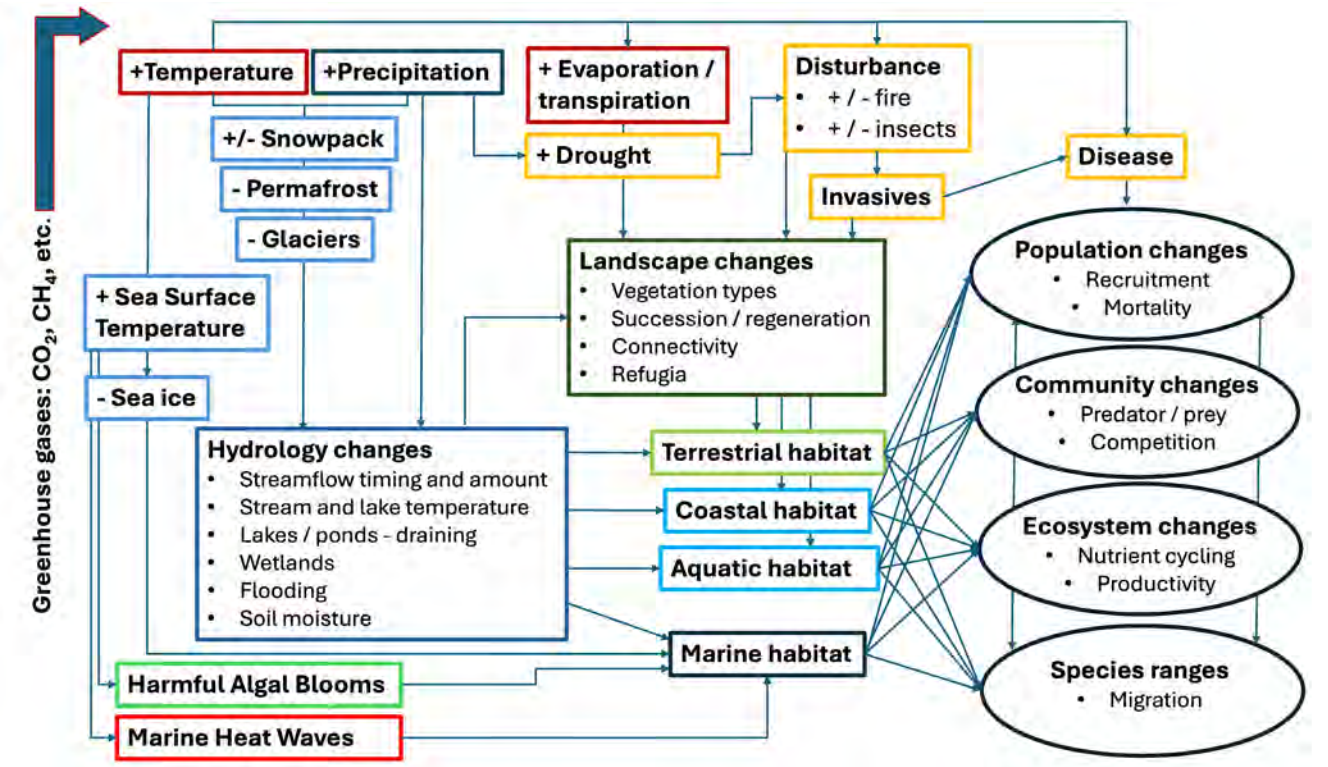


Figure 7.1. Climate change effects on processes that influence species, habitats, populations, communities, and ecosystems in boreal and Arctic systems. Climate changes and variability interact in complex ways with these systems, affecting species of concern and their habitats.

Heat waves are also increasing in the Arctic (Dobricic et al. 2020). A 2019 summer heatwave brought record-high temperatures to the Southcentral biogeographic region (Bhatt et al. 2021). Daily high temperatures exceeded normal temperatures by more than 20°F, resulting in uncharacteristically severe disturbances, such as the Swan Lake Fire on the Kenai Peninsula (Jandt and York 2021) and fish kills from thermal stress in multiple areas of the state including Norton Sound, Yukon River, Kuskokwim River, Bristol Bay, Matanuska-Susitna area, Cook Inlet, and Prince William Sound (von Biela et al. 2022).

Precipitation in Alaska has generally been increasing since the late 1950s, but trends vary by region, observation source, season, and statistical method. The largest precipitation trend is on the North Slope, with increases in annual average precipitation of 2.5% to 3.5% per decade since the 1950s (Ballinger et al. 2023). Recent unprecedented extreme rainfall and seasonal precipitation events have presented challenges in multiple parts of Alaska. For example, an atmospheric river (an atmospheric flow that causes extreme precipitation) in December 2020 broke all-time extreme 24-hour precipitation records (Lader et al. 2022) in 11 Southeast Alaska locations (National Weather Service Juneau 2021).

Snow, Permafrost, Sea Ice, and Glaciers

Temperature increases are driving a shortened period of snow cover during the winter season, resulting in melting glaciers, thawing permafrost, and less predictable sea ice extent (Meredith et al. 2022, Ballinger et al. 2023). Snowfall has also decreased in 12 of 13 Alaska climate divisions in both spring and autumn (Ballinger et al. 2023). Midwinter snowfall has increased except in the

central and southern panhandle of Southeast Alaska, particularly in the Southcentral and Central biogeographic regions (Ballinger et al. 2023). In recent years, uncharacteristic rain-on-snow events across the Arctic have been observed, negatively impacting forage and habitat availability for mammals and resident birds (Serreze et al. 2021). Permafrost thaw is increasing and is associated with thermokarst (ground slumps or cave-ins), lake drainage, and surface pooling, depending on the ice content of the ground and continuity of permafrost (Lara et al. 2016, Nitze et al. 2020, Chen et al. 2021, Lara et al. 2021, Lindgren et al. 2021). Depending on local topography, these effects also contribute to accelerating erosion of river and coastal systems, changing sediment patterns, and destabilizing ground. Collectively, these changes are projected to affect wildlife habitats and hydrology in the Arctic (Jones et al. 2022).

Even though sea ice can be highly variable from year to year, the overall sea ice season is becoming shorter in the Bering, Chukchi, and Beaufort seas. Also, sea ice structure is less predictable when there are novel extremes (Stabeno and Bell 2019). In March, historically the month of maximum sea ice extent, the Bering Sea ice extent has decreased by about 20,000 square miles per decade since 1957 (Meredith et al. 2022), and record minimums in 2018 and 2019 were associated with warm ocean temperatures (Thoman et al. 2020). For September, historically the month of minimum sea ice extent, the Chukchi and Beaufort ice extents have decreased by about 27,000 square miles per decade and 31,000 square miles per decade, respectively (Meredith et al. 2022).

The majority of glaciers across Alaska are retreating and thinning rapidly, which is having complex effects on rivers and coastal systems (O'Neel et al. 2015). Increased glacial contributions to streamflow and coastal systems have the potential to alter nearshore food webs, which would affect coastal fish and wildlife species (Arimitsu et al. 2016). Glacial retreat is also creating notable new salmon habitat in the Southcentral and Southeast biogeographic regions (Pitman et al. 2021).

Species of Conservation Need: Harbor Porpoise *(Phocoena phocoena)*

Harbor porpoise, NOAA Fisheries/Northeast Fisheries Science Center, used with permission.

The harbor porpoise is a small, elusive cetacean distributed throughout coastal and offshore waters of the Northern Hemisphere. It is the second smallest cetacean species, with adults averaging five feet long and weighing between 130 and 170 pounds. Described as "living in the fast lane," harbor porpoises reach sexual maturation early (females at three years and males at three to four years) and give birth every one to two years. Harbor porpoises can live up to 24 years, with a mean lifespan of 12 years. Despite their long-distance dispersal capabilities, harbor porpoises seldom make long-distance movements and are typically observed in shallow waters less than 100 meters deep and within 10 kilometers of shore. One of the main potential threats to harbor porpoise populations is entanglement in fishing gear. The National Marine Fisheries Service has recently raised conservation concerns and taken management actions for harbor porpoises in Southeast Alaska based on inadequate information. To understand if there is a true conservation concern and need for those management changes, ADF&G has begun multiple extensive studies of harbor porpoise in Southeast Alaska.

Hydrology

The changes in temperature, precipitation, and snowpack described above affect the timing and magnitude of streamflow. Across most of Alaska, the duration of the snow cover season has decreased due to earlier melt and runoff. For river systems where seasonal streamflow patterns were historically dominated by snowmelt, warming since the 1970s is driving a shift from snow-dominated hydrology toward transitional (mix of rain and snow) hydrology or even rain-dominated hydrology (Littell et al. 2018). These changes in the timing of peak streamflow and the role of snow versus rain affect individual streams and rivers in different ways. In river systems where glacial melt subsidizes summer streamflow, the effects of climate change on streamflow and temperature may be buffered in comparison to nonglacial systems, or it can result in increased streamflow. Streamflow changes can impact stream temperatures that affect salmon growth, migration, and spawning (Shaftel et al. 2020). For example, high summer air temperatures can increase glacial melt, increase summer stream flows, and decrease stream temperatures in glacial systems. By contrast, elevated air temperatures can increase stream temperatures in nonglacial streams, sometimes to lethal levels (von Biela et al. 2022), affecting anadromous fish migration.

Marine Systems

In recent decades, Alaska marine ecosystems have experienced several substantial changes including rapid ocean warming, (Huntington et al. 2020, Stabeno and Bell 2019, Thoman et al. 2020, Walsh et al. 2018), the highest global rates of ocean acidification (Qi et al. 2017), and an increasing frequency (Carvalho et al. 2021) of extreme climate events such as Marine Heat Waves (Bond et al. 2015, Walsh et al. 2018). These physical changes have caused large perturbations to the marine system such as reduced productivity, shifting seasonal timing of productivity, altered food web dynamics, and steep declines in prey availability for some species (Hunt et al. 2020, Siddon et al. 2021).

Ocean acidification describes decreases in marine pH and carbonate ion concentrations and occurs due to oceanic uptake of anthropogenic carbon dioxide (CO_2) in the atmosphere (Mathis et al. 2015, Hauri et al. 2021). Although ocean acidification is a global phenomenon, ocean water in Alaska is more susceptible to the acidification effects of increased atmospheric CO_2 because of its colder temperatures (Steinacher et al. 2009). Some of the most abundant and productive species of marine plankton, shellfish, and other benthic arthropods in the marine waters of Alaska form shells using carbonate minerals, and ocean acidification has already reached threshold levels that negatively affect the development of these organisms (Mathis et al. 2011, Fabry et al. 2008). This group of animals is often a critical component of the marine trophic systems that produce much of the forage relied on by seabirds, marine mammals, and many species of commercially harvested fish (Fabry et al. 2009). More recently, modeling efforts predict that under certain climate scenarios, the months in which ocean acidification events occur are expected to increase (Pilcher et al. 2022).

Ocean acidification is predicted to have negative impacts on many aspects of marine ecosystems and the people that rely on them for economic, subsistence, cultural, personal, and recreational uses. A risk assessment for Alaska's commercial and subsistence fisheries found that southeastern and southwestern Alaska communities faced the highest risk from ocean acidification (Mathis et al. 2015). These locations rely most highly on fisheries harvests and co-occur in regions where increased ocean acidification is expected to occur (Mathis et al. 2015). Another study that used hindcast simulations found that local wind stress influenced upwelling in areas of the Gulf of Alaska

As ice cover declines in the Arctic, the darker water absorbs more heat from the sun and accelerates ice melting. C. Michel, used with permission.

and caused extreme acidification events (Hauri et al. 2021). After these extreme ocean acidification events, the Gulf of Alaska then experienced the unprecedented marine heatwave in 2014–2016 known as "the Blob," which is the largest and longest global marine heat wave to date (Hauri et al. 2021). Other areas of Alaska waters are also expected to experience ocean acidification events and continued warming. An analysis in the Bering Sea found that the southeastern Bering Sea shelf and outer shelf regions were projected to experience the greatest increases in ocean acidification (Pilcher et al. 2022). Ocean acidification events and marine heatwaves affect important components of the current marine ecosystem, and these events may continue to increase in frequency.

Many arctic seabird and marine mammal species are likely to be negatively impacted by climate change and require conservation and management to support their resilience. Ocean warming and record-low sea ice in the Chukchi Sea have impacted the food web (Huntington et al. 2020, Romano et al. 2020). An observed shift from large-bodied, lipid-rich arctic zooplankton species to small-bodied, lipid-poor subarctic species (Mordy et al. 2022, Ershova et al. 2017) corresponds with the reduced energy content of zooplanktivorous fish such as Arctic cod, saffron cod, sandlance, and capelin (Copeman et al. 2022). Subsequently, seabirds and marine mammals preying on these fish may have a nutritionally poor diet, which could result in reproductive failures and mortality. Indeed, emaciated seabird carcasses were found on beaches during mortality events in the Bering and Chukchi Seas (Romano et al. 2020), with evidence suggesting starvation was the underlying cause. Similarly, Renner et al. (2024) attributed the mortality of half of Alaska's Common Murre population (four million birds) to the 2014–2016 marine heatwave, demonstrating persistent effects of climate change on top predators in these systems.

Marine mammal and seabird health may become increasingly affected by toxic harmful algal blooms (HABs) in Alaska (Hendrix et al. 2021; Lefebvre et al. 2016; Van Hemert et al. 2021, 2020). HABs produce the neurotoxins saxitoxin and domoic acid, both of which can result in illness and mortality among wildlife. The largest bed of resting cysts of HAB species in the world has been discovered in the Chukchi Sea (Anderson et al. 2021). Warming ocean temperatures and loss of sea ice may mean these cysts will hatch into recurring toxic algal blooms (Anderson et al. 2021).

Current and Projected Impacts of Climate Changes on Wildlife

Habitat Changes

Recent changes in the physical environment have been attributed to climate change (Figure 7.2), which can impact fish and wildlife species in positive or negative ways (Figure 7.3). Ongoing warming is associated with rapid changes in vegetation; depending on each species' habitat preferences, vegetation changes may increase or decrease habitat availability for fish and wildlife (Marcot et al. 2015). Unusually high midsummer tundra productivity (greening) has been observed on the North Slope of Alaska, but lower productivity (browning) has continued in the Southwest biogeographic region (Frost et al. 2021a, b). Shrub expansion in arctic tundra has been widely observed in these greening areas, partly due to temperature increases. As a result, moose and beaver are colonizing previously inhospitable Arctic areas (Tape et al. 2016, 2018). Lapland Longspur prefer sedge-dominated tussock tundra for nesting and could plausibly lose habitat as shrubs invade, while White-crowned Sparrows could gain habitat (Boelman et al. 2015). Shrub expansion is also occurring at higher elevations than in previous decades. In a long-term study in Denali National Park, passerine species shifted to higher elevations in response to advancing treeline (Mizel et al. 2016). Herbivores

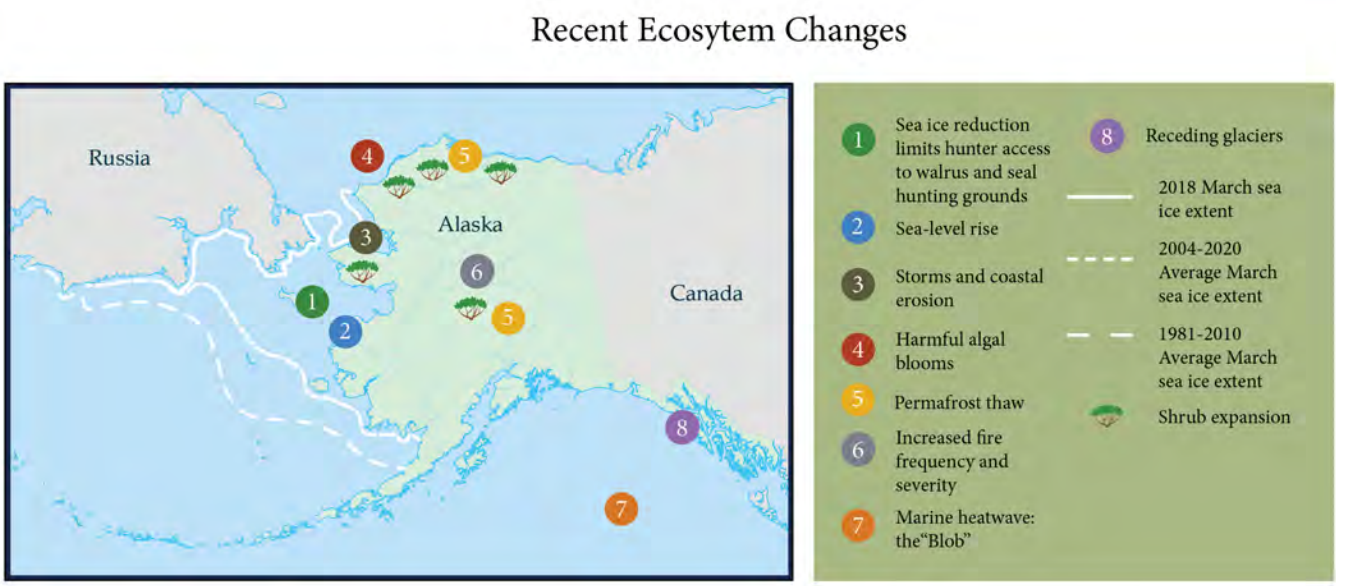


Figure 7.2. Recent observed changes in the physical environment related to climate change. A wide range of climate-driven changes to Alaska's ecosystems have implications for the species that depend on them. Data sources: 1. Larsen Tempel et al. 2021; 2. Arendt et al. 2022; 3. Kettle et al. 2020, Overeem et al. 2011; 4. Osborne et al. 2018, Gobler et al. 2017, Anderson et al. 2022; 5. Smith et al. 2010, Jorgenson et al. 2020; 6. Kasischke and Turetsky 2006; 7. Gobler et al. 2017, Quan et al. 2018; 8. Arendt et al. 2021; Sea ice extent: Historical Sea Ice Atlas for Alaska and the Arctic, 1850–2022; Shrub expansion: Mekonnen et al. 2021.

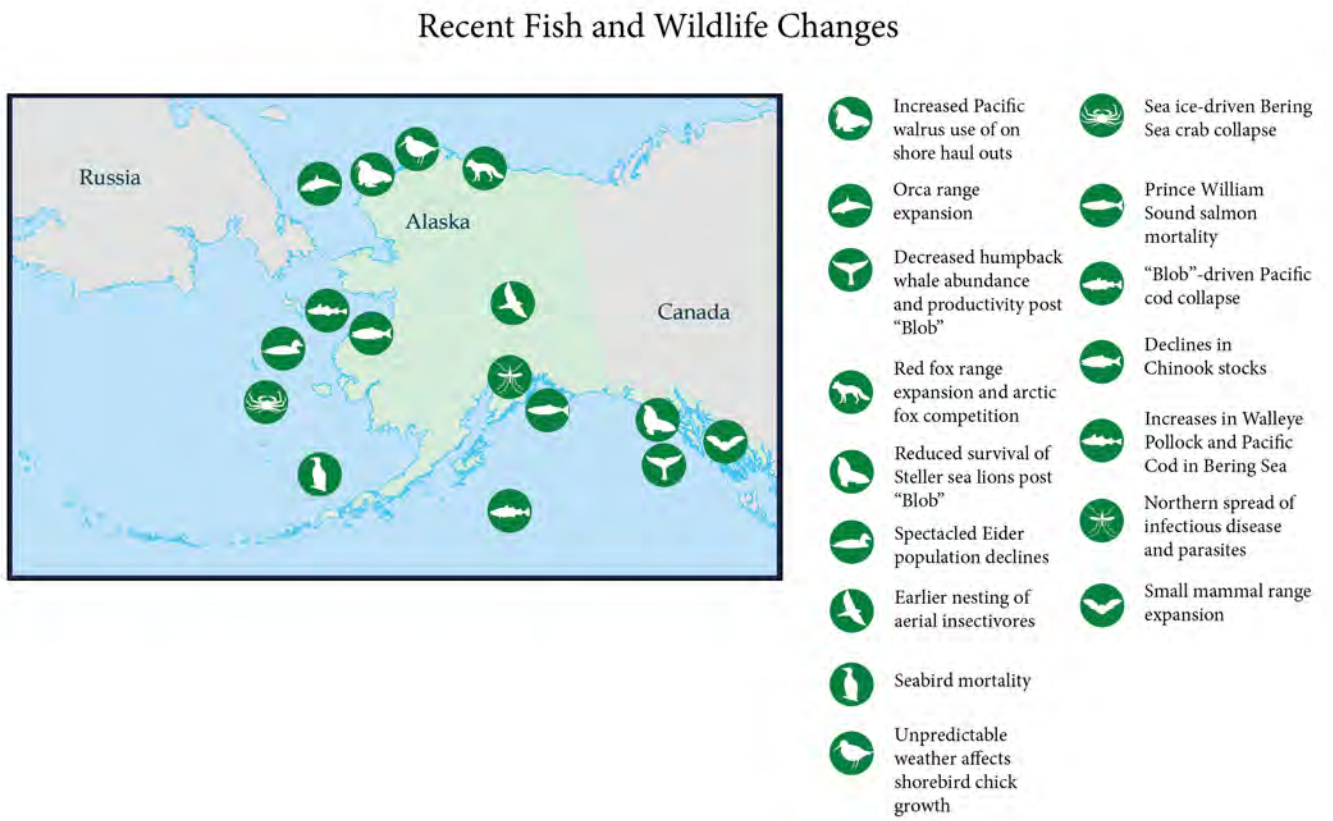


Figure 7.3. Recent observed changes in fish and wildlife species related to climate change. Fish and wildlife species are experiencing a wide range of impacts related to climate change. Data sources: Walrus, Fishbach et al. 2022; Orca, Stafford et al. 2019; Humpback whale, Gabriele et al. 2022; Red fox, Elmhagen et al. 2017; Steller sea lion, Hastings et al. 2023a,b, Maniscalco 2023; Spectacled Eider, Dunham et al. 2021; Aerial insectivores, Irons et al. 2017; Seabirds, Jones et al. 2019, Piatt et al. 2020, Van Hemert et al. 2021; Shorebirds, Saalfeld et al. 2019; Bering Sea crab, Szuwalski et al. 2023; Salmon, von Biela et al. 2022; Pacific cod, Laurel et al. 2020; Chinook, Eiler et al. 2014; Walleye Pollock and Pacific Cod, Larsen Tempel et al. 2021; Small mammals, Baltensperger et al. 2024.

have the capacity to moderate the rate of shrub expansion in tundra environments, at least on a local scale (Olofsson et al. 2009, Ravolainen et al. 2014), but the degree to which this phenomenon may forestall landscape-level changes is unknown.

Increases in temperature and evapotranspiration are projected to increase the area burned by wildfire, despite increased precipitation (McGuire et al. 2018). Tundra fires are increasing in frequency (Hu et al. 2015), and boreal forest fires are increasing in frequency and the amount of biomass burned (Kasischke and Turetsky 2006, Kelly et al. 2013). Projected fire-driven transitions from conifer- to deciduous-dominated boreal forest (Mann et al. 2012) already appear to be occurring at a regional scale. Wildfires in 2015 (Central biogeographic region; Partain et al. 2016), 2019 (Southcentral biogeographic region; Bhatt et al. 2021), and 2022 (Southwest biogeographic region; Thoman 2022) burned large areas with atypical severity or occurred in places where fire was previously rare (Jandt and York, 2021). Alaska has experienced an increase in overwintering or "zombie" fires, which occur when uncharacteristically severe burning during hot, dry summers results in burning during the following fire season (Jandt and York 2021).

Temperature increases, combined with changes in precipitation, glacial melt, snowmelt, and runoff, can change streamflow timing and affect stream and lake temperatures. These changes are complex and may be positive or negative for anadromous and resident fishes, depending on the circumstances. Continued monitoring is essential for determining whether management actions are necessary to promote resilience of these species. Projections for the Southeast biogeographic region include decreases in precipitation as snow (Littell et al. 2018) and increases in rainfall, glacial melt, and snowmelt during fall and winter months. This would result in changes to the region's freshwater hydrology, including greater stream flow rates in fall and winter and reduced rates in spring and summer. Fall flow increases may benefit parr-to-smolt survival, but decreases in summer flow may lower survival during the juvenile rearing period (Crozier et al. 2021). In Southcentral Alaska, a watershed-specific analysis found above-average precipitation had a positive corollary effect on juvenile Chinook salmon and a negative effect on spawning adults (Jones et al. 2020).

Changes in freshwater flow rates can also impact adult salmon. Low summer discharge with high spawning return rates can create hypoxic conditions leading to adult mortality, as observed previously in the Southeast biogeographic region (Sergeant et al. 2017). Yet, increased glacial melting may also provide additional salmon habitat in the region, buffering these effects. By modeling glacial retreat driven by temperature and precipitation projections, Pitman et al. (2021) mapped potential increases in salmon-accessible streams created by glacial runoff in Alaska. In general, salmon stream habitat was predicted to increase by approximately 6% in northern Southeast Alaska, 5% in the Prince William Sound area, and the largest gains were expected to occur in the Gulf of Alaska region (approximately 27% increase), demonstrating the potential for climate resilience among salmonids. Anadromous fish have additional stressors from marine conditions during their life history, which can be impacted by increasing marine temperatures, heat waves, and ocean acidification effects on their prey.

Range Expansion, Pathogens, and Problematic Insects

With temperature increases and climate-induced habitat alterations, Alaska is becoming more habitable for southern species that were previously limited by factors characteristic of cold environments in boreal and Arctic regions. This trend allows "leading edge" species—historically rare or absent species (e.g., mule deer, mountain lions, or some marine fishes)—to expand their ranges into the state. Similarly, invasive species whose climatic tolerances are met in a warming Alaska could become established more easily. Bird species that were historically migratory could become resident (Wu et al. 2018).

Other changes are more complex, such as the increased frequency and magnitude of insect outbreaks. Spruce beetle outbreaks are influenced by a combination of factors, which can include warm temperature-synchronized life cycles and the frequency of cold temperatures sufficient to limit beetle overwinter survival. Since 2016, the rapid expansion of an ongoing spruce beetle outbreak in the Southcentral region has caused extensive spruce mortality across 2.25 million acres (see above section on Problematic Native Species).

In the Southeast biogeographic region, a hemlock sawfly outbreak followed by a western blackheaded budworm outbreak resulted in 1.4 million cumulative acres of defoliation and caused hemlock mortality on over 218,000 acres between 2018 and 2024 (J. Moan, DOF pers. comm.). These outbreaks

affected forests throughout the region, with damage primarily occurring on western hemlock and, to a lesser extent, Sitka spruce (Howe et al. 2024). Outbreaks of these defoliator species were best explained by host tree availability, a limited range of spring, summer, and winter temperatures, and low precipitation (Howe et al. 2024).

While climate change may negatively impact some species across their entire range, other resident species will demonstrate resilience through mechanisms such as dispersal, behavioral and phenological shifts, and changes in microhabitat use, among others. Salmon have recently colonized streams where they were previously absent (Dunmall et al. 2022). Other species, such as walruses, are showing adaptability to climate change in their increased use, in recent years, of terrestrial haulouts when sea ice margins are not near suitable feeding grounds (Fischbach et al. 2022).

Mismatched Phenology and Food Webs

Climate change can have complex effects on wildlife because interactions among many variables, such as temperature, precipitation, habitat availability, ecosystem processes, and species interactions, are complicated and difficult to predict. For example, combined with the changes in habitat and seasonality described above, changes in the timing of spring leafout of vegetation or other historically reliable indicators can create a "mismatch" for migratory bird flight timing and food availability. These changes can result in reduced adult, nest, and brood survival (Kwon et al. 2019). Dates of first arrival for 16 migratory bird species that breed in Alaska's northern biogeographic region correlate with temperature, and species appear to adapt to changing temperatures differently (Ward et al. 2016). A study using six years of citizen science data found the most common migratory timing changes observed with increasing temperatures in Alaska were later arrivals, earlier departures, and shorter stopovers (Zaifman et al. 2017).

A species' dependence on specific ecological conditions or on other species affected by climate change increases its likelihood of being negatively impacted. For example, Liebezeit et al. (2012) identified Common Eiders as being highly vulnerable to climate change due to their dependence on barrier-island nest sites that are threatened by inundation and erosion due to increased storm frequency (Jones et al. 2009). Likewise, Pomarine Jaegers are diet specialists and appear to nest successfully only in years when their primary prey, brown lemmings, are abundant. Changes in climate are shifting lemming population cycles (Ims and Fuglei 2005) and thus could affect jaeger breeding potential (Liebezeit et al. 2012). By contrast, generalist species, such as Glaucous Gulls and Common Ravens are expected to be more resilient to the impacts of climate change (Liebezeit et al. 2012).

As sea ice thins and retreats earlier in the season, food webs under the ice are anticipated to switch from a benthic-dominated to a more pelagic-dominated marine ecosystem (Moore and Stabeno 2015). As relatively larger organisms (e.g., zooplankton) become more abundant, they can efficiently graze on the smaller plant organisms (such as phytoplankton) and reduce the amount of food supplied to benthic communities. These changing conditions create competitive advantages for species favoring warmer water, such as saffron cod and pollock, and have potential negative impacts on cold water species such as Arctic cod. Changes in productivity pathways have the potential to have cascading effects due to those effects propagating across multiple levels of ecological hierarchy that result in a reshuffling of energy flow throughout the food web.

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8 | Conservation Actions

A researcher surveys for collared pikas in Snowhawk Valley. A. Underwood, ADF&G.

Conservation actions are activities conducted to improve the status and understanding of "species of greatest conservation need" (SGCN) in Alaska, reduce the need for future listings under the Endangered Species Act (ESA), and fulfill Alaska Department of Fish and Game's (ADF&G's) mission and mandate under the Alaska Constitution to manage fish and wildlife species according to the sustained yield principle (Alaska Constitution, Art. VIII, § 4). Conservation actions can take many forms, including filling critical information gaps on population status and trends; understanding habitat use during breeding, migration, and nonbreeding seasons; managing broad-scale threats to support species' resilience; and monitoring population recovery. Priority conservation actions include identifying drivers of decline, promoting partnerships, and implementing effective and achievable projects to ensure sustained yield.

This chapter is organized by the conservation-action categories outlined by Salafsky et al. (2008) and updated in the Conservation Measures Partnership's (CMP) Conservation Actions Classification, version 2.0 (CMP 2016). Some of these categories have been modified slightly to reflect conditions unique to Alaska, and within each category, examples of effective actions are provided. For many SGCN, especially long-distance migratory birds, their biogeographic ranges include migration stopover sites and nonbreeding areas outside Alaska and the United States. Because these species occur only seasonally in Alaska, partnerships outside the state in nonbreeding areas where populations are more vulnerable may be important for implementing conservation actions that benefit Alaska-breeding species. For these species and groups, potential conservation actions could be based within or outside of Alaska.

Research and Monitoring

Current and accurate data are essential for conservation. For many of Alaska's SGCN, only a limited understanding of population size, population trends, and seasonal movement patterns exists. Migratory pathways are just starting to be understood for some Alaska SGCN that travel as far as Antarctica, Argentina, and New Zealand. Information on population dynamics and movement ecology is often a prerequisite to making an informed assessment of a species' conservation status, to ensure use of other natural resources is compatible with conservation, and to identify what conservation actions, if any, are necessary.

Long-term monitoring and data collection efforts are often necessary to obtain population trend information. Alaska has and will continue to make essential research and monitoring activities a priority among its conservation actions. Important research and monitoring actions include the following:

- Determine distribution and habitat associations of SGCN within Alaska (Chapters 5 and 6).
- Determine population trends and abundance of SGCN.
- Estimate survivorship by age class and identify causes of mortality throughout the annual life cycle of SGCN (e.g., breeding, migration, nonbreeding).
- Map long-distance migratory movements, stopover sites, nonbreeding locations, and habitat use by SGCN.
- Assess the vulnerability of SGCN to climate change and other potential threats.
- Determine sustainable exploitation rates (sustained yield) for harvested SGCN.
- Identify important spawning and rearing habitats for aquatic SGCN.
- Predict if and how key habitats are likely to change in the future due to the changing climate and other potential threats, including which species may be resilient to habitat changes versus those that may require additional conservation actions to support their resilience (e.g., Marcot et al. 2015).
- Determine how habitat changes could affect SGCN and what conservation measures could slow or reverse population declines and support resilience.

Sockeye salmon in Dry Bay, Glacier Bay National Preserve, Alaska. NPS, used with permission.

Conservation Designation and Planning

Alaska has one of the most extensive networks of conservation lands and waters on the continent (see the "Conservation Lands" section in this chapter). Large expanses of remote and intact ecosystems create a unique and advantageous situation regarding conservation designation and planning. Conserving fragmented remains of habitats crucial to SGCN is a common need throughout the country. However, unlike much of the northern hemisphere, Alaska has experienced little anthropogenic habitat fragmentation outside urban centers due to its limited road network, existing regulations that help ensure conservation of high-quality fish and wildlife habitat, and restriction of development in Alaska's national parks and wildlife refuges (a significant proportion of the state's land). Therefore, the primary question in Alaska is how to understand and predict the potential impacts of broad-scale threats that have a high level of uncertainty (e.g., climate change, fish and wildlife diseases, harmful algal blooms, and introduction of invasive species) in order to support the resilience of SGCN.

Wetlands along the Kobuk River. N. Herbert, NPS, used with permission.

Conservation Lands

State and federal lands account for about 88% of all the land in Alaska. A substantial proportion of these lands—and, by extension, much of Alaska's landscape—is already designated for conservation, whether as park land (managed and preserved unimpaired lands for public use), wildlife refuge (habitats managed for the conservation of wildlife and plant resources), or wilderness (preserved lands without human habitation or modification). Alaska holds 64% of all national park lands in the United States (NPS 2024), 80% of wildlife refuge acreage excluding U.S. territories (USFWS 2022), and 54% of designated wilderness in the nation (Norris 2007). The Alaska Department of Natural Resources (DNR) administers eight state parks comprising 3.4 million acres of state-owned land and 105 million acres of other recreation areas, historical sites, and marine parks (DNR 2019). In addition, ADF&G manages 3.2 million acres of special wildlife conservation areas (12 game refuges, 17 critical habitat areas, and three wildlife sanctuaries; ADF&G 2024a). Some of Alaska's state- and federally-owned lands are designated for other uses, including energy development, recreation, and timber harvest.

Management of Anadromous Waters

Under Alaska Statutes (AS 16.05.871–901), waters identified as important for the spawning, rearing, and migration of anadromous fish species are conserved and managed by ADF&G under a permitting system that attempts to ensure compatibility of conservation and any development or

Researchers use fyke nets to capture fish for identification purposes. ABR, used with permission.

resource extraction that occurs in such waters. Additional management is also accomplished by the National Marine Fisheries Service (NMFS), which designates essential fish habitat (EFH) under the Magnuson–Stevens Fishery Conservation and Management Act. ADF&G maintains and continually updates the *Catalog of Anadromous Waters* (ADF&G 2024b) that identifies where permitting of anadromous waters is required. These cataloged waters represent most of the state's large rivers and streams and a growing number of smaller streams. As of October 2024, there were 19,247 streams, including mainstem reaches and tributaries, listed as supporting anadromous fishes in Alaska. Considering this large number of anadromous streams alone, Alaska has taken a critical role in managing and maintaining high-quality freshwater habitats for anadromous fishes.

In addition to conserving and managing anadromous streams, ADF&G also maintains a program to secure instream flow reservations on waters identified as important to fish and wildlife to ensure adequate habitat. Both the *Catalog of Anadromous Waters* and the instream flow reservations program are essential aspects of anadromous waters conservation in the state. Funding from the State Wildlife Grants (SWG) program will continue to support these efforts.

Conservation in Marine Waters

Over the past two decades, several important efforts have been undertaken to safeguard marine areas important to Alaska's fish and wildlife. In 2002, ADF&G convened a task force that developed a public process by which marine waters can be legally designated for conservation by the Alaska Board of Fisheries (ADF&G 2002a). Because federal marine habitat areas are of particular concern, likely candidates for conservation and management have been identified by the North Pacific Fishery Management Council (NPFMC 2010).

Marine biodiversity is correlated with structural habitat diversity. Areas of the seafloor that are characterized by boulders, corals, and other living organisms are susceptible to damage from fishing gear, particularly bottom trawls. Regulations prohibiting groundfish bottom trawling and scallop dredging have been implemented to conserve and manage areas where this habitat type is known to occur. These locations comprise a relatively large portion of the continental shelf and, in many respects, serve as marine conservation areas.

Researchers evaluate stream water quality. ADF&G.

Audubon Alaska, a nongovernmental conservation organization (NGO), has identified a series of globally Important Bird Areas (IBAs) in the pelagic waters in the Beaufort/Chukchi Seas, Bering Sea, and Gulf of Alaska biogeographic regions. These areas are primarily associated with physical features that increase marine productivity. The IBAs encompass just 6% of the marine waters surrounding Alaska but support about 34% of Alaska's summer-season marine birds and 38% of Alaska's winter-season marine birds (estimated to be 24.6 and 5.9 million individuals, respectively; Smith et al. 2014). IBAs do not constitute legal designation as conservation areas; instead, they are a starting point for understanding seascape patterns of occurrence for seabirds in waters off Alaska and can be used to inform marine resource management decisions.

Voluntary conservation measures can reduce impacts to marine habitats used by fish and wildlife. The Aleutian Islands are home to many coastal and offshore habitats important to marine mammals and fish, but they also lie along the North Pacific Great Circle Route, which is heavily used by marine vessel traffic (see "Shipping Lanes," Chapter 7). To reduce maritime risks and enhance navigational safety, the International Marine Organization designated five Areas To Be Avoided (ATBA) along the route in 2016 (Sullender et al. 2021). These measures resulted in a significant decrease in marine traffic in these areas, from over 76% in 2014–2015 to under 12% in 2016–2017.

Land and Water Management

The Land and Water Management category includes actions to conserve or restore sites, habitats, and the broader regional environment. These include management of areas for conservation, eradicating and controlling invasive species, enhancing degraded habitats, and restoring ecosystem function (CMP 2016).

In Alaska, climate change is altering habitat availability—sometimes rapidly—through reductions in sea ice and glacial extent, as well as changes in shrub cover and hydrology (Chapter 7). However, the high level of habitat connectivity in Alaska's large and relatively undisturbed terrestrial ecosystems will likely allow many SGCN to transition to other suitable habitats as they develop in a changing environment. Ongoing and future monitoring of SGCN and their habitats is important to determine which species and ecosystems will be resilient to environmental changes and which will require additional conservation actions to support their resilience.

Stream Management and Restoration

ADF&G has statutory authority under Title 16 to maintain fish habitat and passage programs to conserve and improve the value of riverine and adjacent riparian ecosystems for fish. Alaska's fisheries enjoy strong public support due to their economic and recreational value, making stream restoration and management efforts a priority. Several restoration projects have been completed to reintroduce large woody debris, such as logs and root balls, into streams that were degraded by historical logging practices and other activities, and similar projects could be implemented in the future, where needed, to maintain high-quality riverine habitats in Alaska. These projects aim to increase structure and complexity in streams by creating pools, riffles, and runs while also providing cover for fish, stabilizing stream banks, restoring connectivity to off-channel habitats, and moderating stream flow. Such actions can have significant and long-lasting benefits for salmon, steelhead, and aquatic invertebrates, as well as the many wildlife species that depend directly or indirectly on salmon, including bears (Hilderbrand et al. 1999) and songbirds (Burnett et al. 2005).

Multiple efforts are underway to control and eradicate invasive species that negatively impact SGCN and their aquatic habitats. For example, the State of Alaska, federal agencies, and local Tribal organizations are continuing efforts to eradicate the invasive aquatic plant *Elodea* from several water bodies in the state (see "Species Management" below). ADF&G and partner organizations are also continuing to eradicate and suppress invasive populations of northern pike in the Southcentral biogeographic region. As of 2024, all known populations of invasive northern pike on the Kenai Peninsula have been eradicated.

In addition to agency work on stream management and restoration and invasive species removal, Alaska has six Fish Habitat Partnerships that share a mission of conserving, restoring, and enhancing Alaska's fish and aquatic communities through fish habitat conservation. These voluntary, locally-driven, and nonregulatory partnerships help identify and fund local projects and leverage resources and expertise of member organizations to benefit Alaska's native fishes and their habitats. Activities involve assessing, mapping, and prioritizing fish habitat needs in Alaska, as well as developing partnerships with agencies, NGOs, and individuals to accomplish important habitat restoration and conservation activities.

Wetlands Management and Restoration

The changing climate will cause gradual shifts in the types of wetland and aquatic habitats available to Alaska's fish and wildlife (see the "Climate Change" section in Chapter 7). Understanding that local and regional conditions will be variable, increases in temperature and precipitation due to climate change are expected to have widespread ecosystem effects across some portions of Alaska. Higher temperatures have resulted in increased evapotranspiration (the atmosphere's ability to draw water out of plants and off the land's surface) and soil drying, which will continue to drive the alteration of wetlands and wetland functions in the future (Frost et al. 2020). This is expected to result in a gradual transition of wetlands to more well-drained upland habitats during the next 10-20 years, particularly in the Central, Southcentral, and Southwest biogeographic regions, which have discontinuous or no permafrost (Jorgenson et al. 2008). At the same time, glacial retreat in Alaska has and will continue to expose new land, which may result in the creation of new wetland habitats. The formation of new wetlands is a lengthy process, as it takes multiple decades for development of the complex vegetation structure that provides habitat for a diversity of wildlife species (Chapter 6).

The National Wetland Inventory mapping of Alaska is a valuable tool in management planning for lands and waters. The ongoing expansion and update by the United States Fish and Wildlife Service (USFWS) includes data on the location and type of palustrine (freshwater) wetlands and the extent of open water habitats for wildlife, both of which will increase the inventory's value to managers. Used in conjunction with data on the importance of broad-scale land cover types for SGCN across the six terrestrial biogeographic regions in Alaska (Chapter 6), these updated wetland data will facilitate improved management, conservation, and restoration of important wetland habitats.

Much of the water provided to palustrine wetlands does not come from large waterbodies (e.g., streams, rivers, lakes) but from discharge slopes, sheet flow, small seeps, springs, and rivulets. Along with broad-scale wetland types, these small wetlands should also be identified, mapped, and acknowledged in management of Alaska's water resources. Industry partners can play a role in this effort by providing fine-scale mapping of small wetlands and wetland functions near proposed developments. There will also be opportunities for these partners to promote the conservation or restoration of wetland habitats in Alaska during mitigation planning for development projects.

Forest Habitat Management and Restoration

Effective timber management practices and sustainable timber harvest are key to maintaining a diversity of important forest and scrub habitats that support SGCN populations. The Alaska Forest Resources Protection Act (AS 41.17) ensures that forestry practices are compatible with SGCN conservation, especially in sensitive riparian areas. The State of Alaska is working to maintain sustainable populations of SGCN while also benefitting the regeneration and resilience of managed forests and avoiding negative impacts on harvest opportunities.

Impact of an invasive species on "species of greatest conservation need" (SGCN): Northern Pike *(Esox lucius)*

Northern pike have a circumpolar distribution but have been widely introduced around the world to establish recreational fisheries. In Alaska, their management is complicated because northern pike are native to Interior and western Alaska, where they naturally occupy an apex predator niche in aquatic ecosystems. The Alaska Range is a geologic barrier that restricts the natural distribution of northern pike in the state. In the late 1950s, a bush pilot illegally introduced northern pike from Minto Flats in the Interior to the Susitna river basin in Southcentral, and northern pike have been spreading ever since. Currently, over 150 water bodies in Southcentral Alaska have documented populations of northern pike, and it has become the most damaging aquatic invasive species in Alaska.

Salmonids in northern pike stomach. J. Ching, UAF, used with permission.

Northern pike have a generalist diet but prey heavily on other fish when available. They thrive in areas with dense aquatic vegetation, which is necessary for egg adhesion during spawning, camouflage as juveniles, and ambush predation as adults. Northern pike do not frequent deep littoral zones of lakes or turbid, high-velocity rivers. Habitat plays a key role in the severity of ecological impacts where northern pike are introduced. In drainages where northern pike are introduced and have complete habitat overlap with native fish, the native fish populations are typically extirpated within a few years of northern pike invasion. This degree of impact is typically less severe in drainages that contain a mix of habitat types where prey species can seek refuge from northern pike predation. Historically, shallow, vegetated, and marshy drainages in Southcentral Alaska naturally functioned as important rearing habitats for coho salmon, Chinook salmon, rainbow trout, and other native fish; however, in many of these places, the native fish assemblages have been entirely replaced by northern pike. Alexander Creek in the Susitna River drainage is a prime example of the high degree of impact northern pike can have on local salmon stocks. This drainage is a homogenous network of wetlands, sloughs, and slow meandering rivers. At one time, Alexander Creek was the most popular Chinook salmon fishery in the Matanuska-Susitna Valley; today, Chinook salmon typically return here in numbers of less than 100 fish. State Wildlife Grants funding is used to suppress northern pike in Alexander Creek with the goal of reducing predation pressure on Chinook, coho, and sockeye salmon, increasing the abundance of their stocks in this system. These funds also support the early detection of northern pike in other watersheds, when eradicating their populations is most feasible.

ADF&G published principles and guidelines for state forest areas in Central Alaska that aimed to identify opportunities and actions mutually beneficial to both timber and wildlife management (Paragi et al. 2020). The recommendations were incorporated into the Alaska State Forest Action Plan developed by the DNR Division of Forestry and Fire Protection (DOF; DOF 2020: 67–68). The overriding goal of these guidelines is to assist wildlife and forest managers in collaboratively integrating their separate, but often compatible, responsibilities for managing resources. The report describes best management practices for SGCN that can enhance forest regeneration and make mature tree stands more resilient. For example, managing coarse woody debris can occur in a manner that benefits small mammal SGCN. Small mammals consume, disperse, and inoculate soils with mycorrhizal fungi that are essential for tree regeneration and can also make mature trees more resilient to environmental change. Other benefits come from maintaining forest habitat features, such as cavity trees or snags that have little economic value but provide important nesting, feeding, or roosting sites for a diversity of SGCN wildlife, including bats, small insectivorous birds, woodpeckers, and raptors. These SGCN can reduce the risk of tree damage by keeping irruptive populations of potentially damaging herbivores (insects and other vertebrates) in check. Wildlife managers have an opportunity to provide foresters with guidance that can minimize forest damage by maintaining or improving habitat for these predatory SGCN.

The transition zone where tree growth stops and alpine vegetation begins. F. Kovalchek, used with permission.

On a landscape scale, ADF&G's guidelines (Paragi et al. 2020) also suggest consultation with DOF on five-year timber sales to identify opportunities for maintaining wildlife habitat connectivity in managed forests. For example, wildland fire remains the dominant agent of landscape-level disturbance in Central Alaska. ADF&G's guidelines provide a framework for foresters and wildlife managers to work together to plan harvest in a way that mimics natural disturbance at a relatively large scale while maintaining a diversity of connected habitats and their structural features vital to SGCN. ADF&G is also working with DOF to identify and evaluate forest practices that can create early seral habitat beneficial to game species through tree harvest and prescribed burning. Examples of these habitat management activities include prescribed burns in the Alphabet Hills (Central Alaska) and mechanical habitat modifications on the Kenai Peninsula and near Tok (ADF&G 2024c).

In federally managed forests, restoration projects include silvicultural thinning to open up dense second-growth stands that develop 20 to 40 years after clearcutting (Hanley et al. 2013). Although this restoration activity has limited benefits for songbirds (Matsuoka et al. 2012), there is evidence it benefits small mammal populations and may benefit the Queen Charlotte Goshawk (USFS 2011).

Other forest management prescriptions designed to benefit old-growth-dependent species include retention of snags and mature trees within cutting units, establishment of natural old-growth buffers along shorelines and riparian areas, and maintenance of adequate old-growth stands to ensure the sustainability of wildlife populations (USFS 2008).

Species Management

Species management refers to any activity implemented to improve the population status for an individual SGCN or groups of SGCN (CMP 2016). This can involve management of native species or invasive species. In Alaska, where the population status and migratory pathways for many SGCN are unknown or uncertain, effective species management activities can be guided by efforts to better understand population dynamics, migratory routes, and stopover sites, or a combination of these. Effective monitoring can identify SGCN that may require additional conservation actions to support their resilience, including reintroduction or assisted dispersal.

Native Species

ADF&G prioritizes careful management of native species, and these efforts fall into two broad categories: indirect management and direct management. Indirect species management can include a range of actions to improve suitable habitats available for SGCN (e.g., predator reduction efforts to increase populations of prey species) and actions that may mitigate broad threats (e.g., improving water quality, removing invasive species). Direct species management can involve reintroducing species to areas where they formerly occurred (e.g., wood bison and muskoxen reintroductions), and assisting species with low dispersal capabilities in colonizing newly available suitable habitats

Species of Conservation Need: Alaska Black-backed Woodpecker *(Picoides arcticus)*

The Black-backed Woodpecker is a seldom-seen bird of the North American boreal forests and montane forests in the western United States. Its core range in Alaska is largely within the range of white spruce in the Central and Southcentral bioregions, but it has been observed in most of the state's forested regions, and individuals have strayed as far as Kodiak and St. Paul islands. It feeds by excavating larval bark- and wood-boring beetles from dead or dying coniferous tree trunks, and it often nests in decaying trees in stands with high snag densities. Because of its reliance on dead and dying trees, it frequents recently burned areas and can colonize forests within weeks of a wildfire. Little is known about its population trends in Alaska. Fire suppression and postfire salvage logging can potentially affect these birds on a local scale. Spruce beetle outbreaks can provide additional feeding opportunities, and evidence from another species in this genus indicates that woodpecker predation on spruce beetles may have a stabilizing role on the dynamics of beetle outbreaks, which can cause widespread tree die-offs.

Alaska Black-backed Woodpecker. A. Bankert, used with permission.

that develop as a result of climate change. When there is incomplete information or uncertainty regarding the productivity of a population, proactive management actions are often taken to provide for sustainable population levels. Sometimes, however, declines occur that were not anticipated (e.g., Western Alaska chum salmon), and recovery of the stocks can be slow or incomplete (e.g., some king crab and herring stocks and Cook Inlet beluga whale). Three examples of SWG-funded conservation actions for SGCN in Alaska are discussed below.

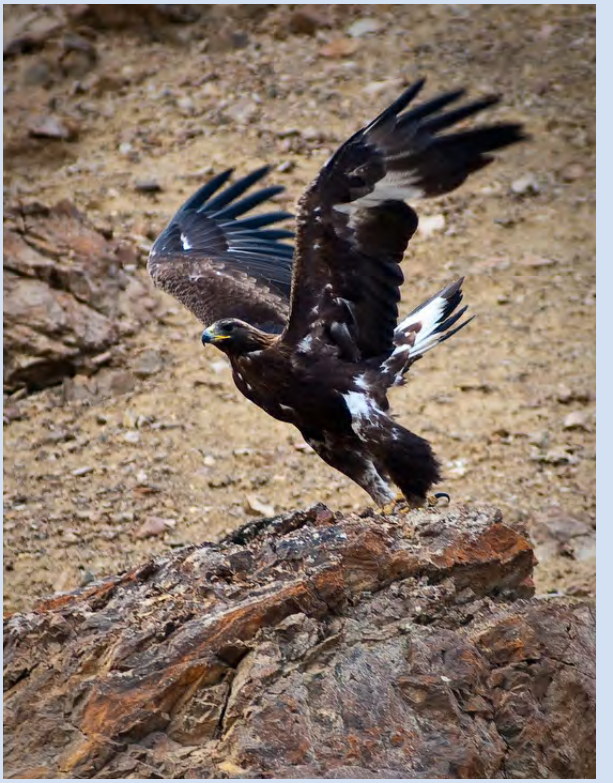
There are concerns that Golden Eagles may be declining across North America, and this has resulted in management constraints on incidental eagle take under the federal Bald and Golden Eagle Protection Act. Biologists suspected that Alaska supports a large number of breeding Golden Eagles because of the vast availability of suitable open habitat; however, the number of Golden Eagles occurring in Alaska in the summer was unknown due to a lack of statewide systematic surveys. Estimating the statewide population size for this species is difficult because of the size and remoteness of Alaska. In partnership with HawkWatch International, USFWS, and the National Park Service, ADF&G's Threatened, Endangered, and Diversity (TED) Program developed a novel method to roughly estimate the number of Golden Eagles in Alaska by combining satellite tracking data of marked eagles with eagle migration counts. Results of this work indicate there are at least 12,000 Golden Eagles in Alaska each summer, an estimate that is more than four times larger than previous estimates (Booms et al. 2021). These modeling results emphasize that the Pacific Eagle Management Unit, which includes Alaska, supports more Golden Eagles than any of the other three Eagle Management Units in the United States.

Travis Booms (ADF&G) banding a Golden Eagle. ADF&G.

Understanding seasonal interactions during a species' full annual cycle can be crucial for effective management (Marra et al. 2015), even when part of that cycle occurs outside of Alaska. An emerging example is the Olive-sided Flycatcher, a migratory songbird that breeds in Alaska and is experiencing steep population declines across its range. SWG-funded research seeks to reduce the decline of the Olive-sided Flycatcher in Alaska and to identify potential management solutions for recovery. Adults that breed in Alaska undertake one of the longest migratory journeys of any North American songbird (12,000–17,000 miles annually), and as with many long-distance migratory birds, adult mortality during migration is high. Tagged individuals from Alaska revealed a series of important migratory stopovers throughout their annual journey (Hagelin et al. 2021).

Species of Conservation Need: Golden Eagle *(Aquila chrysaetos)*

Golden Eagles inhabit a wide range of latitudes and habitats around the world. In Alaska, Golden Eagles favor mountainous regions and Arctic tundra, where they primarily hunt snowshoe hares, Arctic ground squirrels, and other birds. However, they will also scavenge carcasses and prey on medium-sized mammals, such as marmots and young sheep and caribou. Most Golden Eagles in Alaska are migratory and winter in the western contiguous United States and southern Canada. Breeding pairs nest almost exclusively on cliffs, though they have been known to nest in trees. They build nests out of sticks and other vegetation, often maintaining several nests per territory and reuse them for many years. Therefore, their nests can grow to great size. Threats to this species include habitat loss, shooting, electrocution, wind turbine strikes, and lead poisoning from feeding on carcasses. These threats are greatest outside of Alaska while migrating or overwintering. Research led by ADF&G has helped document that the Alaska breeding population of Golden Eagles is robust and has helped spur conservation actions to reduce lead poisoning by encouraging hunters to switch to using nontoxic ammunition.



Golden Eagle. J. Frank, NPS, used with permission.

These data enable Alaska researchers to collaborate with managers in other states along the Pacific migratory flyway and internationally to identify important stopover sites along the migration route and, if habitat is a limiting factor, potential management options as well. The work aims to ensure breeding adults successfully return to Alaska, where they benefit from large expanses of intact habitat and experience high nest survival rates.

The Alaska hare, also known as the tundra hare, is a widely used recreational and subsistence food and fur resource for residents in western and southwestern Alaska. Historical accounts from the 1970s by local residents, area biologists, and published game bird reports describe groups of hares numbering 300–800 individuals; however, the current abundance of this species is believed to be well below those historical accounts. It is now rare to find groups of hares larger than 3–4 individuals, though it should be noted that the Alaska hare's population status, vital rates, and habitat use have been poorly understood until recent years. In 2018, the ADF&G Small Game and TED programs initiated a study with two goals in mind 1) develop a feasible, repeatable method to quantify the current population level, and 2) study hare movement patterns to determine home range sizes and habitat use. Population monitoring was conducted by identifying individuals using genetic information from winter fecal pellets collected at several study areas throughout the species' range in western and southwestern Alaska. To investigate movement patterns, 12 trapped hares were fitted with GPS necklace collars. The results of this research were used by the Board of Game and

Species of Conservation Need: Olive-sided Flycatcher *(Contopus cooperi)*

The Olive-sided Flycatcher, a long-distance migratory songbird, is a distinctive inhabitant of Alaska's boreal forests. True to its name, this bird primarily feeds on aerial insects and aligns its peak nesting season with the abundance of insects in Alaska's moist and buggy boreal forests. It is estimated that the population of Olive-sided Flycatchers has declined by almost 80% across North America in the past 40 years. Much of this decline is attributed to adult mortality during their extensive migration—one of the longest of any North American songbird. Adults travel between 12,000 and 17,000 miles annually, migrating south through Mexico and Central America to winter in South America, reaching as far as Bolivia and the Andes Mountains. Satellite tracking studies done by ADF&G biologists have identified crucial stopover sites along their migration route, and these data are also being used by partners in efforts to help halt the decline of this species. One of the Olive-sided Flycatcher's identifying behaviors is "tree topping" or perching on the highest point of a coniferous tree or dead snag from which it flies to and fro, capturing insect foods in the air column. More often heard than seen, its distinctive call of "Quick! Three beers!" is a sound many Alaskans look forward to hearing during summer.

Olive-sided Flycatcher. S. Germain, USFWS, used with permission.

Federal Subsistence Board to make substantial changes to the regulatory structure for Alaska hares, including closing harvest in some areas for the 2025–2026 hunting season.

Future priority SWG-funded conservation actions include gaining a better understanding of SGCN population sizes, distributions within and outside Alaska, and habitat use; and identifying actions that can be implemented to mitigate and reverse population declines. These actions have been identified by ADF&G along with statewide and boreal working groups, such as the Alaska Shorebird Group (ASG 2019), Boreal Partners in Flight (Handel et al. 2021), the Alaska Small Mammal Group, and the Alaska Pollinator Coordination Group (ACCS 2024a). These working groups typically represent a range of species expertise and include members from state and federal agencies, universities, NGOs, Alaska Native organizations, and Canadian entities. Opportunities for potential SWG-funded projects on migratory birds also include national and international partnerships with groups interested in identifying migratory pathways and threats to migratory species throughout their full annual life cycle. The Association of Fish and Wildlife Agencies (AFWA) established the Southern Wings program specifically to facilitate state fish and wildlife agency participation in the conservation of migratory birds across their full life cycle (Southern Wings 2025). With funding from 41 state agencies, Southern Wings has helped facilitate the collection of important bird tracking data and habitat-use information at stopover sites and nonbreeding areas in Mexico, Central America, South America, and the Caribbean that are linked to breeding areas for migratory species in the United States. Because Alaska continues to provide high-quality, undisturbed breeding habitats for many migratory birds, this type of information collected outside the state will be especially important to understand where most mortality is likely to occur for neotropical migratory species that breed in Alaska.

Effective and timely management of individual species is necessary to maintain sustainable population levels of SGCN in Alaska. Within the broad scope of species management actions, including SWG-funded activities, ADF&G will continue the ongoing and careful management of Alaska SGCN, including harvested species managed under the sustained yield principle for the use and enjoyment of future generations.

Alaska hare. ABR, used with permission.

Invasive Species

Conservation actions to minimize the risk of introducing invasive species, controlling their spread, and eradicating their populations where feasible, are a priority. These conservation actions typically involve efforts to control or eradicate infestations of aggressive invasive species. Invasive species are considered one of the top two threats to imperiled species in the United States (Wilcove et al. 1998); however, in Alaska the extent of their impacts may not be fully understood or documented (Duenas et al. 2018). Invasive species are considered the leading cause of historical extinctions worldwide (Groombridge 1992). Globally, 14% of critically endangered vertebrates, including 25% of critically endangered birds, are threatened by invasive species (Duenas et al. 2021).

To date, Alaska has relatively few invasive species compared to other states, but invasive plants and animals are recognized as a growing problem (see the "Invasive and Other Problematic Species, Genes, and Pathogens" section in Chapter 7). For example, as of 2024, the most comprehensive list of nonnative plants in Alaska includes 415 taxa (ACCS 2024b), an increase from the 283 species reported in 2007 (Carlson and Shepherd 2007). The Alaska Department of Transportation and Public Facilities now routinely prepares invasive plant surveys and removal plans for projects along the road system in Alaska, where invasive plants have gained a foothold in the state, including as far north as the Arctic Coastal Plain. Invasive freshwater aquatic plant species such as *Elodea* are of concern because they can alter habitats important for aquatic animal species.

Invasive fish and wildlife species can have devastating impacts on native aquatic and terrestrial species. The European green crab has recently become established in marine waters in Southeast Alaska (ADF&G 2024d), and this aggressive, invasive species has been known to prey heavily on commercially important marine invertebrates, as well as benthic organisms (Davis 2021), which are important food items for migratory shorebirds building fat reserves at stopover sites. The European Starling, an introduced bird species, has also become established in Alaska after expanding its range from the south; the species is now resident in the state, especially in areas of human habitation, and can displace native cavity-nesting birds.

Alaska's extensive island archipelagos in the Southwest and Southeast biogeographic regions have harbored nonnative mammals at various times, which have either had large impacts, particularly on ground-nesting seabirds, or have the potential to do so in these insular ecosystems. Some of the invasive or nonnative introduced mammals on various islands in Alaska include Arctic and red fox,

mink, ground squirrel, Norway rat, house mouse, caribou, reindeer, cattle, and Arctic and European hare (Ebbert and Byrd 2002, USFWS 2024).

USFWS has eradicated invasive species and restored over one million acres on nearly 50 islands in the Aleutians, including the removal of introduced fox populations from 45 islands. On two Aleutian islands (Nizki and Alaid) that were studied before and after fox removal, the numbers of 12 waterbird and seabird species increased from 5,000 prior to fox removal to 14,000 after removal was complete (Byrd et al. 1994).

Although introduced foxes and large mammals may be hunted and trapped to eradication, small mammals occur at high densities, often underground, and are more difficult to eradicate. Rats are still present on at least 12 islands in the Alaska Maritime National Wildlife Refuge, and shipping mishaps could introduce them to others. Invasive rats have severe ecological impacts on islands, particularly for native wildlife. While rodent eradication from remote islands is possible, it is often prohibitively expensive and logistically challenging. The most common method, rodenticide application, poses risks to native birds, especially scavengers. During 2007–2009, rats were successfully removed from Hawadax (Rat) Island, a 7,100-acre island in the Aleutians, leading to ecosystem recovery (Buckelew et al. 2011, Croll et al. 2016). However, some nontarget bird mortality occurred, mostly consisting of Glaucous-winged Gulls and Bald Eagles that had scavenged rat carcasses (Ebbert and Burek-Huntington 2010, Buckelew et al. 2011). Invasive rodents continue to threaten seabird colonies on certain Aleutian Islands, where nesting birds are highly vulnerable to predation (Witmer et al. 2006). Removing introduced rats can mitigate these ecological threats and support the recovery of seabirds and other native species (Major et al. 2013). ADF&G's Small Game Program also sees promise for rat removal improving endemic populations of Rock Ptarmigan.

In a comprehensive review by Nadol (1999), the level of state regulation of invasive species in the western United States (including Alaska) was deemed inadequate. Since then, the State of Alaska and federal agencies have released several management plans, including the *Alaska Aquatic Nuisance Species Management Plan* (ADF&G 2002b), the *Rapid Response Plan for Invasive Rodents in Alaska* (USFWS 2020), the *Early Detection and Rapid Response Plan for Invasive European Green Crab* (Carcinus maenus) *in Alaska, 2023–2028* (DeBruyckere et al. 2023), and the *Technical Guidance and Management Plan for Invasive Northern Pike in Southcentral Alaska: 2022–2030* (Dunker et al. 2022) to address invasive species within the state. In 2021, Alaska enacted restrictions and prohibitions on possessing some aquatic invasive species (ADF&G 2024e).

Currently, ADF&G partners with DNR, the Alaska Department of Environmental Conservation, the University of Alaska, U.S. Customs Agricultural and Plant Health Inspection Service, U.S. Forest Service (USFS), U.S. Geological Survey, USFWS, and local NGOs and Tribal organizations to implement an "Early Detection, Rapid Response" program to prevent the establishment of invasive plants and animals in the state. Harmful nonnative species in aquatic systems and on islands are of particularly high concern. Specific actions that reduce impacts from invasive species promise lasting benefits to Alaska's native wildlife.

Awareness Raising

Efforts to improve people's understanding of SGCN and conservation actions and build their skills so that they can engage in conservation efforts are included in this category (CMP 2016). SWG projects are statutorily limited to funding education and outreach at no more than 10% of the project's

total cost. However, well-designed citizen science initiatives that enlist volunteer observers can yield useful scientific information and provide ancillary benefits for public education and scientific literacy (Bonney et al. 2009, Silvertown 2009). Alaska is a huge and remote state with relatively few scientists and limited funds available to study the state's many species of fish and wildlife that occur in it. With the help of local residents and biologists, land managers can expand survey efforts and do more with limited resources.

The Alaska Citizen Science Program (ADF&G 2024f) was developed by the TED Program at ADF&G to focus on two wildlife resources in road-accessible parts of Alaska: bats and wetland-associated breeding birds. As a partnership between members of the public and professional scientists, the program provides opportunities for interested individuals to assist wildlife biologists in collecting important data as part of ongoing research projects and conservation planning. The program provides opportunities for individuals, families, community organizations, and school groups to be outdoors and involved in collecting monitoring data on wildlife populations.

These citizen science projects have collected basic information on the occurrence and distribution of Alaska's wildlife species. Reports of bat sightings from citizen scientists greatly expanded the known range of the little brown bat in the Western and Central biogeographic regions and have

Culture and place-based shorebird conservation outreach in schools and communities in the Yukon-Kuskokwim Delta

Shorebirds migrate across continents and oceans, relying on key areas to rest, eat, and refuel. Alaska hosts about one-third of all shorebirds on Earth. Within Alaska, the Yukon-Kuskokwim Delta provides important habitat for millions of shorebirds. This delta is also within the homeland of the Indigenous Yup'ik people, who rely on shorebirds for food and cultural resources. Shorebirds are harvested in relatively small numbers in Alaska, but this harvest now includes SGCN, such as the Bar-tailed Godwit (*tevatevaaq* and *teguteguaq* in the Yup'ik language). The objectives of the Yukon-Kuskokwim learning and outreach program are to support awareness of and stewardship about shorebird ecology and conservation, transmission of Indigenous knowledge and Yup'ik language, and interest in learning and nature. In collaboration with schools, communities, and other partners, the shorebird outreach program reached 18 communities, 88 local educators, and 3,179 students in 2022–2024. Community meetings, management meetings, and local presentations addressed other audiences. Shorebirds provide engaging contexts for learning about healthy habitats, food chains, geography, and the diverse peoples across shorebirds' migratory routes.

On the Yukon-Kuskokwim Delta, students and teachers in Hooper Bay sent this shorebird flock to the Pukorokoro Shorebird Centre in New Zealand. The Bar-tailed Godwit breeds on the Yukon-Kuskokwim Delta and North Slope in Alaska and winters in New Zealand and Australia. C. Ralls, Pukorokoro Shorebird Centre, used with permission.

Pacific Loon. R. Askren, USGS, used with permission.

provided insights into this bat's seasonal ecology and habitat use. In addition, most of the known bat maternity colonies in the state were first identified and reported by citizen scientists. Since the summer of 2014, citizen scientists have been helping conduct acoustic driving surveys for bats (ADF&G 2024f). These data will be contributed to the North American Bat Monitoring Program to help develop estimates of population trends at both regional and continental scales.

ADF&G's Birds 'n' Bogs Program (see the "Current Monitoring Efforts" section of Chapter 9) has also relied upon citizen scientists to monitor populations of 12 boreal nesting bird species in Alaska's Southcentral and Central biogeographic regions. This program expanded from the Alaska Loon Watch, which started in 1985. In 2019, a scientific paper analyzing long-term population trends of Common and Pacific Loons in Southcentral Alaska utilized 30 years of data contributed by the program (McDuffie et al. 2019).

In addition to state-supported projects, several citizen science online platforms, including eBird and iNaturalist, have helped form a better understanding of the distribution of wildlife and plant species in road-accessible areas of Alaska (Chapter 9). For instance, the distributions and trends of many bird species have been modeled and mapped across remote areas of Alaska using eBird data and predictive models (Fink et al. 2022).

Education and Training

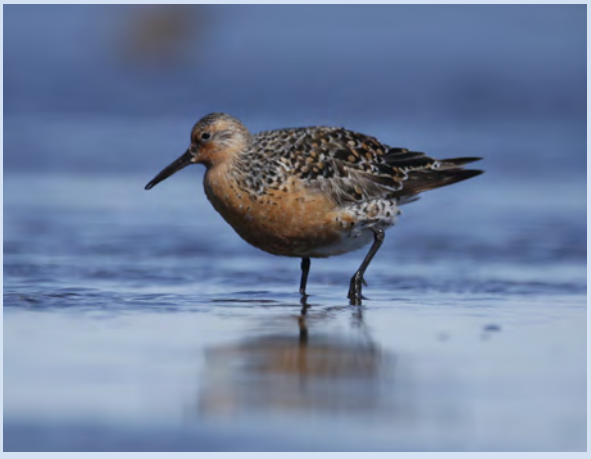
Beyond citizen science, ADF&G engages in numerous education and outreach activities to raise awareness of wildlife concerns. For example, outreach concerning endangered Cook Inlet beluga whales has led to more signage aimed at increasing awareness for boaters that share the water with these animals. Funding support for school programs, such as in-class activities, public and scientific presentations, reach a broad audience to build awareness about wildlife SGCN, including the importance of population counts and the impacts of marine debris. ADF&G also partners with agencies, organizations, and community groups to provide presentations, run interactive activities, and engage with the public at annual events such as Belugas Count!, STEAM (Science, Technology, Engineering, Arts, and Mathematics) Events, and Sea Week.

Legal and Policy Frameworks

Legal and policy frameworks aim to develop, change, influence, and implement formal legislation, regulations, and voluntary standards (CMP 2016). For example, in 2012, with support from ADF&G's Division of Sport Fish, the Alaska Board of Fisheries passed a regulation prohibiting the use of felt-soled waders in the freshwaters of Alaska to stop one common method by which fish diseases and invasive species can be moved between waterbodies (ADF&G 2012). In addition, DNR has quarantined five aquatic plant species to prevent the aquarium trade from importing invasive species (DNR 2024). In 2021, the state banned the possession of 33 species of amphibians, crustaceans, fishes, and mollusks (ADF&G 2024e). ADF&G does not generally propose legislation, but it does

Species of Conservation Need: Pacific Red Knot *(Calidris canutus roselaari)*

The Pacific Red Knot is a sandpiper known for its beautiful, terracotta-orange breeding plumage and long-distance migration. The Pacific population is one of six recognized subspecies of Red Knots, which can be found on every continent except Antarctica. Pacific Red Knots are known to overwinter along the sandy coasts and wetlands of northwestern Mexico and breed in the tundra of northern and northwestern Alaska and on Wrangell Island, Russia, resulting in an annual migration of 6,000 miles or more. The Pacific subspecies is considered the least studied globally, and its population has declined over the last four decades for unknown reasons. Potential threats across the species' vast range that may be causing this decline include climate change, sea level rise, coastal development, anthropogenic disturbances, and invasive species such as smooth cordgrass. Smooth cordgrass can take over open mudflat habitat and alter sediment characteristics, causing reductions in available foraging habitat. Atlantic Red Knots are famous for eating horseshoe crab eggs in Delaware Bay; however, in general, the species is thought to specialize on bivalves. Current work by ADF&G includes determining important stopover habitat in Alaska during spring migration and determining their diet in Alaska and across the Pacific Flyway. Understanding what Red Knots eat in various locations can help researchers understand whether they have dietary plasticity and can adapt to changes in their prey base or are specialists with a limited ability to respond to large changes in prey.



Pacific Red Knot. B. Richard, ADF&G.

offer comments on pending proposals or legislation affecting wildlife in the state. For example, ADF&G engages with federal partners in multiple ways regarding ESA listing decisions involving Alaska's wildlife; data and information are provided to federal partners so that the best available science can inform decision making. The state also comments on proposed and existing ESA listings, which may include the designation of critical habitat or the delisting or downlisting of species.

In the future, information that identifies important wildlife habitats and management actions to mitigate or reverse SGCN population declines could inform the decisions of policy makers. In addition, information on the deleterious ecosystem effects of nonnative invasive species might help inform legislation and policy to further reduce imports of nonnative species, even if some stakeholders deem certain species desirable (e.g., introduced populations of northern pike, agricultural or aquaculture species, aquarium species, and exotic pets).

Livelihood, Economic, and Moral Incentives

Livelihood, economic, and moral incentives can influence human behavior and assist in the conservation of SGCN (CMP 2016). These can range from the use of subsistence and natural resources to substitutes for environmentally damaging products and behaviors and may or may not be monetary in nature.

Some programs offer direct economic incentives to benefit the conservation of Alaska's fish and wildlife. In 2024, ADF&G and partner organizations initiated the Alaska Copper Ammo Challenge, a public education and incentive program to reduce the use of lead ammunition across the state

with the goal of minimizing accidental lead poisoning of wildlife. This program educates hunters about the benefits of lead-free ammunition and offers rebates to those who purchase copper ammunition (AK Copper Ammo Challenge, 2025).

Incentives do not have to be monetary. Participants in ADF&G wildlife observation programs, for example, may receive public recognition in a local newspaper, or certificates of achievement (e.g., based on the number of animals observed). Additionally, groups that "adopt" an important local habitat area for birds and other wildlife, and work to improve habitat, remove invasive plants, or promote responsible dog control can be publicly commended.

Institutional Development

Institutional development refers to actions that build infrastructure and relationships to implement better conservation and management actions (CMP 2016). This includes developing working collaborations with other agencies, NGOs, private entities, or in-state and interstate consortiums. ADF&G has many potential partners including the Alaska Pollinator Coordination Group, Boreal Partners in Flight, Alaska Shorebird Group, Fish Habitat Partnerships, watershed conservation groups, Alaska Small Mammal Group, Pacific Birds Habitat Joint Venture, and the Western Bat Working Group. In some cases, ADF&G staff have provided expertise for formulating conservation and management strategies (e.g., bird conservation plans) or assisted with scientific meetings (e.g., American Fisheries Society, The Wildlife Society, Alaska Marine Science Symposium, and Alaska Bird Conference) that increase the effectiveness of conservation and management actions.

A specific priority for building capacity is engaging with species working groups, as noted above, and the Pacific Flyway Council Study and Nongame Technical Committees. These groups help support conservation and management actions for populations of Alaska's wildlife at migratory staging and wintering areas across state and national boundaries, where threats to species that breed in Alaska are often high. Other priority areas for building capacity include collaborative activities to promote stream and wetland restoration efforts, as well as invasive species control and eradication.

Oxbow lakes along the Kobuk River. N. Herbert, NPS, used with permission.

For example, ADF&G's TED Program has fostered more than 140 SWG-based partnerships over the past 10 years, thanks to collaborations with other state programs, government agencies, species working groups, universities, NGOs, Alaska Native organizations and environmental contractors. The work has built on collective strengths and expertise to leverage scientific outcomes that inform conservation and management actions for over 100 SGCN. The outcomes have recruited many new voices for collaborative conservation and management in the state. Nontraditional conservation partners (e.g., oil and gas, mining, and

timber industries) also stand to provide valuable opportunities for collaboration. For example, partnering with industry could help ADF&G develop and implement more effective wildlife mitigation measures, balancing development with the long-term viability of fish and wildlife populations. Encouraging and strengthening institutional development with external partners for conservation and management can be a powerful tool, and these efforts will continue.

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9 | Monitoring and Evaluation

Seabirds at Round Island, Bristol Bay, in southwest Alaska. A. Underwood, ADF&G.

This chapter describes the existing efforts and proposed plans for monitoring "species of greatest conservation need" (SGCN) and their habitats, determining the effectiveness of conservation actions, and adapting these actions to respond appropriately to new information and changing conditions. The State Wildlife Action Plan (SWAP) is a strategic document that describes the Alaska Department of Fish and Game's (ADF&G's) overall strategy for conserving SGCN. It informs proposals that are later developed to monitor species and their habitats and implement conservation actions. Monitoring is designed to identify trends in wildlife populations (numbers, movements, reproductive success) and key habitats (condition and use) over time. This work occurs at different levels (population, species, species group, habitat) and may be designed to evaluate the impacts of threats, assess the effectiveness of programs or management actions, determine take thresholds, or collect ambient or baseline data.

The first part of this chapter describes current and ongoing SGCN monitoring efforts in Alaska and identifies needs for additional or improved monitoring in the future. Existing projects and datasets that ADF&G is aware of are listed in Appendix H. For convenience, these monitoring efforts are

classified under the subheadings of Air and Climate, Land, Vegetation, Climate Change, Contaminants, Marine and Intertidal, Birds, Marine Mammals, Terrestrial Mammals, Invertebrates, Amphibians and Fish, Non-native and Problematic Species, Fire Ecology, Human Use, and Biodiversity.

The second part of this chapter provides an evaluation of ADF&G's progress toward meeting its conservation and management goals (see the "Priority Conservation and Management Actions" section in Chapter 10). This evaluation uses the following guidelines adapted from Stem et al. (2005):

- Is the work appropriate for the species and/or habitats with the greatest needs?
- Is the work being done in a cost-effective manner?
- Is the work successfully achieving goals?
- Is the monitoring plan flexible enough to respond to new information and changing conditions?

Challenges in Alaska

Monitoring Alaska wildlife populations and their habitats presents unique challenges. Alaska's terrestrial and marine biogeographic regions are extensive, rugged, and inaccessible, which makes systematic or random sampling of large areas of the state costly and difficult. Many species, particularly invertebrates, are poorly studied, and insufficient information is available to assess their population status or trends. Appendix E lists estimated population sizes for a subset of SGCN based

Augustine Volcano, located in Cook Inlet, about 175 miles from Anchorage. ADF&G.

on published estimates in the peer-reviewed literature, stock assessments for marine mammals, and estimates provided in partner organization databases and conservation plans. Statistically reliable population abundance, trend, and stock estimates for SGCN are currently available for aerial surveys for large waterbirds (Schmidt et al. 2009, Amundson et al. 2019), mark-recapture bird-banding studies (Wilson et al. 2007, Sedinger et al. 2019), mark-resight bird studies (Lyons et al. 2016), population modeling (Bentzen and Powell 2012, Wilson et al. 2012), ship-based and aerial surveys of seabirds (Arimitsu et al. 2023, Kuletz et al. 2024), stock assessments for marine mammals (Young et al. 2024), razor clam population assessments (Kerkvliet et al. 2021), salmon in-river abundance estimates (e.g., Decovich et al. 2024), rockfish stock assessments (ADF&G unpublished data), whitefish research (Gryska 2021, Albert and Tyers 2022), *Anadromous Waters Catalog* surveys (Giefer and Graziano 2024a–f), and aquatic invasive species distribution and early detection (Bradley et al. 2024, ADF&G 2025e).

Population index counts can also be used if it is assumed that trends in the index areas are representative of trends across the species' range during the assessed time periods. Examples of such index counts include Christmas Bird Counts (Audubon 2025), Breeding Bird Surveys (USGS 2025), Alaska Landbird Monitoring Surveys (ALMS; Handel and Sauer 2017), Program for Regional and International Shorebird Monitoring (PRISM) surveys, modified PRISM surveys (Bart and Johnston 2012, Martin et al. 2020), and beluga whale surveys in Cook Inlet (Goetz et al. 2023). There are biases inherent in some of these efforts (Sauer et al. 1994, Keller and Scallan 1999), but they are not so large as to overly influence estimated population trends.

Fish and wildlife monitoring is often time-consuming and costly. Counts from the air are often not feasible except for large animals using open habitats, and counts from the ground or aboard vessels are laborious and expensive. An unknown number and potentially high percentage of animals are missed, requiring some estimate of detection probability if absolute abundance is desired (Thompson 2002). In some cases, species misidentification and the allocation of survey effort spatially and temporally can yield unreliable trend estimates (Pollock et al. 2002, Hodges and Kirchhoff 2012). These limitations can be partially addressed through replication, specifically by conducting enough surveys over a long time period and a broad area (e.g., regional Breeding Bird Surveys) to identify meaningful trends that inform conservation and management actions.

Remote monitoring tools and techniques can also address some of the monitoring challenges in Alaska and have improved substantially in terms of reliability, accuracy, and availability in the last decade. Devices such as passive acoustic monitors, small-form time-lapse cameras, and video cameras allow continuous monitoring of a wide variety of species and environments. Additionally, observation networks such as the North American Bat Monitoring Program and eBird have developed advanced modeling tools and datasets that management agencies now use for tracking and evaluating the status of wildlife populations.

The availability of funding for wildlife research can also be challenging and vary depending on which species group is being studied. Available funding is not typically commensurate with the overall need. Some of the funding for research comes from sources that ADF&G directs, whereas other funding requires applying for competitive grants. For example, much of ADF&G's monitoring and evaluation work of terrestrial, nongame wildlife, and aquatic invasive species is supported by funding from the State Wildlife Grants (SWG) program, while marine mammal monitoring and invasive species management rely on competitive external grants from other agencies that guide the

direction of these efforts. These efforts include Cooperative Endangered Species Act Conservation Fund (Section 6) grants administered by the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA), as well as other grants administered by the North Pacific Research Board, the Alaska Fish and Wildlife Fund, and the Alaska Sustainable Salmon Fund.

Current Monitoring Efforts

Monitoring efforts in Alaska fall into two broad categories: environmental monitoring and wildlife monitoring. Environmental monitoring measures variables such as air and water temperature, ocean currents, salinity, carbon dioxide levels, ice extent, forest cover, and land use patterns. Measurement of these variables can predict habitat changes that may affect future fish and wildlife populations. Environmental data can often be collected remotely from satellites, buoys, or data loggers, providing large-scale, long-term, and often inexpensive monitoring. By contrast, wildlife monitoring is generally more resource-intensive and involves collecting data on the abundance, distribution, behavior, composition, health, and harvest of fish and wildlife populations. These data can be used to detect trends in fish and wildlife abundance over time, guiding conservation and management efforts.

Due to limited SWG funding, ADF&G prioritizes monitoring to fill data gaps and avoids duplication of work already being conducted by other agencies. Examples of SGCN monitoring projects conducted by ADF&G are listed in Table 1.1 in Chapter 1, and statewide monitoring efforts by other organizations are listed in Appendix H. ADF&G takes a lead or supporting role in monitoring efforts for SGCN depending on staff capacity and expertise, funding availability, and roles identified in interagency species working groups. The Marine Mammals Program utilizes external competitive federal funding to monitor SGCN under their purview across the state. Partnerships with other agencies increase effectiveness and efficiency in allocating funding toward specific monitoring objectives.

North Pacific right whale. J. Durban, NOAA, used with permission.

A Redpoll in late winter. D. Hejna, used with permission.

Monitoring efforts vary depending on the objectives and the degree of statistical rigor required to meet these objectives. Many monitoring programs in Alaska are overseen by resource management agencies, with the monitoring work conducted by trained biologists and ecologists. These efforts tend to be extensively planned, with designs that consider statistical power to detect trends (Hatch 2003, Seavy and Reynolds 2007). Typically, these monitoring efforts are restricted to the lands and waters (e.g., parks and refuges) or species for which a particular agency has management responsibility. For example, biologists in Denali National Park and Preserve have conducted systematic, repeated surveys of songbirds since the 1990s to determine trends in songbird abundance and distribution (Mizel et al. 2016); understand the effects of threats, such as recreational activities, on songbirds (Meeker et al. 2022); and evaluate the efficacy of survey and analysis techniques (Schmidt et al. 2013). Several decades-long raptor monitoring projects, including Golden Eagles in Denali National Park and Preserve (Schmidt et al. 2018), Peregrine Falcons in Yukon-Charley Rivers National Preserve (Ambrose et al. 2016), and cliff-nesting raptors in Nome conducted by ADF&G staff (Bente 2011), have yielded information about their population status and recovery. Surveys designed specifically for an SGCN can often consider unique aspects of its distribution, habitat, and behavior to produce trend estimates with adequate precision (Kissling et al. 2007, Kirchhoff 2011). Federal and state agencies can often ensure a long-term commitment to funding, staffing, and reporting this work, which is essential for effective monitoring.

Citizen science monitoring efforts typically have lower statistical rigor; however, many citizen science data products have yielded scientifically useful indices, such as relative abundance measurements and long-term trends, for various species. For example, eBird, managed by the Cornell Lab of Ornithology, allows bird watchers to enter bird sightings into an app that aggregates these data into an online, publicly available database. SWG grants originally funded Alaska's participation in the program in the 2000s. Since then, the dataset has become more robust, and sophisticated analysis tools have been developed (Cornell Lab of Ornithology 2024). Analyses of these data have provided insights into the distribution, habitat use, migration, and population trends of bird species found in Alaska (Scurr et al. 2023). Also, agencies in the contiguous United States have used eBird data to identify sites for wind energy development that minimize bird collision risk (Ruiz-Gutierrez et al. 2021). Similarly, sightings and photographs of whales by scientists and citizens have been aggregated into several databases managed by agencies and independent researchers (e.g., Happywhale, Whale Alert, Cook Inlet Beluga PhotoID Project). New algorithms have enabled researchers to match these and other photos more effectively to identify individual whales, their movements, and population trends (Calambokidis et al. 2017; Cheeseman et al. 2023, 2024).

Other citizen science wildlife monitoring projects in Alaska include the Alaska Bee Atlas (ACCS 2025), Christmas Bird Counts (National Audubon Society 2025), Gunsight Mountain HawkWatch (HawkWatch International 2025), bat monitoring (ADF&G 2025a), and the Coastal Observation and Seabird Survey Team (University of Washington 2024). ADF&G uses SWG funding to facilitate and support a community-based citizen science network in coastal communities statewide. This

The Yukon River flows 1,980 miles from its headwaters in Canada through Alaska, ending in the Bering Sea. T. Christopherson, NPS, used with permission.

network facilitates early detection and understanding of population shifts of marine invasive species, particularly European green crab, and their impact on nearshore ecosystems. Although the types of questions citizen science can address are limited, its key strength lies in the ability to collect large quantities of data across broad spatial and temporal scales at relatively low cost (Shively and Barboza 2017, McDuffie et al. 2019, Snively et al. 2021).

SWG funds have supported monitoring efforts around the state, including some projects described above and those that either fill survey gaps or are designed to improve survey methodology. Examples include recent work to understand Aleutian Tern population status and diet (Tengeres 2022), tracking of Lesser Yellowlegs (Christie et al. 2023), bat monitoring and research in Southeast Alaska (Rae et al. 2025), and research on collared pika ecology (ADF&G 2025b). Alaska has used SWG funding for Birds 'n' Bogs (formerly the Loon and Grebe Watch Program; ADF&G 2025c), a citizen science monitoring project focused on documenting the distribution and abundance of birds that breed in the boreal forest bogs in Southcentral Alaska. Such efforts engage the public, promote awareness and support for wildlife conservation, and provide data on distribution and habitat use.

Monitoring Plans for the Next 10 Years

Over the next 10 years, ADF&G will continue to focus on gaining a better understanding of trends in fish and wildlife populations and their habitats, as well as impacts from invasive species, to help prioritize conservation and management actions. SWAP implementation can be challenging due to limited funding, so ADF&G considers many factors before deciding what species and objectives will receive SWG funding, such as conservation need, stewardship responsibility, and efficiency (see "Funding Decisions" section in Chapter 11). The ADF&G Marine Mammal Program maintains the list of SWAP priority actions for the next 10 years for marine mammal SGCN in Alaska (ADF&G 2025f). Additionally, monitoring some raptors and harvested species such as Alaska hare, salmon, rockfish, and razor clams will inform recommendations on take thresholds, permitting, and regulatory decisions. New and current development projects across the state may provide additional opportunities for ADF&G and its collaborators to partner with industry to monitor wildlife

populations. Monitoring may provide insights for simple mitigation actions at development sites that will promote sustained yield of SGCN, especially as these species may face threats that are cumulative. Although insufficient SWG funds are available for ADF&G to be the sole or primary sponsor of monitoring all SGCN, the agency can provide technical, logistical, and financial support for a range of existing and future monitoring efforts. ADF&G's support of other agencies' monitoring projects may include providing funding, training, biostatistical support (including survey design and analysis), and participating in surveys. ADF&G will continue to lead monitoring efforts for SGCN within its available capacity and identify data gaps in ongoing wildlife and habitat monitoring efforts in Alaska. Our goal is to monitor the highest priority SGCN and habitats in the plan (Chapter 10).

Lesser Yellowlegs. K. Christie, ADF&G.

ADF&G will continue collaborating with organizations and working groups that study individual wildlife species and species groups. For example, organizations such as the Alaska Shorebird Group and Boreal Partners in Flight have identified the need to continue long-term population monitoring efforts (e.g., PRISM surveys) and to compare the efficacy of traditional surveys (e.g., ALMS) to that of remote sensing methods (e.g., Autonomous Recording Units) for monitoring breeding bird populations. Historical datasets from these surveys could be imported into eBird to facilitate and improve the precision and ability to forecast population and distribution trends. Improving these surveys and tools can assist resource managers in understanding and evaluating the impacts of threats to SGCN and the habitats on which they depend.

Sabine's Gull adult and chick resting on the tundra. A. Bankert, used with permission.

Given Alaska's geographic extent and relative inaccessibility for research, basic information on many species and species groups is needed. Poorly studied species include most small mammals, shorebirds in alpine and boreal ecosystems, and invertebrates, many of which may be endemic to Alaska. For example, Sikes and Allen (2016) reported that over 300 species of nonmarine arthropods are only known from Alaska. Many of these potential endemics are blind, wingless, and soil-dwelling, making them poor dispersers and potentially vulnerable to environmental change (Sikes and Allen

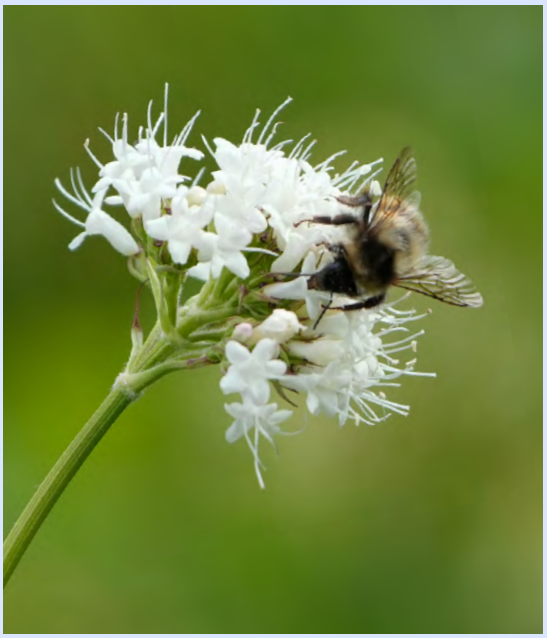
2016). More research on Alaska's potential endemic species is warranted to confirm their taxonomy, distribution within the state, and whether their distribution extends outside it.

Data gaps are particularly notable for Alaska's small mammal populations, including bats, since many species have unknown population trends and incomplete knowledge of range, distribution, or understanding of factors regulating population size (Droghini et al. 2022). Small mammals are not only important prey for many predatory SGCN, they also serve important ecosystem functions. For example, small mammals in the boreal forest, Alaska's largest terrestrial habitat, distribute root-associated fungi critical to tree regeneration, providing a promising benefit to managed forests (e.g., Paragi et al. 2020). ADF&G led a workshop with the Alaska Small Mammal Group to determine priority conservation needs. A coordinated statewide network to monitor small mammal population dynamics is necessary to understand trends, factors limiting growth, and responses to environmental change. The network should develop steps that efficiently link data collection between field studies and museum collections. Other priorities for small mammal monitoring include genetic mark-recapture studies focused on estimating population sizes and a better understanding of diet.

As climate regimes continue to shift in Alaska, the need to assess the effects on wildlife has become more pronounced. Range shifts have already been documented in some species groups (Mizel et al. 2016, Tape et al. 2016, Baltensperger et al. 2024), and long-term monitoring of SGCN distribution and abundance will help prioritize species for conservation and management actions. This is especially important in the face of complex threats like climate change, which may affect SGCN unpredictably and in positive or negative ways.

Species of Conservation Need: Insect Pollinators

Insect pollinators play a critical role in Alaska's ecosystems by moving pollen between flowers, which facilitates plant reproduction. Many plant species that other wildlife and people rely on for food and habitat, such as willows, blueberries, and cloudberries, require insect pollinators to produce fruits and seeds. A wide diversity of insects, including bees, butterflies, moths, flies, and beetles, are pollinators, with flies being particularly important pollinators at higher latitudes. The conservation status of most species of insect pollinators is not well known, and aside from butterflies and bumble bees, the understanding of occurrence and distribution in Alaska is limited for most species.

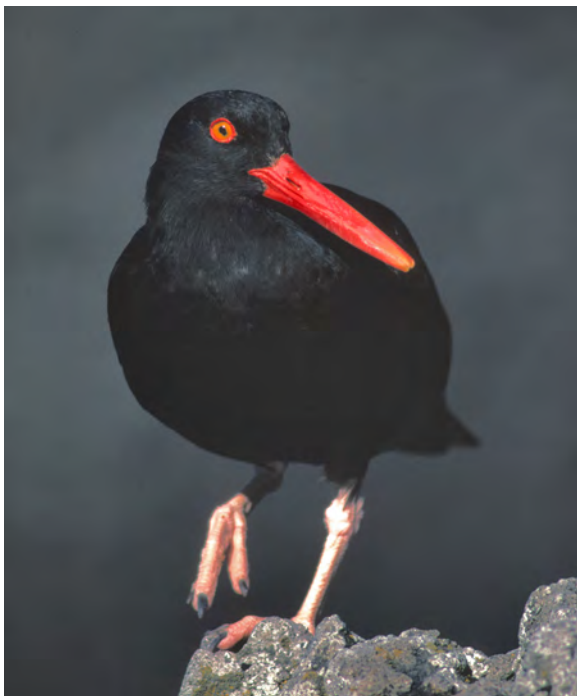


Bee on valarian flower. A. Underwood, ADF&G.

Habitat Monitoring

The conservation status of many species is linked to the amount and quality of suitable habitat. Recognizing this, ADF&G funded several projects to identify important habitats for wildlife conservation and management. Examples include Globally Important Areas for Marine Birds (Smith

et al. 2014), the Gap Analysis Program (Gotthardt et al. 2014), and the Anadromous Waters Catalog (ADF&G 2025d).



Black Oystercatcher. ADF&G.

Alaska is fortunate to have large expanses of intact, functioning ecosystems, and habitat fragmentation is not a widespread issue for our wildlife. Because of this, there is an opportunity to implement landscape-level analyses to identify hotspots of occurrence, high-value habitats, and regions of importance for SGCN. State and federal agencies and NGOs have mapped high-use areas and important habitat types to inform decisions to improve compatibility between development and SGCN conservation. ADF&G also supports the Wildlife Habitat Enhancement and Spatial Analysis Program (WHESAP), which develops strategic approaches to enhance wildlife habitat across different land ownerships and vegetation types. WHESAP primarily focuses on providing forage and habitat for game species (e.g., moose, grouse, bison). Still, the program's activities include prescribed burns and projects related to forest health, which can also improve habitat and benefit nongame SGCN across the state. The Alaska Department of Natural Resources also considers important habitats and wildlife resources when creating land management plans across the state to provide for the "maximum public benefit" (DNR 2025).

Climate change is expected to affect habitat availability for many SGCN by decreasing or increasing the amount of suitable habitat, depending on the species. For species projected to lose habitat, there is a need to identify future habitats and hotspots of occurrence that could serve as climate change refugia and contribute to resiliency of SGCN. This can be done by comparing current and projected future habitat values and identifying physical factors and ecosystem processes that influence current and future habitat suitability (Stralberg et al. 2020, Raiho et al. 2022). Many species, including SGCN, are already altering their distribution in response to climate change, and more research is needed to better understand these shifts. For example, recent work has documented range shifts for terrestrial mammals in Alaska using a combination of data collected by citizen scientists, agency biologists, and university researchers (Baltensperger et al. 2024).

Many migratory species face threats outside the state that impact their populations and, ultimately, their conservation status in Alaska (Chapter 7). Supporting appropriate management, conservation, and restoration activities across a species' entire life cycle, including breeding, migratory stopover, and wintering areas, is often key to maintaining healthy populations in our state. ADF&G can continue to build relationships with resource management personnel and conservation organizations in other states and countries, where politically feasible. For example, through the Pacific Flyway Council and in partnership with the Association of Fish and Wildlife Agencies' Southern Wings Program (Southern Wings 2025), ADF&G can address conservation concerns outside the state.

Sandhill Cranes. J. Dau, ADF&G.

Defining Success

Evaluating the effectiveness of ADF&G's efforts to conserve SGCN requires a clear statement of purpose. The SWG program (Chapter 1) encourages a conservation paradigm of working towards managing species before they become imperiled and to ensure sustained yield. To be successful, ADF&G must be able to:

- Identify which species are most vulnerable or declining (Chapter 4).
- Identify which factors are responsible for their vulnerable status (Chapter 7).
- Identify and employ actions that will reduce that vulnerability (Chapter 8).

ADF&G has emphasized work on species not yet listed but at high conservation risk (small, declining, or threatened populations) as described in Chapter 4. We have conducted research and supported work by others to validate or refine population trend estimates in Alaska. This has included support for developing Alaska eBird, Alaska hare studies, eagle and other raptor research and monitoring, mapping hotspots of biodiversity and possible climate change refugia, and analysis of multidecadal bird banding data. Additionally, we have supported research and monitoring on McKay's Bunting (Richardson et al. 2024), Olive-sided Flycatcher (Hagelin et al. 2021), Lesser Yellowlegs, collared pika, Aleutian Tern, Chinook salmon, Pacific walrus, and other species. SWG funding has also supported monitoring or research on SGCN species scheduled for Endangered Species Act (ESA) status reviews, such as the Gray-headed Chickadee (Booms et al. 2020; Table 9.1). In addition, it is important to monitor populations after a successful conservation action in order to detect any slowing or reversal of the population decline.

ADF&G's participation and support have improved monitoring and conservation efforts and, in some cases, affected ESA listing decisions (Table 9.1). For example, the Alexander Archipelago wolf, a game

Table 9.1. List of at-risk species in Alaska reviewed by the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS)[a] for listing under the federal Endangered Species Act (ESA) during the current State Wildlife Action Plan (SWAP) planning period (2015–2025). The table also lists whether State Wildlife Grant (SWG) funds were spent and the ESA listing status at time of publication. Multiple years in parentheses indicate multiple ESA listing decisions over the 10-year SWAP period.

Species	Date of most recent petition	Funded by SWG?	ESA Listing Decision (year[s])
Tufted Puffin	Feb 12, 2014	Yes	Not warranted (2020)
Yellow-cedar	Jun 24, 2014	Yes	Not warranted (2019)
Iliamna Lake seal	Feb 6, 2020[b]	Yes	Not warranted (2016, 2021[c])
Suckley's bumblebee	Apr 23, 2020	Yes[d]	Alaska excluded from species range. Listing proposed for contiguous U.S. only (2025)
Alexander Archipelago wolf	Jul 15, 2020[e]	Yes	Not warranted (2016, 2023)
Short-finned mako shark	Jan 25, 2021	Yes	Not warranted (2022)
Bull kelp	Sep 1, 2022	No	Not warranted (2023)
Pacific walrus	Service-initiated review[f]	Yes	Not warranted (2017)
		No	Under review
Sunflower sea star	Aug 18, 2021	Yes	Proposed as threatened (2023)
Northern bog lemming	Sep 29, 2014	Yes[d]	Under review
Western bumblebee	Sep 15, 2015	Yes	Under review
Large marble butterfly	Oct 3, 2023	Yes	Under review
Gulf of Alaska Chinook salmon	Jan 11, 2024	Yes	Under review
Alaska glacier buttercup	Feb 1, 2024	Yes	Under review
Wilson's Phalarope	Mar 28, 2024	Yes	Under review
Little brown bat	Service-initiated review[g]	Yes[d]	Under review
Hoary bat	Service-initiated review	Yes[d]	Scheduled for review in FY28
Gray-headed Chickadee	Service-initiated review	Yes[d]	Scheduled for review in FY28

[a] USFWS implements the ESA for terrestrial and freshwater species, as well as the Pacific walrus, northern sea otter, and polar bear. In contrast, NMFS implements the ESA for anadromous fish and other marine mammals.
[b] The Iliamna Lake seal was also petitioned for listing in 2012, but the listing was found to be "not warranted" in 2016.
[c] NMFS issued a "negative" 90-day finding on the 2020 petition to list the Iliamna Lake seal, indicating that listing is not warranted.
[d] SWG funds yielded monitoring data or other distribution and habitat use information.
[e] The Alexander Archipelago wolf was also petitioned for listing in 1996 and 2011. USFWS found that listing was not warranted for each petition.
[f] The Pacific walrus was petitioned for listing in 2008, with an initial finding of "listing warranted but precluded." A "not warranted" finding was issued in 2017, but in response to a court finding, USFWS initiated a new listing review, which is ongoing.
[g] The little brown bat was also petitioned for listing in 2010, with a finding of "listing not warranted."

species previously listed as SGCN due to several petitions for ESA listing, is not on the 2025 SGCN list due to the efforts of ADF&G staff to provide data showing that ESA listing was not warranted (Table 9.1). Additionally, ADF&G biologists worked with the University of Alaska Museum to confirm the status of Suckley's cuckoo bumblebee, a species proposed for ESA listing in 2020. They determined that the species did not occur in Alaska. Those findings were weighed by the USFWS, resulting in the removal of Alaska from the species' range in the proposed endangered species listing under the ESA (89 FR 102074). This example illustrates the cost-effectiveness of investing in conservation work, including filling data gaps, before a species gets listed.

During the current SWAP planning period (2015–2025), federal agencies received 14 petitions to list species as threatened or endangered under the ESA and initiated four other reviews themselves. Final decisions were issued for eight reviews; all eight were determined to be "not warranted," and SWG funding contributed to seven of the eight not warranted outcomes (Table 9.1). The remaining proposal to list the sunflower sea star as threatened under the ESA has not yet been finalized. SWG funding specifically contributed to monitoring efforts or other research on distribution and habitat use for five species proposed for listing (Table 9.1). For example, research on little brown bat hibernation behavior demonstrated that bats in Alaska likely have a reduced threat of white-nose syndrome compared with bats in the continental United States due to their use of dispersed hibernacula, among other variables (Blejwas et al. 2021). ADF&G's efforts contribute directly to better-informed decisions by the USFWS and NOAA fisheries.

Species of Conservation Need: Alaska Hare *(Lepus othus)*

Alaska hare. C. Barger, ADF&G.

Alaska hares are one of the world's largest species of lagomorphs and are endemic to western and southwestern Alaska's maritime and tundra environments. Notably, Alaska hares are three times larger than snowshoe hares and differ remarkably in their ecology. Recent ADF&G research has shown that the home ranges of Alaska hares can be upwards of 7,000 acres, compared to 35 acres for snowshoe hares. Additionally, an adult Alaska hare can travel as far as 13 kilometers in one day through open tundra, dense willow and alder thickets, and high rocky outcroppings. Alaska hares hold cultural significance as a furbearer, known for their beautiful, solid white coat with black-tipped ears during the long winters. For a brief period in the short summer months, they can be observed with dusky brown fur. These herbivores primarily feed at dusk and dawn on a variety of leafy and woody vegetation, as well as crowberry fruits. Alaska hares tend to be difficult to study due to their remote and challenging habitats, elusive nature, low densities, and large home ranges. Historical accounts from the 1970s suggested a greater abundance of Alaska hares, with groups ranging from 300 to 800 individuals; however, more recently, it is rare to find groups of hares larger than three or four individuals. ADF&G's research and monitoring of Alaska hares has led to changes in both state and federal harvest regulations, reducing bag and season limits to help ensure sustained yield.

ADF&G also collaborates with federal and local partners to monitor listed ESA species. For instance, ringed and bearded seals are being monitored to understand productivity, movements, habitat use, and responses to a changing Arctic (Quakenbush 2020). Researchers from ADF&G and partner agencies have refined methods for locating polar bear dens using wildlife-detection dogs (Shideler 2013), collecting environmental DNA to track polar bear movements, and understanding prey availability for various species (Von Duyke et al. 2023). Fish abundance data are being analyzed to understand if there are potential ecological constraints on beluga whales in Cook Inlet (ADF&G unpublished data).

Sunflower sea star. J. Nichols, NOAA, used with permission.

In addition to changing the course of regulatory action at the federal level, ADF&G's research on SGCN has also changed state policy. Research and monitoring of Alaska hares has led to changes in both state and federal harvest regulations, reducing bag and season limits to aid in the recovery of this now rare species (see Alaska hare vignette). Results of cliff-nesting raptor population monitoring conducted by ADF&G staff were used to inform Board of Game proposals to change falconry take thresholds and ensure take was within sustained yield limits.

ADF&G has also pursued projects on relatively abundant and secure species, such as bats, wood frogs, loons, and grebes. Although these species are not at risk of extinction, they often serve as useful indicators of ecosystem health and studying them allows for early detection of potential problems. Furthermore, these species provide a valuable opportunity to engage the public in conservation work through citizen science projects. In some cases, federal agencies have undertaken ESA listing reviews despite a species being relatively abundant (e.g., Chinook salmon and little brown bat), and such species can even become listed under the ESA (e.g., ringed and bearded seals). Data collected as part of ADF&G projects has been used to inform these reviews and avoid ESA listing (Table 9.1).

Finally, some projects have been funded due to a lack of data on a particular species of interest and an inability to assess its population status or trends using current information. Filling basic knowledge gaps is particularly relevant to fish and wildlife populations in Alaska, which are among the least studied populations in North America. Obtaining better information on abundance and habitat use is preliminary to establishing population monitoring programs and is critical to planning conservation and management actions. Research efforts motivated by the need to fill data gaps have focused on invertebrates, Golden Eagles, small mammals, bats, harbor porpoises, and potentially endemic species. Because data are lacking for most invertebrates, current efforts focus primarily on establishing presence or absence in Alaska, in addition to the species' range, rather than long-term population trends. For example, targeted surveys for species petitioned for listing under the ESA (e.g., western bumble bee) have provided valuable information. In the case of the western

bumble bee, it was unknown if this declining species occurs in Alaska. Surveys thus far have found no evidence that it does.

The effectiveness of conservation actions often depends on identifying the life stage at which a species faces the greatest risks; this, in turn, depends on effective monitoring of a species during its entire life cycle. For example, SWG funds supported a project to remove invasive northern pike from Susitna River tributaries to ensure the survival of juvenile Chinook salmon (see the vignette, "Impact of an invasive species on SGCN: Northern Pike *(Esox lucius)*," in Chapter 8). Without invasive northern pike suppression efforts, Chinook salmon would likely be extirpated from the Alexander Creek drainage (Bradley et al. 2022). ADF&G has also conducted research on migratory species, including the Black Oystercatcher and Rusty Blackbird, two species of continental concern for which breeding populations in Alaska were productive and appeared stable (Greenberg and Droege 1999, Tessler et al. 2010). In such cases, it is unlikely that any conservation actions could be implemented on these species' Alaska breeding grounds that would directly improve their conservation status. However, data from monitoring studies can be used to develop population models (e.g., integrated population models) to determine which portion of a species' life cycle is most at risk, identify important habitats used during that life stage, and develop targeted conservation actions to reverse declines.

Alexander Creek. National Fish Habitat Partnership (identification number 10133), used with permission.

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Maritime tundra dominates the coastal areas of Western Alaska, and provides important breeding habitat for many waterfowl and shorebirds. A. Pokrzywinski, used with permission.

10 | Alaska Priorities

Pelagic Cormorants and gulls. J. Jenniges, used with permission.

In a review of the original State Wildlife Action Plans (SWAP), the Association of Fish and Wildlife Agencies (AFWA) recommended greater prioritization of "species of greatest conservation need" (SGCN), habitats, threats, and conservation actions in plan revisions (AFWA 2012). There is a rich literature on the need for and the approaches to setting conservation priorities (Margules and Pressey 2000, Bunnell et al. 2004, Joseph et al. 2009, Arponen 2012). In addition to extinction risk, other factors such as ecological, cultural, and economic importance may be considered (AFWA 2012). Conservation priorities can also include subjective factors such as threats (Master 1991), available remedies, costs (Hughey et al. 2003), and prospects for a given project's success (Wilson et al. 2009). Broadly, Alaska Department of Fish and Game's (ADF&G's) goal is to manage fish and wildlife species according to the sustained yield principle, to ensure maximal long-term use of natural resources across the state, while simultaneously avoiding the need to list species as threatened or endangered under the Endangered Species Act (ESA). In this chapter, we focus on priority species, habitats, and threats, as well as priority conservation and management actions to achieve that goal.

Species Priorities

The intentionally large list of SGCN reflects the inherent uncertainty surrounding the status of these species in Alaska, where the landscapes are expansive, rugged, and remote; ecosystems remain largely intact; and data on populations are sparse. The scope of species on the SGCN list is important

for proactive conservation aimed at avoiding the need to list species as threatened or endangered under the ESA. For example, monitoring a variety of SGCN enables earlier detection of (and appropriate responses to) unanticipated declines. However, due to limited funding and capacity, ADF&G chooses to undertake research projects based on species priorities. As an initial screening step, we assigned the highest priority to SGCN with documented conservation and management concerns, such as a steep population decline (e.g., negative trend) or a small population size, and for which Alaska has high stewardship responsibility. Examples of high-priority taxa on this basis are shown in Table 10.1.

The highest priority species logically include those that meet multiple criteria for inclusion as SGCN. For example, a stewardship species, an ecologically important aquatic or invertebrate species, or a culturally and/or economically important species with a small, declining (at risk) population would naturally rank high. Our initial efforts to develop a list of priority species were hampered by the lack of information on the conservation status of many taxa (e.g., unknown population size, trend, and percentage of population in Alaska) and the lack of clear guidelines for defining ecologically important species.

Using the conservation priority criteria described above, the highest priority SGCN are those that are relatively well recognized across agencies and working groups and on which more research has been, or is currently being, conducted. For example, there is much more population status information on birds and marine mammals than on small mammals and marine invertebrates. Additional attempts to prioritize SGCN using these conservation criteria were met with objections from those whose interests and concerns are on data-deficient taxa. In this 2025 version of the SWAP, we have adopted the Alaska Species Ranking System as an objective method to rank and identify at-risk species and to assist in setting wildlife conservation and management priorities for terrestrial vertebrates and marine mammals. This system recognizes not only species in decline but also the importance of filling information gaps, which is included as a criterion for inclusion as SGCN.

King Eider. A. Bankert, ABR, used with permission.

The list in Table 10.1 represents one set of SGCN priorities for Alaska. We refer the reader to Appendices A through C, which list the reasons for including each SGCN in this action plan. Different taxa will rise or fall in priority depending on the categories of conservation need that one chooses to prioritize, whether it be an "at-risk" species in steep decline, a data-deficient species, a culturally important species, or a stewardship species.

In addition to assessing the perceived need for work on a given species, other factors such as feasibility, affordability, and utility of expected results should be considered before any State Wildlife Grant (SWG) project is proposed and approved. The process for considering these additional factors is covered in the "Funding Decisions" section in Chapter 11.

Table 10.1. Examples of high-priority "species of greatest conservation need" (SGCN) from several taxonomic groups. Each is notable for its relatively small, declining, or vulnerable population that heavily depends on habitats in Alaska. The list is not ordered by priority.

Species	Population Size or Index	Percent in Alaska	Trend	Status	Reference
North Pacific right whale (East population)	31	100%	Stable	Endangered. Very small, depleted population.	Young et al. (2024: 327)
Beluga whale (Cook Inlet)	279	100%	Stable	Endangered. Declined, depleted population.	Young et al. (2024: 327)
Alaska hare	Unknown	100%	Unknown	Endemic species, hunted, suspected decline.	ADF&G studies underway
Emperor Goose	18,788[a]	>80–90%	Declining	Small population, below management threshold.	Frost et al. (2024)
Spectacled Eider	~369,000	>90%	Declining[b]	Threatened. Vulnerable to sea ice conditions.	USFWS (2021)
Marbled Godwit *(beringiae)*	2,000	100%	Declining	Small population, declining, vulnerable.	ASG (2019)
Aleutian Tern	5,529	100%	Declining	Small population, declining.	Renner et al. (2015)
McKay's Bunting	19,481	100%	Declining	Small population, endemic.	Richardson et al. (2024)
Rock Sandpiper *(ptilocnemis)*	19,800	100%	Unknown	Small population, restricted breeding range.	ASG (2019)
Gray-headed Chickadee	Unknown, likely not more than a few thousand	~90%	Unknown	Suspected decline, small population, declining range in North America.	Booms et al. (2020)
Pacific Black Brant[c]	~245,000	100%	Stable	Vulnerable during migratory staging in Alaska, recent population decline.	USFWS (2025)
Bristle-thighed Curlew	10,000	100%	Stable	Small population, vulnerable.	ASG (2019)

[a] Survey index from the Yukon-Kuskokwim Delta only (not a total population count).
[b] Alaska breeding population is declining. Winter surveys of the global population are apparently stable.
[c] Pacific Brant Fall Photographic Survey at Izembek Lagoon, estimate of Brant in fall including breeders from Russia and Canada

The selection and prioritization of aquatic SGCN has been and will continue to be handled differently from terrestrial species. Large, ongoing shifts in aquatic ecosystems due to climate change, high levels of interdependence among species, and lack of knowledge about individual species status necessitate addressing aquatic issues on higher taxa or ecosystem levels (ADF&G 2025). Additionally, the existing SWG funding mechanism is inadequate for managing some exploited aquatic species and stocks. Therefore, the ADF&G's Division of Sport Fish has increasingly directed SWG funding for the conservation and management of aquatic species more strongly towards species fished for sport, subsistence, or commercial uses and those that are highly vulnerable to impacts from aquatic invasive species. Conserving the habitats of these exploited species not only aids in their conservation and management but also promotes the conservation of many other aquatic species that use similar habitats. Aquatic species, including those that are culturally and economically important (Appendices B and C), remain an important focus of the 2025 SWAP.

Partnership and Outreach Priorities

In a state the size of Alaska, partnering is essential for the efficient use of funds and labor. Partnerships offer various benefits and efficiencies at all management stages, including identifying areas of concern, sharing information, leveraging resources, and disseminating results. For example, over the past 10 years, ADF&G's Threatened, Endangered, and Diversity (TED) Program alone has partnered with nearly 150 groups to meet the conservation and management needs of SGCN. Partnerships include programs within state and federal agencies, Alaska Native and First Nations organizations, academic institutions, conservation and management working groups, species recovery teams, nongovernmental organizations and environmental consultants. At the agency level, ADF&G has also partnered with U.S. Fish and Wildlife Service (USFWS) and Alaska Native representatives from 10 subsistence regions in Alaska to form the Alaska Migratory Bird Co-Management Council (AMBCC) Harvest Assessment Program, which monitors harvest and engages subsistence users in management and bird conservation. The Emperor Goose (Table 10.1) is one priority species that is a focus of the AMBCC.

Emperor Geese on Adak Island. ADF&G.

Partnerships are also invaluable opportunities for addressing cross-border concerns. For the 2025 revision of wildlife action plans, states increasingly focus on landscape-level strategies that support multistate conservation and management activities and coordinated SGCN lists (Hamilton et al. 2024). Examples of cross-border cooperation include ADF&G participation in the Pacific Flyway Council and the Southern Wings program; the latter

An Arctic fox on the Pribilofs. ADF&G.

is a collaborative effort among state wildlife agencies and other partners to study, conserve, and manage migratory bird species that spend a significant portion of their life cycle in Central and South America (Southern Wings 2025).

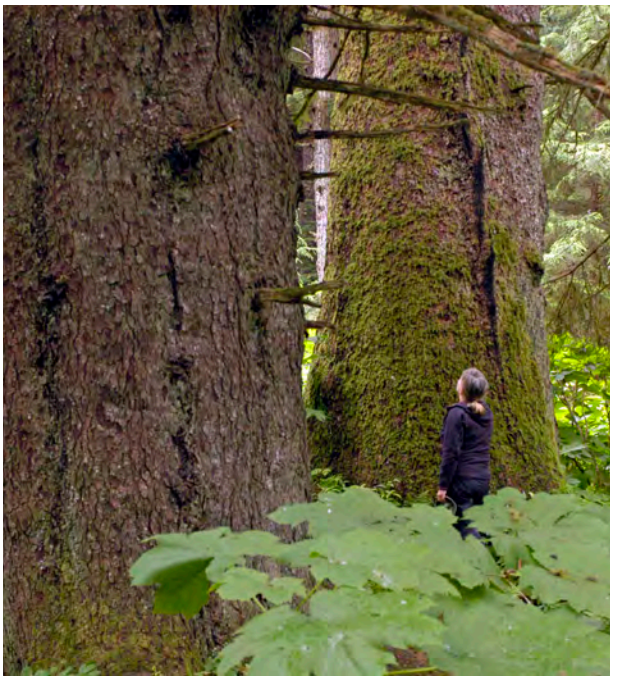
In addition, ADF&G developed several specific outreach programs, including citizen science programs and community engagement activities, to promote awareness of SGCN and collect monitoring data in Alaska (see the "Awareness Raising" section of Chapter 8). Additional outreach activities to gather input on the content and use of the material presented in the SWAP, as well as outreach efforts to understand the cultural importance of shorebirds and the magnitude of subsistence shorebird harvests in Alaska Native communities on the Yukon-Kuskokwim Delta are described in Chapter 11. Both partnership and outreach efforts will continue to be a priority in implementing the SWAP over the next 10 years.

Habitat Priorities

Habitats essential to rare and declining species are themselves priorities to conserve and manage. If the important habitat types are unknown, habitats that naturally have high species richness (see Chapter 6) and are expected to diminish with potential climate change effects or other broad-scale threats may be conservation and management priorities.

Chapter 5 describes an initial analysis of distributional hotspots, or areas at the statewide scale where multiple SGCN taxa are predicted to co-occur. Studying these potential biodiverse areas will help managers prioritize the use of limited funds, collect data on multiple SGCN taxa at once, describe habitat factors that produce high levels of biodiversity, and, where needed and possible, develop practical and applied solutions.

An example of a rare habitat with relatively high biodiversity is the beach-fringe forest habitat in Southeast Alaska. This habitat is far rarer than upland forest habitat and supports relatively more species per unit area because it represents an ecotone, or edge, between closed forest and open beach. Moreover, the beach-fringe forest has been



Saook Bay, Baranof, Alaska. ADF&G.

subject to a high level of historical logging because it is accessible, flat, and supports (as a rule) larger, more valuable trees compared to average forest stands. Knowing nothing about the requirements of a specific SGCN, in this case, it would be logical to prioritize beach-fringe habitat over upland forest habitat for conservation and management.

With these general rules in mind, the following habitats rise as priorities (with the main reason in parentheses):

- Sea ice (diminishing with climate change and important for wildlife populations, including ice seal species, walrus, and polar bear).
- Alpine and Arctic tundra (changing with evolving climate patterns).
- Rivers, streams, and fjords dependent on ice-melt flow (influenced by climate variability).
- Palustrine wetlands underlain by permafrost (shifting with climate change and productive for many breeding waterbirds).
- Beaches and sea cliffs, especially mudflats and eelgrass beds (these support high numbers of invertebrates, waterfowl, and shorebirds).
- Temperate rainforest (old growth), especially stands with large trees (beach-fringe old growth and stands with unique structural and functional attributes).
- Nearshore and continental shelf marine (highly productive habitats important for at-risk species, including whales, eiders, fish, and many commercially exploited populations).

This could be further enhanced through ADF&G-led interagency discussions that aim to identify common habitat monitoring priorities. Please note that the SWAP provides key habitat information, such as Appendix F, which contains descriptions and distribution maps for terrestrial habitats. Chapter 5 also identifies promising terrestrial regions at the statewide scale where we might expect to find higher species richness of terrestrial vertebrate SGCN.

Polar bears (permit 6862203253). G. Kramer, USFWS, used with permission.

Threat Priorities

Factors that are considered when prioritizing among potential threats to Alaska fish and wildlife include the magnitude of the threat to populations, geographic extent (including number of species, population size, or habitats involved), the potential for prevention or mitigation, public concern, and the financial cost of addressing the problem. The primary purpose of Alaska's SWAP is to avoid the need to list species as threatened or endangered under the ESA; therefore, those threats that may negatively affect broad areas of Alaska are top priorities.

Climate change is likely the most impactful threat to wildlife in Alaska because it affects habitats across the state and, for migratory species, where those species migrate and overwinter outside the state. Species that inhabit the northern edge of the continent or depend on sea ice are likely to be the

Harbor seal on ice floe in Prince William Sound. ADF&G.

most vulnerable to climate change because their niche is both shifting and disappearing. Climate change has been the principal driver of ESA listing petitions in Alaska in the last 20 years; it is the basis for positive findings concerning ice seal species and polar bears. Also, it was cited as an important driver of declines in the sunflower sea star, which was proposed as an ESA-threatened species in 2023 (NOAA 2023). However, the high uncertainty and long time-horizon before ice seal populations are likely to decline make ESA listings of those species inappropriate (State of Alaska 2019). Oceanographic effects of climate change (e.g., current patterns, acidification, temperature rise) have altered marine ecosystems; these shifts are ongoing, and affected marine systems are unlikely to return to historical conditions (NOAA 2021, Overland et al. 2024). However, other expected climate change impacts to wildlife, especially for terrestrial species, will likely be slow to occur or will have delayed measurable impacts, and may affect fewer Alaska species. We also expect some species to benefit from climate change as some terrestrial habitats and wildlife species ranges expand in Alaska. Therefore, although climate change is considered to be a high-priority threat, with limited potential for mitigation, effects on individual species may be inconsistent and difficult to predict. Ongoing and future research and monitoring is needed to determine which species are likely to be resilient to the effects of climate change and which will need additional management to support their resilience.

Invasive species represent another high-priority threat due to the potential for widespread effects on native fish and wildlife populations and their habitats. They have elevated priority because of their contribution to worldwide biodiversity loss (Pysek and Richardson 2010), and since relatively few invasive species are widely established in Alaska, some eradication and control efforts are feasible and potentially cost-effective. On the other hand, climate change, especially climate warming, has led to environmental changes that can allow harmful nonindigenous species from lower latitudes to become established in Alaska. For example, in the past two decades, Alaska has seen the arrival of non-native ticks (Hahn and George 2019), and a northward shift of marine species has been observed and is projected to increase (Morley et al. 2018). Some invasive species that have been present in small numbers for decades, such as the European Starling (Kessel 1979), have increased in recent years. The likelihood of invasive species establishment in Alaska and the possible efficacy of control efforts make this a high-priority threat.

Horned Puffin. ADF&G.

Wildlife diseases are another potential threat to wildlife. With climate change, Alaska may see an expansion of disease vectors, such as

ticks and host animals, that could increase zoonotic diseases (Hueffer et al. 2013), avian malaria, and avian influenza. In the marine environment, warming has increased the prevalence of harmful algal blooms (Van Hemert et al. 2021), which can harm people, wildlife, and ecosystems.

Another threat priority is the low-probability but high-impact possibility of a major oil spill in Arctic waters. Although redundant measures are in place to minimize the risk of catastrophic accidents, such as the Exxon Valdez spill in Prince William Sound, the impact of such an accident on the Arctic region's wildlife could be serious. Most of coastal Alaska is far from the resources required for oil spill response such as ships and personnel, and there is limited experience in containment and cleanup under arctic conditions, such as ice cover and prolonged darkness (O'Rourke 2010: 62). For example, the USFWS Spectacled Eider recovery team predicted that a large oil spill in the species' winter habitat could have "catastrophic" consequences due to the lack of response capabilities in Arctic waters (USFWS 2010). Unlike many threats we identified, a major oil spill is a low-likelihood potential occurrence, not an ongoing one, and is thus preventable. Both the potential severity and the preventability of a major oil spill in Arctic waters combine to make this a high-priority threat.

Another threat that can operate at the species level and threaten population persistence is overharvest by humans. While overharvest is exceedingly rare in Alaska due to the constitutional mandate to manage natural resources for sustained yield and the various state promulgated statutes, regulations, and policies, overharvest of Alaska species does frequently occur outside of Alaska. This was the basis for dramatic declines in several listed species in Alaska, including the great whales, and Short-tailed and Laysan albatrosses (Hasegawa and DeGange 1982). Extinctions or near-extinctions of species occurring in Alaska in the nineteenth century (prior to statehood) have also been attributed to overharvesting (e.g., Eskimo Curlew and elephant seal). Many once-threatened species have now

Species of Conservation Need: Collared Pika *(Ochotona collaris)*

Collared pika. A. Underwood, ADF&G.

The collared pika is a cold-adapted lagomorph found only in northwestern Canada and Alaska, inhabiting alpine boulder fields. Pikas do not hibernate but remain active under the snow-covered boulder fields throughout winter. During the summer, pikas collect alpine vegetation and store it in "haypiles" beneath large boulders, relying on this stored food throughout the colder months. Pikas are alpine specialists that occur most often in places with milder summer temperatures and colder winter temperatures with heavy snowpack. Pikas depend on a consistent snowpack to provide insulation during winter, which can buffer external temperatures in their dens by up to 30 degrees. As a result, collared pikas are considered a sensitive indicator species for the effects of climate change on alpine ecosystems, and continued monitoring is important to ensure their resilience.

Frosted landscape in the Alaska Range. ADF&G.

recovered or are recovering through conservative harvest management and the implementation of various science-based conservation actions taken by coalitions of state and federal agencies, various hunting conservation organizations, and other conservation organizations and interested parties. For example, Alaska is working with a broad coalition to reestablish wood bison in Alaska. State and federal statutes now prohibit overharvest, and well-designed population monitoring programs to inform management strategies have been highly successful at conserving harvested populations. However, uncertainty and unanticipated environmental variability from other factors (e.g., reduced ocean productivity) can still lead to lower-than-anticipated abundance of harvested species.

Threats to migratory species that spend long periods outside Alaska are also a high priority. The hazards faced by wintering and migrating birds when they are outside of Alaska include habitat loss, collisions with infrastructure, harvest in the winter range, predation by domestic cats, and poisoning. Over the last several decades, evidence has been accumulating indicating that among the top threats to neotropical migrant birds are ongoing habitat loss, conversion to agriculture, and other uses on the wintering grounds (Terborgh 1989, Curtis et al. 2018, Negret et al. 2021). Threats of this kind cross state boundaries and occur on land administered by municipal, state, and federal agencies, neighboring countries, private landowners, and corporations. Threats to SGCN outside Alaska's borders are a high priority, and solutions will require innovative partnering and outreach to collectively solve problems in a manner that mitigates or reverses declines. One example is the Conserva Aves initiative that aims to recover, manage, and restore millions of acres of degraded habitat in Latin America (Conserva Aves 2025), including areas where many Alaska migratory birds spend the winter months and are vulnerable to habitat losses. Canada, which shares many

overlapping conservation and management interests with Alaska regarding reducing declines in boreal migratory birds, is one of several partners with the Conserva Aves initiative (Birds Canada 2025).

Spectacled Eider. A. Bankert, ABR, used with permission.

Priority Conservation and Management Actions

Over the next 10 years, ADF&G will flexibly engage in priority conservation and management actions through individual projects and partnerships. This plan describes the overall strategy for conserving all SGCN and informs more detailed proposals that include specific projects, species, and conservation actions. We expect the highest priority conservation actions to be directed to the highest priority SGCN and threats. Still, other important factors will be considered in the implementation of conservation actions (see the "Funding Decisions" section in Chapter 11). For example, it might be clear that habitat loss and degradation in the Yellow Sea during nonbreeding is the preeminent threat to many of Alaska's breeding shorebirds (Piersma et al. 2016, Studds et al. 2017). If those are the causes of population decline, conservation and management actions aimed at improving breeding habitat in Alaska might be ineffective. Identifying a conservation challenge is an important first step; applying timely and effective conservation and management actions is often more difficult, especially for threats that we may have limited ability to control at a landscape scale.

To meet these challenges, the ADF&G TED Program has identified three priority objectives, including 1) identify drivers of population declines, 2) work with partners to identify, prioritize, and implement actions that benefit high-priority SGCN across their annual life cycle, and 3) implement projects that mitigate threats in an effort to slow or reverse declines.

Long-tailed Jaeger hovering over the Arctic tundra. A. Bankert, ABR, used with permission.

Achieving these objectives generally involves three elements. First data on demographics and threats to SGCN (first element) must be applied to fish and wildlife management decisions (2nd element). These two actions prioritize public engagement, including the potential creation of management plans and maps of diversity hotspots or culturally and publicly valued resources. Equipped with these two elements, ADF&G can implement direct conservation actions (3rd element) to a) mitigate threats, b) maintain or increase survival, reproduction, and abundance of SGCN populations, and c) maintain, restore, and conserve SGCN habitat when it is limiting.

Cliffs adjacent to the Tanana River, interior Alaska, used by raptors for nesting. ABR, used with permission.

The list of possible and potentially valuable conservation and management actions is long and varied. With the above factors and objectives in mind, the types of conservation and management actions that we believe will emerge as priorities over the next 10 years include, but are not limited to, the actions described below.

Monitoring Vulnerable Populations

Identifying a population that could benefit from conservation and management actions requires basic information on trends in the population size or changes in the available habitat for a given species if the habitat is believed to be limiting. Having quantitative information on population size and rate of decline allows evaluation of the severity of the concern and the type of conservation action needed. Once a population has been identified as declining, acquiring information on reproductive success, mortality, movements, and habitat use is a conservation action priority, since this information is essential for identifying sources of decline.

Removing Invasive Species

An example of an effective and achievable conservation action is removing invasive species from places they colonized (e.g., rats and Arctic fox from islands where they are not native, northern pike from waters in Southcentral Alaska). When successful, this one-time action can have profound and potentially permanent effects on native flora and fauna (Ebbert and Byrd 2002, Dunker et al. 2018). Invasive species management actions are determined in part by existing state statutes and regulations, as well as guidance in management plans such as the Alaska Aquatic Nuisance

Species Management Plan (ADF&G 2002), the Rapid Response Plan for Invasive Rodents in Alaska (USFWS 2020), the Early Detection and Rapid Response Plan for Invasive European Green Crab *(Carcinus maenas)* in Alaska, 2023–2028 (DeBruyckere et al 2023), and the Technical Guidance and Management Plan for Invasive Northern Pike in Southcentral Alaska: 2022–2030 (Dunker et al. 2022). Because invasive species are especially problematic on islands, we stand to improve and restore centers of island endemism, including places where Alaska has high stewardship responsibility. Compared to other parts of North America, invasive species have not spread as widely in Alaska, which provides a better chance for successful eradication. Collectively, invasive species removal or eradication is a priority conservation action in Alaska since it confers a direct benefit to SGCN and promotes ecosystem health.

Mitigating Losses in High-Use Terrestrial and Marine Areas

Not all areas are equal in value to wildlife. Knowing what areas and habitats support the greatest wildlife resources provides important information that can facilitate multiple-use strategies without unnecessarily restricting human access and activities in regions that are also valuable to wildlife. For example, understanding seabird and marine mammal distribution in space and time, shipping through the Arctic Ocean might be guided to travel corridors to avoid most breeding and foraging areas for birds and mammals (Lovvorn et al. 2009). Similarly, based on knowledge of the timing and flight patterns of migrating bats and raptors, wind turbines can be placed in optimal locations, and the blades feathered under certain conditions to avoid wildlife collisions (Martin et al. 2017, Murgatroyd et al. 2021). With robust data addressing likely tradeoffs between human development and wildlife resources, implementing wildlife mitigation and management plans are important high-priority conservation actions in Alaska.

Sea otters at Resurrection Bay, Alaska. A. Underwood, ADF&G.

Walrus at Round Island. ADF&G.

Informing the Alaska Boards of Game and Fisheries Processes

The Alaska Board of Game and Board of Fisheries are charged with making allocative and regulatory decisions on game and fish species to ensure management under the sustained yield principle. Therefore, studies that inform their decision-making process while also addressing SGCN conservation and management are high priorities. Examples include Alaska hare and raptor research and monitoring to inform the implementation of sustained yield limits on hare harvest and trapping of falconry species. Similarly, Chinook salmon research informs revisions to management plans.

Informing Federal Regulations and Permits

Addressing issues with a direct population management nexus at the federal level is a high priority because a lack of information can result in precautionary federal management decisions. Collecting additional information that indicates healthy populations can enable ongoing and additional human use activities while ensuring sustained yield of fish and wildlife populations. Examples include research and monitoring of subsistence species, marine mammals, migratory birds, and Bald and Golden Eagles by providing better estimates of population size and threats in Alaska (Booms et al. 2021) to inform take limits under federal statutes. Providing accurate information on the status of these species is a shared priority among state, federal, local, and Tribal stakeholders, since these federal regulations directly affect resource use in Alaska.

Reducing Known Sources of Mortality and Morbidity

Activities beneficial to wildlife that can be supported by ADF&G programs, especially through partnerships, are a high priority. Possible examples include the installation of powerline diverters or window decals to avoid bird collisions (Ferrer et al. 2020, Underwood 2024) and modified lighting to reduce bird attraction to artificial light sources (Rebke et al. 2019). Recently, ADF&G partnered

Arctic fox. ADF&G.

with the Alaska Falconers Association, Alaska Backcountry Hunters and Anglers, and Conservation Science Global to launch the "Alaska Copper Ammo Challenge," a rebate program designed to replace lead ammunition with lead-free alternatives (ACAC 2024). Programs such as these serve the three-fold purposes of directly addressing threats, educating the public on important wildlife issues, and engaging Alaskans in conservation efforts.

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11 | Plan Development, Implementation, and Review

Rufous Hummingbird © Steve Heinl, used with permission.

This chapter addresses the remaining required elements (6, 7, and 8) of Alaska's 2025 State Wildlife Action Plan (SWAP; see also Chapter 2, Table 2.1). The sixth element describes procedures involved in plan review and revision of the 2025 SWAP and into the future. The seventh element requires describing "plans for coordinating the development, implementation, review, and revision of the revised action plan with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats." The eighth element calls for public participation in the development and implementation of the plan.

This chapter has four main parts. Part I outlines the evaluation and coordination of SWAP development among agencies, specialists, and partners (element 6). Part II describes the process of our extensive partner and public outreach, summarizing results and examples of how the gathered input was integrated into the 2025 revision (elements 6, 7, and 8). Part III discusses how suggestions from partners and the public were incorporated into the implementation of the 2025 SWAP (elements 7, 8) and the types of work eligible for State Wildlife Grants (SWG) funding. Part IV addresses how future planning and review will occur prior to the next SWAP revision (in 2035; element 6).

Part I: 2015 SWAP Evaluation and Development of the 2025 Revision

Alaska Department of Fish and Game (ADF&G) coordinated internally and externally to evaluate and prioritize areas in the 2015 SWAP for improvement and updating, and to develop the 2025 SWAP revision. Key aspects of such coordination are described below.

Internal Coordination

ADF&G formed an internal team led by the Division of Wildlife Conservation's Threatened, Endangered, and Diversity (TED) Program. The team discussed and assigned tasks within and among key divisions and programs (e.g., TED Program, Division of Sport Fish, Marine Mammals Program). Outcomes were reviewed internally by the Division of Wildlife Conservation, the Division of Sport Fish, the Division of Commercial Fisheries, the Habitat Section, and the Commissioner's Office. Examples of modifications made due to internal evaluation include:

1. Implementing the Alaska Species Ranking System (ASRS) as a more quantitative and Alaska-specific method to rank terrestrial "species of greatest conservation need" (SGCN) occurring within the state. The ASRS was previously developed with SWG funding in partnership with the Alaska Center for Conservation Science to systematically evaluate the status of terrestrial vertebrate taxa in Alaska (Chapter 4).
2. Developing landscape-scale descriptions of SGCN diversity at both the statewide level and within key habitats of Alaska's biogeographic regions. These descriptions were included in the 2025 SWAP to inform research by identifying areas where Alaska's nongame wildlife resources overlap and to provide a more unified approach to examining habitat types and the species that use them in each region (Chapters 5, 6).

Coordination with Technical Specialists

ADF&G's internal team then worked with consultants and other technical specialists to develop Alaska's 2025 SWAP. The technical specialists included environmental consultants and subject-matter specialists (e.g., social and environmental scientists, species specialists). The combined team efforts, collectively referred to as the SWAP Project Team, revised the SWAP by gathering and incorporating new data and other information and updating methods for improving the plan's accessibility for users. All changes were made in close coordination with ADF&G personnel.

Short-eared Owl release. ADF&G.

Coordination with Other Key Stakeholders

The SWAP Project Team used qualitative inquiry to gain input from 39 agency partners, Tribal entities, nongovernmental organizations (NGOs), academic and industry professionals, and other organizations. Desired input pertained to the development of the SWAP, including an assessment of familiarity and use of the SWAP, identification of areas in the plan needing improvement, suggested priorities, and preferred methods of engagement, revision, and implementation. ADF&G staff also led lengthy workshops with select statewide working groups (e.g., Boreal Partners in Flight, Alaska Shorebird Group, Alaska Small Mammal Group) to identify highly ranked conservation objectives in other

existing plans that should be linked to the SWAP revision. The workshops also sought to identify near-term projects to coordinate high-priority actions for Alaska's SGCN.

Part II: Partner Input and Public Outreach

Input from partners for the 2025 SWAP revision was primarily gathered by 1) conducting qualitative interviews of existing and potential SWAP implementation partners, and 2) collecting comments during a 30-day public review period. This section describes the methods for participation, results summary, and how input was incorporated into the revised SWAP.

During the spring and autumn of 2024, an independent social scientist consultant conducted qualitative interviews (30–45 minutes in duration) with 46 individuals representing 38 organizations and agencies (Table 11.1) that were identified by ADF&G staff, the consultant, and existing partners as being either focused on, or substantively interested in, wildlife conservation and management in Alaska. Organizations included existing and previous agency collaborators, as well as new organizations that were identified as promising partners for the future.

Table 11.1. Organizations and agencies interviewed (in alphabetical order).

ORGANIZATIONS AND AGENCIES	
Alaska Beluga Monitoring Program	Great Land Trust
Alaska Center for Conservation Science	Manomet Conservation Sciences
Alaska Division of Forestry and Fire Protection	Mat-Su Salmon Fish Habitat Partnership
Alaska Migratory Bird Co-management Council	National Marine Fisheries Service
Alaska Miners Association	Northern Alaska Environmental Center
Alaska Oil and Gas Association	Northern Latitudes Partnerships
Alaska Outdoor Council	Ocean Conservancy
Alaska Resource Development Council	Peregrine Fund, The
Alaska SeaLife Center	ProNatura Noroeste
Alaska Travel Industry Association	Road to Recovery
Alaska Wildlife Conservation Center	Safari Club International-Alaska Chapter
Arctic Migratory Birds Initiative	Tandem Global (formerly Wildlife Habitat Council)
Audubon Alaska	Trout Unlimited
Backcountry Hunters and Anglers-Alaska Chapter	USFS[1] Chugach National Forest
Barnacle Strategies	USFWS[2] Fisheries and Ecological Services
Boreal Partners in Flight	USFWS[2] Migratory Birds Management
Bureau of Land Management	USFWS[2] Proactive Conservation Program
Chugach Region Resources Commission	USGS[3] Alaska Science Center
Defenders of Wildlife-Alaska	Wildlife Conservation Society

[1] United States Forest Service
[2] United States Fish and Wildlife Service
[3] United States Geological Survey

The purpose of the interviews was to:

1. Understand partners' backgrounds and perceptions about working with ADF&G on SGCN-related projects.
2. Broadly determine the degree to which partners are familiar with the SWAP and how they use it.
3. Understand partner priorities and ways to improve the SWAP.
4. Assess preferred methods of engagement in the SWAP revision process and implementation.
5. Increase partner awareness of the opportunity to review and provide feedback during the public review period of the SWAP revision process.

Results Highlights

Backgrounds and perceptions about working with ADF&G on SGCN-related projects

Implementing the SWAP requires collaboration with a large diversity of partners. For example, ADF&G has engaged nearly 150 organizations in SGCN research and conservation projects in the past decade. Partners that contributed to implementing the 2025 SWAP included federal and state agencies, conservation and species working groups, technical committees, academic institutions, NGOs, Alaska Native entities, and environmental consultants. Of the partners that worked closely with the ADF&G's TED Program on SGCN-related projects, nearly all held the staff and program in high regard and valued the collaboration, science, tools, and information produced to benefit Alaska's SGCN.

Familiarity, value, and use of the Alaska SWAP

Interviewees who reported using the SWAP indicated it had value, particularly for grant preparation, justification of work on particular SGCN, prioritization of their organizations' efforts, or informing advocacy and educational activities. The interviews also highlighted the value of partnering with ADF&G staff on SWG-funded activities, given frequently overlapping concerns for SGCN taxa. An example of a common conservation or management action included addressing the decline of long-distance migratory birds throughout the annual cycle to ensure that breeding birds survive and return to Alaska.

Overall, interviewees exhibited modest familiarity with the SWAP, and the nature of SWAP use varied. In cases where ADF&G staff partnered directly with an agency, projects were directly related to SWAP implementation. Other organizations used the SWAP and its associated appendices to secure funds for SGCN projects. Few respondents offered specific examples of where the SWAP was used to identify broader priorities or direct activities. The SWAP's value primarily came from its baseline of credible information regarding the status of species or their habitats. For example, baseline information ensured that SGCN were considered in National Environmental Policy Act compliance documents and was also used to describe priority habitats across the state.

Some interviewees recognized the potential for the SWAP to facilitate collaboration and improve coordination of conservation and management efforts for specific species. Since many species on the SGCN list occur on multiple organizations' priority lists, there is significant potential for

future collaborative work on SWG-funded projects. However, as a standalone State of Alaska document, the SWAP had a limited effect on the monitoring or conservation actions of individual agencies, except when they were directly partnered with ADF&G.

Partner priorities

The scope and nature of partner interests are wide-ranging in geographic scale (local to international), taxonomic focus (individual species to species groups and communities), and scope (research, conservation and management, education and outreach, monitoring, advocacy, food security, cultural sustainability, human health, etc.). The remarkable breadth of organizational priorities identified across partner interviews presents both opportunity and challenge, offering the potential for extensive resources for SWAP implementation while making it difficult to gain consensus on the highest priorities based on those interests.

Interest in providing input or assisting in other ways with the implementation of the 2025 Alaska SWAP

In addition to their willingness to be interviewed as part of the SWAP revision process, all partners expressed at least some interest in assisting with the SWAP implementation in ways consistent with their individual missions. Many interviewees, however, did not see themselves as implementation partners and sought guidance from ADF&G on ways they could make a more meaningful contribution. These offers of assistance ranged from providing feedback during SWAP revision to disseminating information to their members regarding opportunities for collaboration on research, monitoring, or citizen science programs. By pursuing these offers strategically, ADF&G can increase its ability to implement the SWAP successfully.

Species of Conservation Need: Hudsonian Godwit *(Limosa haemastica)*

The Hudsonian Godwit is a large shorebird that migrates over 16,000 miles each year from subarctic meadows across North America to tidal mudflats in southern South America. Up to half of its population breeds in low densities at several disjunct areas across Alaska. Nesting habitat includes wet bogs, open meadows, and dwarf shrub tundra. The greatest threats to this species occur outside of Alaska during the nonbreeding season, including habitat loss due to development and disturbance from humans and dogs on beaches. Satellite tracking data from birds nesting in Cook Inlet have revealed southbound migratory stopover sites in Central Saskatchewan, the Amazon Basin in Colombia, and Buenos Aires Province in Argentina on the southbound migration. An ADF&G partner, the Western Hemisphere Shorebird Reserve Network, helps conserve many of these critical migratory stopover sites.

Hudsonian Godwit. A. Bankert, used with permission.

Suggestions for improving the usefulness of the SWAP

Interviewee suggestions for improving the usefulness of the SWAP fell into two categories, 1) improving development of the SWAP and 2) suggestions for improving implementation of the SWAP. The suggestions and additions for improving SWAP development have been incorporated into the 2025 revision (Table 11.2). Suggestions for improving implementation and plans for ADF&G response can be found in Part III.

Table 11.2. Key suggestions by interviewees for improving development of Alaska's 2025 State Wildlife Action Plan (SWAP) and how these suggestions were addressed in the current revision.

Suggestion	Action/response in 2025 revision
1) Incorporate partner priorities and improve alignment with existing plans, especially where it is possible to facilitate collaboration at statewide, interstate, and international scales.	We gathered input from interviews, statewide species working group sessions, and public review of the draft SWAP. Additionally, we reviewed existing conservation and management plans. Based on these efforts, various chapters of the 2025 SWAP include new text to identify and highlight common priorities. For example, Alaska Department of Fish and Game (ADF&G) led workshops to identify common priority objectives for "species of greatest conservation need" (SGCN) at working groups of species specialists (Alaska Shorebird Group, Boreal Partners in Flight, Alaska Small Mammal Group), and these objectives were included in the revised SWAP (e.g., Chapter 8, Chapter 9).
2) Clarify why a species is listed as an SGCN and has a particular priority designation.	For SGCN designation, we adopted the Alaska Species Ranking System (ASRS), a quantitative metric for prioritizing species via a standardized procedure with transparent, objective, and repeatable ranking criteria (Chapter 4). The species scores and ranking information are available on the Alaska Center for Conservation Science website.[1]
3) Use and share existing data on SGCN. Update SGCN data as needed, including threats and actions; be as geographically specific as possible.	Existing data on SGCN were updated (Appendices A–C), as well as all appendices with species and habitat information by biogeographic region (Appendices D–H). Potential threats and actions have been identified through input by technical specialists and partners.
4) Update threats and actions, including a more in-depth treatment of climate change, in the SWAP.	Partners identified new issues that have emerged or intensified since 2015 (e.g., microplastics in the marine environment). Threats (Chapter 7) and conservation actions (Chapter 8) have been updated accordingly, including a detailed discussion of climate change impacts.
5) Improve awareness and accessibility of the SWAP.	Outreach efforts were increased compared to 2015 by interviewing 39 organizations as part of the SWAP revision. ADF&G also developed a SWAP draft communication strategy to raise partner awareness of and access to the SWAP. The strategy includes guidelines for identifying new partners and advising partners about how they can contribute to high-priority projects (see also Part III of this chapter).
6) Gather and integrate Alaska Native knowledge.	ADF&G worked with multiple Alaska Native organizations and some Canada-based First Nations partners while implementing the 2015 SWAP through research, monitoring, and outreach efforts. ADF&G's Division of Subsistence continues to lead conservation and management efforts for SGCN shorebirds with Alaska Native communities. Working with these communities is also the focus of ongoing projects related to marine mammal and waterfowl SGCN.

[1] https://accs.uaa.alaska.edu/wildlife/alaska-species-ranking-system/

Public Review Process and Integration of Public Comment into the SWAP

The best practice guide for SWAP development (AFWA 2022) recommends collaborative partner and public engagement that fosters an understanding of how input is used and valued. Consistent with this recommendation, ADF&G invited 133 organizations, agencies, and industry groups to review the draft plan and also solicited public comments over a 30-day period. Opportunities for feedback were advertised via social media posts, a news release, press interviews, and by making the draft available on ADF&G's website.

Comments were received from 64 organizations (e.g., agencies, NGOs) and individuals. The majority of commenters (58) submitted input via an online survey form, and six were submitted via email. Note that the comments received were of various kinds and levels of detail.

ADF&G greatly appreciates and considered all comments, inputting them to the extent possible. The summary below provides an overview of key changes. We also indicate comments that can inform future revisions of the SWAP, and those that we could not address, because they were beyond the scope of the SWAP. Finally, we thank respondents for numerous, smaller edits or corrections that greatly improved this document.

Overall response

Most commenters appreciated the process ADF&G used for developing the Alaska SWAP, as well as its format, layout, and content. They characterized the plan and its development as transparent, readable, engaging, informative, well-organized, actionable, vastly improved, and easy to understand. The positive impressions of the plan overall provide a foundation for a more informed SWAP implementation process in which public and partner involvement can continue to be refined over time.

Many respondents also expressed appreciation for ADF&G's efforts to seek and incorporate public input, for example:

> "*ADF&G is open to hearing comments and concerns from residents of the state*."
>
> "*[An] opportunity to voice our concerns and shape guidelines*"
>
> "*Thank you for the opportunity to review this draft update! Great work!*"

Recommended improvements

Below, we provide a summary of how we addressed more than 210 comments, many of which were integrated into and improved the SWAP. We received some comment on introductory materials (Chapters 1–3), but the majority of input focused on Chapters 4–11.

Introductory material (Chapters 1–3): Commenters expressed a need for text to be more inclusive of the range of consumptive users of state wildlife resources and the important connection Alaskans have to natural resources. ADF&G acknowledged the broad array of fish and wildlife user groups (e.g., consumptive, recreation, commercial, subsistence, Alaska Native users), wherever appropriate, throughout the text. We also acknowledge the value of several responses, that are likely amenable for future SWAP revisions. For example, giving the SWAP document more of a regional focus.

SGCN (Chapter 4): Most respondents were satisfied with the treatment of SGCN. Suggestions primarily related to the need for more details on which species qualified for SGCN status. We provided clarification that all species (fish, game, and nongame) listed under the Endangered Species Act (ESA) qualify as SGCN. Species may be removed from SGCN status when their ESA-listing status changes (e.g., Alexander Archipelago wolf). To address funding questions, we described how SWG funds for SGCN compared to the overall ADF&G budget for managing fish and wildlife.

Several comments asked for new species to be included or removed from the SGCN list. Respondents also emphasized both the intrinsic and cultural values of wildlife. Edits emphasize that the 2025 SWAP adopted the Alaska Species Ranking System (ASRS), which is a quantitative way of ranking conservation needs of all vertebrate species in Alaska based on population trend and vulnerability. The system also identifies species with key data deficiencies. We highlighted that a future goal of the SWAP is to also rank fish as part of the ASRS, as some commenters noted differences between SGCN considerations for aquatic vs. terrestrial species.

Species distributions and abundance (Chapter 5): A majority of respondents were satisfied with the treatment of species distribution, and many liked the new state-wide heatmap of SGCN richness. As requested, we added more detail and provided web links to allow access to the data associated with the heatmap. We also clarified text, directing readers to Appendix E, where they can find all available population estimates of SGCN abundance. Finally, to better describe sites important to multiple SGCN, we added some locations important to sea ducks, other waterfowl, and shorebirds that respondents recommended. Many respondents agreed that species vignettes throughout the SWAP connected multiple important elements (SGCN, habitats, threats, and actions) for the reader.

Key habitats of SGCN (Chapter 6): Most commenters were satisfied with the new treatment of habitats. Some felt the SWAP contained too many fine-scale habitat designations, while others questioned why the plan emphasizes "key habitats" rather than "all habitats." We clarified further that habitat categories are based on the U.S. National Vegetation Classification (USNVC), which allows Alaska to align habitat types and terminology with other conservation documents, including other states' SWAPs. We also describe why the USNVC macro group level of habitat descriptions is appropriate. Some respondents pointed out that Indigenous knowledge is a source of insight into fish and wildlife conservation and habitats, pertinent to the SWAP and its implementation. We agree and aspire to include Indigenous knowledge in the 2035 SWAP revision. We recognize that incorporating Indigenous knowledge is an effort that must be grounded in trust and collaboration with Indigenous knowledge holders, which is not something that can be completed before our 2025 deadline. Comments also indicated that recognition of the interdependent relationships in the ecosystem can help readers understand the SWAP as a holistic, systems-aware scientific document. We find this observation very useful and intend to explore it more with interested partners in the SWAP implementation phase.

Threats (Chapter 7): Some respondents were satisfied with the treatment of threats, but many were not. A recurring theme in a majority of comments called on ADF&G to address the topic of bycatch and trawling. In response, ADF&G added an entirely new section to Chapter 7 on this multi-faceted issue. Some commenters also expressed that resident consumptive use should be prioritized over commercial use of Alaska's fisheries. ADF&G manages fish and wildlife according to the sustained yield mandate of the Alaska Constitution (Art. VIII, § 4), which provides for the beneficial use of fisheries and other natural resources by all Alaskans. While we acknowledge the importance of

Engaging Indigenous partners and knowledge to inform Alaska's SGCN research

Limited data on harvest and population parameters impede assessments of shorebird harvest sustainability. Because of sharp declines in shorebird populations (many included in Alaska's SGCN list; Chapter 4), timely conservation efforts require approaches that account for uncertainty in harvest sustainability. ADF&G has partnered with Alaska Native communities and other entities to quantify subsistence harvests in Alaska, better understand related management and conservation concerns, and support culturally sensible conservation actions. For example, in 2017–2019, ADF&G led interdisciplinary, collaborative research to estimate Alaska-wide shorebird subsistence harvest, document Yup'ik Indigenous knowledge on the Yukon-Kuskokwim Delta, and better understand the importance of shorebirds for the local communities (Naves et al. 2019). Harvest estimates were based on surveys conducted in 1990–2015 (n = 775 community years). Key respondent interviews (n = 72) documented shorebird ethnotaxonomy and ethnography. The estimated average Alaska-wide shorebird harvest was 2,783 birds per year, including 1,115 godwits per year. The geographic and seasonal distribution of the harvest suggested that harvested godwits are mostly Bar-tailed Godwits *(Limosa lapponica baueri)*, whose population has low harvest potential. The shorebird egg harvest was 4,678 eggs per year, mostly reported as small shorebird eggs. Documented Yup'ik ethnotaxonomy included at least 24 shorebird names and 10 ethnotaxonomic categories. Children learning harvesting skills focused on small birds. Adults also occasionally harvested shorebirds, but shorebirds were not a prominent food source. Older generations associated shorebirds with a time when people were closer to nature and Yup'ik tradition. Shorebirds connected people to their environment in addition to Yup'ik culture and language. The results of this research have informed improvements to harvest assessment and management, including outreach and communication efforts to engage subsistence users in shorebird conservation.

Sharing a meal of wild foods with the James family at the Alaska community of Platinum after an Indigenous knowledge interview. L. Naves, ADF&G Division of Subsistence, 2017.

resident consumptive use for many Alaskans, determining allocation among user groups is outside the scope and purpose of the SWAP and is the responsibility of the Board of Fish and Board of Game. Similarly, comments relating to improvement of regulations and enforcement, although important, were also outside the scope of the SWAP.

Some commenters thought the draft SWAP expressed sufficient urgency for threats and need for action, while others felt more research was required to understand impacts on fish and wildlife. ADF&G recognizes both sides of this issue. In addition to inserting greater detail and references for the threats described above, we added language in Chapter 11 on the importance of enhancing our partnership network to help us collaboratively apply conservation resources where we can have the greatest impact on Alaska's SGCN. Additionally, we added, reviewed, and revised text as needed in Chapter 7 to clarify other anthropogenic threats, such as the potential for vessels and lighted infrastructure (including gas flaring from oil and gas development) to attract migrating birds and cause collisions and the potential for recreational vehicles to impact habitat at local scales. In response to other comments about oil and gas exploration and extraction, in Chapters 7 and 11, we emphasized an opportunity to partner with industry in the next 10 years for potential research, monitoring and/or mitigation activities related to SGCN. Finally, we assessed the treatment of urbanization on wildlife populations, but found that this topic was already discussed in Chapter 7. We agree that future efforts to improve information in this chapter could investigate methods to assess scale and severity of threats.

Many respondents liked the new information on climate change in Chapter 7 and throughout the SWAP. However, others believed that rapidly changing environmental conditions required longer planning horizons or climate models, which could help align the SWAP with regional and national climate adaptation efforts. The SWAP is intended to be a plan for fish and wildlife conservation and management over the next decade and therefore longer-term planning efforts, although important, are outside the plan's scope.

Conservation Actions (Chapter 8): A majority of commenters suggested that ADF&G add more specifics about conservation actions, such as projects to facilitate collaboration for implementation of the SWAP, or note where additional capacity is needed, or provide lists of in-state and out-of-state partnerships or coordination opportunities. While ADF&G recognizes the value of collaboration and the need for connecting actors in conservation, such lists can quickly become outdated. Instead, we have included new text in the implementation section of Chapter 11, directing readers to a set of ADF&G contacts, who can direct and assist interested parties in engaging more with SGCN and SWAP-related activities. Potential and sustaining partners are encouraged to reach out to these ADF&G staff to facilitate making connections.

Monitoring and Evaluation (Chapter 9): A majority of respondents were satisfied with the monitoring and evaluation processes described in the SWAP. Commenters expressed interest in engaging more in citizen-science activities related to monitoring and evaluation. We have added a goal to strive for greater public involvement, education and outreach as part of SWAP implementation. Other suggestions called for a mechanism whereby local or nonprofit monitoring data can be submitted and considered in ongoing ADF&G-led tracking efforts. Though the suggestion has merit, ADF&G currently lacks capacity for additional data curation tasks.

Some expressed interest in developing a list of top-priority data gaps by region, taxon, etc., so that tribes, NGOs, and universities can address them. Plan readers are reminded of the "Alaska Priorities"

chapter (Chapter 10 and Table 10.1), which provides top species examples. We would like to acknowledge the value of comments encouraging new metrics, frameworks, or processes that can lead to summative evaluations of both project and overall SWAP accomplishments. In the near term, ADF&G will investigate how other states handle evaluation topics in their SWAPs and plan to update our evaluation process in future SWAP revisions.

Alaska Priorities (Chapter 10): Some respondents wanted a better understanding of ADF&G's priorities in specific terms, such as projects planned for the next 10 years. Others thought the priorities were clear and liked Table 10.1, which illustrates example SGCN of high concern. Since every SWG-funded project develops its own set of species- or conservation-specific objectives, a comprehensive articulation is not practical for inclusion in the SWAP. We revised text to explain that developing specific work plans is a two-stage process, requiring different information at the strategic (action plan) stage and the operational (project proposal) stage.

Plan Development, Implementation and Review (Chapter 11): A majority indicated satisfaction with how the SWAP was developed and the plans we described for implementation. However, commenters wanted to see specific examples and more detail related to implementation focus areas. Many existing or aspiring partners were ready to work more with ADF&G on SWAP implementation by sharing specialized knowledge and skillsets, disseminating information, and/or engaging their members, customers, or visitors.

To better facilitate collaboration and tap into public and partner interest, we have enhanced the implementation section with more detail, adding and emphasizing the importance of improving our efforts to increase public and partner awareness and participation. We have also added new text about how organizations and the public can contact ADF&G staff to facilitate engagement in SWAP activities.

Part III: SWAP Implementation

Advancing the SWAP's impact will require focusing on implementation actions and establishing clearly defined criteria for evaluating proposed work eligible for SWG funding. This part provides an overview of both implementation components for the 10 years until the 2035 SWAP revision.

Interviewees from partner organizations and comments from the 30-day public review provided numerous suggestions for improving SWAP implementation. Most suggestions fell into one of three themes, including expanding the list of partners involved in SWAP implementation; exploring how partners can contribute to implementation; and making a greater effort to increase general public awareness of Alaska's SWAP, while identifying ways people can get involved. Coordination with partners and Tribes is essential to ensure alignment across jurisdictions, fulfill shared responsibilities, and maximize the impact of conservation efforts.

The first suggestion was that ADF&G strategically expand its list of SWAP implementation partners, specifically those key to effective implementation. To address this suggestion, we identified three potential areas for future partner expansion:

1. **Alaska Native knowledge holders.** As landowners and Indigenous knowledge holders for the entire state, Alaska Native Tribes and organizations are key to conservation and management of Alaska's SGCN. Although there has been some engagement with Alaska Native groups in implementing previous Alaska SWAPs, it is an area that needs increased attention for the 2025 plan. Enhancement and expansion of partnerships

with Alaska Native knowledge holders through direct engagement with tribes, Alaska Native consortia, or nonprofit organizations (e.g., Northern Latitudes Partnership) that work effectively with Alaska Native people is a high priority to help ensure successful implementation of the 2025 SWAP. Exploring ways to work with these entities and others to develop pathways for use of Indigenous knowledge to help inform species assessments and conservation strategies is a priority for SWAP implementation and will be important moving forward.

2. **Non-Alaskan partners, including other states or cross-border partnerships.** Migratory wildlife that return annually to breed in Alaska often encounter environmental stressors elsewhere that can negatively impact them and even cause high mortality during the nonbreeding period. Migratory bird conservation emphasizes the need to engage in long-distance partnerships to address conservation and management actions throughout a species' annual life cycle (Hagelin et al. 2021; McDuffie et al. 2022a, b). ADF&G intends to expand its engagement with interested partners across boundaries to identify research/monitoring needs and conservation actions where collaboration is essential to ensure desired outcomes for Alaska's SGCN.
3. **Industry.** Many sectors have interest, means, and incentives to participate in implementing Alaska's SWAP. For example, the tourism industry in Alaska markets wildlife viewing, photography, fishing, and hunting as activities for Alaskans and visitors alike. Many industry partners also conduct environmental monitoring and have wildlife experts on staff. Industry partners work hard to minimize impacts on wildlife and often provide valuable insights on improving mitigation measures and wildlife monitoring (e.g., in oil and gas development areas), making collaborations with industry a good fit for SWAP implementation.

The second suggestion was for ADF&G to more actively and broadly involve interested partners in implementation. We invite interested organizations and individuals to reach out to the following ADF&G staff, who can explore potential opportunities for collaboration on SGCN and SWAP-related projects:

- Conservation & Management Coordinator of the TED Program (https://www.adfg.alaska.gov/index.cfm?adfg=wildlifediversity.staff)
- Coordinator of the Invasive Species Program (https://www.adfg.alaska.gov/index.cfm?adfg=invasive.report)

Other opportunities to collaboratively involve interested partners came from interviews and comments during the public review period. For example, the new landscape-scale perspective in the 2025 SWAP may also help identify geographic areas ideal for new partnerships. ADF&G could also explore workshops with entities that have developed their own plans (e.g., tribes, Joint Ventures) to identify and consider local, regional and larger-scale priorities. In addition, there may be opportunities to engage partners in assisting with species-level research, such as monitoring, in an effort to understand changing habitats, populations, revise ASRS assessments of SGCN, or to develop more comprehensive statewide species or landcover maps for wildlife research. ADF&G plans to explore ways to keep the SWAP updated and to keep partners engaged and informed between decadal revisions. This can be done by continuing work with partners to make SWAP-related tools and information more accessible, spatially explicit, and interactive. ADF&G aims to share progress

on conservation activities, SGCN status changes, and will encourage partners to incorporate this information in their relevant planning documents.

The third suggestion for SWAP implementation involved greater emphasis on increasing the public's awareness and engagement. There is a particular opportunity to collaborate with partners that can connect their members, visitors and clients to implementation. For example, it may be beneficial to work with partners that have high public interaction (e.g., Alaska Sea Life Center, state and national refuges and parks, Alaska Wildlife Conservation Center, tourism industry) to increase public exposure to the SWAP and participation in Alaska species conservation (e.g., citizen science, such as helping to ground truth heatmaps). Further, it will be beneficial for ADF&G to continue enhancing the momentum built during the revision process (e.g., increased social media content related to the SWAP) to increase awareness, interest and support for Alaska's SGCN conservation among Alaskans and visitors alike.

Funding Decisions

One challenge for SWAP implementation is identifying how to best apply limited funding to many potential project ideas, given conservation needs and the broad interests of partners and the public. When there is an opportunity to initiate a new project, ADF&G considers several factors before deciding what species and objectives SWG will fund:

- **Conservation need.** Is the species ranked highly on the ASRS, or is it likely to become threatened, endangered, or extinct in the near future?
- **Stewardship responsibility.** Does the species have a high proportion of its population in Alaska relative to its range?
- **Cultural, economic, commercial, and ecological importance.** Is it important to conserve the species for multiple reasons?
- **Efficiency and feasibility.** Is the specific research or monitoring project likely to succeed (i.e., is the project technically feasible, and would the results be useful for conservation)?
- **Program capacity.** Does ADF&G have the expertise and capacity to successfully address a given species, habitat, threat, or action? If not, is creating new capacity the best alternative, or should the work be directed to a partner with existing capacity and expertise?
- **Opportunity for synergy.** Does a project leverage available synergies by partnering with other agencies and organizations, or is it redundant to the work those agencies are already doing well?
- **Funding availability.** Can a project be completed successfully with the current funds available? Are there opportunities for attracting matching funds, personnel, or other resources that might elevate one proposal over another?

Eligible Activities

As ADF&G implements the 2025 SWAP, it is important to describe the types of activities eligible for SWG funding (Table 11.3; USFWS 2024).

Continued coordination among existing and new partners to implement the SWAP is essential. Through outreach to agencies, organizations, and others during the revision process, ADF&G gained a greater understanding of the diversity of interest, capacity, and opportunities that exist to assist

Table 11.3. Key implementation activities described in Alaska's State Wildlife Action Plan eligible for State Wildlife Grants funding.

Type of funding eligible activity	Specific activities and limitations
1) Conservation and management actions, such as:	a) Research. b) Surveys. We may approve surveys and monitoring to obtain data for ADF&G to decide if it should designate a species as an SGCN. c) Species monitoring. d) Species and habitat management. If an SGCN depends on a plant species for its survival, we consider the plant species as part of its habitat. e) Habitat evaluations. f) Evaluations of the effectiveness of conservation and management actions. g) Acquisition of real property, including monitoring acquired properties to ensure that they continue to serve the purpose for which they were acquired. h) Facilities development.
2) Coordination and administrative activities, such as:	a) Developing and maintaining data management systems to record, store, or disseminate information. b) Monitoring progress of projects. c) Developing strategic and operational plans. d) Coordinating implementation meetings with partners. Partners are entities that take part in planning or carrying out a State Plan. These entities include but are not limited to: federal, state, and local agencies; tribes; nonprofit organizations; academic institutions; industry groups; and private individuals.
3) Education and law enforcement activities, when the activities:	a) Are critical to achieving the project's objectives. b) Are no more than 10 percent of the respective project costs, and c) Specifically benefit SGCN or their habitats.

Source: USFWS (2024).

in collaborative implementation of the SWAP. Consequently, ADF&G incorporated input from the public and partners into its implementation plans and looks forward to increased collaboration to advance conservation and management of Alaska's SGCN.

Part IV: Future Revision of Alaska's State Wildlife Action Plan

The sixth element required for Alaska's SWAP is a description of procedures for reviewing and revising the plan at intervals not to exceed 10 years (e.g., by 2035). ADF&G will monitor the implementation and effectiveness of the current plan annually. Specific guidance for future revisions to the plan is provided in a 2017 joint memorandum from the U.S. Fish and Wildlife Service (USFWS) and the Association of Fish and Wildlife Agencies (AFWA 2022, USFWS and AFWA 2017). The guidelines

outline the revision process and provide clear procedural steps for comprehensive, major, and minor revisions. These guidelines intend to offer states flexibility to update their plans based on new insights and shifting circumstances. With this framework in mind, we aim to make updates or revisions as needed. If new information suggests a major revision is warranted before 2035, ADF&G will undertake that effort. Barring that circumstance, we expect to revise the plan on the normal 10-year schedule, which would put the next comprehensive revision of this action plan due in October 2035.

The core of any SWAP revision is an updated assessment of the conservation and management status of native species and their key habitats. The process helps evaluate the relative risks facing wildlife and ecosystems and identify potential actions. Therefore, we plan to continue updating the ASRS to provide guidance on the at-risk status of SGCN and keep up-to-date taxonomy, scientific names, and English names. If new SGCN are designated or issues are raised that are not in the current plan, we will amend through the "process to address emerging issues" (Table 11.4; USFWS 2024).

We anticipate that spatial information will continue to improve over the next decade; thus, we will strive to integrate landscape-level information into the 2035 SWAP revision. Also, AFWA recently provided voluntary guidance on integrating climate information and actions into SWAPs (AFWA 2022). We updated climate topics throughout the 2025 SWAP and will do so again in the future to ensure we include the best available information on climate and environmental change.

As outlined in Part III, ADF&G will continue to engage partners in implementing the SWAP and expand and create new partnerships. Enhancing existing partnerships and engaging new ones is possible due to the new information we gathered while interviewing many organizations during this SWAP revision. ADF&G will also strive to ensure more consistent communication with the public and partners to increase awareness and use of the SWAP to achieve mutually beneficial outcomes for Alaska's SGCN. Before undertaking the next revision, ADF&G will meet with partners to determine a process that will produce the most useful plan in the most efficient manner possible.

Table 11.4. U.S. Fish and Wildlife Service (USFWS) requirements for documenting emerging issues.

The following requirements for documenting emerging issues must be met if applicant(s) propose to address an emerging issue, per Federal guidance (517 FW 10.15; USFWS 2024).[1]
Requirements: a) Describe the emerging issue fully by identifying the SGCN or habitats that would benefit from the proposed action(s); b) Explain why it is an emerging issue; and c) Commit the State of Alaska to monitoring the effectiveness of the completed action(s) so the state can adaptively manage future activities.

[1] The application must include a commitment letter that the director of the state fish and wildlife agency has signed, stating that the next version of the SWAP will include the emerging issue if it remains a priority. The assistant regional director for Migratory Birds and State Programs, or a USFWS official in a similar position associated with the Office of Conservation Investment (OCI), must review the grant application or any future amendments that include emerging issues not in the SWAP before the application is sent to the national review panel for scoring. The assistant regional director of the Service must concur that the issue is an emerging one, or the application will not be considered for funding. OCI must retain the original paper copy or an electronic copy of the concurrence or nonconcurrence document.

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American Three-toed Woodpecker. ABR, used with permission.

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Appendix A. "Species of greatest conservation need" (SGCN) in Alaska by justification—terrestrial vertebrates and marine mammals. Please refer to Appendix B when subspecies, stock or Distinct Population Segment (DPS) qualifies as SGCN. Chapter 4 describes SGCN justification in detail.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Amphibians and Reptiles									
Rana luteiventris, Columbia Spotted Frog			•						
Ambystoma macrodactylum, Long-toed Salamander			•						
Ambystoma gracile, Northwestern Salamander			•						
Anaxyrus boreas, Western Toad			•						•
Lithobates sylvaticus, Wood Frog			•						
Waterfowl									
Anser canagicus, Emperor Goose						•		•	•
Anser albifrons, Greater White-fronted Goose	•								
Branta bernicla, Brant	•		•						
Branta hutchinsii, Cackling Goose	•								
Branta canadensis, Canada Goose	•								
Cygnus buccinator, Trumpeter Swan								•	
Anas acuta, Northern Pintail						•			
Aythya affinis, Lesser Scaup									•
Aythya valisineria, Canvasback								•	
Polysticta stelleri, Steller's Eider		TH	•			•		•	•
Somateria fischeri, Spectacled Eider		TH	•			•		•	•
Somateria spectabilis, King Eider						•			•
Somateria mollissima, Common Eider	•								•
Melanitta perspicillata, Surf Scoter			•						•
Melanitta fusca, White-winged Scoter									•
Melanitta americana, Black Scoter						•		•	•
Clangula hyemalis, Long-tailed Duck						•			•
Histrionicus histrionicus, Harlequin Duck								•	
Grouse and Ptarmigan									
Canachites canadensis, Spruce Grouse	•		•		•				
Lagopus lagopus, Willow Ptarmigan			•		•			•	
Lagopus muta, Rock Ptarmigan	•				•				
Dendragapus fuliginosus, Sooty Grouse					•			•	
Loons and Grebes									
Podiceps auritus, Horned Grebe			•			•			
Podiceps grisegena, Red-necked Grebe			•						
Aechmophorus occidentalis, Western Grebe			•				•		
Gavia arctica, Arctic Loon			•						
Gavia stellata, Red-throated Loon			•						
Gavia adamsii, Yellow-billed Loon			•			•	•		

Appendix A. Continued.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Swifts and Hummingbirds									
Cypseloides niger, Black Swift			•		•		•		
Chaetura vauxi, Vaux's Swift			•			•	•		
Selasphorus rufus, Rufous Hummingbird			•		•	•	•		
Cranes									
Antigone canadensis, Sandhill Crane								•	•
Shorebirds									
Haematopus bachmani, Black Oystercatcher			•	•			•	•	
Pluvialis squatarola, Black-bellied Plover			•	•		•		•	
Pluvialis dominica, American Golden-Plover			•	•		•	•	•	
Pluvialis fulva, Pacific Golden-Plover			•	•				•	
Charadrius vociferus, Killdeer			•	•					
Bartramia longicauda, Upland Sandpiper			•	•					
Numenius tahitiensis, Bristle-thighed Curlew			•	•		•	•	•	
Numenius phaeopus, Whimbrel	•					•			
Limosa lapponica, Bar-tailed Godwit	•		•			•	•		
Limosa haemastica, Hudsonian Godwit				•		•	•	•	
Limosa fedoa, Marbled Godwit	•					•	•		
Arenaria interpres, Ruddy Turnstone			•	•		•		•	
Arenaria melanocephala, Black Turnstone				•		•	•	•	
Calidris canutus, Red Knot	•					•			
Calidris virgata, Surfbird			•	•		•		•	
Calidris acuminata, Sharp-tailed Sandpiper				•				•	
Calidris himantopus, Stilt Sandpiper			•	•		•			
Calidris ruficollis, Red-necked Stint			•						
Calidris alba, Sanderling			•	•		•			
Calidris alpina, Dunlin	•		•			•			
Calidris ptilocnemis, Rock Sandpiper	•								
Calidris minutilla, Least Sandpiper			•	•					
Calidris subruficollis, Buff-breasted Sandpiper			•	•		•	•		
Calidris melanotos, Pectoral Sandpiper			•	•		•	•	•	
Calidris pusilla, Semipalmated Sandpiper				•		•		•	
Calidris mauri, Western Sandpiper			•	•		•		•	
Limnodromus griseus, Short-billed Dowitcher	•					•	•		
Limnodromus scolopaceus, Long-billed Dowitcher			•	•		•		•	
Gallinago delicata, Wilson's Snipe			•	•					
Actitis macularius, Spotted Sandpiper				•		•			
Tringa solitaria, Solitary Sandpiper	•								
Tringa brevipes, Gray-tailed Tattler			•						

Appendix A. Continued.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Tringa incana, Wandering Tattler			•	•		•	•	•	
Tringa flavipes, Lesser Yellowlegs			•	•		•	•		
Tringa melanoleuca, Greater Yellowlegs			•	•		•			
Tringa glareola, Wood Sandpiper			•						
Phalaropus lobatus, Red-necked Phalarope			•	•				•	
Phalaropus fulicarius, Red Phalarope			•	•					
Gulls, Terns, and Jaegers									
Stercorarius pomarinus, Pomarine Jaeger			•					•	
Stercorarius parasiticus, Parasitic Jaeger			•						
Stercorarius longicaudus, Long-tailed Jaeger			•					•	
Rissa tridactyla, Black-legged Kittiwake			•			•		•	
Rissa brevirostris, Red-legged Kittiwake						•	•	•	
Pagophila eburnea, Ivory Gull			•			•	•		
Xema sabini, Sabine's Gull								•	
Rhodostethia rosea, Ross's Gull			•			•	•		
Larus brachyrhynchus, Short-billed Gull			•			•			•
Larus argentatus, Herring Gull			•			•			
Larus glaucescens, Glaucous-winged Gull			•					•	
Larus hyperboreus, Glaucous Gull						•		•	
Onychoprion aleuticus, Aleutian Tern			•				•	•	
Seabirds									
Uria aalge, Common Murre									•
Uria lomvia, Thick-billed Murre									•
Cepphus grylle, Black Guillemot			•						
Cepphus columba, Pigeon Guillemot			•					•	
Brachyramphus marmoratus, Marbled Murrelet						•	•	•	
Brachyramphus brevirostris, Kittlitz's Murrelet						•	•	•	
Ptychoramphus aleuticus, Cassin's Auklet						•	•		
Aethia psittacula, Parakeet Auklet			•					•	
Aethia pusilla, Least Auklet			•					•	
Aethia pygmaea, Whiskered Auklet						•	•	•	
Aethia cristatella, Crested Auklet			•					•	
Fratercula corniculata, Horned Puffin			•					•	
Fratercula cirrhata, Tufted Puffin			•				•	•	
Phoebastria immutabilis, Laysan Albatross						•	•		
Phoebastria nigripes, Black-footed Albatross						•	•		
Phoebastria albatrus, Short-tailed Albatross		EN	•						
Hydrobates furcatus, Fork-tailed Storm-Petrel	•								
Hydrobates leucorhous, Leach's Storm-Petrel	•								

Appendix A. Continued.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Fulmarus glacialis, Northern Fulmar			•					•	
Pterodroma inexpectata, Mottled Petrel			•			•	•		
Ardenna bulleri, Buller's Shearwater			•			•	•		
Puffinus tenuirostris, Short-tailed Shearwater			•						
Puffinus griseus, Sooty Shearwater			•						
Puffinus creatopus, Pink-footed Shearwater			•				•		
Cormorants									
Urile urile, Red-faced Cormorant			•			•	•	•	
Urile pelagicus, Pelagic Cormorant			•			•			
Hawks and Eagles									
Aquila chrysaetos, Golden Eagle			•		•				
Astur atricapillus, American Goshawk	•				•			•	
Haliaeetus leucocephalus, Bald Eagle					•			•	•
Buteo jamaicensis, Red-tailed Hawk	•		•		•				
Buteo lagopus, Rough-legged Hawk			•						
Falco sparverius, American Kestrel			•		•				
Falco columbarius, Merlin	•								
Falco rusticolus, Gyrfalcon			•		•				
Falco peregrinus, Peregrine Falcon	•				•				
Owls									
Megascops kennicottii, Western Screech-Owl			•				•		
Bubo scandiacus, Snowy Owl			•		•		•		•
Surnia ulula, Northern Hawk Owl			•		•			•	
Strix nebulosa, Great Gray Owl			•						
Asio flammeus, Short-eared Owl			•		•	•	•		
Aegolius funereus, Boreal Owl			•						
Aegolius acadicus, Northern Saw-whet Owl			•						
Woodpeckers									
Sphyrapicus ruber, Red-breasted Sapsucker					•			•	
Picoides dorsalis, American Three-toed Woodpecker			•						
Picoides arcticus, Black-backed Woodpecker			•						
Dryobates villosus, Hairy Woodpecker	•				•				
Flycatchers									
Contopus cooperi, Olive-sided Flycatcher			•		•	•	•		
Contopus sordidulus, Western Wood-Pewee			•		•				
Empidonax alnorum, Alder Flycatcher			•						
Shrikes and Corvids									
Lanius borealis, Northern Shrike			•						
Perisoreus canadensis, Canada Jay			•						

Appendix A. Continued.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Corvus corax, Common Raven	•				•				
Chickadees, Larks, Swallows, and Leaf Warblers									
Poecile rufescens, Chestnut-backed Chickadee					•		•	•	
Poecile hudsonicus, Boreal Chickadee								•	
Poecile cinctus, Gray-headed Chickadee	•		•		•				
Eremophila alpestris, Horned Lark			•		•	•			
Riparia riparia, Bank Swallow			•		•	•			
Tachycineta bicolor, Tree Swallow			•						
Tachycineta thalassina, Violet-green Swallow			•						
Hirundo rustica, Barn Swallow			•						
Phylloscopus borealis, Arctic Warbler			•		•			•	
Kinglets, Creepers, and Wrens									
Corthylio calendula, Ruby-crowned Kinglet	•								
Regulus satrapa, Golden-crowned Kinglet			•			•			
Certhia americana, Brown Creeper	•		•						
Troglodytes pacificus, Pacific Wren	•		•		•			•	
Waxwings and Thrushes									
Bombycilla garrulus, Bohemian Waxwing			•		•	•			
Bombycilla cedrorum, Cedar Waxwing			•						
Catharus minimus, Gray-cheeked Thrush			•		•			•	
Catharus guttatus, Hermit Thrush	•								
Ixoreus naevius, Varied Thrush					•		•	•	
Luscinia svecica, Bluethroat			•					•	
Oenanthe oenanthe, Northern Wheatear			•		•			•	
Pipits, Finches, Longspurs, and Buntings									
Anthus cervinus, Red-throated Pipit			•					•	
Anthus rubescens, American Pipit			•			•			
Fringilla montifringilla, Brambling			•						
Pinicola enucleator, Pine Grosbeak						•			
Leucosticte tephrocotis, Gray-crowned Rosy-Finch	•		•		•	•		•	
Acanthis flammea, Redpoll			•		•	•		•	
Spinus pinus, Pine Siskin					•	•			
Calcarius lapponicus, Lapland Longspur	•		•		•	•			
Calcarius pictus, Smith's Longspur			•		•				
Plectrophenax nivalis, Snow Bunting	•		•		•	•			
Plectrophenax hyperboreus, Mckay's Bunting			•		•	•	•	•	
Sparrows, Blackbirds, and New World Warblers									
Passerella iliaca, Fox Sparrow	•				•			•	
Spizelloides arborea, American Tree Sparrow			•		•	•		•	

Appendix A. Continued.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Junco hyemalis, Dark-eyed Junco					•			•	
Zonotrichia leucophrys, White-crowned Sparrow			•		•			•	
Zonotrichia atricapilla, Golden-crowned Sparrow			•		•			•	
Passerculus sandwichensis, Savannah Sparrow			•			•			
Melospiza melodia, Song Sparrow	•				•				
Melospiza lincolnii, Lincoln's Sparrow	•				•				
Agelaius phoeniceus, Red-winged Blackbird			•						
Euphagus carolinus, Rusty Blackbird					•	•			
Leiothlypis celata, Orange-crowned Warbler			•		•			•	
Geothlypis tolmiei, MacGillivray's Warbler			•						
Setophaga ruticilla, American Redstart			•						
Setophaga striata, Blackpoll Warbler			•		•	•			
Setophaga coronata, Yellow-rumped Warbler			•						
Setophaga townsendi, Townsend's Warbler					•			•	
Cardellina pusilla, Wilson's Warbler			•		•			•	
Mice and Lemmings									
Zapus hudsonius, Meadow Jumping Mouse			•						
Dicrostonyx groenlandicus, Nearctic Collared Lemming			•						
Lemmus trimucronatus, Nearctic Brown Lemming	•		•						
Synaptomys borealis, Northern Bog Lemming		U	•						
Voles and Deermice									
Microtus abbreviatus, Insular Vole								•	
Microtus longicaudus, Long-tailed Vole	•		•						
Microtus miurus, Singing Vole			•					•	
Microtus oeconomus, Root or Tundra Vole	•		•					•	
Microtus pennsylvanicus, Meadow Vole	•		•						
Microtus xanthognathus, Taiga or Yellow-cheeked Vole			•					•	
Clethrionomys gapperi, Southern Red-backed Vole	•		•						
Peromyscus keeni, Northwestern Deermouse			•					•	
Muskrats and Woodrats									
Ondatra zibethicus, Common Muskrat			•						
Neotoma cinerea, Bushy-tailed Woodrat			•						
Squirrels and Marmots									
Glaucomys sabrinus, Northern Flying Squirrel	•		•						
Marmota broweri, Alaska Marmot			•					•	
Marmota caligata, Hoary Marmot	•		•						
Urocitellus parryii, Arctic Ground Squirrel	•		•						
Pikas and Hares									
Ochotona collaris, Collared Pika			•					•	

Appendix A. Continued.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Lepus americanus, Snowshoe Hare									•
Lepus othus, Alaska Hare			•					•	•
Shrews									
Sorex alaskanus, Glacier Bay Water Shrew								•	
Sorex cinereus, Cinereus or Masked Shrew	•		•						
Sorex hoyi, Pygmy Shrew			•						
Sorex jacksoni, Saint Lawrence Island Shrew			•					•	
Sorex monticolus, Southern Montane Shrew			•						
Sorex obscurus, Northern Montane Shrew			•						
Sorex pacificus, Pacific Shrew			•						
Sorex navigator, Western Water Shrew			•						
Sorex pribilofensis, Pribilof Island Shrew			•					•	•
Sorex tundrensis, Tundra Shrew			•						
Sorex ugyunak, Barrren Ground Shrew			•					•	
Sorex minutissimus, Holarctic Least Shrew			•						
Bats									
Lasionycteris noctivagans, Silver-haired Bat			•						
Myotis californicus, California Myotis			•						
Myotis lucifugus, Little Brown Bat			•						
Myotis evotis, Long-eared Myotis			•					•	
Myotis volans, Long-legged Myotis			•						
Canids									
Vulpes lagopus, Arctic Fox								•	
Mustelids									
Enhydra lutris, Sea Otter	•	TH[7]							•
Lontra canadensis, North American River Otter	•								
Martes americana, American Marten	•								
Martes caurina, Pacific Marten			•						
Pinnipeds									
Callorhinus ursinus, Northern Fur Seal	•								
Erignathus barbatus, Bearded Seal	•	TH[7]							
Histriophoca fasciata, Ribbon Seal			•					•	
Phoca largha, Spotted Seal	•								
Phoca vitulina, Harbor Seal	•								
Pusa hispida, Ringed Seal	•	TH[7]							
Eumetopias jubatus, Steller Sea Lion	•	EN[7]							
Odobenus rosmarus, Pacific Walrus	•	U	•						
Polar Bears									
Ursus maritimus, Polar Bear	•	TH	•						•

Appendix A. Continued.

Species of Conservation Need	See Appendix B for subspecies, stock, or DPS	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	ACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Baleen Whales									
Balaena mysticetus, Bowhead Whale	•	EN	•						
Eubalaena japonica, North Pacific Right Whale	•	EN	•						
Balaenoptera acutorostrata, Common Minke Whale	•								
Balaenoptera borealis, Sei Whale		EN	•						
Balaenoptera physalus, Fin Whale	•	EN	•						
Megaptera novaeangliae, Humpback Whale	•	EN/TH[7]	•						
Toothed Whales									
Delphinapterus leucas, Beluga	•	EN[7]	•						
Physeter macrocephalus, Sperm Whale	•	EN	•						
Berardius bairdii, Baird's Beaked Whale	•								
Mesoplodon stejnegeri, Stejneger's Beaked Whale	•								
Ziphius cavirostris, Cuvier's Beaked Whale	•								
Dolphins and Porpoises									
Sagmatias obliquidens, Pacific White-sided Dolphin	•								
Phocoena phocoena, Harbor Porpoise	•		•						
Phocoenoides dalli, Dall's Porpoise	•								

[1] Endangered Species Act (ESA). EN = Endangered, TH = Threatened, P = Proposed for listing under the ESA, U = Undergoing status review currently for possible ESA listing by U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS).

[2] ACCS (Alaska Center for Conservation Science). 2025. Alaska Species Ranking System. https://accs.uaa.alaska.edu/wildlife/alaska-species-ranking-system/ (Accessed June 23, 2025).

[3] Alaska Shorebird Group 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK. 139 pp. https://ak.audubon.org/sites/default/files/alaska_shorebird_conservation_plan_2019.pdf (Accessed July 23, 2025).

[4] Handel, C. M., I. J. Stenhouse, and S. M. Matsuoka (Eds.). 2021. Alaska Landbird Conservation Plan, version 2.0. Boreal Partners in Flight, Anchorage, AK. 146 pp. https://www.usgs.gov/media/files/alaska-landbird-conservation-plan-version-2 (Accessed July 23, 2025).

[5] Partners in Flight. 2024. Avian Conservation Assessment Database, version 2024. https://pif.birdconservancy.org/avian-conservation-assessment-database/ (Accessed July 24, 2025).

[6] USFWS (U.S. Fish and Wildlife Service). 2021. Birds of Conservation Concern, 2021. U.S. Fish and Wildlife Service, Migratory Birds, Falls Church, VA. https://www.fws.gov/media/usfws-bird-species-concern (Accessed July 24, 2025).

[7] Subspecies, stock, or DPS have different ESA listings and some may not be listed. See Appendix B.

Appendix B. Subspecies, stocks, and distinct population segments (DPS) of "species of greatest conservation need" (SGCN) in Alaska by justification—terrestrial vertebrates and marine mammals. Chapter 4 describes SGCN justification in detail.

Species of Conservation Need	Justification							
	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	AACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Waterfowl								
Anser albifrons frontalis, Greater White-fronted Goose (midcontinent population)								•
Anser albifrons elgasi, Tule Greater White-fronted Goose		•					•	•
Branta bernicla nigricans, Pacific Black Brant		•					•	•
Branta hutchinsii minima, Minima Cackling Goose							•	•
Branta hutchinsii taverneri, Taverner's Cackling Goose							•	•
Branta canadensis occidentalis, Dusky Canada Goose		•					•	•
Somateria mollissima v-nigrum, Pacific Common Eider							•	•
Grouse and Ptarmigan								
Canachites canadensis isleibi, Spruce Grouse							•	
Lagopus muta evermanni, Evermann's Rock Ptarmigan		•		•			•	
Lagopus muta townsendi, Townsend's Rock Ptarmigan		•		•			•	
Lagopus muta dixoni, Dixon's Rock Ptarmigan				•			•	
Lagopus muta atkhensis, Turner's Rock Ptarmigan		•		•			•	
Shorebirds								
Numenius phaeopus hudsonicus, Whimbrel		•	•				•	
Limosa lapponica baueri, Bar-tailed Godwit		•	•				•	
Limosa fedoa beringiae, Marbled Godwit		•	•		•	•	•	
Calidris canutus roselaari, Pacific Red Knot		•	•		•	•	•	
Calidris alpina pacifica, Pacific Dunlin			•				•	
Calidris alpina arcticola, Arctic Dunlin		•	•			•	•	
Calidris ptilocnemis ptilocnemis, Pribilof Rock Sandpiper		•	•		•	•	•	
Calidris ptilocnemis couesi, Aleutian Rock Sandpiper		•	•				•	
Calidris ptilocnemis tschuktschorum, Bering Sea Rock Sandpiper		•	•				•	
Limnodromus griseus caurinus, Short-billed Dowitcher		•	•		•	•	•	
Tringa solitaria cinnamomea, Solitary Sandpiper			•			•	•	
Seabirds								
Hydrobates furcatus furcatus, Fork-tailed Storm-Petrel							•	
Hydrobates furcatus plumbeus, Fork-tailed Storm-Petrel		•						
Hydrobates leucorhous leucorhous, Leach's Storm-Petrel		•						

Appendix B. Continued.

Species of Conservation Need	Justification							
	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	AACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Hawks and Eagles								
Astur atricapillus laingi, Queen Charlotte Goshawk		•					•	
Falco columbarius suckleyi, Black Merlin		•						
Buteo jamaicensis alascensis, Red-tailed Hawk							•	
Falco peregrinus pealei, Peale's Peregrine Falcon		•					•	
Woodpeckers								
Dryobates villosus sitkensis, Hairy Woodpecker							•	
Shrikes and Corvids								
Corvus corax kamtschaticus, Common Raven		•					•	
Chickadees								
Poecile cinctus lathami, Gray-headed Chickadee		•				•	•	
Kinglets, Creepers, and Wrens								
Corthylio calendula calendula, Ruby-crowned Kinglet		•						
Corthylio calendula grinnelli, Ruby-crowned kinglet							•	
Certhia americana alascensis, Brown Creeper		•						
Troglodytes pacificus kiskensis, Kiska Pacific Wren		•		•			•	
Troglodytes pacificus helleri, Kodiak Pacific Wren		•		•			•	
Troglodytes pacificus meligerus, Attu Pacific Wren		•		•			•	
Troglodytes pacificus semidiensis, Semidi Pacific Wren		•		•			•	
Troglodytes pacificus alascensis, Pribilof Pacific Wren		•		•			•	
Thrushes								
Catharus guttatus nanus, Hermit Thrush							•	
Finches, Longspurs and Buntings								
Calcarius lapponicus alascensis, Lapland Longspur		•					•	
Plectrophenax nivalis townsendi, Snow Bunting		•						
Plectrophenax nivalis nivalis, Snow Bunting		•						
Leucosticte tephrocotis griseonucha, Gray-crowned Rosy-Finch				•			•	
Leucosticte tephrocotis umbrina, Gray-crowned Rosy-Finch				•			•	
Sparrows, Blackbirds, and New World Warblers								
Passerella iliaca insularis, Kodiak Fox Sparrow		•		•			•	
Passerella iliaca unalaschcensis, Shumagin Fox Sparrow		•		•			•	
Passerella iliaca townsendi, Townsend's Fox Sparrow				•			•	
Passerella iliaca sinuosa, Valdez Fox Sparrow		•		•			•	
Passerella iliaca annectens, Yakutat Fox Sparrow		•		•			•	

Appendix B. Continued.

Species of Conservation Need	Justification							
	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	AACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Passerella iliaca chilcatensis, Chilkat Sooty Fox Sparrow		•		•			•	
Melospiza melodia insignis, Bischoff Song Sparrow		•		•			•	
Melospiza melodia caurina, Yakutat Song Sparrow		•		•			•	
Melospiza melodia rufina, Sooty Song Sparrow		•		•			•	
Melospiza melodia kenaiensis, Kenai Song Sparrow		•		•			•	
Melospiza melodia sanaka, Aleutian Song Sparrow		•		•			•	
Melospiza melodia maxima, Giant Song Sparrow		•		•			•	
Melospiza lincolnii gracilis, Lincoln's Sparrow				•			•	
Mice and Lemmings								
Lemmus trimucronatus nigripes, Black-footed Brown Lemming		•						
Lemmus trimucronatus harroldi, Nunivak Island Brown Lemming		•						
Voles and Deermice								
Microtus longicaudus coronarius, Coronation Island Long-tailed Vole		•						
Microtus longicaudus littoralis, Long-tailed Vole		•						
Microtus oeconomus elymocetes, Montague Island Root Vole		•						
Microtus oeconomus punukensis, Punuk Island Root Vole		•						
Microtus oeconomus popofensis, Shumagin Island Root Vole		•						
Microtus oeconomus sitkensis, Sitka Root Vole		•						
Microtus oeconomus unalascensis, Unalaska Root Vole		•						
Microtus oeconomus yakutatensis, Yakutat Root Vole		•						
Microtus pennsylvanicus admiraltiae, Admiralty Meadow Vole		•						
Clethrionomys gapperi stikinensis, Gapper's Southern Red-backed Vole		•						
Clethrionomys gapperi phaeus, Phaeus Southern Red-backed Vole		•						
Clethrionomys gapperi solus, Revillagigedo Island Southern Red-backed Vole		•						
Clethrionomys gapperi wrangeli, Wrangell Island Southern Red-backed Vole		•						
Squirrels and Marmots								
Glaucomys sabrinus griseifrons, Prince of Wales Northern Flying Squirrel		•					•	
Marmota caligata vigilis, Glacier Bay Hoary Marmot		•						
Marmota caligata sheldoni, Montague Island Hoary Marmot		•						
Urocitellus parryii plesius, Arctic Ground Squirrel		•						
Urocitellus parryii ablusus, Aleutian Arctic Ground Squirrel		•					•	
Urocitellus parryii kennicottii, Barrow Arctic Ground Squirrel		•					•	
Urocitellus parryii kodiacensis, Kodiak Island Arctic Ground Squirrel		•					•	
Urocitellus parryii osgoodi, Osgood's Arctic Ground Squirrel		•					•	

Appendix B. Continued.

Species of Conservation Need	Justification							
	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	AACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Urocitellus parryii nebulicola, Shumigan Islands Arctic Ground Squirrel		•					•	
Urocitellus parryii lyratus, St. Lawrence Island Arctic Ground Squirrel		•					•	
Shrews								
Sorex cinereus hollisteri, Cinereus Shrew		•					•	
Sorex cinereus streatori, Cinereus Shrew		•					•	
Mustelids								
Enhydra lutris kenyoni, Northern Sea Otter, Southwest Alaska DPS	TH	•					•	•
Lontra canadensis kodiacensis, Kodiak River Otter		•						
Lontra canadensis mira, Prince of Wales River Otter		•						
Martes americana kenaiensis, Kenai American Marten		•						
Pinnipeds								
Callorhinus ursinus, Northern Fur Seal, Eastern Pacific Stock		•					•	•
Erignathus barbatus nauticus, Bearded Seal, Beringia DPS	TH	•					•	•
Phoca largha, Spotted Seal, Bering Stock		•					•	•
Phoca vitulina richardii, Harbor Seal, Alaska Stocks							•	•
Pusa hispida hispida, Ringed Seal, Arctic Subspecies	TH	•					•	•
Eumetopias jubatus, Steller Sea Lion, Western DPS	EN	•						•
Odobenus rosmarus divergens, Pacific Walrus, Alaska Stock	U	•						•
Polar Bears								
Chukchi/Bering Stock	TH							•
Southern Beaufort Sea Stock	TH	•						•
Baleen Whales								
Balaena mysticetus, Bowhead Whale, Western Arctic Stock	EN	•					•	•
Eubalaena japonica, North Pacific Right Whale, Eastern North Pacific Stock	EN	•					•	
Balaenoptera acutorostrata, Minke Whale, Alaska Stock		•						
Balaenoptera physalus, Fin Whale, Northeast Pacific Stock	EN	•						
Megaptera novaeangliae, Humpback Whale, Western North Pacific DPS	EN	•					•	
Megaptera novaeangliae, Humpback Whale, Mexico DPS	TH	•					•	
Toothed Whales								
Delphinapterus leucas, Beluga, Cook Inlet DPS	EN	•					•	•
Delphinapterus leucas, Beluga, Beaufort Sea Stock							•	•
Delphinapterus leucas, Beluga, Bristol Bay Stock							•	•
Delphinapterus leucas, Beluga, Eastern Bering Sea Stock							•	•

Appendix B. Continued.

Species of Conservation Need	Justification							
	ESA Listed, Proposed, or Under Review[1]	ASRS[2]	AK Shorebird Plan[3]	AK Landbird Plan[4]	AACAD Priority Species[5]	Birds of Conservation Concern[6]	Stewardship	Culturally Important
Delphinapterus leucas, Beluga, Eastern Chukchi Sea Stock							•	•
Physeter macrocephalus, Sperm Whale, North Pacific Stock	EN	•						
Berardius bairdii, Baird's Beaked Whale, Alaska Stock		•						
Mesoplodon stejnegeri, Stejneger's Beaked Whale, Alaska Stock		•						
Ziphius cavirostris, Cuvier's Beaked Whale, Alaska Stock		•						
Dolphins and Porpoises								
Sagmatias obliquidens, Pacific White-sided Dolphin, North Pacific Stock		•						
Phocoena phocoena, Harbor Porpoise, Southeast Alaska Stock		•						
Phocoena phocoena, Harbor Porpoise, Gulf of Alaska Stock		•						
Phocoena phocoena, Harbor Porpoise, Bering Sea Stock		•						
Phocoenoides dalli, Dall's Porpoise, Alaska Stock		•						

[1] Endangered Species Act (ESA). EN = Endangered, TH = Threatened, P = Proposed for listing under the ESA, U = Undergoing status review currently for possible ESA listing by U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS).

[2] Alaska Species Ranking System (ASRS). https://accs.uaa.alaska.edu/wildlife/alaska-species-ranking-system/.

[3] Alaska Shorebird Plan. https://alaskashorebirdgroup.com/conservation-plans/.

[4] Alaska Landbird Conservation Plan. https://www.usgs.gov/media/files/alaska-landbird-conservation-plan-version-2.

[5] Avian Conservation Assessment Database (ACAD). https://pif.birdconservancy.org/.

[6] Birds of Conservation Concern. https://www.fws.gov/media/usfws-bird-species-concern.

Appendix C. "Species of greatest conservation need" (SGCN) in Alaska by justification—invertebrate and aquatic taxa. Chapter 4 describes SGCN justification in detail.

Species of Conservation Need	Justification						
	ESA Listed, Proposed or Under Review[1]	Stewardship Species	Culturally Important	Economically Important	Ecologically Important	Data Deficient	Known or Anticipated Declines in Local Populations
Terrestrial Invertebrates							
Hymenoptera (Order – ants, bees, wasps, hornets)					•	•	
Bombus occidentalis (Western Bumblebee)[2]	U				•	•	
Diptera (Order – flies, midges, mosquitos, gnats)					•	•	
Odonata (Order – dragonflies, damselflies)					•	•	
Lepidoptera (Order – butterflies, moths)					•	•	
Euchloe ausonides (Large Marble Butterfly)	U				•	•	
Arachnida (Order – spiders)					•	•	
Coleoptera (Order – beetles)					•	•	
Deep-sea Corals							
Deep-sea corals of Classes *Anthozoa* and *Hydrozoa*					•	•	
Freshwater Invertebrates							
Ephemeroptera (Order – Mayflies)					•	•	
Odonata (Order – Dragon and Damselflies)					•	•	
Plecoptera (Order – Stoneflies)					•	•	
Trichoptera (Order – Caddisflies)					•	•	
*Cladocera (*Order – Water Fleas)					•	•	
Beringiana beringiana, Yukon Floater Mussel		•	•				
Marine Zooplankton							
Euphasiacea, Euphasids					•	•	
Copepoda, Copepods, primarily Calanoida					•	•	
Mysida, Mysids					•	•	
Amphipoda, Benthic Amphipods					•	•	
Crabs							
Chionoecetes opilio, Snow Crab			•	•		•	•
Lithodes aequispinus, Golden King Crab		•	•	•		•	•
Paralithodes camtschaticus, Red King Crab		•	•	•		•	•
Paralithodes platypus, Blue King Crab		•	•	•		•	•
Cockles, Scallops, Clams, Mussels, and Abalone							
Haliotis kamtschatkana, Pinto Abalone			•	•		•	•
Patinopecten caurinus, Weathervane Scallop		•	•	•			
Siliqua patula, Razor Clam			•	•			•

Appendix C. Continued.

Species of Conservation Need	Justification						
	ESA Listed, Proposed or Under Review[1]	Stewardship Species	Culturally Important	Economically Important	Ecologically Important	Data Deficient	Known or Anticipated Declines in Local Populations
Sea Stars							
Pycnopodia helinathodoies, Sunflower Sea Star	P				•		•
Lamprey							
Lethenteron alaskense, Alaskan Brook Lamprey		•			•		
Herring							
Clupea pallasii, Pacific Herring			•	•	•		
Mudminnows							
Dallia pectoralis, Alaska Blackfish		•	•				
Smelt							
Mallotus villosus, Capelin		•	•			•	
Thaleichthys pacificus, Eulachon		•	•			•	
Cisco							
Coregonus laurettae, Bering Cisco		•	•			•	
Salmon							
Oncorhynchus keta, Chum Salmon			•	•	•		•
Oncorhynchus tshawytscha, Chinook Salmon	U[3]		•	•	•		•
Trout							
Oncorhynchus clarki clarki, Coastal Cutthroat Trout			•			•	
Oncorhynchus mykiss, Steelhead, Rainbow Trout			•	•		•	•
Rockfish							
Sebastes spp. (Demersal)			•	•		•	•
Sebastes spp. (Pelagic)			•	•		•	•
Greenling							
Ophiodon elongates, Lingcod			•	•		•	•
Sand Lance							
Ammodytes hexapterus, Pacific Sand Lance			•		•	•	

[1] Endangered Species Act (ESA). EN = Endangered, TH = Threatened, P = Proposed for listing under the ESA, U = Undergoing status review currently for possible ESA listing by U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS).

[2] Taxonomy of this species in Alaska has changed to McKay's Bumblebee (*Bombus mckayi*; Williams 2021). https://www.tandfonline.com/doi/full/10.1080/00222933.2021.1900444

[3] State press release: https://www.adfg.alaska.gov/index.cfm?adfg=pressreleases.pr&release=2024_05_23.

Appendix D. Distribution of "species of greatest conservation need" (SGCN) in Alaska by biogeographic region. ● = Regular or common, naturally occurring. Subspecies, stock or Distinct Population Segment (DPS) from Appendix B is also indicated, where relevant. Distribution is not well documented for many invertebrates, but provided to the extent known.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Terrestrial Invertebrates									
Hymenoptera (Order – ants, bees, wasps, hornets)	●	●	●	●	●	●			
Bombus occidentalis (Western Bumblebee)[2]	●	●	●	●	●				
Diptera (Order – flies, midges, mosquitos, gnats)	●	●	●	●	●	●			
Odonata (Order – dragonflies, damselflies)	●	●	●	●	●	●			
Lepidoptera (Order – butterflies, moths)	●	●	●	●	●	●			
Euchloe ausonides (Large Marble Butterfly)		●	●						
Arachnida (Order – spiders)	●	●	●	●	●	●			
Coleoptera (Order – beetles)	●	●	●	●	●	●			
Deep Sea Corals									
Anthozoa and *Hydrozoa*, sea anemones, sea pens, corals								●	●
Freshwater Invertebrates									
Ephemeroptera (Order – Mayflies)	●	●	●	●	●	●			
Odonata (Order – Dragon and Damselflies)	●	●	●	●	●	●			
Plecoptera (Order – Stoneflies)	●	●	●	●	●	●			
Trichoptera (Order – Caddisflies)	●	●	●	●	●	●			
*Cladocera (*Order – Water Fleas)	●	●	●	●	●	●			
Beringiana beringiana, Yukon Floater Mussel		●	●	●	●				
Marine Zooplankton									
Euphasiacea, Euphasids							●	●	●
Copepoda, Copepods, primarily Calanoida							●	●	●
Mysida, Mysids							●	●	●
Amphipoda, Benthic Amphipods							●	●	●
Crabs									
Chionoecetes opilio, Snow Crab								●	●
Lithodes aequispinus, Golden King Crab								●	●
Paralithodes camtschaticus, Red King Crab								●	●
Paralithodes platypus, Blue King Crab								●	●
Cockles, Scallops, Clams, Mussels, and Abalone									
Haliotis kamtschatkana, Pinto Abalone								●	●
Patinopecten caurinus, Weathervane Scallop									●
Siliqua patula, Razor Clam								●	●
Sea Stars									
Pycnopodia helinathodoies, Sunflower Sea Star								●	●
Lamprey									
Lethenteron alaskense, Alaskan Brook Lamprey				●					
Herring									
Clupea pallasii, Pacific Herring							●	●	●

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Mudminnows									
Dallia pectoralis, Alaska Blackfish		●	●	●	●	●			
Smelt									
Mallotus villosus, Capelin							●	●	●
Thaleichthys pacificus, Eulachon								●	●
Cisco									
Coregonus laurettae, Bering Cisco			●	●	●	●	●	●	
Salmon									
Oncorhynchus keta, Chum Salmon	●	●	●	●	●	●	●	●	●
Oncorhynchus tshawytscha, Chinook Salmon	●	●	●	●	●	●	●	●	●
Trout									
Oncorhynchus clarki clarki, Coastal Cutthroat Trout	●								●
Oncorhynchus mykiss, Steelhead	●	●						●	●
Rockfish									
Sebastes spp. (Demersal)[3]								●	●
Sebastes spp. (Pelagic)								●	●
Greenling									
Ophiodon elongates, Lingcod									●
Sand Lance									
Ammodytes hexapterus, Pacific Sand Lance							●	●	●
Amphibians and Reptiles									
Rana luteiventris, Columbia Spotted Frog	●								
Ambystoma macrodactylum, Long-toed Salamander	●								
Ambystoma gracile, Northwestern Salamander	●								
Anaxyrus boreas, Western Toad	●	●							
Lithobates sylvaticus, Wood Frog	●	●	●	●	●				
Waterfowl									
Anser canagicus, Emperor Goose				●	●				
Anser albifrons elgasi, Tule Greater White-fronted Goose		●		●					
Anser albifrons frontalis, Greater White-fronted Goose (midcontinent population)			●		●	●			
Branta bernicla nigricans, Pacific Black Brant		●		●	●	●			
Branta hutchinsii minima, Minima Cackling Goose			●	●	●				
Branta hutchinsii taverneri, Taverner's Cackling Goose					●	●			
Branta canadensis occidentalis, Dusky Canada Goose		●							
Cygnus buccinator, Trumpeter Swan	●	●	●	●					
Anas acuta, Northern Pintail	●	●	●	●	●	●			
Aythya affinis, Lesser Scaup	●	●	●						
Aythya valisineria, Canvasback		●	●		●	●			
Polysticta stelleri, Steller's Eider				●	●	●	●	●	●

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Somateria fischeri, Spectacled Eider					●	●	●	●	
Somateria spectabilis, King Eider				●	●	●	●	●	●
Somateria mollissima v-nigrum, Pacific Common Eider				●	●	●	●	●	●
Melanitta perspicillata, Surf Scoter	●	●	●	●	●	●	●	●	●
Melanitta fusca, White-winged Scoter	●	●	●	●	●				
Melanitta americana, Black Scoter	●	●		●	●				
Clangula hyemalis, Long-tailed Duck	●	●	●	●	●	●		●	
Histrionicus histrionicus, Harlequin Duck	●	●	●	●	●	●			
Grouse and Ptarmigan									
Canachites canadensis, Spruce Grouse	●	●	●	●					
Lagopus lagopus, Willow Ptarmigan	●	●	●	●	●	●			
Lagopus muta, Rock Ptarmigan	●	●	●	●	●	●			
Dendragapus fuliginosus, Sooty Grouse	●								
Loons and Grebes									
Podiceps auritus, Horned Grebe	●	●	●	●					●
Podiceps grisegena, Red-necked Grebe	●	●	●	●	●			●	●
Aechmophorus occidentalis, Western Grebe	●								●
Gavia arctica, Arctic Loon					●				
Gavia stellata, Red-throated Loon	●	●	●	●	●	●	●	●	●
Gavia adamsii, Yellow-billed Loon	●	●			●	●	●	●	●
Swifts and Hummingbirds									
Cypseloides niger, Black Swift	●								
Chaetura vauxi, Vaux's Swift	●								
Selasphorus rufus, Rufous Hummingbird	●	●							
Cranes									
Antigone canadensis, Sandhill Crane	●	●	●	●	●	●			
Shorebirds									
Haematopus bachmani, Black Oystercatcher	●	●		●					
Pluvialis squatarola, Black-bellied Plover	●	●		●	●	●			
Pluvialis dominica, American Golden-Plover		●	●	●	●	●			
Pluvialis fulva, Pacific Golden-Plover				●	●				
Charadrius vociferus, Killdeer	●								
Bartramia longicauda, Upland Sandpiper			●			●			
Numenius tahitiensis, Bristle-thighed Curlew					●				
Numenius phaeopus, Whimbrel		●	●	●	●	●			
Limosa lapponica, Bar-tailed Godwit				●	●	●			
Limosa haemastica, Hudsonian Godwit		●	●	●	●				
Limosa fedoa, Marbled Godwit		●		●					
Arenaria interpres, Ruddy Turnstone		●		●	●	●			
Arenaria melanocephala, Black Turnstone	●	●		●	●				

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Calidris canutus roselaari, Pacific Red Knot		●			●				
Calidris virgata, Surfbird	●	●	●	●	●				
Calidris acuminata, Sharp-tailed Sandpiper				●	●				
Calidris himantopus, Stilt Sandpiper						●			
Calidris ruficollis, Red-necked Stint				●	●	●			
Calidris alba, Sanderling	●	●		●	●	●			
Calidris alpina pacifica, Pacific Dunlin	●	●		●	●				
Calidris alpina arcticola, Arctic Dunlin					●	●			
Calidris ptilocnemis ptilocnemis, Probilof Rock Sandpiper		●		●					
Calidris ptilocnemis couesi, Aleutian Rock Sandpiper				●					
Calidris ptilocnemis tschuktschorum, Bering Sea Rock Sandpiper	●	●		●	●				
Calidris minutilla, Least Sandpiper	●	●	●	●	●	●			
Calidris subruficollis, Buff-breasted Sandpiper						●			
Calidris melanotos, Pectoral Sandpiper	●	●	●	●	●	●			
Calidris pusilla, Semipalmated Sandpiper		●	●	●	●	●			
Calidris mauri, Western Sandpiper	●	●		●	●	●			
Limnodromus griseus caurinus, Short-billed Dowitcher	●	●		●					
Limnodromus scolopaceus, Long-billed Dowitcher		●	●	●	●				
Gallinago delicata, Wilson's Snipe	●	●	●	●	●	●			
Actitis macularius, Spotted Sandpiper	●	●	●	●	●				
Tringa solitaria cinnamomea, Solitary Sandpiper		●	●	●	●				
Tringa brevipes, Gray-tailed Tattler				●	●				
Tringa incana, Wandering Tattler	●	●	●	●	●				
Tringa flavipes, Lesser Yellowlegs	●	●	●	●	●				
Tringa melanoleuca, Greater Yellowlegs	●	●	●	●	●				
Tringa glareola, Wood Sandpiper				●	●				
Phalaropus lobatus, Red-necked Phalarope	●	●	●	●	●	●	●	●	●
Phalaropus fulicarius, Red Phalarope		●		●	●	●	●	●	●
Gulls, Terns, and Jaegers									
Stercorarius pomarinus, Pomarine Jaeger		●		●	●	●	●	●	●
Stercorarius parasiticus, Parasitic Jaeger	●	●		●	●	●	●	●	●
Stercorarius longicaudus, Long-tailed Jaeger		●	●	●	●	●	●	●	●
Rissa tridactyla, Black-legged Kittiwake	●	●		●	●	●	●	●	●
Rissa brevirostris, Red-legged Kittiwake				●	●			●	
Pagophila eburnea, Ivory Gull							●	●	
Xema sabini, Sabine's Gull					●	●	●	●	●
Rhodostethia rosea, Ross's Gull						●	●	●	
Larus brachyrhynchus, Short-billed Gull	●	●	●	●	●	●	●	●	●
Larus argentatus, Herring Gull	●	●	●					●	●
Larus glaucescens, Glaucous-winged Gull	●	●		●	●			●	●

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Larus hyperboreus, Glaucous Gull				●	●	●	●	●	●
Onychoprion aleuticus, Aleutian Tern		●		●	●		●	●	●
Seabirds									
Uria aalge, Common Murre	●	●		●	●		●	●	●
Uria lomvia, Thick-billed Murre	●	●		●	●		●	●	●
Cepphus grylle, Black Guillemot						●	●	●	
Cepphus columba, Pigeon guillemot	●	●		●	●			●	●
Brachyramphus marmoratus, Marbled Murrelet	●	●		●				●	●
Brachyramphus brevirostris, Kittlitz's Murrelet	●	●		●	●		●	●	●
Ptychoramphus aleuticus, Cassin's Auklet	●	●		●				●	●
Aethia psittacula, Parakeet Auklet		●		●	●		●	●	●
Aethia pusilla, Least Auklet				●	●		●	●	●
Aethia pygmaea, Whiskered Auklet				●				●	
Aethia cristatella, Crested Auklet				●	●		●	●	●
Fratercula corniculata, Horned Puffin	●	●		●	●		●	●	●
Fratercula cirrhata, Tufted Puffin	●	●		●	●		●	●	●
Phoebastria immutabilis, Laysan Albatross								●	●
Phoebastria nigripes, Black-footed Albatross								●	●
Phoebastria albatrus, Short-tailed Albatross								●	●
Hydrobates furcatus furcatus, Fork-tailed Storm-Petrel		●		●				●	●
Hydrobates furcatus plumbeus, Fork-tailed Storm-Petrel	●								●
Hydrobates leucorhous leucorhous, Leach's Storm-Petrel	●	●		●				●	●
Fulmarus glacialis, Northern Fulmar				●	●		●	●	●
Pterodroma inexpectata, Mottled Petrel								●	●
Ardenna bulleri, Buller's Shearwater									●
Puffinus tenuirostris, Short-tailed Shearwater							●	●	●
Puffinus griseus, Sooty Shearwater								●	●
Puffinus creatopus, Pink-footed Shearwater									●
Cormorants									
Urile urile, Red-faced Cormorant		●		●				●	●
Urile pelagicus, Pelagic Cormorant	●	●		●	●			●	●
Hawks and Eagles									
Aquila chrysaetos, Golden Eagle	●	●	●	●	●	●			
Astur atricapillus, American Goshawk	●	●	●	●	●				
Astur atricapillus laingi, Queen Charlotte Goshawk	●								
Haliaeetus leucocephalus, Bald Eagle	●	●	●	●	●	●			
Buteo jamaicensis, Red-tailed Hawk	●	●	●	●	●				
Buteo lagopus, Rough-legged Hawk		●	●	●	●	●			
Falco sparverius, American Kestrel			●						

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Falco columbarius suckleyi, Black Merlin	●								
Falco rusticolus, Gyrfalcon		●	●	●	●	●			
Falco peregrinus, Peregrine Falcon	●	●	●	●	●	●			
Falco peregrinus pealei, Peale's Peregrine Falcon	●	●		●					
Owls									
Megascops kennicottii, Western Screech-Owl	●	●							
Bubo scandiacus, Snowy Owl				●	●	●			
Surnia ulula, Northern Hawk Owl		●	●	●					
Strix nebulosa, Great Gray Owl		●	●						
Asio flammeus, Short-eared Owl	●	●	●	●	●	●			
Aegolius funereus, Boreal Owl		●	●	●					
Aegolius acadicus, Northern Saw-whet Owl	●	●							
Woodpeckers									
Sphyrapicus ruber, Red-breasted Sapsucker	●								
Picoides dorsalis, American Three-toed Woodpecker	●	●	●	●	●				
Picoides arcticus, Black-backed Woodpecker		●	●						
Dryobates villosus sitkensis, Hairy Woodpecker	●								
Flycatchers									
Contopus cooperi, Olive-sided Flycatcher	●	●	●						
Contopus sordidulus, Western Wood-Pewee	●	●	●						
Empidonax alnorum, Alder Flycatcher	●	●	●	●	●				
Shrikes and Corvids									
Lanius borealis, Northern Shrike	●	●	●	●	●	●			
Perisoreus canadensis, Canada Jay		●	●	●	●	●			
Corvus corax kamtschaticus, Common Raven				●					
Chickadees, Larks, Swallows, and Leaf Warblers									
Poecile rufescens, Chestnut-backed Chickadee	●	●							
Poecile hudsonicus, Boreal Chickadee		●	●	●	●				
Poecile cinctus, Gray-headed Chickadee			●		●	●			
Eremophila alpestris, Horned Lark		●	●		●	●			
Riparia riparia, Bank Swallow		●	●	●	●				
Tachycineta bicolor, Tree Swallow	●	●	●	●	●				
Tachycineta thalassina, Violet-green Swallow	●	●	●	●					
Hirundo rustica, Barn Swallow	●								
Phylloscopus borealis, Arctic Warbler		●	●	●	●	●			
Kinglets, Creepers, and Wrens									
Corthylio calendula calendula, Ruby-crowned Kinglet		●	●	●	●	●			
Corthylio calendula grinnelli, Ruby-crowned Kinglet	●	●							
Regulus satrapa, Golden-crowned Kinglet	●	●	●	●					
Certhia americana alascensis, Brown Creeper		●	●	●					
Troglodytes pacificus, Pacific Wren	●	●		●					

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Troglodytes pacificus kiskensis, Kiska Pacific Wren				●					
Troglodytes pacificus helleri, Kodiak Pacific Wren		●		●					
Troglodytes pacificus meligerus, Attu Pacific Wren				●					
Troglodytes pacificus semidiensis, Semidi Pacific Wren				●					
Troglodytes pacificus alascensis, Pribilof Pacific Wren				●					
Waxwings, Dippers, and Thrushes									
Bombycilla garrulus, Bohemian Waxwing		●	●						
Bombycilla cedrorum, Cedar Waxwing	●								
Catharus minimus, Gray-cheeked Thrush	●	●	●	●	●	●			
Catharus guttatus, Hermit Thrush	●	●	●	●					
Ixoreus naevius, Varied Thrush	●	●	●	●	●				
Luscinia svecica, Bluethroat					●	●			
Oenanthe oenanthe, Northern Wheatear		●	●		●	●			
Pipits, Finches, Longspurs, and Buntings									
Anthus cervinus, Red-throated Pipit					●				
Anthus rubescens, American Pipit	●	●	●	●	●	●			
Fringilla montifringilla, Brambling				●	●				
Pinicola enucleator, Pine Grosbeak	●	●	●	●	●				
Leucosticte tephrocotis griseonucha, Gray-crowned Rosy-Finch				●					
Leucosticte tephrocotis umbrina, Gray-crowned Rosy-Finch				●					
Acanthis flammea, Redpoll	●	●	●	●	●	●			
Spinus pinus, Pine Siskin	●	●		●					
Calcarius lapponicus, Lapland Longspur		●	●	●	●	●			
Calcarius pictus, Smith's Longspur		●	●			●			
Plectrophenax nivalis, Snow Bunting	●	●	●	●	●	●			
Plectrophenax hyperboreus, Mckay's Bunting					●				
Sparrows, Blackbirds, and New World Warblers									
Passerella iliaca, Fox Sparrow	●	●	●	●	●				
Passerella iliaca insularis, Kodiak Fox Sparrow	●	●							
Passerella iliaca unalaschcensis, Shumagin Fox Sparrow				●					
Passerella iliaca townsendi, Townsend's Fox Sparrow	●								
Passerella iliaca sinuosa, Valdez Fox Sparrow		●							
Passerella iliaca annectens, Yakutat Fox Sparrow		●							
Passerella iliaca chilcatensis, Chilkat Sooty Fox Sparrow	●								
Spizelloides arborea, American Tree Sparrow	●	●	●	●	●	●			
Junco hyemalis, Dark-eyed Junco	●	●	●	●	●				
Zonotrichia leucophrys, White-crowned Sparrow	●	●	●	●	●				

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Zonotrichia atricapilla, Golden-crowned Sparrow	●	●		●	●				
Passerculus sandwichensis, Savannah Sparrow	●	●	●	●	●	●			
Melospiza melodia insignis, Bischoff Song Sparrow		●		●					
Melospiza melodia caurina, Yakutat Song Sparrow	●	●		●					
Melospiza melodia rufina, Sooty Song Sparrow	●								
Melospiza melodia kenaiensis, Kenai Song Sparrow		●							
Melospiza melodia sanaka, Aleutian Song Sparrow				●					
Melospiza melodia maxima, Giant Song Sparrow				●					
Melospiza lincolnii, Lincoln's Sparrow	●	●	●	●	●				
Agelaius phoeniceus, Red-winged Blackbird	●	●	●						
Euphagus carolinus, Rusty Blackbird	●	●	●	●	●				
Leiothlypis celata, Orange-crowned Warbler	●	●	●	●					
Geothlypis tolmiei, MacGillivray's Warbler	●								
Setophaga ruticilla, American Redstart	●								
Setophaga striata, Blackpoll Warbler		●	●	●	●				
Setophaga coronata, Yellow-rumped Warbler	●	●	●	●	●				
Setophaga townsendi, Townsend's Warbler	●	●	●						
Cardellina pusilla, Wilson's Warbler	●	●	●	●	●				
Mice and Lemmings									
Zapus hudsonius, Meadow Jumping Mouse	●	●	●	●	●				
Dicrostonyx groenlandicus, Nearctic Collared Lemming				●	●	●			
Lemmus trimucronatus, Nearctic Brown Lemming	●	●	●	●	●	●			
Synaptomys borealis, Northern Bog Lemming	●	●	●	●					
Voles and Deermice									
Microtus abbreviatus, Insular Vole					●				
Microtus longicaudus, Long-tailed Vole	●	●	●						
Microtus miurus, Singing Vole		●	●	●	●	●			
Microtus oeconomus, Root or Tundra Vole	●	●	●	●	●	●			
Microtus pennsylvanicus, Meadow Vole	●	●	●	●					
Microtus xanthognathus, Taiga or Yellow-cheeked Vole			●		●				
Clethrionomys gapperi, Southern Red-backed Vole	●								
Peromyscus keeni, Northwestern Deermouse	●								
Muskrats and Woodrats									
Ondatra zibethicus, Common Muskrat	●	●	●	●	●	●			
Neotoma cinerea, Bushy-tailed Woodrat	●								
Squirrels and Marmots									
Glaucomys sabrinus, Northern Flying Squirrel	●	●	●						
Glaucomys sabrinus griseifrons, Prince of Wales Northern Flying Squirrel	●								
Marmota broweri, Alaska Marmot			●		●	●			

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Marmota caligata, Hoary Marmot	●	●	●	●					
Urocitellus parryii, Arctic Ground Squirrel		●	●	●	●	●			
Urocitellus parryii plesius, Arctic Ground Squirrel		●							
Urocitellus parryii ablusus, Aleutian Arctic Ground Squirrel		●	●	●	●				
Urocitellus parryii kennicottii, Barrow Arctic Ground Squirrel						●			
Urocitellus parryii kodiacensis, Kodiak Island Arctic Ground Squirrel		●							
Urocitellus parryii osgoodi, Osgood's Arctic Ground Squirrel			●						
Urocitellus parryii nebulicola, Shumigan Islands Arctic Ground Squirrel				●					
Urocitellus parryii lyratus, St. Lawrence Island Arctic Ground Squirrel					●				
Pikas, and Hares									
Ochotona collaris, Collared Pika	●	●	●	●					
Lepus americanus, Snowshoe Hare	●	●	●	●	●	●			
Lepus othus, Alaska Hare				●	●				
Shrews									
Sorex alaskanus, Glacier Bay Water Shrew	●								
Sorex cinereus, Cinereus or Masked Shrew	●	●	●	●	●	●			
Sorex hoyi, Pygmy Shrew		●	●	●	●				
Sorex jacksoni, Saint Lawrence Island Shrew					●				
Sorex obscurus, Northern Montane Shrew	●	●	●	●	●	●			
Sorex navigator, Western Water Shrew	●	●	●						
Sorex pacificus, Pacific Shrew	●								
Sorex pribilofensis, Pribilof Island Shrew					●				
Sorex tundrensis, Tundra Shrew		●	●	●	●	●			
Sorex ugyunak, Barrren Ground Shrew					●	●			
Sorex minutissimus, Holarctic Least Shrew		●	●	●	●	●			
Bats									
Lasionycteris noctivagans, Silver-haired Bat	●								
Myotis californicus, California Myotis	●								
Myotis lucifugus, Little Brown Bat	●	●	●	●					
Myotis evotis, Long-eared Myotis	●								
Myotis volans, Long-legged Myotis	●								
Canids									
Vulpes lagopus, Arctic Fox				●	●	●			
Mustelids									
Enhydra lutris kenyoni, Northern Sea Otter, Southwest Alaska DPS				●				●	●
Lontra canadensis kodiacensis, Kodiak River Otter				●	●				

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Lontra canadensis mira, Prince of Wales River Otter	●								
Martes americana kenaiensis, Kenai American Marten		●							
Martes caurina, Pacific Marten	●								
Pinnipeds									
Callorhinus ursinus, Northern Fur Seal, Eastern Pacific Stock								●	●
Erignathus barbatus nauticus, Bearded Seal, Beringia DPS							●	●	
Histriophoca fasciata, Ribbon Seal							●	●	
Phoca largha, Spotted Seal, Bering Stock							●	●	
Phoca vitulina richardii, Harbor Seal, Alaska Stocks								●	●
Pusa hispida hispida, Ringed Seal, Arctic Subspecies							●	●	
Eumetopias jubatus, Steller Sea Lion, Western DPS								●	●
Odobenus rosmarus, Pacific Walrus, Alaska Stock							●	●	
Polar Bears									
Ursus maritimus, Polar Bear, Southern Beaufort Sea Stock							●	●	
Ursus maritimus, Polar Bear, Chukchi/Bering Stock							●	●	
Baleen Whales									
Balaena mysticetus, Bowhead Whale, Western Arctic Stock							●	●	
Eubalaena japonica, North Pacific Right Whale				●	●			●	●
Balaenoptera acutorostrata, Minke Whale								●	●
Balaenoptera borealis, Sei Whale								●	●
Balaenoptera physalus, Fin Whale								●	●
Megaptera novaeangliae, Humpback Whale, Western North Pacific DPS								●	●
Megaptera novaeangliae, Humpback Whale, Mexico DPS								●	●
Toothed Whales									
Delphinapterus leucas, Beluga, Cook Inlet DPS									●
Delphinapterus leucas, Beluga, Beaufort Sea Stock							●	●	
Delphinapterus leucas, Beluga, Bristol Bay Stock								●	
Delphinapterus leucas, Beluga, Eastern Bering Sea Stock								●	
Delphinapterus leucas, Beluga, Eastern Chukchi Sea Stock							●	●	
Physeter macrocephalus, Sperm Whale, North Pacific (NP) Stock								●	●
Berardius bairdii, Baird's Beaked Whale, Alaska Stock									●
Mesoplodon stejnegeri, Stejneger's Beaked Whale, Alaska Stock							●	●	
Ziphius cavirostris, Cuvier's Beaked Whale, Alaska Stock									●

Appendix D. Continued.

SGCN	BIOGEOGRAPHIC REGIONS[1]								
	SE	SC	C	SW	W	N	BCS	BER	GOA
Dolphins and Porpoises									
Sagmatias obliquidens, Pacific White-sided Dolphin, NP Stock								●	●
Phocoena phocoena, Harbor Porpoise—all stocks on the list	●						●	●	●
Phocoenoides dalli, Dall's Porpoise, Alaska Stock								●	●

[1] SE = Southeast, SC = Southcentral, C = Central, SW = Southwest, W = Western, N = Northern, BCS = Beaufort/Chukchi Seas, BER = Bering Sea, GOA = Gulf of Alaska. See also Chapter 5, Figure 5.1.

[2] Taxonomy of this species in Alaska has changed to McKay's Bumblebee *(Bombus mckayi*; Williams 2021). https://www.tandfonline.com/doi/full/10.1080/00222933.2021.1900444

[3] Five species of demersal rockfish also occur in the BCS biogeographic region, in addition to BER and GOA.

Appendix E. Alaska population estimates for "species of greatest conservation need" (SGCN). Population size in Alaska for most SGCN is unknown, or very approximate. Estimates that report to the individual animal (e.g., 10, 209, 160, 235) are the result of quantitative surveys, and have greater reliability than rounded numbers.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Alder Flycatcher	*Empidonax alnorum*	23,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Aleutian Tern	*Onychoprion aleuticus*	5,529	Renner, H. M., M. D. Romano, M. Renner, et al. 2015. Assessing the breeding distribution and population trends of the Aleutian Tern Onychoprion aleutica. Marine Ornithology 43:179–187.
American Golden-Plover	*Pluvialis dominica*	290,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
American Kestrel	*Falco sparverius*	17,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
American Pipit	*Anthus rubescens*	190,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
American Redstart	*Setophaga ruticilla*	78,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
American Tree Sparrow	*Spizelloides arborea*	9,600,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Arctic Warbler	*Phylloscopus borealis*	8,200,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Bank Swallow	*Riparia riparia*	1,200,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Barn Swallow	*Hirundo rustica*	39,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Bar-tailed Godwit *(baueri)*	*Limosa lapponica baueri*	90,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Bearded Seal, Beringia DPS	*Erignathus barbatus nauticus*	301,836	Muto, M. M., V. T. Helker, B. J. Delean, et al. 2021. Alaska marine mammal stock assessments, 2020. https://doi.org/10.25923/yn3s-n786 (Accessed on 1/8/2025).
Beluga, Cook Inlet DPS	*Delphinapterus leucas*	279	Young, N. C., Brower, A. A., Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Black Brant, Pacific	*Branta bernicla nigricans*	245,172[2]	U.S. Fish and Wildlife Service. 2025. Pacific Flyway Data Book, 2025. U.S. Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Pacific Flyway Office, Washington D.C.
Black Guillemot	*Cepphus grylle*	700	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Black-backed Woodpecker	*Picoides arcticus*	25,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Black-bellied Plover	*Pluvialis squatarola*	261,144	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.

Appendix E. Continued.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Black-capped Chickadee	*Poecile atricapillus*	1,700,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Black-legged Kittiwake	*Rissa tridactyla*	1,300,000	Hatch, S. A., G. J. Robertson, and P. H. Baird. 2020. Black-legged Kittiwake *(Rissa tridactyla)*, version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.
Blackpoll Warbler	*Setophaga striata*	14,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Bohemian Waxwing	*Bombycilla garrulus*	540,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Boreal Chickadee	*Poecile hudsonicus*	3,200,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/. Accessed on 1/8/2031
Bowhead Whale, Western Arctic Stock	*Balaena mysticetus*	15,227	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Bristle-thighed Curlew	*Numenius tahitiensis*	10,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Brown Creeper	*Certhia americana*	580,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. hhttps://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Buff-breasted Sandpiper	*Calidris subruficollis*	14,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Canada Jay	*Perisoreus canadensis*	4,600,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Cassin's Auklet	*Ptychoramphus aleuticus*	473,000	Gotthardt, T. A., K. M. Walton, and T. L. Fields. 2012. Setting Conservation Priorities for Alaska's Wildlife Action Plan. Alaska Natural Heritage Program, University of Alaska Anchorage, AK
Cedar Waxwing	*Bombycilla cedrorum*	63,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Chestnut-backed Chickadee	*Poecile rufescens*	3,200,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. http://pif.birdconservancy.org/PopEstimates (Accessed on 1/8/2025).
Common Murre	*Uria aalge*	2,800,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Crested Auklet	*Aethia cristatella*	3,000,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Dark-eyed Junco	*Junco hyemalis*	57,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Dunlin, Arctic	*Calidris alpina arcticola*	475,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Dunlin, Pacific	*Calidris alpina pacifica*	550,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.

Appendix E. Continued.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Emperor Goose	*Anser canagicus*	18,788[3]	Frost, C. J., D. E. Safine, J. B. Fischer, and E. E. Osnas. 2024. Emperor Goose Population Index Update. U.S. Fish and Wildlife Service, Migratory Bird Management, Alaska Region.
Fork-tailed Storm-Petrel	*Hydrobates furcatus*	3,200,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Fox Sparrow	*Passerella iliaca*	16,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Glaucous Gull	*Larus hyperboreus*	100,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Glaucous-winged Gull	*Larus glaucescens*	250,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Golden-crowned Kinglet	*Regulus satrapa*	13,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Goshawk, American	*Astur atricapillus*	69,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Gray-cheeked Thrush	*Catharus minimus*	18,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Great Gray Owl	*Strix nebulosa*	5,700	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Greater Yellowlegs	*Tringa melanoleuca*	36,990	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Gray-headed Chickadee	*Poecile cinctus*	Unknown, likely not more than a few thousand	Booms, T. L., L. H. DeCicco, C. P. Barger, and J. A. Johnson. 2020. Current Knowledge and Conservation Status of the Gray-Headed Chickadee in North America. Journal of Fish and Wildlife Management 11: 654-664.
Gyrfalcon	*Falco rusticolus*	8,300	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/
Harbor Porpoise, Gulf of Alaska Stock	*Phocoena phocoena*	31,046	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Harbor Porpoise, Southeast Alaska Stock	*Phocoena phocoena*	2,509	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Harbor Seal, Pacific	*Phoca vitulina richardii*	243,938	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Hermit Thrush	*Catharus guttatus*	8,400,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Horned Lark	*Eremophila alpestris*	220,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).

Appendix E. Continued.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Horned Puffin	*Fratercula corniculata*	900,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Hudsonian Godwit	*Limosa haemastica*	21,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Humpback Whale, Western North Pacific DPS	*Megaptera novaeangliae*	1,084	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Killdeer	*Charadrius vociferus*	20,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Kittlitz's Murrelet	*Brachyramphus brevirostris*	33,583	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Lapland Longspur	*Calcarius lapponicus*	9,700,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Least Auklet	*Aethia pusilla*	5,500,000–9,000,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Least Sandpiper	*Calidris minutilla*	266,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Lesser Yellowlegs	*Tringa flavipes*	158,400	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Lincoln's Sparrow	*Melospiza lincolnii*	12,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Long-billed Dowitcher	*Limnodromus scolopaceus*	487,500	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Macgillivray's Warbler	*Geothlypis tolmiei*	97,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Marbled Godwit (*beringiae*)	*Limosa fedoa beringiae*	2,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Marbled Murrelet	*Brachyramphus marmoratus*	859,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Mckay's Bunting	*Plectrophenax hyperboreus*	19,481	Richardson, R. M., C. L. Amundson, J. A. Johnson, et al. 2024. Rapid population decline in McKay's Bunting, an Alaskan endemic, highlights the species' current status relative to international standards for vulnerable species. Ornithological Applications 126:1–12.
North Pacific Right Whale, Eastern North Pacific Stock	*Eubalaena japonica*	31	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Northern Fulmar	*Fulmarus glacialis*	1,400,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Northern Fur Seal, Eastern Pacific Stock	*Callorhinus ursinus*	626,618	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.

Appendix E. Continued.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Northern Sea Otter, Southwest Alaska Stock	*Enhydra lutris kenyoni*	51,935	U.S. Fish and Wildlife Service. 2023. Northern Sea Otter Stock Assessment Report Soutwest Alaska. https://www.fws.gov/sites/default/files/documents/Northern-Sea-Otter-Stock-Assessment-Report-Southwest-Alaska-2023.pdf (accessed 1/8/2025).
Northern Wheatear	*Oenanthe oenanthe*	78,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Olive-sided Flycatcher	*Contopus cooperi*	430,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Orange-crowned Warbler	*Leiothlypis celata*	31,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Pacific Golden-Plover	*Pluvialis fulva*	42,500	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Pacific Walrus	*Odobenus rosmarus*	257,193	U.S. Fish and Wildlife Service. 2023. Pacific Walrus Stock Assessment Report. https://www.fws.gov/sites/default/files/documents/Pacific-Walrus-Stock-Assessment-Report-2023.pdf (accessed 1/8/2025)
Pacific White-sided Dolphin, North Pacific Stock	*Sagmatias obliquidens*	26,880	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Pacific Wren	*Troglodytes pacificus*	2,900,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Parakeet Auklet	*Aethia psittacula*	1,000,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Pectoral Sandpiper	*Calidris melanotos*	1,142,400	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Pigeon Guillemot	*Cepphus columba*	49,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Pine Grosbeak	*Pinicola enucleator*	1,200,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Pine Siskin	*Spinus pinus*	4,100,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Polar Bear, Southern Beaufort Sea Stock	*Ursus maritimus*	900	U.S. Fish and Wildlife Service. 2019. Polar bear southern beaufort sea stock assessment report. https://www.fws.gov/sites/default/files/documents/polar-bear-southern-beaufort-sea-stock-assessment-report-may-2019.pdf
Red Knot, Pacific	*Calidris canutus roselaari*	16,786	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Red-legged Kittiwake	*Rissa brevirostris*	210,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Red-necked Phalarope	*Phalaropus lobatus*	1,250,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.

Appendix E. Continued.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Redpoll	*Acanthis flammea*	56,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Red-tailed Hawk	*Buteo jamaicensis*	21,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Red-winged Blackbird	*Agelaius phoeniceus*	21,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Ribbon Seal	*Histriophoca fasciata*	184,697	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Rock Ptarmigan	*Lagopus muta*	590,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Rock Sandpiper, Aleutian	*Calidris ptilocnemis couesi*	75,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Rock Sandpiper, Pribilof	*Calidris ptilocnemis ptilocnemis*	19,800	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Rough-legged Hawk	*Buteo lagopus*	57,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Ruby-crowned Kinglet	*Corthylio calendula*	9,700,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Rufous Hummingbird	*Selasphorus rufus*	4,500,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Rusty Blackbird	*Euphagus carolinus*	920,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Sanderling	*Calidris alba*	2,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Savannah Sparrow	*Passerculus sandwichensis*	41,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Semipalmated Sandpiper	*Calidris pusilla*	1,450,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Sharp-tailed Sandpiper	*Calidris acuminata*	14,400	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Short-billed Dowitcher (*caurinus*)	*Limnodromus griseus caurinus*	60,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Short-eared Owl	*Asio flammeus*	130,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Short-tailed Albatross	*Phoebastria albatrus*	<2,000 globally	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.

Appendix E. Continued.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Solitary Sandpiper (*cinnamomea*)	*Tringa solitaria cinnamomea*	49,770	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Song Sparrow	*Melospiza melodia*	910,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Spectacled Eider	*Somateria fisheri*	~369,000	USFWS. 2021. Species Status Assessment for the Spectacled Eider. US Fish and Wildlife Service, Fairbanks Field Office, Fairbanks, Alaska.
Spotted Sandpiper	*Actitis macularius*	132,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Spotted Seal, Bering Stock	*Phoca largha*	461,625	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Steller Sea Lion, Western DPS	*Eumetopias jubatus*	49,837	Young, N. C., A. A. Brower, M. M. Muto, et al. 2024. Alaska marine mammal stock assessments, 2023. U.S. Department of Commerce, NOAA technical Memorandum NMFS-AFSC-493, 327 p.
Stilt Sandpiper	*Calidris himantopus*	124,370	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Surfbird	*Calidris virgata*	56,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Thick-billed Murre	*Uria lomvia*	2,200,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Townsend's Warbler	*Setophaga townsendi*	6,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Tree Swallow	*Tachycineta bicolor*	990,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Tufted Puffin	*Fratercula cirrhata*	2,300,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Upland Sandpiper	*Bartramia longicauda*	7,500	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Vaux's Swift	*Chaetura vauxi*	1,200	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Violet-green Swallow	*Tachycineta thalassina*	410,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Wandering Tattler	*Tringa incana*	9,975	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Western Sandpiper	*Calidris mauri*	3,325,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Western Wood-Pewee	*Contopus sordidulus*	150,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).

Appendix E. Continued.

Species (or subspecies, stock, DPS[1])	Latin name	Population estimate	Citation
Whimbrel (*hudsonicus*)	*Numenius phaeopus hudsonicus*	38,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Whiskered Auklet	*Aethia pygmaea*	116,000	U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 136 pp.
Willow Ptarmigan	*Lagopus lagopus*	6,400,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).
Wilson's Snipe	*Gallinago delicata*	500,000	Alaska Shorebird Group. 2019. Alaska Shorebird Conservation Plan. Version III. Alaska Shorebird Group, Anchorage, AK.
Wilson's Warbler	*Cardellina pusilla*	35,000,000	Partners in Flight. 2025. Population Estimates Database, version 3.1. https://pif.birdconservancy.org/population-estimate-database-scores/ (Accessed on 1/8/2025).

1 DPS = distinct population segment.

2 Pacific Brant Fall Photographic Survey at Izembek Lagoon, estimate of Brant in fall including breeders from Russia and Canada.

3 Survey index from Yukon-Kuskokwim Delta only (not a total population count).

Appendix F. Detailed habitat descriptions and distribution maps for terrestrial, freshwater, and coastal habitats in Alaska. The habitats discussed below, except for Rivers and Streams, Lakes and Ponds, and Freshwater Aquatic Vegetation are based on the draft Alaska Vegetation Map (Nawrocki et al. 2025) at the Macrogroup level of the U.S. National Vegetation Classifica-tion (USNVC Version 3.0).

FOREST AND WOODLANDS

Temperate Coastal Rainforest

USNVC Synonym: Vancouverian Coastal Rainforest (M024)

Figure F1. Distribution of temperate coastal rainforest in Alaska.

Physiognomy:
Temperate coastal rainforests are productive needleleaf forests comprised of full-stature trees. Stands develop over a broad elevational range from sea level to the subalpine. Canopy cover ranges from open with a well-developed deciduous shrub understory to closed with a species poor understory of pocket wetlands and bryophyte carpets.

Floristics:
Canopies are codominated by Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*). Sitka spruce is more common on sites prone to disturbance or receiving salt spray and occurs throughout the range. Western hemlock and Alaska cedar (*Callitropsis nootkatensis*) are present throughout Southeast Alaska and westward to Prince William Sound, with western red cedar (*Thuja plicata*) restricted to the southern half of Southeast. Alaska cedar abundance increases in wetter sites. Subalpine fir (*Abies lasiocarpa*) occurs in limited areas usually associated with mainland corridors through which cold air drains from inland, continental climates. Mountain hemlock (*Tsuga mertensiana*) is common at mid- to higher elevations with deeper snow in the Southeast biogeographic region and largely replaces Western hemlock, even at lower elevations, in the Southcentral biogeographic region. Characteristic understory shrubs include blueberries (*Vaccinium ovalifolium, Vaccinium alaskaense)*, huckleberry (*Vaccinium parvifolium*), rusty menziesia (*Rhododendron menziesii*), and devilsclub (*Oplopanax horridus*). Forbs (*Circaea alpina*, *Maianthemum dilatatum*, *Tiarella trifoliata, Streptopus amplexifolius*), ferns (*Athyrium filix-femina, Dryopteris expansa, Gymnocarpium dryopteris, Struthiopteris spicant*), and bryophytes (*Hylocomium splendens*, *Rhytidiadelphus loreus*) are common components of the lower strata. Epiphytic, arboreal lichens (*Usnea lapponica, Bryoria capillaris*, *Alectoria sarmentosa*) can be abundant in this habitat type.

Appendix F. Continued.

Range:
Forming a near continuous band through the Southeast and Southcentral biogeographic regions, rimming the Gulf of Alaska and extending to upper islands of the Kodiak Archipelago (Figure F1). This habitat has also been mapped sparingly in the Southwest and Central regions.

Climate:
The maritime climate is cool in the summer and mild in the winter with low annual variation in temperature. Precipitation as rain, snow, and fog drip is abundant.

Environment:
Occurring along mountain sideslopes, footslopes, valleys, and less commonly, on beach ridges from sea level to the subalpine. Terrain slope, or in the case of beach ridges, sandy substrates, impart good drainage. Wet pockets may develop in mature forests with pit and mound topography.

Disturbance:
Timber harvest is the primary large-scale disturbance. At the local scale, windthrow is a driver of secondary gap succession, avalanche and landslides control the extent of the habitat type, with pests and pathogens affecting forest health. Alaska cedar is experiencing increasing occurrence of mortality, due to shallow roots freezing because of insufficient insulation by snow. This phenomenon is attributed to a greater proportion of precipitation falling as rain, rather than snow in the winter months.

Temperate Subalpine Woodland

USNVC Synonym: Vancouverian Subalpine-High Montane Forest (M025)

Figure F2. Distribution of temperate subalpine woodland in Alaska.

Physiognomy:
Temperate subalpine woodlands form as treeline communities of needleleaf forest interspersed with thickets of tall deciduous shrubs, dwarf shrub heaths, and herb meadows. Expression on the landscape ranges, with increasing elevation, from open forest, to tree islands, to woodlands. Trees become dwarf or krummholz at the upper elevational limit of growth and in exposed sites.

Appendix F. Continued.

Floristics:
Subalpine-high montane forests and woodlands are dominated by mountain hemlock (*Tsuga mertensiana*) in the Southeast and Southcentral biogeographic regions; subalpine fir (*Abies lasiocarpa*) may occur as a codominant species on karst topographies or along corridors of cold air drainage in the Southeast. Thickets of low shrubs including copperbush (*Elliottia pyroliflora*), blueberries (*Vaccinium ovalifolium, Vaccinium alaskaense*), and rusty menziesia (*Rhododendron menziesii*) often skirt the isolated stands of trees. Dwarf shrub heaths and herb meadows grow among these tree islands. Heaths are comprised of ericaceous and other dwarf shrubs including crowberry (*Empetrum nigrum*), Alaska bellheather (*Harrimanella stelleriana),* partridgefoot (*Luetkea pectinata),* Aleutian mountainheath (*Phyllodoce aleutica*), and western moss heather (*Cassiope mertensiana*). Herb meadows are comprised of a diversity of forbs (*Nephrophyllidium crista-galli*, *Geum calthifolium, Cornus canadensis*, *Erigeron peregrinus*), ferns (*Dryopteris expansa*, *Gymnocarpium dryopteris*, *Struthiopteris spicant*), and graminoids (*Carex microchaeta, Festuca altaica, Hierochloë alpina*).

Range:
Occurring in subalpine and montane settings throughout the Southeast biogeographic region and continuing westward through Southcentral to Cook Inlet and the Kenai Peninsula (Figure F2). This subalpine habitat has also been mapped sparingly in the Central region.

Climate:
This habitat type spans maritime and boreal-maritime transitional climates where the extreme conditions present at high-elevations often override the influence of regional climate. Summers are short and cool and winters are long and cool with abundant wet snow.

Environment:
Developing on mountain sideslopes, basins, and ridges, extending from the subalpine to treeline. Most common at upper elevations that are exposed to cold temperatures and desiccating winds, but also developing at lower elevations in areas of cold air drainage. Heavy, late-lying snowpack restricts tree establishment, which contributes, in part, to the patchiness of the habitat type at elevational limits. Soils are often thin and coarse-textured over shallow bedrock.

Disturbance:
Avalanche and landslide tend to control local extent, with small-scale windthrow driving stand dynamics in open canopies.

Appendix F. Continued.

Boreal Forest

USNVC Synonym: Alaskan-Yukon North American Boreal Forest (M156)

Figure F3. Distribution of boreal forest in Alaska.

Physiognomy:
Boreal forests occur as mixed needleleaf-broadleaf closed to open forests, with a dwarf to low shrub understory with forbs and graminoids. Lichens and feathermosses are important on dry and mesic sites, respectively.

Floristics:
Forests and woodlands dominated by white spruce (*Picea glauca*), black spruce (*Picea mariana*), Alaska birch (*Betula neoalaskana*), and quaking aspen (*Populus tremuloides*), with tamarack (*Larix laricina*), and balsam poplar (*Populus balsamifera*) occasionally present. Towards the southern, boreal-temperate transition, Alaska birch may be replaced by Kenai birch (*Betula kenaica*) and white spruce may be replaced by Lutz spruce (*Picea* × *lutzii*), a hybrid of white and Sitka spruce.

Canopy and understory species composition follows a moisture and productivity gradient. The driest stands, often developing on warm, south-facing slopes tend to be dominated by quaking aspen with an open understory of shrubs including kinnikinnick *(Arctostaphylos uva-ursi*), prickly rose *(Rosa acicularis)*, and buffaloberry *(Shepherdia canadensis)*. Characteristic forbs include fireweed *(Chamaenerion angustifolium)*, subalpine aster *(Eurybia sibirica)*, and northern bedstraw *(Galium boreale)*.

More mesic, low productivity stands often developing on cold, north-facing slopes or over shallow permafrost, tend to be dominated by black spruce with a dwarf and low shrub understory of crowberry *(Empetrum nigrum)*, bog blueberry *(Vaccinium uliginosum)*, and dwarf birch *(Betula nana)*. Feathermosses (*Hylocomium splendens, Pleurozium schreberi*) and lichens in the *Cladonia* genus are important ground covers.

Mesic, moderately productive stands developing on comparatively warmer sites tend to be dominated by white spruce, with black spruce, Alaska birch, quaking aspen, balsam poplar, and tamarack occasionally subdominant. Characteristic shrub associates include deciduous species such as Siberian alder (*Alnus alnobetula* ssp. *fruticosa*), resin birch *(Betula glandulosa)*, dwarf birch, prickly rose, and shorter stature ericaceous shrubs including marsh and bog Labrador tea (*Rhododendron tomentosum* ssp. *decumbens* and *Rhododendron groenlandicum*), crowberry, bog blueberry, and lingonberry *(Vaccinium vitis-idaea)*. The

Appendix F. Continued.

herbaceous layer is sparse and often species poor. Common species include bluejoint reedgrass (*Calamagrostis canadensis*), horsetails (*Equisetum arvense, Equisetum sylvaticum*), oakfern (*Gymnocarpium dryopteris*), and false toadflax (*Geocaulon lividum*). Feathermosses (*Hylocomium splendens, Pleurozium schreberi, Abietinella abietina*) are important groundcovers.

Moist, productive stands developing toward the boreal temperate transition, which are rarely underlain by permafrost, may be codominated by white or Lutz spruce and Alaska or Kenai birch; mountain hemlock (*Tsuga mertensiana*) may codominate with Lutz spruce where their ranges overlap, and balsam poplar may be replaced by cottonwood (*Populus trichocarpa*). The understory becomes more typical of coastal maritime forests, with taller, deciduous shrub species such as highbush cranberry (*Viburnum edule*), rusty menziesia (*Rhododendron menziesii*), devilsclub (*Oplopanax horridus*), and blueberry (*Vaccinium ovalifolium*) becoming more common. Forb and fern diversity is high. Additional to species characteristic of mesic boreal stands, fireweed (*Chamerion angustifolium*), bluebells (*Mertensia paniculata*), woolly geranium (*Geranium erianthum*), lady fern (*Athyrium filix-femina*), and woodfern (*Dryopteris expansa*) are characteristic.

Range:
A common and widespread habitat type centered in the Central and Southcentral biogeographic regions, extending into Western and Southwest regions to the longitudinal limit of trees (Figure F3). Boreal forests have also been mapped sparingly in the Southeast and Northern regions.

Climate:
The boreal climate has long, very cold winters, allowing persistence of snow cover during all but the brief, relatively warm summer season. Annual variation in temperature is broad and total annual precipitation is relatively low. Physiological processes are often temperature controlled, although soil moisture and aspect play a role, with south-facing slopes receiving more direct solar radiation and north-facing slopes more likely to be underlain by permafrost.

Environment:
Developing on mountain sides, in broad valleys and across rolling hills and flat terrain. Soils are variable, ranging from well-drained coarse-grained mineral soils on hillsides to moderately drained loams in the lowlands. Permafrost is largely discontinuous in the north and absent in the south.

Disturbance:
The disturbance regime is characterized by large crown fires, though other disturbances, such as insect infestation and blowdown are common. Spruce beetle (*Dendroctonus rufipennis*) infestations are a major natural disturbance of spruce forests.

Appendix F. Continued.

Boreal Subalpine and Subarctic Woodland

USNVC Synonym: North American Northern Boreal Woodland (M179)

Figure F4. Distribution of boreal subalpine and subarctic woodland in Alaska.

Physiognomy:

Boreal woodlands occur as sparse to open stands comprised of short stature needleleaf and or broadleaf trees, a low to dwarf shrub understory, with lower strata comprised of forbs, lichens and bryophytes and a variable contribution of graminoids. In areas of treeline expansion, trees are evenly distributed and display normal growth forms. In areas of treeline regression, or at the limit of a species' climatic tolerance, trees may be stunted or contorted.

Floristics:

Stands tend to be dominated by white spruce (*Picea glauca*), however, black spruce (*Picea mariana*), Alaska birch (*Betula neoalaskana*), and balsam poplar (*Populus balsamifera*) may co-occur or assume dominance. The abundance of black spruce increases in nutrient-poor, mesic soils underlain by ice-rich and shallow permafrost. Alaska birch increases abundance with maritime influence and may be replaced by Kenai birch (*Betula kenaica*) towards the boreal-temperate transition. Balsam poplar often occurs on south-facing slopes within or beyond the limit of white spruce. Low deciduous shrubs including grayleaf willow (*Salix glauca*), Richardson's willow (*Salix richardsonii*), Bebb willow (*Salix bebbiana*), and resin birch (*Betula glandulosa)* are common in the understory where either a more developed tree canopy or terrain provides protection from desiccating winds and/or insulation from low temperatures. Similar to trees, the shrub understory becomes dwarfed where exposure increases. In these less-protected sites, dwarf birch (*Betula nana*), and the ericaceous species marsh labrador tea *(Rhododendron tomentosum* ssp. *decumbens)***,** crowberry *(Empetrum nigrum)*, bog blueberry (*Vaccinium uliginosum*), and lingonberry (*Vaccinium vitis-idaea*) are characteristic of the shrub stratum. Also depending on site productivity, composition of the herbaceous stratum varies from graminoid- to forb-rich. Tussock cottongrass (*Eriophorum vaginatum*) and Bigelow's sedge (*Carex bigelowii*) may be abundant in subarctic sites. Bryophytes and lichens are abundant in this habitat type with lichens increasing with greater site exposure and drainage. Common mosses include splendid feather moss (*Hylocomium splendens*) and *Sphagnum* species, with lichens, primarily *Cladonia* spp., *Stereocaulon* spp., *Nephroma arcticum, Peltigera* spp., and *Cetraria* spp., becoming an important component of the understory in mature stands.

Appendix F. Continued.

Range:
Occurring in treeline and cold-soil settings throughout all six biogeographic regions but primarily in the Central, Western, and Southwest regions (Figure F4).

Climate:
The boreal continental climate is characterized by short, warm summers and long, very cold winters. Permafrost is nearly continuous, which contributes to slow tree growth and open canopies.

Environment:
As treelines can be limited by elevation, latitude, or longitude, this habitat type develops at the transition from subalpine to alpine habitat in the mountains, from subarctic to Arctic habitat in northern and western Alaska. Subalpine woodlands may occupy a narrow elevational band whereas subarctic woodlands may occupy a wide latitudinal or longitudinal expanse of many kilometers. Woodlands also develop in nontreeline settings where soils are abnormally cold due to shallow permafrost or cold air drainage. Soils are either thin, rocky and well-drained, developing on residual bedrock and hillside colluvium or mesic and nutrient poor, underlain by ice-rich permafrost.

Disturbance:
The expression of boreal woodlands on the landscape is largely dependent on climate, and the associated frequent presence of permafrost. Regional change in temperature and precipitation can cause expansion or contraction of treeline, or aggradation or degradation of permafrost. Where climate becomes milder, woodlands are likely to transition to forest or shrubland and extend their range. For example, in response to a changing climate, treeline is advancing throughout boreal Alaska and extending into the low Arctic in the western Brooks Range. Where climate becomes more extreme, subalpine and subarctic woodlands are likely to transition to alpine and Arctic tundra, respectively. Wildland fire is a common disturbance in boreal ecosystems. Depending on the severity and scale of a burn, woodlands may revert to grasslands or shrublands. Subalpine sites may be susceptible to avalanche.

FLOODPLAIN FORESTS

Temperate Floodplain Forest

USNVC Synonym: Vancouverian Flooded & Swamp Forest (M035)

Figure F5. Distribution of temperate floodplain forests in Alaska.

Appendix F. Continued.

Physiognomy:
Temperate floodplain forests form broad mosaics across floodplains of high-volume rivers and narrow corridors along smaller streams. Structure varies from mixed needleleaf-broadleaf floodplain forests, to young broadleaf forests along riparian corridors. Tall to low deciduous broadleaf shrub understories are associated with frequently disturbed floodplain and riparian sites while forbs occupy more stable substrates.

Floristics:
In temperate floodplain forests, plant community composition is largely dependent on the source of floodwaters. Glacially-fed rivers are characterized by large-scale and frequent flood events with high sediment input. In these areas, species that can tolerate inundation and sedimentation establish. Canopies are typically dominated by black cottonwood (*Populus trichocarpa*) and red alder (*Alnus rubra*) with Sitka spruce (*Picea sitchensis*) gaining dominance as the community matures. In the understory, Sitka alder (*Alnus alnobetula* ssp. *sinuata*) occupies the most frequently disturbed sites with forbs, including threeleaf foamflower (*Tiarella trifoliata*), enchanter's nightshade (*Circaea alpina*), pioneer violet (*Viola glabella*), and twisted stalk (*Streptopus amplexifolius*) indicating aerated, nutrient-rich soils with good water flow.

Nonglacial streams experience smaller-scale and less frequent overbank flooding. Along these riparian corridors, the forest canopy is dominated by Sitka spruce with red alder establishing. Characteristic understory shrubs include salmonberry (*Rubus spectabilis*), devilsclub (*Oplopanax horridus*), redosier dogwood (*Cornus sericea*), and stink currant (*Ribes bracteosum*). On the most stable sites, western hemlock (*Tsuga heterophylla*) can establish in the subcanopy but does not assume dominance. Forbs such as skunkcabbage (*Lysichiton americanus*), false lily of the valley (*Maianthemum dilatatum*), and lady fern (*Athyrium filix-femina*) grow on organic-rich or poorly-drained substrates.

Range:
Occurring in settings prone to riverine flooding in the Southeastern biogeographic region; continuing westward through Southcentral to Cook Inlet and the Kenai Peninsula (Figure F5).

Climate:
The maritime climate is cool in the summer and mild in the winter with low annual variation in temperature. Precipitation as rain, snow, and fog drip is abundant.

Environment:
This habitat type develops on well-drained soils subject to overbank flooding. Flooding regimes range from narrow extents driven by precipitation events along low-volume streams to broad-scale seasonal floods driven by glacial runoff and snowmelt. Glacially-fed rivers occur primarily on the mainland, while nonglacially-fed rivers occur on both the mainland and large islands in the Gulf of Alaska. Soils are alluvial, well-drained, and poorly developed. Sand, gravel, or cobble are characteristic of the active floodplain, with finer silts and clays in lower energy depositional environments. Woody debris provides important regeneration sites for spruce and hemlock seedlings.

Disturbance:
Flooding and the associated erosion and redeposition of sediment are the primary disturbances. Along small, low-energy streams, seasonal overbank flooding will deposit fine, often nutrient rich, sediment. Alternatively, spring breakup along glacially-fed rivers are high-energy events resulting in channel migration and occasionally, catastrophic damage to the built environment.

Appendix F. Continued.

Boreal Floodplain Forest

USNVC Synonym: North American Boreal Flooded & Rich Swamp Forest (M300)

Figure F6. Distribution of boreal floodplain forest in Alaska.

Physiognomy:
Boreal floodplain forests form broad mosaics across floodplains of high-volume rivers and narrow corridors along smaller streams. The forest canopy is dominated by broadleaf or needleleaf trees, or a mixture of both. Tall to low deciduous broadleaf shrub understories are associated with frequently disturbed floodplain settings.

Floristics:
Plant community composition depends on the extent, duration, and frequency of flooding. New alluvial surfaces are pioneered by early-seral herbaceous species such as subalpine aster (*Eurybia sibirica*), alpine sweetvetch (*Hedysarum americanum*), blacktip ragwort (*Senecio lugens*), and field horsetail (*Equisetum arvense*). Mid-seral woody shrubs, such as feltleaf willow (*Salix alaxensis*), and alder species establish next. Thinleaf alder (*Alnus incana* ssp. *tenuifolia*) occurs across the region, Siberian alder (*Alnus alnobetula* ssp. *fruticosa*) is more common to the north, and Sitka alder (*Alnus alnobetula* ssp. *sinuata*) is more common in the south. Trees establish as the communities mature and the tall-shrub component is gradually shaded out. Mid-seral floodplain forests are dominated or codominated by balsam poplar (*Populus balsamifera*) and white spruce (*Picea glauca*) with an understory of alder and willow shrubs, bluejoint reedgrass (*Calamagrostis canadensis*), and bryophytes. Black cottonwood (*Populus trichocarpa*) and Lutz spruce (*Picea* × *lutzii*) may replace balsam poplar and white spruce towards the south. Balsam poplar does not regenerate in the understory, and consequently white spruce gains dominance on older surfaces. Here, common understory species include prickly rose (*Rosa acicularis*), highbush cranberry (*Viburnum edule*), twinflower (*Linnaea borealis*), wintergreen (*Pyrola* spp.), and bunchberry dogwood (*Cornus canadensis*). Feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and lichens such as *Peltigera* spp. also occur on these older floodplain surfaces.

Range:
Occurring in settings prone to riverine flooding in the Central, Western, and Southwest biogeographic regions (Figure F6). This habitat has also been mapped sparingly in the Southcentral region.

Appendix F. Continued.

Climate:
The boreal continental climate is characterized by short, warm summers and long, very cold winters. Although permafrost is nearly continuous in the region, the capacity of water to hold heat depresses the elevation of permanently frozen ground along large rivers. Local conditions related to the deep seasonal thaw of soils in combination with the extreme effects of flooding often override the influence of regional climate.

Environment:
This habitat type develops on well-drained soils subject to overbank flooding. Flooding regimes range from narrow extents driven by precipitation events along low-volume streams to broad-scale seasonal floods driven by glacial runoff, snowmelt, and the breakup of river ice. Soils are alluvial, well-drained, and poorly developed. Sand, gravel, or cobble are characteristic of the active floodplain, with finer silts and clays in lower energy depositional environments. Permafrost is usually deep or absent.

Disturbance:
Flooding and the associated erosion and redeposition of sediment are the primary disturbances. Along small, low-energy streams, seasonal overbank flooding will deposit fine, often nutrient rich, sediment. Alternatively, spring breakup along glacially-fed rivers are high-energy events resulting in channel migration and occasionally, catastrophic damage to the built environment. Ice dams and ice scour are important disturbance dynamics that can affect large areas, primarily along larger rivers. Fire frequency in floodplain systems is less than that of the surrounding terrain as channels can act as firebreaks and early-seral vegetation is less flammable than the surrounding, mature boreal forest.

FRESHWATER WETLANDS

Temperate Forested Wetland

USNVC Synonyms: North Pacific Bog (M559)

Figure F7. Distribution of temperate forested wetland in Alaska.

Physiognomy:
Temperate forested wetlands occur as dwarf needleleaf woodlands in bog and fen settings and as full-stature, closed canopy stands of needleleaf trees. Woodland bogs are characterized by dwarf ericaceous shrubs and

Appendix F. Continued.

bryophytes in the understory while woodland fens support low deciduous shrubs and a diversity of forbs and graminoids. Mature wetland forests are characterized by tall needleleaf trees and a discontinuous low to tall broadleaf shrub understory punctuated by wetter pockets of obligate wetland species; bryophytes can provide a nearly continuous groundcover.

Floristics:

Bogs and fens differ in the source and flow of their water inputs. Bogs, which receive most of their water from nutrient-poor precipitation, have minimal throughflow of groundwater, resulting in acidic conditions, which in turn, favors the establishment of slow-growing plants such as ericaceous shrubs and *Sphagnum* moss. Conversely, fens receive water inputs from the throughflow of more nutrient-rich groundwater, resulting in circumneutral to alkaline conditions that promote a diverse growth of productive plants, such as deciduous shrubs, forbs, and brown mosses.

Woodland bogs and fens, known colloquially as 'muskeg', are characterized by a mosaic of trees, low shrubs, herbs, mosses, and standing water across hummocky topography. Conifers capable of growing in saturated conditions such as beach pine (*Pinus contorta* var. *contorta*), western hemlock (*Tsuga heterophylla*), mountain hemlock (*Tsuga mertensiana*), Alaska cedar (*Callitropsis nootkatensis*), and Sitka spruce (*Picea sitchensis*) are common species. Trees, together with other low and dwarf shrubs, occupy the higher, better drained ground with herbaceous species and bryophytes relegated to the wetter hollows.

In bog settings, the shrub understory is dominated by ericaceous shrubs including bog labrador tea (*Rhododendron groenlandicum*), bog blueberry (*Vaccinium uliginosum),* and crowberry (*Empetrum nigrum*). Forbs, including cloudberry (*Rubus chamaemorus*), burnet (*Sanguisorba officinalis*), sticky tofieldia (*Triantha glutinosa*), roundleaf sundew (*Drosera rotundifolia*), deercabbage (*Nephrophyllidium crista-galli*), and sedges such as tufted bulrush (*Trichophorum cespitosum*), fewflower sedge (*Carex pauciflora*), livid sedge (*Carex livida*), Arctic sedge (*Carex anthoxanthea*), manyflower sedge (*Carex pluriflora*), and variegated sedge (*Carex stylosa*) are interspersed. *Sphagnum* mosses are common in depressions and at water margins.

Woodland fens differ in supporting a greater diversity of species, many of which are calciphytes. While many taxa are common to both woodland bogs and fens, fens typically lack beach pine, ericaceous shrubs, and *Sphagnum* mosses. Woody species characteristic of fens include small trees and shrubs such as crab apple (*Malus fusca*), redosier dogwood (*Cornus sericea*), sweetgale (*Myrica gale*), and alpine laurel (*Kalmia microphylla*). The forbs: buckbean (*Menyanthes trifoliata*), darkthroat shooting star (*Dodecatheon pulchellum*), and fringed grass of parnassus (*Parnassia fimbriata*), mountain bladderfern (*Cystopteris montana*), and graminoids including yellow sedge (*Carex flava*), star sedge (*Carex echinata*), thinleaf cottonsedge (*Eriophorum viridicarinatum*), and tufted hairgrass (*Deschampsia cespitosa*) are characteristic. The moss flora of fens is typically dominated by brown mosses such as the aquatic species *Scorpidium scorpioides* and members of the *Drepanocladus* genus and wet-site species such as *Tomentypnum nitens, Aulacomnium turgidum*, and *Paludella squarrosa*.

Forested wetlands support an even mixture of western hemlock (*Tsuga heterophylla)*, mountain hemlock *(Tsuga mertensiana)*, and Alaska cedar *(Callitropsis nootkatensis)*. The giant, charismatic forb, skunkcabbage, *(Lysichiton americanus)* is diagnostic of the habitat type, occupying pockets of standing water on the forest floor. Similar to coastal rainforests, common understory shrubs include blueberries (*Vaccinium ovalifolium*, *Vaccinium alaskaense)*, rusty menziesia *(Rhododendron menziesii)*, and devilsclub *(Oplopanax horridus)*, with salal *(Gaultheria shallon)* restricted to the southern half of the range. Forbs *(Veratrum viride*, *Cornus canadensis*, *Coptis aspleniifolia*, *Rubus pedatus)*, ferns *(Athyrium filix-femina*, *Gymnocarpium dryopteris)* and *Sphagnum* mosses are frequent associates.

Range:

Occurring in peatland settings in the Southeastern biogeographic region; continuing westward through Southcentral to Cook Inlet and the Kenai Peninsula (Figure F7).

Appendix F. Continued.

Climate:
The maritime climate is cool in the summer and mild in the winter with low annual variation in temperature. Precipitation as rain, snow, and fog drip is abundant.

Environment:
Saturated soils result from high levels of precipitation and impeded drainage due to gentle terrain and shallow mineral soils with low permeability or bedrock. Owing to their depressional, concave topography, woodland bogs receive most of their water input from precipitation and surface flow. Woodland fens, which are often located in basins or toeslope positions receive water from groundwater flow. When this groundwater has passed through calcareous parent material (limestone, dolomite, or marble), soil water conditions are alkaline and unique plant communities develop. Owing also to differences in hydrology, bogs are characterized by pools of standing water among hummocks, whereas fens often support small channels across more even terrain. The saturation and inundation that, in part, defines the wetland condition, slows soil decomposition such that organic matter accumulates as woody, *Sphagnum*, or sedge peat. Poorly drained soils range from organic veneers over wet mineral soils, to peat over shallow bedrock, to deeper organics.

Disturbance:
Any activity that influences the balance between surface and ground water inflow and discharge will impact wetlands. Wetland sites with saturated soils and mature, full stature trees are subject to landslide and windthrow. Forested wetlands located in watersheds that are heavily managed for timber may be adversely impacted by the increased runoff following upgradient harvest.

Boreal Forested Wetland

USNVC Synonym: North American Boreal Conifer Poor Swamp (M299)

Figure F8. Distribution of boreal forested wetland in Alaska.

Physiognomy:
Boreal forested wetlands have woodland to open canopies dominated by needleleaf trees. Where wetland conditions result from the presence of shallow and ice-rich permafrost, the growth of trees is stunted and dwarf shrubs and bryophytes are important components of the understory. This is a common and widespread habitat type that is colloquially referred to as “black spruce bog.” Where wetland conditions result from high

Appendix F. Continued.

groundwater levels that are unrelated to permafrost, soil and water is warmer and needleleaf trees are more likely to reach full stature; broadleaf shrubs and herbs characterize the lower strata. Tamarack fens are a good example of this less common variant.

Floristics:
Forested bogs are dominated by black spruce (*Picea mariana*) and *Sphagnum* mosses are consistently present. Dwarf, often ericaceous shrubs, including lingonberry (*Vaccinium vitis-idaea*), bog blueberry (*Vaccinium uliginosum*), bog Labrador tea (*Rhododendron groenlandicum*), marsh Labrador tea (*Rhododendron tomentosum*), resin birch (*Betula glandulosa*), dwarf birch (*Betula nana*), crowberry (*Empetrum nigrum),* and small cranberry (*Oxycoccus microcarpus*) are characteristic of the understory. Herbaceous species include wet site species such as water sedge (*Carex aquatilis*) and tall cottongrass (*Eriophorum angustifolium*) and mesic site species such as tussock cottongrass (*Eriophorum vaginatum*) and cloudberry (*Rubus chamaemorus*). In addition to *Sphagnum* species, bryophytes in the *Drepanocladus, Campylium, Tomentypnum, Ptilium, Pleurozium*, and *Rhytidiadelphus* genera are common. Lichens in the *Cladonia* genus establish on drier microsites.

Forested fens are comprised of a mix of black spruce, Alaska birch (*Betula neoalaskana*), and tamarack (*Larix laricina*). Understory shrubs include bog rosemary (*Andromeda polifolia*), dwarf birch, leatherleaf (*Chamaedaphne calyculata*), sweetgale (*Myrica gale*), marsh labrador tea (*Rhododendron tomentosum* ssp. *decumbens*), and cloudberry (*Rubus chamaemorus*). The herbaceous layer may include water horsetail (*Equisetum fluviatile*), roundleaf sundew (*Drosera rotundifolia*), Bigelow's sedge (*Carex bigelowii*), narrowleaf bur-reed (*Sparganium angustifolium*), buckbean (*Menyanthes trifoliata*), and purple marshlocks (*Comarum palustre*). The moss flora often includes brown mosses such as *Tomentypnum nitens* and *Aulacomnium palustre*.

Range:
A common and widespread habitat type developing in peatland settings across the Central and Southcentral biogeographic regions, extending to the limit of continuous forest in the Western and Southwest regions (Figure F8). This habitat has also been mapped sparingly in the Northern and Southeast regions.

Climate:
The boreal climate is characterized by short, warm summers and long, very cold winters. Permafrost is nearly continuous, which contributes to slow tree growth, open canopies, and the accumulation of organic matter as peat.

Environment:
Boreal wetlands occur at scales ranging from discrete patches in depressions to extensive wetland complexes over large areas of level, poorly drained terrain. Soils are invariably wet with soil development and nutrient availability varying between forested bogs and fens. As nutrient-poor precipitation is the primary water source for bogs, soils are poorly developed and acidic with thick accumulations of organic matter. Permafrost is shallow with high volumes of interstitial ice, which retards the infiltration of water and maintains soil saturation. Woody species root on microsites that are elevated above the water table. Fens, which are fed by nutrient-rich groundwater and are not underlain by shallow permafrost tend to have more well-developed and alkaline soils. In these systems, high groundwater is maintained by proximity to a waterbody or change in hydrology that results in the damming or diversion of groundwater. Change in hydrology is often related to permafrost thaw but may also result from human disturbance.

Disturbance:
The expression of boreal wetlands on the landscape is largely dependent on climate, and the associated presence of permafrost. Where regional increase in temperature results in permafrost degradation and

Appendix F. Continued.

improved drainage, sites may transition out of the wetland condition. Wildland fire is a common disturbance in boreal ecosystems. Depending on the severity and scale of a burn, forested wetlands may revert to grasslands or shrublands.

In forested wetlands located adjacent to a waterbody, groundwater levels change in concert with lake or pond levels. Under conditions of prolonged inundation, plants not adapted to wetland or aquatic hydrology may die. Under low water conditions, ruderal species may colonize previously inundated substrates.

Tamarack (aka larch) is susceptible to several insect pests, which have caused widespread mortality of stands in the past. These include the larch sawfly (*Pristiphora erichsonii*), larch bud moth (*Zieraphera* sp.) and eastern larch beetle (*Dendroctonus simplex*).

Temperate Marsh, Wet Meadow, and Shrubland

USNVC Synonym: Vancouverian Lowland Marsh, Wet Meadow & Shrubland (M073)

Figure F9. Distribution of temperate marsh, wet meadow, and shrubland in Alaska.

Physiognomy:
Temperate marshes and wet meadows and shrublands are freshwater wetland systems comprised of annual herbs, emergent, rhizomatous graminoids and forbs, and low deciduous broadleaf shrubs. The establishment of trees and lichens is impeded by inundation; however, aquatic mosses may be locally abundant. Stands include sparse, nonsaline mudflats, emergent marshes, herbaceous wet meadows, and riparian shrublands. Vegetation may occur as a near monoculture in permanently flooded basin sites or as a mosaic of herbaceous and woody types in sites with more heterogenous topography and moisture gradients.

Floristics:
As this habitat type occurs across a broad range of settings, it supports a variety of species. Sparse non-saline mudflats are home to low forbs such as mountain mare's tail (*Hippuris montana*), and annuals such as toad rush (*Juncus bufonius*) and water mudwort (*Limosella aquatica*). By definition, freshwater marshes are dominated by emergent species. Rhizomatous graminoids, such as common spikerush (*Eleocharis palustris*), softstem bulrush (*Schoenoplectus tabernaemontani*), water sedge (*Carex aquatilis*), Sitka sedge (*Carex sitchensis*), Northwest Territory sedge (*Carex utriculata*), beaked sedge (*Carex rostrata*), rock sedge (*Carex saxatilis*), broadleaf cattail (*Typha latifolia*), Baltic rush (*Juncus balticus*), and narrowleaf bur-reed (*Sparganium angustifolium*) may form monocultures in such habitats. Rhizomatous forbs such as water

Appendix F. Continued.

horesetail (*Equisetum fluviatile*), variegated scouringrush (*Equisetum variegatum*), common mare's tail (*Hippuris vulgaris*), water arum (*Calla palustris*), buckbean (*Menyanthes trifoliata*), and purple marshlocks (*Comarum palustre*) may occupy smaller, often marginal patches within the marsh. Aquatic mosses such as *Scorpidium scorpioides, Scorpidium revolvens*, and *Philonotis fontana* as well as the wet-site species *Tomentypnum nitens* and *Aulacomnium turgidum* may occur at the transition from water to land.

Wet meadows with some movement of groundwater and protection from wind tend to be dominated by bluejoint reedgrass (*Calamagrostis canadensis*), with a mix of subdominant forbs including fireweed (*Chamaenerion angustifolium*), seacoast angelica (*Angelica gmelinii*), field horsetail (*Equisetum arvense*), water horsetail (*Equisetum fluviatile*), marsh pea (*Lathyrus palustris*), and beachhead iris (*Iris setosa*). In the alpine, where hydrology is sustained by seepage from nearby snow melt or seeps rather than groundwater, meadows tend to be more forb rich. Typical herbs include: deercabbage (*Nephrophyllidium crista-galli*), patridgefoot (*Luetkea pectinata*), creeping sibbaldia (*Sibbaldia procumbens*), alpine mountainsorrel (*Oxyria digyna*), Mertens' rush (*Juncus mertensianus*), dwarf fireweed (*Chamaenerion latifolium*), monkey flower (*Mimulus guttatus*), marsh grass of parnassus (*Parnassia palustris)*, marsh violet (*Viola epipsila*), and burnet (*Sanguisorba canadensis*). The snowbed-associated moss, *Andreaea blyttii* may be locally abundant.

Riparian or otherwise wet shrublands are typically dominated by alder in disturbed or nutrient-poor settings and willow in sites with more mature soils and available nutrients. Common alder species include thinleaf (*Alnus incana* ssp. *tenuifolia*) and Sitka *(Alnus alnobetula* ssp. *sinuata*) alder; common willows include Barclay's (*Salix barclayi*), undergreen (*Salix commutata*), grayleaf (*Salix glauca*), and tealeaf (*Salix pulchra*) willow. Shrub associates may include redosier dogwood (*Cornus sericea*), and in the southern portion of the range, rose spirea (*Spiraea douglasii*). In addition to herbaceous species associated with wet meadows, ferns and fern allies such as ladyfern (*Athyrium filix-femina*), oakfern (*Gymnocarpium dryopteris*), and field horsetail (*Equisetum arvense*) may be common in the understory.

Range:
Occurring in wetland settings in the Southeast, Southcentral, and Southwest biogeographic regions (Figure F9). These wetlands have also been mapped sparingly in the Central region.

Climate:
The maritime climate is cool in the summer and mild in the winter with low annual variation in temperature. Precipitation as rain, snow, and fog drip is abundant.

Environment:
Temperate marshes and wet meadows and shrublands develop at low elevations along the coast in interdune swales and inter-levee sloughs, and farther inland on floodplains, shallow lake beds, the margins of ponds and lakes, and the banks of rivers and streams. Above treeline, wet meadows may also develop in alpine floodplains. These are freshwater systems that form in areas of regular inundation (mudflats), saturation (wet meadows), or slow moving or standing water (emergent marshes and wet shrublands). Soils may be mineral silts or sands or well-decomposed organic mucks; water is nutrient-rich. These systems are highly productive and have high rates of decomposition.

Disturbance:
These wetlands are subject to flooding, groundwater discharge, or surface inundation resulting from proximity to waterbodies, including tidal pulses of freshwater or subsurface water due to high water table. Flooding may be accompanied by burial by sand and other coarse material. Isolated wetlands in backdune systems are subject to changes in the size and location of the wet swales as the sand dunes shift with active dune migration. Systems will be impacted by any alterations to the natural hydrology that raise or lower the elevation of the groundwater or surface water, or change the frequency of flooding or duration of inundation. Temperate wet meadows and marshes are particularly susceptible to colonization by invasive reed canarygrass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*).

Appendix F. Continued.

Temperate Fen

USNVC Synonym: North Pacific Fen (M560)

Figure F10. Distribution of temperate fen in Alaska.

Physiognomy:
Temperate fens are small in extent and uncommon on the landscape. Vegetation cover is continuous and characterized by a species-rich assemblage of graminoids, forbs, and bryophytes. Low to dwarf shrubs establish but do not gain dominance.

Floristics:
Fens are characterized by a high diversity of graminoids and forbs where typically no single species is dominant. Species composition is driven by hydrogeochemistry with fens categorized as poor (low pH) or rich (circumneutral to high pH). Poor fens resemble bogs and are more likely to support low and dwarf shrubs. Different from bogs, poor fens lack ericaceous shrubs and *Sphagnum* is either absent or present in small amounts. Rich fens support a diversity of herbs, many of which are calciphytes. Species characteristic of both poor and rich fens include the forbs: buckbean *(Menyanthes trifoliata)*, purple marshlocks *(Comarum palustre)*, deercabbage *(Nephrophyllidium crista-galli)*, burnet *(Sanguisorba canadensis)*, felwort *(Swertia obtusa),* scentbottle *(Platanthera dilatata),* and graminoids including water sedge *(Carex aquatilis),* rock sedge *(Carex saxatilis)*, and mud sedge *(Carex limosa)*. Shrubs such as sweetgale *(Myrica gale)*, alpine laurel *(Kalmia microphylla)*, and rose spirea *(Spiraea douglasii)* may establish in small amounts. The moss flora of fens is typically dominated by brown mosses such as the aquatic species: *Scorpidium scorpioides*, *Scorpidium revolvens*, and *Philonotis fontana* as well as the wet-site species *Tomentypnum nitens* and *Aulacomnium turgidum*. Rich fens consistently feature the graminoids: Sitka *(Carex sitchensis)*, yellow *(Carex flava)*, star *(Carex echinata)*, and thinleaf cotton *(Eriophorum viridicarinatum)* sedges, Suksdorf's spikerush *(Eleocharis suksdorfiana)*, and tufted hairgrass *(Deschampsia cespitosa)*, the forbs: shootingstar *(Dodecatheon pulchellum)*, fringed grass of parnassus *(Parnassia fimbriata)*, and hooded lady's tresses *(Spiranthes romanzoffiana)*, and the aquatic mosses: *Meesia triquetra* and *Paludella squarrosa*.

Range:
Occurring in peatland settings in the Southeastern, Southcentral, and Southwest biogeographic regions (Figure F10). This habitat has also been mapped sparingly in the Central region.

Appendix F. Continued.

Climate:
The maritime climate is characterized by relatively cool summers and warm winters, high annual precipitation, high humidity, and particularly along the Aleutian Archipelago, strong and consistent winds.

Environment:
As shallow and flowing groundwater is requisite for the formation and maintenance of fens, they typically develop across gentle slopes, or in areas of groundwater discharge such as toeslopes, alpine basins, and adjacent to ponds and small streams. In some locations, high precipitation can overcome the drainage afforded by terrain, allowing fens to develop on relatively steep slopes. The soil and water chemistry of a fen is largely determined by the bedrock composition of the surrounding watershed. Granitic rocks produce acidic waters (low pH), while limestone and volcanic rocks produce circumneutral to alkaline water (high pH). Saturation and inundation slow soil decomposition such that in fens, organic matter accumulates as sedge peat. Poorly drained soils range from organic veneers over wet mineral soils, to peat over shallow bedrock, to deeper organics. Small channels are common.

Disturbance:
Fens are slow-developing systems that are difficult to restore following disturbance. Fens on slopes are susceptible to soil creep and landslides whereas fens developing on gentle terrain are more stable. The dominant factor governing the dynamics of these systems is a stable hydrologic regime. Changes in water level or frequency and duration of inundation may initiate transition to a different habitat type.

Boreal Marsh, Wet Meadow, and Shrubland

USNVC Synonym: North American Boreal Marsh, Wet Meadow & Shrubland (M894)

Figure F11. Distribution of boreal marsh, wet meadow, and shrubland in Alaska.

Physiognomy:
Boreal marshes and wet meadows and shrublands are freshwater wetland systems comprised of emergent, rhizomatous graminoids and forbs, and low deciduous broadleaf shrubs. The establishment of trees and lichens is impeded by inundation; however, aquatic mosses may be locally abundant. Stands include sparse, nonsaline mudflats, emergent marshes, herbaceous wet meadows, and riparian shrublands. Vegetation may occur as near monocultures in permanently-flooded basin sites or as a mosaic of herbaceous and woody types

Appendix F. Continued.

in sites with more heterogenous topography and moisture gradients. Particularly in marsh settings, species diversity may be low.

Floristics:
Vegetation zonation is related to water depth and duration of inundation. A typical sequence along a gradient of decreasing water depth progresses from open water to emergent marsh to wet meadow and shrubland. Characteristic plant community composition for each habitat type is described in the following.

By definition, marshes are dominated by emergent species, many of which are rhizomatous. Graminoids, such as water sedge (*Carex aquatilis*), Northwest Territory sedge (*Carex utriculata*), softstem bulrush (*Schoenoplectus tabernaemontani*), and broadleaf cattail (*Typha latifolia*), and forbs such as purple marshlocks (*Comarum palustre*), buckbean (*Menyanthes trifoliata*), water horsetail (*Equisetum fluviatile*), marsh horsetail (*Equisetum palustre*), and common mare's-tail (*Hippuris vulgaris*) are common. Pendant grass (*Arctophila fulva*) becomes more common in the northern portions of the range. Aquatic mosses such as *Scorpidium scorpioides, Scorpidium revolvens*, and *Philonotis fontana* as well as the wet-site species *Tomentypnum nitens* and *Aulacomnium turgidum* may occur at the transition from water to land.

Wet meadows in wind-protected sites are dominated by bluejoint reedgrass (*Calamagrostis canadensis*), with a mix of subdominant herbs including fireweed (*Chamaenerion angustifolium*), woolyfruit sedge (*Carex lasiocarpa*), bluebells (*Mertensia paniculata*), and field horsetail (*Equisetum arvense*). In the alpine, where sites are exposed and hydrology is sustained by the melt of upgradient snow or seeps rather than groundwater, meadows tend to be more forb rich and shorter in stature. Typical herbs include dwarf fireweed (*Chamaenerion latifolium*), creeping sibbaldia (*Sibbaldia procumbens*), alpine mountainsorrel (*Oxyria digyna*), nodding saxifrage (*Saxifraga cernua*), meadow bistort (*Bistorta plumosa*), marsh grass of parnassus (*Parnassia palustris)*, marsh violet (*Viola epipsila*), burnet (*Sanguisorba canadensis*), Bigelow's sedge (*Carex bigelowii*), and ice grass (*Phippsia algida*). The snowbed-associated moss *Andreaea blyttii* may be locally abundant.

Riparian or otherwise wet shrublands are typically dominated by alder in disturbed or nutrient-poor settings and willow in sites with more mature soils and available nutrients. Common alder species include thinleaf (*Alnus incana* ssp. *tenuifolia*) and Sitka *(Alnus alnobetula* ssp. *sinuata*) alder; common willows include tealeaf (*Salix pulchra*) and Richardson's (*Salix richardsonii*) willow. Shrub birch (*Betula nana, Betula glandulosa*) and sweetgale (*Myrica gale*) may be present in organic-rich depressions. On floodplains and deltas, shrub dominance transitions to feltleaf willow (*Salix alaxensis*) and grayleaf willow (*Salix glauca*). Common understory species include subalpine aster (*Eurybia sibirica*), blacktipped ragwort (*Senecio lugens*), merckia (*Wilhelmsia physodes*), and field horsetail (*Equisetum arvense*).

Range:
Developing in wetland settings primarily in the Central and Western biogeographic regions (Figure F11). These habitats have also been mapped sparingly in the other four terrestrial biogeographic regions.

Climate:
The boreal climate is characterized by short, warm summers and long, very cold winters. While permafrost is nearly continuous, the high capacity of water to store heat reduces the effects of permafrost in these near-aquatic systems.

Environment:
Boreal marshes and wet meadows and shrublands are freshwater wetland systems that form in areas of regular inundation (floodplains), saturation (wet meadows), or slow moving or standing water (emergent marshes and wet shrublands). The habitat type develops in a variety of settings. At low elevations wetlands develop in interdune swales, across the lower energy portions of floodplains, on inland deltas where rivers drain into large lakes, and along the margins of ponds, lakes, and streams. Above treeline, wet meadows may

Appendix F. Continued.

also develop in alpine floodplains. Soils may be mineral silts or sands or well-decomposed organic matter, and water is nutrient-rich. These systems are highly productive and have high rates of decomposition. Permafrost may contribute to waterlogging of sites where it is ice-rich and shallow.

Disturbance:
These wetlands are subject to flooding, groundwater discharge, or surface inundation, resulting from proximity to waterbodies, or subsurface water due to high water table. Flooding may be accompanied by burial by sand and other coarse material. Isolated wetlands in inland dune systems are subject to changes in the size and location of the wet swales as the sand dunes shift with active dune migration. Systems are impacted by any alterations to the natural hydrology that raise or lower the elevation of the groundwater or surface water, or change the frequency of flooding or duration of inundation. Beaver, through their dam-building activities, can cause substantial hydrologic change to wetland systems, either causing flooding or the lowering of the water table, depending on the location of the site in relation to the dam. Wildland fire is a common disturbance in boreal ecosystems. Depending on the severity and scale of a burn, wetlands may revert to upland grasslands or shrublands.

Boreal Bog

USNVC Synonym: North American Boreal & Subboreal Bog & Acidic Fen (M876)

Figure F12. Distribution of boreal bog in Alaska.

Physiognomy:
Boreal bogs develop as mosaics of low to dwarf shrubs, graminoids, and bryophytes. Ericaceous shrubs and *Sphagnum* are consistently present. Dwarf trees encroach on drier margins and ridges but do not gain dominance. Sites are nutrient poor and species diversity is low.

Floristics:
Bogs are characterized by low to dwarf, often ericaceous shrubs, including bog blueberry (*Vaccinium uliginosum*), lingonberry (*Vaccinium vitis-idaea*), bog labrador tea (*Rhododendron groenlandicum*), marsh labrador tea (*Rhododendron tomentosum*), crowberry (*Empetrum nigrum*), bog rosemary (*Andromeda polifolia*), small cranberry (*Oxycoccus microcarpus*), resin birch (*Betula glandulosa*), dwarf birch (*Betula nana*), and leatherleaf (*Chamaedaphne calyculata*). The graminoids: tussock cotton grass (*Eriophorum*

Appendix F. Continued.

vaginatum), water sedge (*Carex aquatilis*), and smallawn sedge (*Carex microchaeta*) may be locally abundant. *Sphagnum* mosses are consistently present providing nearly continuous ground cover. The nitrogen-fixing feathermosses *Hylocomium splendens* and *Pleurozium schreberi* may be locally abundant. Lichens occur in low abundance on drier microsites. While forbs are not frequent, cloudberry (*Rubus chamaemorus*) and Arctic sweet coltsfoot (*Petasites frigidus*) show fidelity to this habitat type. Insectivorous plants such as roundleaf sundew (*Drosera rotundifolia*), butterwort (*Pinguicula vulgaris*), and bladderwort (*Utricularia intermedia*) are common features of nutrient-poor bogs. Dwarf black spruce (*Picea mariana*) may establish on drier margins and inclusions. The occurrence of tamarack (*Larix laricina*), sweet gale (*Myrica gale*), and leatherleaf (*Chamaedaphne calyculata*) increases with the availability of soil nutrients.

Range:
Occurring in peatland settings primarily across the Central, Western, Southwest, and Southcentral biogeographic regions (Figure F12). Boreal bogs have also been mapped sparingly in the other two terrestrial biogeographic regions.

Climate:
The boreal climate is characterized by short, warm summers and long, very cold winters. Permafrost is nearly continuous, which contributes to the slow growth of woody species and the accumulation of organic matter as peat.

Environment:
As nutrient-poor precipitation is the primary water source for bogs, soils are poorly developed and acidic, with thick accumulations of organic matter. Permafrost ranges from continuous in the central and western regions to isolated towards the south. Where permafrost is shallow with high volumes of interstitial ice, the infiltration of water is retarded and soil saturation is maintained. Anerobic conditions in combination with low temperatures slows decomposition and allows organic matter to accumulate as *Sphagnum* peat. The surface morphology of a bog may be flat to gently undulating with microtopography characterized by hummocks and hollows. As peat accumulates, elevated strings and depressed flarks may form, leading to extreme gradients of pH and moisture over short distances. The water table is at or just above the surface, allowing small pools to form in depressions. Woody species root on microsites that are elevated above the water table.

Disturbance:
The expression of boreal wetlands on the landscape is largely dependent on climate, and the associated presence of permafrost. Where regional increase in temperature results in permafrost degradation and improved drainage, sites may transition out of a wetland condition. Wildland fire is a common disturbance in boreal ecosystems. Depending on the severity and scale of a burn, bogs may transition to wet meadows or shrublands. Beaver, through their dam-building activities, can cause substantial hydrologic change to peatland systems, either causing flooding or the lowering of the water table, depending on the location of the site in relation to the dam.

Appendix F. Continued.

Arctic Marsh, Wet Meadow, and Shrubland

USNVC Synonym: Arctic Freshwater Marsh & Wet Meadow (M870)

Figure F13. Distribution of Arctic marsh, wet meadow, and shrubland in Alaska.

Physiognomy:

Arctic marshes, wet meadows, and wet shrublands establish as well-vegetated areas of emergent graminoids and broadleaf shrubs. Emergent graminoids often form monocultures. Shrubs tend to be low-statured in areas of ice-rich permafrost, and taller on well-drained substrates where seasonal thaw is deep. Aquatic mosses are abundant in waterlogged sites with ice-rich permafrost and lichens are typically absent. Species diversity is low in marsh settings, becoming richer in wet meadows and shrublands.

Floristics:

Plant community composition follows a gradient of water depth and persistence. Deep and permanently flooded standing water often supports monocultures of pendant grass (*Arctophila fulva*) with dominance transitioning to creeping sedge (*Carex chordorrhiza*), water sedge (*Carex aquatilis*), and tall cottongrass (*Eriophorum angustifolium*) as the water shallows. Emergent forbs such as purple marshlocks (*Comarum palustre*), common mare's tail (*Hippuris vulgaris*), buckbean (*Menyanthes trifoliata*), and water horsetail (*Equisetum fluviatile*) are commonly associated species. Characteristic aquatic mosses include *Scorpidium scorpioides, Scorpidium revolvens, Sarmentypnum sarmentosum,* and *Drepanocladus* and *Sphagnum* species.

Where soils are inundated to oversaturated, a greater diversity of sedges flourish. In addition to water sedge, rock sedge (*Carex saxatilis*), round sedge (*Carex rotundata*), fragile sedge (*Carex membranacea*), looseflower alpine sedge (*Carex rariflora*), white cottongrass (*Eriophorum scheuchzeri*), and red cottongrass (*Eriophorum russeolum*) are common.

Low-statured wet shrublands are often dominated by tealeaf willow (*Salix pulchra*), bog willow (*Salix fuscescens*), and dwarf birch (*Betula nana*), with many of the above-mentioned sedges occurring in the wettest portions of the site. Mosses in the *Hylocomium, Sphagnum, Aluocomium,* and *Dicranum* genera show relatively high cover and constancy.

Floodplain and riparian shrublands often support taller willows such as *Salix arbusculoides, Salix glauca, Salix niphoclada, Salix pulchra*, and *Salix richardsonii* in areas receiving seasonal floods of low velocity water. Inactive portions of the floodplain subject to seasonal inundation are often dominated by mats of the

Appendix F. Continued.

prostrate shrub entireleaf mountain-avens (*Dryas integrifolia*). Members of the horsetail genus (*Equisetum*) and fen-associated bryophytes in the *Tomentypnum, Calliergon,* and *Meesia* genera are consistently present.

Range:
Occurring in wetland settings primarily in the Northern and Western biogeographic regions (Figure F13). These wetlands have also been mapped sparingly in the Central and Southwest regions.

Climate:
The Arctic climate is dry and cold, characterized by very short summers and long winters. Most of the region is above the Arctic Circle and consequently receives continuous sunlight for several weeks in summer and continuous dark for several weeks in winter.

Environment:
Arctic freshwater marshes, wet meadows, and wet shrublands occur on the margins of ponds and lakes, in drained lake basins, low-center polygons, and polygon troughs, and along beaded streams and water tracks, and across string and flark topographies. They are also found on large to small floodplains in wet depressions, oxbows, and abandoned channels. Sites experience seasonal to semi-permanent flooding and water is at, or above, the surface for most of the short growing season. Soils are muck or mineral, and water is often nutrient-rich. The vegetation in this area is underlain by continuous permafrost; however, the active-layer thickness on floodplains alongside Arctic rivers is typically deeper than in the surrounding landscape. This results in deeper rooting depths and better-drained soils compared to adjacent tundra outside the floodplain.

Disturbance:
The dynamics of these habitats are influenced by periglacial and fluvial processes. In areas of fine-grained, ice-rich sediment, periglacial processes such as permafrost degradation and aggregation, cryoturbation, and solifluction are active. On the landscape scale, the cyclic development of patterned ground such as polygon tundra, thaw lakes, and string and flark fens is ongoing. The development of polygonal ground follows a cycle of ice wedge formation in thermal contraction cracks in permafrost, followed by ice wedge growth and connection to form a reticulate network of higher polygon centers and lower, wetland throughs. Over decades, ridges flanking the ice wedges are built by freeze thaw action and the comparatively lower polygon centers may become flooded. In a related process, thaw lakes may develop in flooded polygons and expand as adjacent terrain is inundated. Lakes are eventually drained by an intersecting stream or failure of a damming feature. Once drained, permafrost aggrades, water collects, and the cycle begins again. String and flark fens may develop where there is directional flow of surface water over shallow, ice-rich permafrost.

In floodplain settings, low-energy flooding may transport and deposit silt, but generally does not damage vegetation. Aggradation of sediment or channel migration away from sites can transition these wetlands of the elevational range or lateral reach of floodwaters thereby allowing development of upland tundra types. Conversely, erosion of sediment and channel migration towards sites can transition these wetlands into the active floodplain.

Appendix F. Continued.

SHRUBLANDS AND GRASSLANDS

Temperate Shrubland and Grassland

USNVC Synonym: Northern Vancouverian Lowland-Montane Grassland & Shrubland (M172)

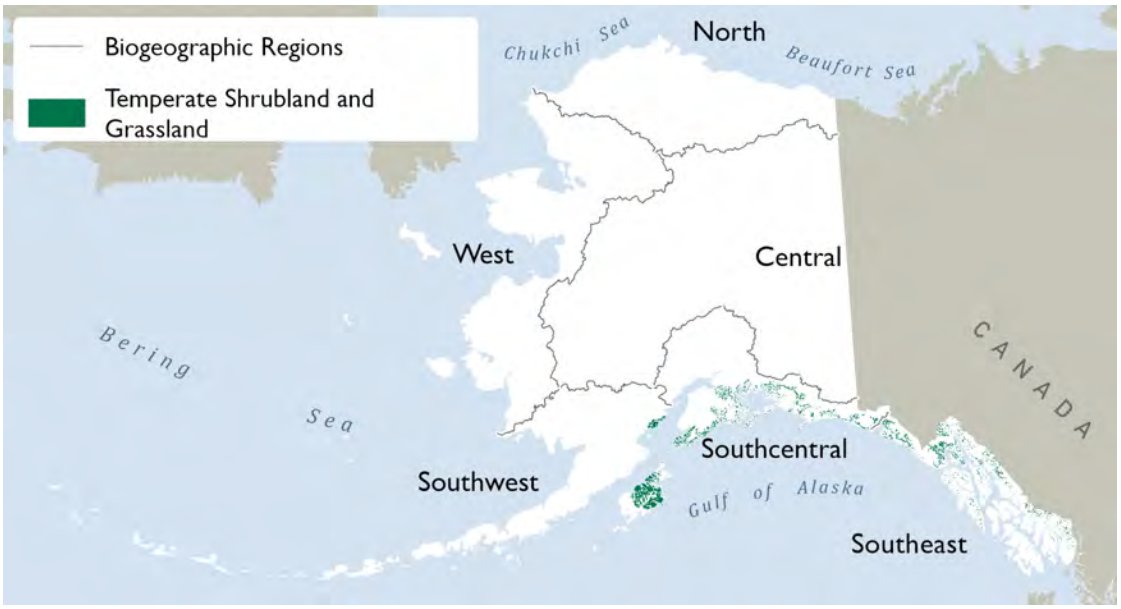

Figure F14. Distribution of temperate shrubland and grassland in Alaska.

Physiognomy:
Temperate shrublands and grasslands form as open to closed thickets of low to tall deciduous shrubs and herbaceous meadows, or mosaics of the types. Herbaceous species either establish as understory to the shrub stratum or as species-rich meadows.

Floristics:
Characteristic shrubs include Sitka alder (*Alnus alnobetula* ssp. *sinuata*), salmonberry (*Rubus spectabilis*), devilsclub (*Oplopanax horridus*), copperbush (*Elliottia pyroliflora*), and blueberry (*Vaccinium ovalifolium*). Willows, such as feltleaf willow (*Salix alaxensis*), Barclay's willow (*Salix barclayi*), grayleaf willow (*Salix glauca*), and Sitka willow (*Salix sitchensis*) occur as associated species in wetter sites. In meadows, a mix of ferns, forbs, and graminoids including ladyfern (*Athyrium filix-femina*), bluejoint reedgrass (*Calamagrostis canadensis*), fireweed (*Chamaenerion angustifolium*), cowparsnip (*Heracleum maximum*), false hellebore (*Veratrum viride*), and Sitka valerian (*Valeriana sitchensis*) are common. Dunegrass (*Leymus mollis*) and Pacific reedgrass (*Calamagrostis nutkaensis*) are important components of coastal meadows.

Range:
Occurring in upland settings throughout the Southeast and Southcentral biogeographic regions; extending into the Southwestern region along the Alaska Peninsula and upper islands of the Kodiak Archipelago (Figure F14). These shrubland and grassland habitats have been mapped sparingly in the Central region as well.

Climate:
The maritime climate is cool in the summer and mild in the winter with low annual variation in temperature. Precipitation as rain, snow, and fog drip is abundant.

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Environment:
Shrublands occur in upland settings where forest development is precluded by either disturbance or climate. The habitat type is common on mountain sideslopes steep enough to produce frequent avalanches, along coastal headlands, and above elevational treeline. Herbaceous meadows are often associated with shrublands, but occur across a greater variety of landforms and topographic positions. Additional to settings where shrublands occur, meadows establish on coastal bluffs, old beach ridges, uplifted tide flats, hillside slopes, stabilized talus, alluvial fans, and rolling hills. Soils are typically mesic to moist, well-drained, shallow, and stony; they can be ash-covered, and underlain by colluvium, alluvium, glacial drift, or glacial residium.

Disturbance:
Landslides, avalanches, and soil creep are the primary disturbance factors for shrublands establishing on sideslopes. Meadows establishing on more gentle terrain are relatively stable, but may be subject to wind and salt spray in coastal settings.

Aleutian Heath and Meadow

USNVC Synonym: North Pacific-Bering Maritime Heath & Meadow (M539)

Figure F15. Distribution of Aleutian heath and meadow in Alaska.

Physiognomy:
Aleutian heath and meadows develop as open canopies of tall and low deciduous shrubs to dwarf shrubs, herbaceous meadows, or mosaics of the types, where dominated by ericaceous dwarf shrubs, the type is referred to as "heath." Shrub stature generally decreases as maritime influence increases. Graminoids, ferns, and forbs may comprise the shrub understory or be interspersed as patches of meadow.

Floristics:
As this habitat type is typically centered across an area of species exchange between the Russian Far East and western Alaska, its floristics are somewhat unique. During previous glaciation events the Aleutian Islands provided a corridor through which species from the Kamchatka and Alaska Peninsulas dispersed. As glaciers subsequently melted and sea level rose, novel assemblages of species became isolated along the islands of the Aleutian chain. Today, the region supports many rare and endemic plant species such

Appendix F. Continued.

as Aleutian saxifrage (*Saxifraga aleutica*). Common low shrubs include Sitka alder (*Alnus alnobetula* ssp. *sinuata*), a variety of willow species (*Salix* spp.), salmonberry (*Rubus spectabilis*), and bog blueberry (*Vaccinium uliginosum*). Common ericaceous dwarf shrubs include crowberry (*Empetrum nigrum*), Aleutian mountainheath (*Phyllodoce aleutica*), and Alaska bellheather (*Harrimanella stelleriana*). While not in the heath family, the dwarf shrub partridge foot (*Luetkea pectinata*) is often associated with heath communities. Common graminoids, ferns, and forbs include dunegrass (*Leymus mollis*), bluejoint reedgrass (*Calamagrostis canadensis*), Pacific reedgrass (*Calamagrostis nutkaensis*), ladyfern (*Athyrium felix-femina*), seacoast angelica (*Angelica gmelinii*), cowparsnip (*Heracleum lanatum*), and Kamchatka aconite (*Aconitum maximum*). Owing to the preponderance of coastline among the islands and narrow peninsulas of the region, species such as dunegrass and Pacific reedgrass, which in other regions are restricted to supratidal beaches and coastal headlands and bluffs, become more widespread. Members of the orchid family are abundant in this habitat type.

Range:
Occurring in the Southwest biogeographic region from the lower Alaska Peninsula and lower Kodiak Archipelago extending through the Aleutian Islands to the Kamchatka Peninsula (Figure F15). These heath and meadow habitats with Aleutian Island floristic affinities have also been mapped sparingly in the Western, Southcentral, and Central regions.

Climate:
The maritime climate is characterized by relatively cool summers and warm winters, high annual precipitation, high humidity, and strong and consistent winds. The maritime influence becomes most intense in the middle of the Aleutian Islands where it largely precludes the establishment of tall and low shrubs.

Environment:
Occurring on moist to mesic sites along a broad elevational range from sea level to the barren alpine, on all aspects and slope positions. While volcanic ash and pumice are common throughout the range, other parent material, such as bedrock or till, are also common. Young soils are highly mineral with abundant coarse fragments. Older soils become more organic with no exposed mineral fragments.

Disturbance:
Volcanism and deglaciation are primary agents of landscape-scale disturbance. Otherwise, wind exposure affects plant community structure and distributions. For example, heath is more common at sites with higher wind exposure than herbaceous plant communities, and tall shrub communities become more common in protected, inland topographies.

Appendix F. Continued.

Boreal Shrubland and Grassland

USNVC Synonym: North American Boreal Shrubland & Grassland (M537)

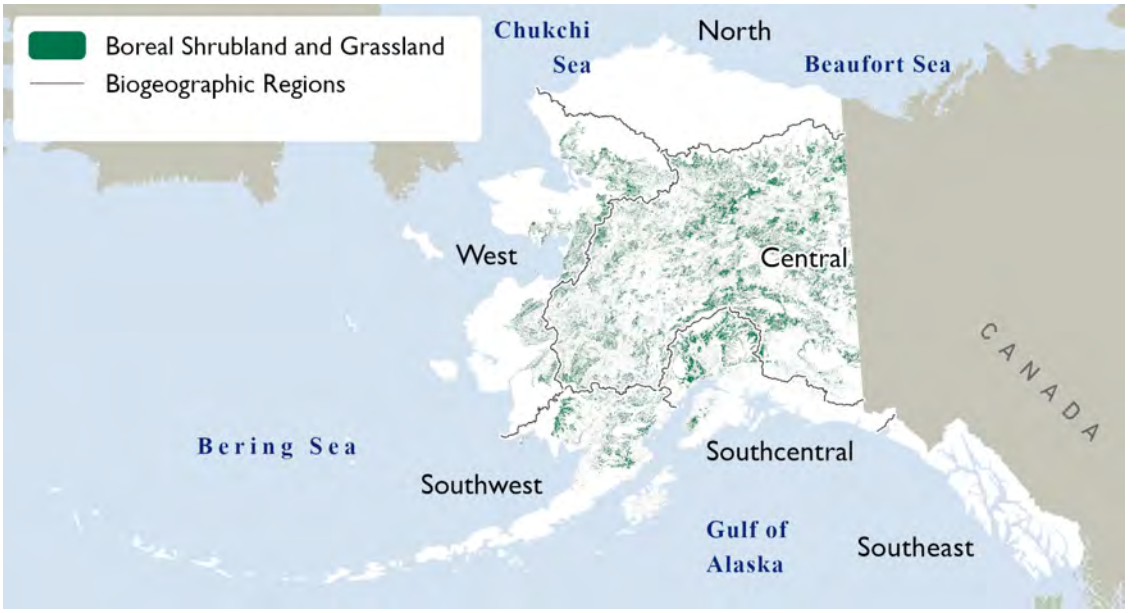

Figure F16. Distribution of boreal shrubland and grassland in Alaska.

Physiognomy:

Boreal shrublands and grasslands develop as shrublands, grasslands, herbaceous meadows, or mosaics of the types. Shrublands vary considerably in cover and composition due to the diverse ecological drivers that produce this type of habitat. Cover ranges from open to closed and may be comprised of deciduous or evergreen shrubs, and can include, or be dominated by dwarf shrubs. Herbaceous communities tend to be dominated by graminoids on dry, wind-exposed sites with the proportion of forbs increasing in more protected sites that are better able to retain moisture. Nonvascular species can contribute ground cover with lichens occurring in drier areas and mosses occurring in wetter areas. As shrublands and grasslands typically represent mid-successional sites, the occurrence of tree seedlings and saplings can increase as the community develops.

Floristics:

Stands are characterized by one or more of the following deciduous shrub species: Siberian alder (*Alnus alnobetula* ssp*. fruticosa*), tealeaf willow (*Salix pulchra*), grayleaf willow (*Salix glauca*), Richardson's willow (*Salix richardsonii*), resin birch (*Betula glandulosa*), and/or dwarf birch (*Betula nana*). South of the Alaska Range, alder dominance transitions to Sitka alder (*Alnus alnobetula* ssp. *sinuata*) and the abundance of Barclay's willow (*Salix barclayi*) and Scouler's willow (*Salix scouleriana*) increases at the expense of more boreal-centric willows. Red elderberry (*Sambucus racemosa*) and species of mountain ash (*Sorbus scopulina, Sorbus sitchensis*) may contribute to the shrub canopy in the Southwest and Southcentral regions.

More productive, alder-dominated sites typically support an herb-rich understory including bluejoint reedgrass (*Calamagrostis canadensis*), fireweed (*Chamaenerion angustifolium*), field horsetail, (*Equisetum arvense*), oakfern (*Gymnocarpium dryopteris*), woodfern (*Dryopteris expansa*), cowparsnip (*Heracleum lanatum*), starflower (*Lysimachia europaea*), burnet (*Sanguisorba canadensis*), and larkspurleaf monkshood (*Aconitum delphiniifolium*). These moist site herbs can occur in species-rich meadows in areas of late-lying snow.

Appendix F. Continued.

Less productive, birch-willow sites are dominated by resin or dwarf birch and/or tealeaf willow. Shrubs associated with birch-dominated scrub include bog blueberry (*Vaccinium uliginosum*), crowberry (*Empetrum nigrum*), lingonberry (*Vaccinium vitis-idaea*), and marsh Labrador tea (*Rhododendron tomentosum* ssp. *decumbens*). Willow-dominated sites support an understory of shrub and sub-shrubs including Arctic raspberry (*Rubus arcticus*) and beauverd spirea (*Spiraea stevenii*). Herbaceous species are sparse and may include boreal sagebrush (*Artemisia arctica*), Altai fescue (*Festuca altaica*), and alpine sweetgrass (*Hierochloë alpina*). Feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and lichens in the *Cladonia* genus are common.

In an uncommon setting, boreal shrublands and grasslands also develop on inland dunes and steppe bluffs. Here vegetation forms dry, open low shrub and herbaceous associations. Dune vegetation is represented by grayleaf willow (*Salix glauca*), feltleaf willow (*Salix alaxensis*), and barrenground willow (*Salix niphoclada*), and grasses: Pumpelly's brome (*Bromus pumpellianus* var. *pumpellianus*), purple reedgrass (*Calamagrostis purpurascens*), and red fescue (*Festuca rubra*). Steppe bluffs are additionally characterized by the low shrubs: prairie sagewort (*Artemisia frigida*), serviceberry (*Amelanchier alnifolia*), silverberry (*Elaeagnus commutata*), buffaloberry (*Shepherdia canadensis*), common juniper (*Juniperus communis*), and kinnikinnick (*Arctostaphylos uva-ursi*). Dry site herbs include Altai fescue, boreal sagebrush, Alaska wormwood (*Artemisia kruhsiana* ssp. *alaskana*), American thorowax (*Bupleurum americanum*), and three toothed saxifrage (*Saxifraga tricuspidata*). Biological soil crust and lichens are important mechanisms for the stabilization of dune and bluff soils.

Range:
Occurring in upland settings where extreme site conditions produce shrub or herb vegetation within a climate that would otherwise support forest. Centered in the Central biogeographic region and extending into the Western, Southwest, and Southcentral regions (Figure F16). The habitat has also been mapped sparingly in the Northern and Southeast regions.

Climate:
The boreal continental climate is characterized by short, warm summers and long, very cold winters. For this habitat type, extreme site conditions tend to override the influence of regional climate.

Environment:
Developing in uplands where extreme site conditions preclude the establishment of trees. Site conditions may be generalized as those related to landscape position and those related to disturbance. With respect to landscape position, alders form continuous bands in montane settings above treeline, birch and willow form thickets at high-elevations and along cold air drainages, and meadows occupy areas of late-lying snow. Excessively drained and easily erodible sands of inland dunes favor the establishment of rhizomatous graminoids and shrubs over trees. With respect to disturbance, boreal shrubland and grasslands may develop on sites temporarily returned to an early successional stage by wildland fire, or held in early succession by slope instability, noncohesive soils, or near constant wind. In the case of steppe bluffs, trees are excluded by dry and warm conditions, which are promoted by excessive drainage across steep slopes, low accumulation and residence of snow, exposure to wind, and high soil temperature, and evaporation and transpiration caused by the slopes' direct orientation to the low-angled sun. These varied ecological drivers result in the diversity of environments across which boreal shrublands and grasslands exist. Soils range from well-drained sand or sandy loams on dunes and bluffs, to thin rocky soils over shallow bedrock in exposed montane settings, to thick mesic loams in sheltered montane settings. While permafrost is nearly continuous in the region, its influence is varied. Where soils are well-drained due to coarse, mineral composition or terrain slope, interstitial ice volumes are low and the effects of permafrost are negligible. In poorly-drained, organic soils, interstitial ice volume may be high and the influence of seasonal freeze-thaw cycles is significant.

Appendix F. Continued.

Disturbance:
Disturbance processes are varied in type and extent. Wildland fire is a major landscape-scale disturbance capable of reverting large areas of forest to shrub and grasslands. Localized disturbances such as exposure to wind and susceptibility to mass wasting events may hold montane, dune, and bluff communities in a mid-successional stage. In response to a changing climate, alder and willow are increasing abundance within their current ranges and notably, alder is extending its range into the low Arctic. Alder defoliators and willow leafblotch miners may cause defoliation, branch dieback, and mortality in rare cases of severe and sustained infestation.

TUNDRA

Temperate Alpine Tundra

USNVC Synonym: Vancouverian Alpine Tundra (M101)

Figure F17. Distribution of temperate alpine tundra in Alaska.

Physiognomy:
Temperate alpine tundra establishes as treeless, sparsely to well-vegetated areas of dwarf shrubs, graminoids, and forbs at high elevations. Bare rock, lichens, and mosses are common ground covers. Dwarf, prostrate, creeping, and cushion growth forms are adapted to reduce wind exposure and heat loss.

Floristics:
Alpine tundra communities largely establish in relation to elevation and exposure. In the most wind-exposed and rocky sites, tundra develops in protected microsites as a sparse cover of prostrate shrubs, graminoids, forbs, and lichens. Shrubs include dry-site species such as mountain-avens (*Dryas ajanensis, Dryas alaskensis*), and graminoids such as longawn sedge (*Carex macrochaeta*) and alpine fescue (*Festuca brachyphylla*). Associated forbs including boreal sagebrush (*Artemisia arctica*), narcissus anemone (*Anemonastrum sibiricum*), and meadow bistort (*Bistorta plumosa*) are characteristic of these habitats. Nonvascular taxa such as *Racomitrium lanuginosum*, *Umbilicaria hyperborea,* and *Stereocaulon alpinum* provide ground cover.

In more protected areas, tundra forms a semi-continuous cover of dwarf ericaceous or willow shrub. Common ericaceous dwarf shrubs include western moss heather (*Cassiope mertensiana*), yellow mountainheath

Appendix F. Continued.

(*Phyllodoce glanduliflora*), Alaska bellheather (*Harrimanella stelleriana*), bog blueberry (*Vaccinium uliginosum*), dwarf bilberry (*Vaccinium caespitosum*), and crowberry (*Empetrum nigrum*); western moss heather is replaced by white Arctic mountain heather (*Cassiope tetragona*) in the northern portion of the range. While not ericaceous, the dwarf shrubs partridgefoot (*Luetkea pectinata*) and species of mountain avens (*Dryas ajanensis, Dryas alaskensis*) are common in the habitat type throughout the region. Dwarf willow communities include Arctic (*Salix arctica*), sprouting leaf (*Salix stolonifera*), and netleaf (*Salix reticulata*) willows. The feathermosses *Hylocomium splendens*, *Pleurozium schreberi,* and species of *Rhytidiadelphus* are common in tundra settings where shrubs provide some protection from desiccating winds; lichens, particularly those in the *Peltigera* genus, become more common in areas where ericaceous shrubs dominate.

In the most wind-protected sites, lush herbaceous meadows develop. Plant communities in these meadows tend to be forb-rich and include larkspurleaf monkshood (*Aconitum delphiniifolium*), burnet (*Sanguisorba canadensis*), Sitka valerian (*Valeriana sitchensis*), Kamchatka fritillary (*Fritillaria camschatcensis*), Alaska Indian paintbrush (*Castilleja unalaschcensis*), wooly geranium (*Geranium erianthum*), and Nootka lupine (*Lupinus nootkatensis*). Dwarf shrubs and bryophytes associated with dwarf shrub tundra are often interspersed in the understory or present as small patches on higher and drier topographies.

Range:
Occurring in alpine and montane settings throughout the Southeast and Southcentral biogeographic regions; extending into the Central and Southwest regions in the area of overlap with the Alaska Range (Figure F17).

Climate:
This habitat type spans maritime and boreal-maritime transitional climates where the extreme conditions present at high-elevations and otherwise exposed sites often override the influence of regional climate. Summers are short and cool and winters are long and cool with abundant wet snow.

Environment:
This habitat type develops at high-elevation or otherwise exposed sites that are typically above the elevational limit of trees. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. Broadleaf, meadow, dwarf shrub, and sparse tundra communities establish as zones of vegetation in relation to increasing elevation and exposure. Herbaceous sites are often fed by some source of sustained water provided by the melt of upgradient snow or groundwater seeps. Soils range from well-drained, thin and rocky mineral soils on convex topographies to moderately drained loams in concave topographies that are better able to retain snow and organic matter. While permafrost is generally absent, seasonal frost is deep and may persist well into the growing season.

Disturbance:
Alpine tundra communities are relatively stable. Disturbances include wind, soil and snow creep, and freeze-thaw action; steeper sites may be subject to avalanche. By moving snow, wind creates microhabitats of varying snow depths, influencing the length of snow-free periods and soil moisture conditions. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. Small mammal activity may have minor impacts. Due to the discontinuous cover of vegetation, low fuel loads, and moist conditions, this habitat type is unlikely to carry fire. On mountain summits where treeline is advancing due to a warming climate, the extent of alpine tundra is expected to be reduced.

Appendix F. Continued.

Boreal Alpine Tundra

USNVC Synonym: Western Boreal Alpine Tundra (M404)

Figure F18. Distribution of boreal alpine tundra in Alaska.

Physiognomy:
Boreal alpine tundra establishes as treeless, sparsely to well-vegetated areas of low to dwarf shrubs, graminoids, and forbs at higher elevations. Bare rock, lichens, and mosses are common ground covers. Dwarf, prostate, creeping, and cushion growth forms reduce wind exposure and heat loss.

Floristics:
Alpine tundra communities largely establish in relation to elevation and exposure. In the most wind-exposed and rocky sites, tundra develops in protected microsites as a sparse cover of prostrate shrubs, graminoids, forbs, and lichens. Shrubs include dry-site species such as mountain avens (*Dryas ajanensis, Dryas alaskensis*), pincushion plant (*Diapensia obovata*), and alpine bearberry (*Arctous alpina*). Graminoids including Altai fescue (*Festuca altaica*), alpine sweetgrass (*Hierochloë alpina*), Bigelow's sedge (*Carex bigelowii*), spike trisetum (*Trisetum spicatum*), and smallawned sedge (*Carex microchaeta*) grow in scattered tufts. Forbs with cushion or creeping growth forms such as Arctic stitchwort (*Cherleria arctica*), moss campion (*Silene acaulis*), blackish oxytrope (*Oxytropis bryophila*), Arctic cinquefoil (*Potentilla nana*), and three toothed saxifrage (*Saxifraga tricuspidata)* are characteristic. Lichens, which have high tolerance to desiccation, are more common than mosses. Typical lichen species are: *Umbilicaria hyperborea*, *Thamnolia vermicularis, Stereocaulon alpinum,* and *Flavocetraria nivalis.*

In more protected areas, tundra forms a semi-continuous cover of dwarf ericaceous or willow shrub. Common shrub species include the ericaceous species: crowberry (*Empetrum nigrum*), alpine azalea (*Kalmia procumbens*), bog blueberry (*Vaccinium uliginosum*), and white Arctic mountain heather (*Cassiope tetragona*), and the willows: Arctic (*Salix arctica*), polar (*Salix polaris*), skeletonleaf (*Salix phlebophylla*), and netleaf (*Salix reticulata*) willow. Graminoids include many of the species present in sparse tundra communities. Characteristic forbs are boreal sagebrush (*Artemisia arctica*), alpine bistort (*Bistorta vivipara*), creeping sibbaldia (*Sibbaldia procumbens*), mountain harebell (*Campanula lasiocarpa*), ledge stonecrop (*Rhodiola integrifolia*), and narcissus anemone (*Anemonastrum sibiricum*). Mosses such as big red stem (*Pleurozium*

Appendix F. Continued.

schreberi) and *Polytrichum juniperium* become more abundant in these sheltered sites; common lichens include species in the *Cetraria,* and *Cladonia* genera.

In the most wind-protected sites, tundra may develop as lush herbaceous meadows. Meadow species, including larkspurleaf monkshood (*Aconitum delphiniifolium*), longawn sedge (*Carex macrochaeta*), Altai fescue (*Festuca altaica*), wooly geranium (*Geranium erianthum*), forget-me-not (*Myosotis alpestris* ssp. *asiatica*), fringed grass of Parnassus (*Parnassia fimbriata*), western buttercup (*Ranunculus occidentalis*), Canadian burnet (*Sanguisorba canadensis*), arrowleaf ragwort (*Senecio triangularis*), Sitka valerian (*Valeriana sitchensis*), and alpine speedwell (*Veronica wormskjoldi*) are common. Dwarf shrubs and bryophytes characteristic of dwarf shrub tundra are often interspersed in the understory or present as small patches on higher and drier topographies.

Range:
Occurring in alpine and montane settings primarily in the Central, Southcentral, Southwest, and Western biogeographic regions (Figure F18). This habitat has also been mapped sparingly in the other two terrestrial biogeographic regions.

Climate:
The boreal continental climate is characterized by short, warm summers and long, very cold winters. Permafrost is nearly continuous, which contributes to the slow growth of woody species. The extreme conditions present at high-elevations and otherwise exposed sites often override the influence of regional climate.

Environment:
This habitat type develops at high-elevation or otherwise exposed sites typically above elevational treeline. By moving snow, wind creates microhabitats of varying snow depths, influencing the length of snow-free periods and soil moisture conditions. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. Meadow, dwarf shrub, and sparse tundra communities tend to establish as zones of vegetation in relation to increasing elevation and exposure. Soils range from well-drained, thin and rocky mineral soils on convex topographies to moderately drained loams in concave topographies that are better able to retain snow and organic matter. Permafrost is nearly continuous.

Disturbance:
Alpine tundra is relatively stable. Disturbances include wind, soil and snow creep, and freeze-thaw action; steeper sites may be subject to avalanche. By moving snow, wind creates microhabitats of varying snow depths, influencing the length of snow-free periods and soil moisture conditions. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. Small mammal activity may have minor impacts. The effect of permafrost is variable; well-drained rocky soils with low interstitial ice volumes are less affected by freeze thaw action than wetter organic soils, which are susceptible to solifluction and cryoturbation. Due to the discontinuous cover of vegetation, low fuel loads, and moist conditions, this habitat type has low susceptibility to fire. On mountain summits where treeline is advancing due to a warming climate, the extent of alpine tundra is expected to be reduced.

Appendix F. Continued.

Arctic Tundra

USNVC Synonym: Arctic Dry-Moist Tundra (M173)

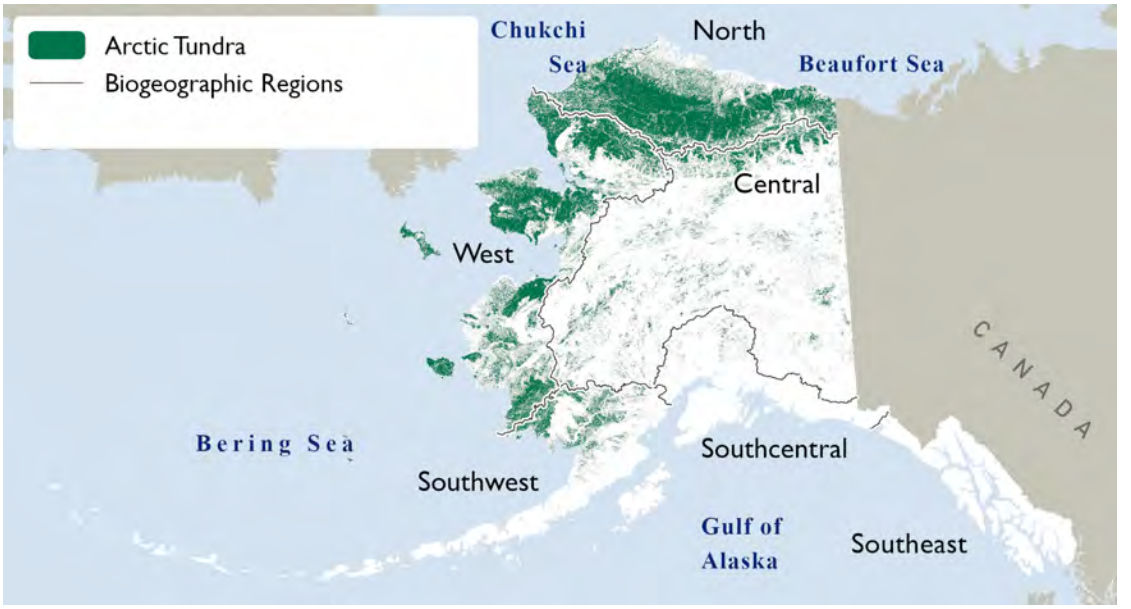

Figure F19. Distribution of Arctic tundra in Alaska.

Physiognomy:

Arctic tundra establishes as treeless, sparsely to well-vegetated areas of shrubs, graminoids, and forbs; mosses and lichens are important components of the understory in mesic and dry settings, respectively. Generally, the stature and cover of vegetation and the abundance of woody species increases as sites become more protected from wind, insulated from freezing temperatures, or gain a sustained source of water through the growing season. Because of this, tundra communities range in structure and composition from sparse assemblages of prostrate shrubs, low-stature herbs, mosses, and lichens in the most exposed, often high-elevation sites, to a continuous cover of low and dwarf shrubs interspersed with tussock-forming sedges, forbs, and a diversity of nonvascular species across the more protected, low elevation coastal plains. Variants of Arctic tundra are present as species-rich and lush herbaceous meadows in mesic, protected sites as well as deciduous shrub communities with a sparse understory of graminoids and forbs on floodplains and inland dunes. The rate and form of plant growth is largely affected by permafrost. A tussocked growth form allows sedges to elevate their live root mass above the level of seasonal or diurnal freeze thaw cycles. Together with thick mats of *Sphagnum* and other nonvascular species, tussocks provide warmer microsites for the establishment of less cold-adapted species. Conversely, in areas of deep seasonal thaw, such as dunes and floodplains, deep-rooted and tall shrubs are able to establish.

Floristics:

Arctic tundra may occur as purely herbaceous associations, but most commonly develops as a mix of herbs and shrubs. Tussock tundra is a common coastal plain type characterized by high abundance of the tussock-forming sedge tussock cottongrass (*Eriophorum vaginatum*) often in combination with low and dwarf shrubs. Characteristic woody species include the low shrubs: dwarf birch (*Betula nana*), tealeaf willow (*Salix pulchra*), and marsh labrador tea (*Rhododendron tomentosum* ssp. *decumbens*); and the dwarf shrubs: lingonberry (*Vaccinium vitis-idaea*), white Arctic mountain heather (*Cassiope tetragona*), entireleaf mountain-avens (*Dryas integrifolia*), and netleaf willow (*Salix reticulata*). Associated herbaceous species are the forbs: meadow bistort (*Bistorta plumosa*), cloudberry (*Rubus chamaemorus*), and narrowleaf saw-wort (*Saussurea angustifolia*), and the graminoids: Bigelow's sedge (*Carex bigelowii*) and wideleaf polargrass (*Arctagrostis*

Appendix F. Continued.

latifolia). Common nonvascular species include the bryophytes *Ptilidium ciliare, Dicranum elongatum, Hylocomium splendens*, and *Aulacomnium turgidum*, and the lichens, *Cetraria ericetorum, Cladonia arbuscula,* and *Flavocetraria cucullata*.

Shrub-dominated tundra may be broadly grouped by *Dryas*, ericaceous, or willow species dominance. *Dryas* prostrate shrub tundra occurs in dry, windswept areas with little retention of snow and is dominated by either eightpetal mountain-avens (*Dryas ajanensis*) in the Brooks Range and foothills or entireleaf mountain-avens (*Dryas integrifolia*) on the Arctic Coastal Plain. Characteristic herbs include blackish oxytrope (*Oxytropis bryophila*), curly sedge (*Carex rupestris*), and purple mountain saxifrage (*Saxifraga oppositifolia*), and dry-site lichens such as *Alectoria nigricans, Flavocetraria cucullata, Cetraria islandica,* and *Dactylina arctica.*

Dwarf willow shrub tundra occurs in small patches on moderately exposed sites and is characterized by netleaf, polar (*Salix polaris*), least (*Salix rotundifolia*), and skeletonleaf (*Salix phlebophylla*) willows. Ericaceous dwarf-shrub tundra is common in more protected, mesic sites where snow cover is retained. This habitat type is characterized by the ericaceous shrubs: marsh labrador tea (*Rhododendron tomentosum* ssp*. decumbens*), white Arctic mountain heather (*Cassiope tetragona*), and lingonberry (*Vaccinium vitis-idaea*). In both willow and ericaceous dwarf shrub tundra, characteristic herbaceous plants include the graminoids: Altai fescue (*Festuca altaica*), alpine sweetgrass (*Hierochloë alpina*), wideleaf polargrass (*Arctagrostis latifolia*), spike trisetum (*Trisetum spicatum*), Bigelow's sedge (*Carex bigelowii*), shortstalk sedge (*Carex podocarpa*), and Arctic bluegrass (*Poa arctica*); and the forbs: meadow bistort (*Bistorta plumosa*), narrowleaf saw-wort (*Saussurea angustifolia*), narcissus anemone (*Anemonastrum sibiricum*), and capitate lousewort (*Pedicularis capitata*). Bryophytes and lichens include those listed for tussock tundra with the additions of *Flavocetraria nivalis, Masonhalea richardsonii, Ochrolechia frigida, Racomitrium lanuginosum, Polytrichum juniperinum, Rhytidium rugosum, and Tomentypnum nitens.* Lichen abundance tends to be higher in willow-dominated dwarf shrub tundra.

Low-shrub tundra commonly occurs on mesic to moist sideslopes and ridges and high-centered polygonal tundra and may be dominated by low willows such as Richardson's willow *(Salix richardsonii)*, tealeaf willow *(Salix pulchra)*, and grayleaf willow *(Salix glauca)*, or dwarf birch *(Betula nana)*. Lower woody and herbaceous strata are largely similar to tussock and dwarf shrub tundras. Bigelow's sedge tends to be more abundant than tussock sedge, and forbs, such as Arctic sweet coltsfoot *(Petasites frigidus)*, tall Jacbo's-ladder *(Polemonium acutiflorum)*, capitate valerian *(Valeriana capitata)*, capitate lousewort *(Pedicularis capitata)*, and field horsetail *(Equisetum arvense)*, and bryophytes such as *Hylocomium splendens*, *Tomentypnum nitens*, and *Rhytidium rugosum* tend to occur at greater frequency.

Mesic herbaceous tundra is an uncommon variant occupying small patches in areas of late-lying snow, seeps, and streamsides. Characteristic species include the forbs: dwarf fireweed *(Chamaenerion latifolium)*, fourpart dwarf gentian *(Gentianella propinqua)*, Arctic sweet coltsfoot *(Petasites frigidus)*, Arctic lupine *(Lupinus arcticus)*, northern Jacob's-ladder *(Polemonium boreale)*, and capitate valerian *(Valeriana capitata),* and the grasses: slimstem reedgrass *(Calamagrostis neglecta)*, wideleaf polargrass *(Arctagrostis latifolia)*, hairgrass *(Deschampsia cespitosa)*, and Arctic bluegrass *(Poa arctica)*.

Floodplain shrublands are characterized by low to tall deciduous shrubs such as feltleaf willow (*Salix alaxensis*), Richardson's willow (*Salix richardsonii*), and Siberian alder (*Alnus alnobetula* ssp. *fruticosa*) on active floodplains, and entireleaf mountain-avens (*Dryas integrifolia*) or Drummond's mountain-avens (*Dryas drummondii*) on the inactive portions of the floodplain. Characteristic herbaceous plants include the forbs: subalpine aster (*Eurybia sibirica*), Tilesius' wormwood (*Artemisia tilesii*), Kotzebue's grass of Parnassus (*Parnassia kotzebuei*), tansy (*Tanacetum bipinnatum*), merckia (*Wilhelmsia physodes*), and dwarf fireweed (*Chamaenerion latifolium*). The horsetails *Equisetum arvense* and *Equisetum variegatum*, and the grass red fescue (*Festuca rubra*) are also characteristic.

The floristics of inland dunes largely resemble the active portion of Arctic floodplains. Willow shrubs such as grayleaf willow (*Salix glauca*), feltleaf willow, and barrenground willow (*Salix niphoclada*) are dominant. The

Appendix F. Continued.

dry-site graminoids: red fescue (*Festuca rubra*), Eurasian Junegrass (*Koeleria asiatica*), Arctic rush (*Juncus arcticus*), dunegrass (*Leymus mollis*), and Pumpelly's brome (*Bromus pumpellianus*) as well as the forbs: field sagewort (*Artemisia borealis*) and northern groundsel (*Packera hyperborealis*) are characteristic components of the understory.

Range:
Occurring in wind-exposed settings north of latitudinal treeline in the Northern biogeographic region and beyond the longitudinal extent of treeline in the Western and Southwest regions (Figure F19). The habitat has also been mapped in the Central and Southcentral regions.

Climate:
The Arctic climate is dry and cold, characterized by very short summers and long winters. Most of the region is above the Arctic Circle and consequently receives continuous sunlight for several weeks in summer and continuous dark for several weeks in winter.

Environment:
Arctic tundra establishes across strong elevational and continentality gradients ranging from the high-latitude, low-elevation Arctic tundra of the Arctic and Bering Sea coastal plains to the high-elevation, alpine tundra of the Brooks Range. The entire area is underlain by continuous permafrost. Where soils are ice-rich, periglacial processes ranging in scale from cryoturbation, and solifluction, to thaw slumping and the development of patterned ground are active. Polygonal tundra, a network of tundra polygons bounded by an orthogonal network of subsurface ice-wedges is particularly common, with shrub and tussock tundra types occupying topographic highs such as polygon ridges and high centers, and wet sedge tundra occupying the bounding troughs and low centers. Where sediment is well-drained with low interstitial ice volumes, such as floodplains, dunes, and high-elevation rocky substrates, the effects of permafrost are negligible.

Disturbance:
Under a warming climate, the degradation of ice-rich permafrost can cause the collapse of the overlying substrate with consequences for man-made infrastructure these terrains may support. While infrequent, wildland fire may have extensive and severe impact on tundra ecosystems. Fire may revert shrub types to a graminoid-dominated system, whereas shrubs may assume dominance with a milder climate or less extreme local conditions. In floodplain settings, inundation and the associated erosion and redeposition of sediment are primary disturbances. In dune settings, the main disturbance process, which both creates and maintains these systems, is the erosion, transport, and deposition of sand by wind.

Appendix F. Continued.

CLIFF, SCREE, AND ROCK

Temperate Cliff, Scree, and Rock Vegetation

USNVC Synonym: Western North American Cliff, Scree & Rock Vegetation (M887)

Figure F20. Distribution of temperate cliff, scree, and rock vegetation in Alaska.

Physiognomy:
Temperate cliff, scree, and rock vegetation consists of sparsely vegetated scree, talus, and bedrock shields, outcrops, and cliffs. Vegetation establishes in protected microsites and overall, there is less than 10% vascular plant cover with a variable cover of mosses and lichens. Forbs and woody species are uncommon and species diversity is low.

Floristics:

Communities range from lichen-encrusted bedrock, to cryptobiotic crust, to a sparse cover of graminoids, dry-site mosses, and fruticose lichens; prostrate shrubs and wind- and cold-adapted forbs are occasional components. On the harshest, driest sites, crustose lichen communities including *Rhizocarpon geographicum*, *Ophioparma lapponica, Umbilicaria hyperborea*, and *Pertusaria* species form. In more protected sites, dry-site mosses such as *Racomitrium lanuginosum, Racomitrium canescens*, and species of *Dicranum*, and fruticose lichens such as *Stereocaulon paschale, Cladonia uncialis*, and *Cladonia stellaris* are characteristic. Where upgradient snowmelt flushes glaciated bedrock, the moss, *Andreaea blyttii* is dominant. The liverworts *Anthelia juratzkana* and *Gymnomitrion corallioides* are major components of cryptogamic crust forming over volcanic deposits.

Increasing nonvascular plant cover provides substrate for the subsequent establishment of graminoids such as Piper's woodrush (*Luzula piperi*), curved woodrush (*Luzula arcuata*), spike trisetum (*Trisetum spicatum*), Pyrenean sedge (*Carex micropoda*), and tufted hairgrass (*Deschampsia cespitosa*). Forbs, including purple mountain saxifrage (*Saxifraga oppositifolia*), moss campion (*Silene acaulis*), and Ross' avens (*Geum rossii*), establish in microsites able to retain moisture. Prostrate shrubs such as alpine azalea (*Kalmia procumbens*), oval-leaf willow (*Salix ovalifolia*), kinnikinnick (*Arctostaphylos uva-ursi*), and crowberry (*Empetrum nigrum*) establish in protected concavities that can retain organic matter and moisture.

Appendix F. Continued.

Range:
Occurring in exposed settings throughout the Southeast and Southcentral biogeographic regions; extending into the Central and Southwest regions where the Alaska and Aleutian ranges overlap (Figure F20).

Climate:
This habitat type spans maritime and boreal-maritime transitional climates where the extreme conditions present at high-elevations and otherwise exposed sites often override the influence of regional climate. Summers are short and cool, and winters are long and cool with abundant wet snow.

Environment:
This habitat type develops in sites that are exposed due to high elevation, recent disturbance, or prominent landscape position. Typically, these sparse communities develop above the elevational limit of trees, but are also found at lower elevations on recently deglaciated substrates, rockfall, volcanic deposits, or wind-exposed sites. Exposure to desiccating winds, rocky and unstable substrates, and a short growing season limit plant growth. The depth and persistence of wind deposited snow influences the length of snow-free periods and soil moisture conditions. Where present, soils are well-drained, thin, and rocky. While permafrost is generally absent, seasonal frost is deep and may persist well into the growing season.

Disturbance:
These sparse vegetation communities are exposed to the regular disturbances of wind, substrate and snow creep, and freeze-thaw action; steeper sites may be subject to avalanche. Small mammal activity may have minor impacts. In particular contexts, colonies of nesting seabirds on cliffs and scree can cause ground disturbance and affect available nutrients. On mountain summits where woody vegetation is advancing due to a warming climate, the extent of high-alpine rocky habitats is expected to be reduced.

Boreal Cliff, Scree, and Rock Vegetation

USNVC Synonym: North American Boreal Cliff, Scree & Rock Vegetation (M895)

Figure F21. Distribution of boreal, cliff, scree, and rock vegetation in Alaska.

Appendix F. Continued.

Physiognomy:
Boreal cliff, scree, and rock vegetation consists of sparsely vegetated scree, talus, and bedrock shields, outcrops, and cliffs. Vegetation establishes in protected microsites and overall, there is less than 10% vascular plant cover with a variable cover of mosses and lichens. Forbs and woody species are uncommon and species diversity is low.

Floristics:
Communities range from lichen-encrusted bedrock, to cryptobiotic crust, to a sparse cover of graminoids, dry-site mosses, and fruticose lichens; prostrate shrubs and wind- and cold-adapted forbs are occasional components. On the harshest, driest sites, crustose lichen communities including *Rhizocarpon geographicum*, *Ophioparma lapponica, Umbilicaria hyperborea*, and *Pertusaria* species form. In more protected sites, dry-site mosses in the *Racomitrium* genus and lichens such as *Thamnolia vermicularis*, and members of the *Stereocaulon* and *Cladonia* genera are common. The liverworts *Anthelia juratzkana* and *Gymnomitrion corallioides* are major components of cryptogamic crust forming over volcanic deposits.

Nonvascular cover provides microsites for the subsequent establishment of graminoids such as tufted hairgrass (*Deschampsia cespitosa*), spike trisetum (*Trisetum spicatum*), and coiled sedge (*Carex circinata*), and forbs including purple mountain saxifrage (*Saxifraga oppositifolia*), Wright's golden saxifrage (*Chrysosplenium wrightii*), moss campion (*Silene acaulis*), Arctic stitchwort (*Cherleria arctica*), and Ross' avens (*Geum rossii*). Prostrate shrubs such as crowberry (*Empetrum nigrum*), alpine azalea (*Kalmia procumbens*), kinnikinnick (*Arctostaphylos uva-ursi*), various species of willow (*Salix*) and mountain avens (*Dryas*), and mountain heather (*Cassiope tetragona, Cassiope lycopodioides)* establish in protected concavities that are able to retain organic matter and moisture.

Range:
Occurring in exposed settings throughout the Central, Southcentral, and Southwest biogeographic regions (Figure F21). This habitat has also been mapped in the Western and Northern regions.

Climate:
The boreal continental climate is characterized by short, warm summers and long, very cold winters. Permafrost is nearly continuous, which contributes to the slow growth of species. The extreme conditions present at high-elevations and otherwise exposed sites often override the influence of regional climate.

Environment:
This habitat type develops in sites that are exposed due to high elevation, recent disturbance, or prominent landscape position. Typically, these sparse communities develop above the elevational limit of trees, but are also found at lower elevations on recently deglaciated substrates, volcanic deposits, rockfall, or wind-exposed sites. Exposure to desiccating winds, rocky and unstable substrates, and a short growing season limit plant growth. The depth and persistence of wind deposited snow influences the length of snow-free periods, insulation from freezing temperatures, and soil moisture conditions. Where present, soils are well-drained, thin, and rocky. Permafrost is nearly continuous.

Disturbance:
These sparse vegetation communities are exposed to the regular disturbances of wind, substrate and snow creep, and freeze-thaw action; steeper sites may be subject to avalanche. Small mammal activity may have minor impacts. The effect of permafrost is variable; well-drained rocky soils with low interstitial ice volumes are less affected by freeze thaw action than wetter organic soils, which are susceptible to solifluction and cryoturbation. On mountain summits where woody vegetation is advancing due to a warming climate, the extent of high-alpine rocky habitats is expected to be reduced.

Appendix F. Continued.

Arctic Cliff, Scree, and Rock Vegetation

USNVC Synonym: Arctic Scree, Rock & Cliff Barrens (M175)

Figure F22. Distribution of Arctic cliff, scree, and rock vegetation in Alaska.

Physiognomy:
Arctic cliff, scree, and rock vegetation consists of sparsely vegetated scree, talus, and bedrock shields, outcrops, and cliffs. Vegetation establishes in protected microsites and overall, there is less than 10% vascular plant cover with a variable cover of mosses and lichens. Forbs and woody species are uncommon and species diversity is low.

Floristics:
Communities range from lichen-encrusted bedrock, to a sparse cover of graminoids, dry-site mosses, and fruticose lichens; prostrate shrubs and wind- and cold-adapted forbs are occasional components. On the harshest, driest sites, crustose lichen-dominated communities are common within which *Rhizocarpon geographicum*, *Ophioparma lapponica, Umbilicaria hyperborea,* and *Pertusaria* species are prominent. Vascular plants, when they do occur, are typically dwarf or prostrate shrubs, graminoids, and rosette- or cushion-forming forbs. Common dwarf-shrubs include alpine azalea (*Kalmia procumbens*), alpine bearberry (*Arctous alpina*), skeletonleaf willow (*Salix phlebophylla*), Arctic willow (*Salix arctica*), pincushion plant (*Diapensia obovata*), white Arctic mountain heather (*Cassiope tetragona*), and various species of mountain-avens (*Dryas*). Commonly occurring species in the herb layer include the graminoids: northern singlespike sedge (*Carex scirpoidea*), smallawned sedge (*Carex microchaeta*), Pyrenean sedge (*Carex micropoda*), alpine fescue (*Festuca brachyphylla*), and Arctic sweetgrass (*Hierochloë alpina*), and the forbs: moss campion (*Silene acaulis*), purple mountain saxifrage (*Saxifraga oppositifolia*), and Arctic stitchwort (*Cherleria arctica*). Lichens associated with more protected sites are: *Alectoria ochroleuca*, and species in the *Cladonia, Cetraria,* and *Flavocetraria* genera.

Range:
Occurring in exposed settings north of latitudinal treeline in the Northern biogeographic region and beyond the longitudinal extent of treeline in the Western and Southwest regions (Figure F22). These rocky habitats have also been mapped sparingly in the Southcentral and Central regions.

Appendix F. Continued.

Climate:
The Arctic climate is dry and cold, characterized by very short summers and long winters. Much of the region is above the Arctic Circle and consequently receives continuous sunlight for several weeks in summer and continuous dark for several weeks in winter.

Environment:
This habitat type develops in sites that are exposed due to high elevation, recent disturbance, or prominent landscape position. Typically, these sparse communities develop in alpine settings, but in the Arctic are also found at lower elevations beyond the latitudinal or longitudinal limit of trees on recent volcanic deposits, rockfall, or wind-exposed sites. Exposure to desiccating winds, intense solar radiation, rocky and unstable substrates, and a short growing season limit plant growth. The depth and persistence of wind deposited snow influences the length of snow-free periods, insulation from freezing temperatures, and soil moisture conditions. Soils are either absent or thin, rocky, and well to excessively drained with little pedogenic development. Permafrost is continuous.

Disturbance:
These sparse vegetation communities are exposed to the regular disturbances of wind, substrate and snow creep, and freeze-thaw action; steeper sites may be subject to avalanche. Small mammal activity may have minor impacts. The effect of permafrost is variable; well-drained rocky soils with low interstitial ice volumes are less affected by freeze thaw action than wetter organic soils, which are susceptible to solifluction and cryoturbation.

COASTAL HABITATS

Temperate Salt Marsh

USNVC Synonym: North American Pacific Coastal Salt Marsh (M081)

Figure F23. Distribution of temperate salt marsh in Alaska.

Physiognomy:
Temperate salt marshes are subject to regular tidal inundation and are dominated by salt-tolerant forbs and graminoids. Vegetation ranges from sparse cover of herbaceous species on mudflats, to lush stands of

Appendix F. Continued.

emergent graminoids in estuaries, to well-vegetated graminoid-shrub communities at the upper reach of tidal influence. Woody and nonvascular plant species are uncommon and species diversity is low.

Floristics:
Vegetation patterns are ultimately related to elevation in so far that it directs the frequency and duration of tidal inundation. Along stable coastlines, the vegetation pattern is zonal with plants establishing according to their tolerance to salinity and inundation.

The low marsh is subject to twice daily tidal inundation. At the seaward margin of vegetation, the halophyte, creeping alkaligrass (*Puccinellia phryganodes*) colonizes bare mud. Moving inland, alkaligrass dominance transitions to Nootka alkaligrass (*Puccinellia nutkaensis*) and succulent, annual forbs such as slender grasswort (*Salicornia maritima*), Canadian sandspurry (*Spergularia canadensis*), Danish scurvygrass (*Cochlearia groenlandica*), and Pursh seepweed (*Suaeda calceoliformis*) occur more frequently. Tidal sloughs and levees spanning low to mid-marsh transition areas support mats of saltmarsh starwort (*Stellaria humifusa*) in slough bottoms and associations of Ramensk's sedge (*Carex ramenskii*), Pacific silverweed (*Potentilla anserina* ssp. *groenlandica*), and sea milkwort (*Lysimachia maritima*) on higher slough banks. Higher levees are codominated by seaside arrowgrass (*Triglochin maritima*) and goose tongue (*Plantago maritima*).

The mid marsh occupies the reach of land that is inundated only at the highest tides. It typically supports dense swards of Lyngbye's (*Carex lyngbyei*) or Ramensk's (*Carex ramenskii*) sedge, with largeflower speargrass (*Arctopoa eminens*) occupying higher or better-drained ground. Herbs associated with the mid marsh at lower abundances include the sedges: manyflower (*Carex pluriflora*), Mackenzie's (*Carex mackenziei*), and lesser saltmarsh (*Carex glareosa*), and the forb Alaska orache (*Atriplex gmelinii* var. *alaskensis*).

The high marsh ranges from the level of seasonal high tides to the maximum reach of storm surges and salt spray. This zone supports a diversity of graminoid, forb, and shrubs with minimal tolerance of saline conditions and inundation. Accordingly, there is a general shift in dominance from sedges to grasses and greater occurrence of woody species. Common grasses include: dunegrass (*Leymus mollis*), Bering's tufted hairgrass (*Deschampsia beringensis*), red fescue (*Festuca rubra*), Pacific reedgrass (*Calamagrostis nutkaensis*), mountain hairgrass (*Vahlodea latifolia*), and bluejoint reedgrass (*Calamagrostis canadensis*). The low shrubs sweetgale (*Myrica gale*) and dune willow (*Salix hookeriana*) may be locally abundant.

Range:
Occurring in coastal settings in the Southeast, Southcentral, and Southwest biogeographic regions (Figure F23). This habitat has also been mapped sparingly in the Western region.

Climate:
The maritime climate is characterized by relatively cool summers and warm winters, high annual precipitation, high humidity, and strong and consistent coastal winds.

Environment:
Salt marshes develop where relatively flat land receives periodic input of tidal waters. As an interface between the ocean and land, marshes combine aquatic and terrestrial habitats, anoxic and oxygenated conditions, as well as saline and fresh waters. This dynamic environment supports vegetation adapted to saturation and saline conditions. Along the Gulf of Alaska coastline, salt marshes are uncommon, developing in protected topographic pockets, or as larger complexes on major river deltas. Substrate ranges from cobble and gravel to fine-grained silts.

Disturbance:
Due to their landscape position, salt marshes are highly susceptible to impacts from development, oil spills, sea level rise, and earthquake-induced slides and tsunamis. Because salt marshes in Southeast Alaska provide flat land along an otherwise rocky coastline, cities, towns, and villages are often located adjacent to these habitats.

Appendix F. Continued.

Along the Gulf of Alaska coastline, land is rising due to isostatic rebound and tectonic uplift, and falling due to tectonic down-warping and climate change-induced sea level rise. Changes in relative sea level have a dramatic effect on coastal systems. Along a rising coastline, the high marsh will pass out of tidal influence and transition to vegetation characteristic of the surrounding nontidal habitats; at the same time, low marsh plants may invade newly exposed mudflats. Along a falling coastline, salt marshes migrate inland with tidewater inundating previously nontidal sites, while low marsh vegetation may erode or drown. Frequent strong winds in the Aleutian Islands and Alaska Peninsula cause erosive waves, retarding seaward marsh development. Consequently, salt marshes are more infrequent along the peninsula and island chain than one would expect based on topography.

Temperate Intertidal Vegetation

USNVC Synonyms: Temperate Pacific Seaweed Intertidal Vegetation (M106) and Temperate Pacific Seagrass Intertidal Vegetation (M184)

Figure F24. Distribution of temperate intertidal vegetation in Alaska.

Physiognomy:
Temperate intertidal vegetation is a linear coastal habitat type comprised of low-statured macroalgae (seaweed), and vascular and lichen species tolerant of periodic inundation by brackish or saltwater.

Floristics:
The distribution of vegetation is influenced by tidal regime with species establishing in relation to their tolerance to inundation and salinity. The width and number of bands of vegetation is related to substrate mobility and exposure to wave action. Narrow bands of a limited number of species typically develop across low-energy, fine-grained beaches where tidal reach is restricted and substrates are susceptible to erosion and redeposition. In contrast, numerous and wide bands tend to develop across high-energy, bedrock beaches where tidal reach is large and substrates are stable.

Along protected shorelines with mud, sand, or cobble shorelines, the low intertidal zone, which may only be exposed once a day, is often vegetated with a band of the flowering plant eelgrass (*Zostera marina*). The mid intertidal zone commonly supports soft brown kelps in the *Saccharina* genus, green seaweeds in the *Ulva* genus, red seaweeds in the *Palmaria* genus, and brown rockweeds such as *Fucus distichus*. Rockweed

Appendix F. Continued.

has high tolerance for fresh water and freezing temperatures and as such it defines and often dominates the reach of regular tidal inundation.

Along exposed shorelines with boulder or bedrock shorelines, a typical sequence of species, listed from the low to mid intertidal begins with the flowering plant scouler's surfgrass (*Phyllospadix scouleri*) at the water's edge, followed by wide bands of ribbon kelp (*Alaria marginata*), or dark brown kelps in the *Laminaria* genus with patchy red seaweeds in the *Porphyra* genus. A barnacle band intermixed with red sea moss (*Endocladia muricata*) may develop in the high intertidal zone.

Marine lichens often form bands in the high-intertidal to supratidal zone. Black seaside lichen (*Hydropunctaria maura*) forms the lowest band, indicating the wave break zone. Seaside lichens may form bands in the higher, supratidal zone that is exposed to storm surge and salt spray. White seaside lichens (*Coccotrema maritimum*) are common on north-facing granitic rocks or areas shaded by overhanging trees. Orange seaside lichens in the *Caloplaca* and *Xanthoria* genera form supratidal bands in areas of high nutrient input, such as seabird rookeries.

Regardless of protection and substrate, these intertidal communities may be bound by canopy kelp forests (e.g., *Eualaria fistulosa, Macrocystis pyrifera, Nereocystis luetkeana*) in the low intertidal to subtidal salt marsh or beach and dune plant communities typically bound high intertidal to supratidal areas.

Range:
Occurring in coastal settings in the Southeast, Southcentral, and Southwest biogeographic regions (Figure F24). This habitat has also been mapped sparingly in the Western region.

Climate:
The maritime climate is characterized by relatively cool summers and warm winters, high annual precipitation, high humidity, and strong and consistent coastal winds.

Environment:
Intertidal vegetation establishes where land is regularly inundated by brackish or salt waters. This dynamic environment supports life adapted to inundation and saline conditions with the type of species present largely dependent on shoreline substrate and exposure. The substrate is categorized as mud, sand, gravel, cobble, boulder, and bedrock. Wave exposure ranges from very protected tidal flats to very exposed bedrock cliffs. Tide regime ranges from mesotidal (2 m) along the Aleutian Island chain to extreme in upper Cook Inlet tides (12 m).

Disturbance:
Intertidal vegetation is subject to the twice daily inundation of saline water, wave action, and during periods of exposure, wind, and extreme cold. Herbivory by echinoderms, crustaceans, and mollusks can strongly influence the community structure of seaweed beds. As an extreme example, sea urchin grazing on kelp may produce an "urchin barren" devoid of macroalgae. Subsistence harvest targeting wakame (*Alaria marginata*), rockweed (*Fucus distichus*), sea lettuce (*Ulva lactuca*), dulse (*Palmaria mollis*), and species of kelp (*Laminaria*) and nori (*Porphyra*) may have minor impacts. Mariculture of oysters and kelp typically occurs in the subtidal, but may impact the adjacent intertidal zone. Due to their topographic location, intertidal zones are highly susceptible to impacts from oil spills, sea level rise, and earthquake-induced slides and tsunamis.

Appendix F. Continued.

Arctic Salt Marsh

USNVC Synonym: Arctic Tidal Salt Marsh (M403)

Figure F25. Distribution of Arctic salt marsh in Alaska.

Physiognomy:
Arctic salt marshes are subject to regular tidal inundation and are comprised of salt-tolerant forbs and graminoids. Vegetation ranges from sparse cover of herbaceous species on mudflats, to lush stands of emergent graminoids in estuaries, to well-vegetated graminoid-shrub communities at the upper reach of tidal influence. Except for a single species of prostrate willow, woody and nonvascular plant species are absent and species diversity is low.

Floristics:
Vegetation patterns are related to elevation, which influences the frequency and duration of tidal inundation. Along coastlines with stable elevations, the vegetation pattern is zonal with plants establishing according to their tolerance to salinity and inundation. Along coastlines experiencing subsidence and erosion due to thermokarst, the vegetation pattern is relict of the preexisting, nontidal type.

The most exposed, unvegetated mudflats are pioneered by the clonal, halophytic graminoids: creeping alkaligrass (*Puccinellia phryganodes*) and Hoppner's sedge (*Carex subspathacea*), with the halophytic, succulent forbs: saltmarsh starwort (*Stellaria humifusa*) and Danish scurvygrass (*Cochlearia groenlandica*) colonizing once the graminoids stabilize the substrate.

In contrast, extensive marshes with continuous cover of emergent vegetation may develop in sheltered lagoons and brackish estuaries. Here, the salt-tolerant grasses pendantgrass (*Arctophila fulva*) and Fisher's tundragrass (*Dupontia fisheri*), the forb fourleaf mare's tail (*Hippuris tetraphylla*), and Ramensk's sedge (*Carex ramenskii*) are common.

Across higher ground that is exposed to storm surges and salt spray only, more structurally-complex plant communities develop. Characteristic species include: prostrate oval-leaf willow (*Salix ovalifolia*), and the herbs: Arctic daisy (*Arctanthemum arcticum*), looseflower alpine sedge (*Carex rariflora*), lesser saltmarsh sedge (*Carex glareosa*), circumpolar reedgrass (*Calamagrostis deschampsioides*), tufted hairgrass (*Deschampsia cespitosa*), and Anderson's alkaligrass (*Puccinellia andersonii*).

Appendix F. Continued.

Sedge dominance transitions from Hoppner's sedge along the Arctic Coastal Plain to Ramensk's sedge along the Bering Sea coast. Lyngbye's sedge (*Carex lyngbyei*) may occur in slightly brackish or freshwater marshes inland of salt marshes dominated by Ramensk's sedge, but does not occur along the Arctic Coastal Plain. With respect to associated salt marsh species, bear sedge (*Carex ursina*), Fisher's tundragrass , Anderson's alkaligrass , and Arctic alkaligrass (*Puccinellia arctica*) occur exclusively along the Arctic Coastal Plain; species with distributions restricted to the Bering Sea Coast include: Mackenzie's sedge (*Carex mackenziei*), Pacific silverweed (*Potentilla anserina* ssp. *groenlandica*), and marsh arrowgrass (*Triglochin palustris*).

Range:
Occurring in coastal settings primarily in the Northern and Western biogeographic regions (Figure F25). This habitat has also been mapped sparingly in the Southwest region.

Climate:
The Arctic climate is dry and cold, characterized by very short summers and long winters. Coastal winds are strong and persistent. Most of the region is above the Arctic Circle and consequently receives continuous sunlight for several weeks in summer and continuous dark for several weeks in winter. River and sea ice may remain frozen from approximately October to June.

Environment:
Salt marshes develop where relatively flat land receives periodic input of tidal waters. As an interface between the ocean and land, tidal marshes combine aquatic and terrestrial habitats, anoxic and oxygenated conditions, as well as saline and fresh waters. This dynamic environment supports vegetation adapted to saturation and saline conditions. Salt marshes along the Arctic Ocean and Bering Sea coasts range from small patches forming in protected topographies, to large lagoon systems forming behind barrier beaches, to extensive inland complexes lining the tidally-influenced waters of large river deltas. Substrates are typically fine-grained silts and peats.

Permafrost ranges from continuous along the Arctic Ocean coast to discontinuous along the Bering Sea coast. Where present, shallow, ice-rich permafrost promotes the inundation of tidal marshes by restricting drainage. However, in all areas underlain by permafrost, the depth of thaw increases with proximity to water bodies due to the capacity of water to retain heat.

Tide regimes vary from microtidal (0.1 m) in the Arctic Ocean to mesotidal (4.5 m) in Bristol Bay. The microtidal regime of the Arctic Ocean reduces the elevational range across which salt marshes develop, however, storm surges across the low-angle topography of coastal plains and deltas can expand the inland extent of salt marshes. The development of salt marshes along high-energy coastlines is further limited by erosion, which truncates the seaward expansion of marsh systems.

Disturbance:
Arctic salt marshes are regularly inundated by storm surges which flood coastal and low-lying inland tundra. Permafrost degradation along the Arctic Ocean coast facilitates the inundation of nearshore basins and polygonal tundra resulting in the conversion of freshwater wetlands to salt marshes. Additionally, an increase in ice-free days exposes the coastline to coastal erosion, ice-rafting, and storm surges for a greater period of time, thereby exacerbating the cumulative impacts of these processes. Sediment deposition within river deltas can change the distribution and extent of estuarine marshes. Grazing by large flocks of geese has been shown to shape species composition and structure of salt marshes on the Arctic Coastal Plain and Yukon-Kuskokwim Delta.

Appendix F. Continued.

Temperate Coastal Beach and Dune

USNVC Synonym: Pacific Coastal Beach & Dune (M059)

Figure F26. Distribution of temperate coastal beach and dune in Alaska.

Physiognomy:

Temperate coastal beach and dune habitats are represented by sparsely vegetated grasslands and herbaceous meadows developing across coastal beaches and dunes. Rhizomatous, stoloniferous, and salt-tolerant graminoids and forbs are typically dominant. Species diversity is low and nonvascular and woody plant species are uncommon.

Floristics:

Species and plant community diversity increases with substrate stability. Grasslands typically occupy mobile substrates on the lower beach with herb meadows developing on more stable stretches of the upper beach and dunes. The dominant plant species occupying the lower beach include the succulent, halophytic forb seaside sandplant (*Honckenya peploides*), dunegrass (*Leymus mollis*), seaside ragwort (*Senecio pseudoarnica*), oysterleaf (*Mertensia maritima*), and beach pea (*Lathyrus japonicus*). In the upper beach, additional grasses, such as red fescue (*Festuca rubra*), meadow barley (*Hordeum brachyantherum*), largeglume bluegrass (*Poa macrocalyx*), largeflower speargrass (*Arctopoa eminens*), Pacific reedgrass (*Calamagrostis nutkaensis*), and Bering's tufted hairgrass (*Deschampsia beringensis*) may intergrade.

Beach meadow communities are characterized by a diversity of associated herbs including the large umbels: common cow parsnip (*Heracleum lanatum*), Scottish licorice-root (*Ligusticum scoticum*), Pacific hemlockparsely (*Conioselinum pacificum*), and seacoast angelica (*Angelica gmelinii*); sedges such as largehead sedge (*Carex macrocephala*), Gmelin's sedge (*Carex gmelini*), Mackenzie's sedge (*Carex mackenziei*), and longawned segde (*Carex macrochaeta*); and the forbs: silverweed cinquefoil (*Potentilla anserina*), fragrant bedstraw (*Galium triflorum*), Nootka lupine (*Lupinus nootkatensis*), wooly geranium (*Geranium erianthum*), false lily of the valley (*Maianthemum dilatatum*), and Kamchatka aconite (Aconitum maximum). Boreal yarrow (*Achillea millefolium* ssp. *borealis*), Tilesius' wormwood (*Artemisia tilesii*), and Arctic rush (*Juncus arcticus*) tend to increase in abundance on more recently disturbed, mineral soils. Sitka spruce (*Picea sitchensis*) saplings may be colonizing in meadows that are lifting out of the range of storm surge and salt spray due to isostatic rebound or regional tectonics.

Appendix F. Continued.

Range:
Occurring in the Southeast and Southcentral biogeographic regions; extending into the Southwest region through the Kodiak Island Archipelago, the Alaska Peninsula, and the Aleutian Island chain (Figure F26).

Climate:
The maritime climate is characterized by relatively cool summers and warm winters, high annual precipitation, high humidity, and strong and consistent coastal winds.

Environment:
This coastal habitat type typically develops along high-energy and exposed coastlines along mainland shores, spits, and barrier islands. Substrates range from coarse sand and gravel along the lower beach to sandy loams in interdune swales. Beach gradients tend to be steep, storm berms are often present, and tidal marshes tend to be absent. Vegetation occupies the elevational range from the upper intertidal zone to the inland extent of salt spray.

Disturbance:
Temperate beaches and dunes are exposed to wind, salt spray, and storm surges. Owing to their landscape position, dunes and beaches are highly susceptible to impacts from oil spills and human use. Degree of damage from an oil spill to nearshore waters is expected to vary with factors such as degree of tidal influx, tide level, location, season, and extent and duration of the spill. Off road vehicle use along beaches is frequent near villages and towns.

Temperate Coastal Cliff and Bluff

USNVC Synonym: Pacific Coastal Cliff & Bluff (M058)

Figure F27. Distribution of temperate coastal cliff and bluff in Alaska.

Physiognomy:
Temperate coastal cliff and bluff vegetation consists of sparsely to moderately vegetated sea cliffs, bluffs, scree slopes, and rocky coastlines exposed to salt spray and ocean wave action. Vascular plants typically have some salt-tolerance and communities are composed of creeping and succulent forbs, low grasses, dwarf

Appendix F. Continued.

shrubs, and stunted trees, which are restricted to small cracks in rock, or slight, sheltered depressions. Lichen and moss cover can be extensive.

Floristics:
Dominant vascular species include the grasses: longawn sedge (*Carex macrochaeta*), Bering's tufted hairgrass (*Deschampsia beringensis*), and red fescue (*Festuca rubra*); and the forbs: goatsbeard (*Aruncus dioicus*), bluebell bellflower (*Campanula rotundifolia*), dwarf fireweed (*Chamaenerion latifolium*), beach strawberry (*Fragaria chiloensis*), alpine heuchera (*Heuchera glabra*), Nootka lupine (*Lupinus nootkatensis*), villous cinquefoil (*Potentilla villosa*), western rattlesnakeroot (*Prenanthes alata*), and ledge stonecrop (*Rhodiola integrifolia*); and the fern long beechfern (*Phegopteris connectilis*). Associated species may include additional forbs such as common yarrow (*Achillea millefolium*), Pacific hemlockparsley (*Conioselinum pacificum*), false lily of the valley (*Maianthemum dilatatum*), seep monkeyflower (*Mimulus guttatus*), and goose tongue (*Plantago maritima*). Sitka spruce (*Picea sitchensis*) tolerates salt spray and stunted individuals may grow from cracks in rocky headlands. Lichen cover can be high, with representation from species in the *Xanthoria* and *Ramalina* genera; dry-site mosses in the *Racomitrium* and *Dicranum* genera also occur.

Range:
Occurring in the Southeast and Southcentral biogeographic regions; extending into the Southwest region through the Kodiak Island Archipelago and the Alaska Peninsula (Figure F27).

Climate:
The maritime climate is characterized by relatively cool summers and warm winters, high annual precipitation, high humidity, and strong and consistent coastal winds.

Environment:
This habitat type consists of sparse yet diverse assemblages of plants on sea cliffs, scree slopes, and rocky coastlines exposed to salt spray and ocean wave action. Soils are thin and limited to fine materials retained in cracks and fissures in the bedrock or rocky substrate.

Disturbance:
Exposure to wave, wind and sheet erosion may create substrates that are unstable and subject to failure.

Appendix F. Continued.

Arctic Coastal Shore

USNVC Synonym: North American Arctic Coastal Shore (M402)

Figure F28. Distribution of Arctic coastal shore in Alaska.

Physiognomy:
The Arctic coastal shore occurs as sparsely vegetated grasslands and herbaceous meadows developing across coastal beaches and dunes. Rhizomatous and salt-tolerant graminoids and forbs are typically dominant. Species diversity is low and nonvascular and woody plant species are generally absent.

Floristics:
Species and plant association diversity increases with substrate stability. Grasslands typically occupy mobile substrates on the lower beach with herb meadows developing on stable portions of the upper beach and dunes. Pioneer species tolerant of salt and sand accumulation are the first to establish on newly exposed or created substrates. Dunegrass (*Leymus mollis)* occupies topographic highs, with the succulent, halophytic forb seaside sandplant (*Honckenya peploides*) occurring on lower, often tidally-influenced substrates. Due to the challenges of germination posed by wind and desiccation in a dune environment, most species reproduce vegetatively and quickly develop to clonal stands. Sand dunes may become stabilized by dunegrass and beach pea (*Lathyrus japonicus*) with seaside sandplant, oysterleaf (*Mertensia maritima*), curved sedge (*Carex maritima*), and Baffin fescue (*Festuca baffinensis*) occurring as minor associates along the Arctic Ocean coast. Stable dune communities become more diverse along the Bering Sea coast and may include additional species such as the grasses: Lapland reedgrass (*Calamagrostis lapponica*), red fescue (*Festuca rubra*), tufted hairgrass (*Deschampsia beringensis*), and the forbs: boreal yarrow (*Achillea millefolium* ssp. *borealis*), boreal sagebrush (*Artemisia arctica*), Tilesius' wormwood (*Artemisia tilesii*), Pacific hemlockparsley (*Conioselinum pacificum*), and Lake Huron tansy (*Tanacetum bipinnatum*).

Range:
Occurring in coastal settings in the Northern and Western biogeographic regions; extending into the Southwest region through the Aleutian Island chain (Figure F28). The habitat has also been mapped sparingly in the Southcentral region.

Appendix F. Continued.

Climate:
The Arctic coastal climate is dry and cold, characterized by very short summers and long winters. Winds are strong and persistent. Most of the region is above the Arctic Circle and consequently receives continuous sunlight for several weeks in summer and continuous dark for several weeks in winter. Sea ice remains frozen from approximately October to June.

Environment:
Coastal vegetation develops on beaches above the elevation of maximum high tide as well as on dunes along mainland shores and barrier islands. Beach meadows may occupy well-drained stable portions of the upper beach and dunes. Permafrost is present at depth along the Arctic Ocean coast but becomes discontinuous along the Bering Sea coast. Among the barrier islands, vegetated dunes are more common on remnant types, which represent relict coastline, rather than constructed types, which are highly dynamic systems representing comparatively recent depositions of sediment. Soils are dry to mesic and typically sandy with small pebbles; surficial bedrock is absent along the Beaufort Sea Coast and rare along the Chukchi and Bering Sea coasts.

Disturbance:
Arctic beaches and dunes are exposed to wind, salt spray, and storm surges. Rafted ice may scour vegetated surfaces and dredge sediment shoreward. An increase in ice-free days exposes the coastline to fetch-dependent processes such as wave action and storm surge for a greater period of time, thereby increasing their cumulative impacts. Owing to their landscape position, dunes and beaches are highly susceptible to impacts from oil spills and human use. Degree of damage from an oil spill to nearshore waters is expected to vary with factors such as degree of tidal influx, tide level, location, season and extent and duration of the spill. Off-road vehicle use along beaches is frequent near villages and towns.

FRESHWATER AQUATIC HABITATS

Rivers and Streams

Alaska's flowing waters range from small, ephemeral streams, to intermittent or groundwater-fed channelized rivers, to large, braided glacial and meandering systems. This aquatic habitat is not mapped in the draft Alaska Vegetation Map (Nawrocki et al. 2025). Perennial rivers and streams support numerous aquatic species, including both anadromous and resident fish. Mainstems and tributaries provide critical spawning, rearing, and overwintering habitats, with the type and ratio of substrate materials determining suitability of the habitat for aquatic species during different life stages. Stream and riverbed substrates vary from large boulders to glacial silt or flour, clay, and mud. Large boulders form eddies providing resting areas for fish, while smaller cobbles and gravels allow for the required aeration and subsequent development of fish eggs buried in the streambed. Larger substrates provide greater surface area for aquatic invertebrates, algae, and mosses. The size of substrate materials decreases with the depositional energy of the waterway. Boulder and cobble bed streams are usually found in the high-energy, upper portion of a watershed. These streams often have pockets of gravel and fine sediment in the pools, behind large rocks, and on the inside of bends and other low velocity areas. Mud, silt, or clay are found in the low-energy, lower reaches of a watershed. Along larger, meandering rivers, sediment eroded from upstream cut banks is deposited along downstream point bars. In broad valleys of major rivers, extensive meanders create oxbow lakes in abandoned channels. Braided channels are formed as a result of erosional and depositional processes and are typical of high-volume glacial rivers with episodic flow. Riparian vegetation and large woody debris are an important component of rivers and streams that help stabilize banks and substrate, preserve spawning bed integrity, provide cover from terrestrial predators, and create habitat for aquatic invertebrates, all of which elevate in-stream productivity.

Appendix F. Continued.

Rivers and streams can be broadly categorized as glacial and nonglacial. Glaciers feed into nearly all major rivers in Alaska and provide the headwaters to some of the state's largest rivers, including the Yukon, Copper, Susitna, Kuskokwim, and Tanana Rivers. Here, the glacial input determines the chemical and physical characteristics of the water, depending on the extent of glacial input relative to other inputs, such as snowmelt and groundwater. Glacial meltwater has high levels of bioavailable nutrients, which fuel high and sustained levels of primary productivity. Glacially driven rivers exhibit variable rates of fluvial activity and channel adjustments from erosional and depositional processes. Rivers originating from glaciers tend to have pronounced daily and seasonal stream flow fluctuations near the glacier, and large interannual fluctuations in discharge along lower reaches. Peak, sediment-laden flows occur during the warmest months of the year, typically May through August. During the winter, when baseflow is derived entirely from groundwater, glacial rivers generally run clear and low.

Nonglacial, or clearwater rivers and streams exhibit low turbidity, high clarity, and flow derived primarily from groundwater and precipitation. Different from glacial waterways, clearwater systems have less variable interannual flow, relatively narrower channel widths, stable and well-defined beds and banks, low sediment loads, and increased habitat complexity in the form of pools, riffles, and large woody debris. Overwintering habitat for anadromous fish can be reduced due to the smaller volume of water available. However, crucial upwelling areas in groundwater-fed streams and perennial spring pools provide some of the most important winter habitats for freshwater aquatic species in Alaska.

Lakes and Ponds

Alaska's lakes and ponds range from small alpine ponds underlain by bedrock to Arctic thermokarst lakes, to large bodies of water occupying glacial troughs carved in the Pleistocene. This aquatic habitat is not mapped in the draft Alaska Vegetation Map (Nawrocki et al. 2025). Lake and pond habitats vary with substrate, bathymetry, and shoreline contour. In the relatively still waters of lakes and ponds, flow regimes of inlets and outlets, and basin contours influence nutrient cycling, hydraulic retention time, and biological productivity. Glacially carved lakes tend to be deep and bedrock bound with permanent surface water connections. Most of the state's larger lakes, particularly those in Southwest and Southcentral Alaska, resulted from glaciation and are important to both resident and anadromous fish species for overwintering. For example, while Kenai Lake and Iliamna Lake differ in their glacial and nonglacial inputs, both are connected to rivers that support large and valuable runs of salmon.

Different from glacial lakes, lakes and ponds of thermokarst, fluvial, and volcanic origin generally lack connecting tributaries. These isolated waterbodies may instead be connected by seasonal or subsurface waterways. For example, thermokarst ponds are often connected by the subsurface flow of groundwater over perennially frozen soil (permafrost), and through connections to deeper aquifers through taliks. In the north, the depth of lakes and ponds is important for the survival of aquatic species. In general, waterbodies less than six feet deep will freeze to the bottom, leaving no free water for the survival of resident fish.

Freshwater Aquatic Vegetation

USNVC Synonym: Western North American Freshwater Aquatic Vegetation (M109) and Boreal Freshwater Aquatic Vegetation (M871).

Physiognomy:
Freshwater aquatic vegetation consists of rooted, submerged, and free-floating herbaceous plants growing in fresh, standing water and slow-moving streams. Vegetation cover is greater than 25%. Woody species are not present and emergent graminoids and nonvascular plants are uncommon. Species diversity is typically low.

Appendix F. Continued.

Floristics:
Aquatic plant communities and the life forms of their constituent species can be partially differentiated by the depth of water in which they occur. Littoral, or nearshore communities are often dominated by robust emergent species intermixed with rooted, often submerged forbs and nonvascular species. Common mare's tail (*Hippuris vulgaris*)* is an emergent forb that forms monocultures along fine-grained, mineral shorelines and gravel. Similar to mare's tail, the emergent bur-reeds: shortspike (*Sparganium angustifolium*) and northern (*Sparganium hyperboreum*)* also form shoreline monocultures, often in more organic-rich sediment. Submerged and often cryptic species of quillwort (*Isoetes*), water-starwort (*Callitriche*), water mudwort (*Limosella aquatica*), and waterawlwort (*Subularia aquatica*) grow in shallow portions of the littoral zone. Nonvascular plants such as the aquatic mosses *Fontinalis antipyretica* and *Sarmentypnum sarmentosum*, the liverwort *Scapania paludosa*, and the lichen *Siphula ceratites* may grow submerged in shallow waters or on pond margins. Free-floating duckweed (*Lemna turionifera*) can form dense mats on the surface of nutrient-rich, sun-exposed waters. While they can occur anywhere on a lake or pond surface, duckweed mats are often blown to the shoreline where they are caught by emergent vegetation. While rarely dominant, aquatic buttercups including threadleaf crowfoot (*Ranunculus trichophyllus*), white water crowfoot (*Ranunculus mongolicus*), high northern buttercup (*Ranunculus hyperboreus*)*, Gemlin's buttercup (*Ranunculus gmelinii*)*, and Pallas buttercup (*Coptidium pallasii*) are commonly associated with shoreline communities and slow-moving waters. In the boreal zone, fineleaf pondweed (*Stuckenia filiformis*)*, Yenisei River pondweed (*Potamogeton subsibiricus*)*, small pondweed (*Potamogeton berchtoldii*)*, Fries' pondweed (*Potamogeton friesii*), and leafy pondweed (*Potamogeton foliosus*), and the insectivorous bladderwort (*Utricularia*)*, may be intermixed in deeper water sections of the littoral zone.

Rocky Mountain pond-lily (*Nuphar polysepala*) frequently occupies the transition from the littoral to limnetic zone in the temperate regions of Alaska. This is a rooted, vascular species with floating leaf pads that is associated with muck-bottomed ponds in forested settings. Deeper, limnetic waters in the temperate zone are dominated by pondweeds including floating pondweed (*Potamogeton natans*), alpine pondweed (*Potamogeton alpinus*)*, whitestem pondweed (*Potamogeton praelongus*)*, variableleaf pondweed (*Potamogeton gramineus*), and Richardson's pondweed (*Potamogeton perfoliatus* ssp. *richardsonii*). Watermilfoil (*Myriophyllum sibiricum*) is a commonly associated, submerged species in these deeper water communities. While not plants, the macroscopic algae species *Chara* and *Nitella* and freshwater sponges, such as *Spongilla lacustris,* resemble submerged aquatic species and perform many of the same ecological functions, including the production of food and protection from predators.

Range:
Occurring in freshwater aquatic settings in all 6 biogeographic regions in Alaska. This aquatic habitat is not mapped in the draft Alaska Vegetation Map (Nawrocki et al. 2025).

Climate:
The maritime climate in the Southeast, Southcentral, and Southwestern biogeographic regions is cool in the summer and mild in the winter with low annual variation in temperature. Precipitation as rain, snow, and fog drip is abundant. The boreal and Arctic biogeographic regions (Central, Western, and Northern) are characterized by short, warm summers and long, very cold winters. The region above the Arctic Circle receives continuous sunlight for several weeks in summer and continuous twilight for several weeks in winter. Permafrost is continuous in the Arctic, becoming discontinuous in the southern boreal region.

* Relatively few aquatic plants are found in the Arctic regions of Alaska; they are denoted here with an asterisk.

Appendix F. Continued.

Environment:
The occurrence of aquatic vegetation tends to be limited in spatial extent and patchy or linear in spatial pattern. Stands develop in lakes, ponds, oxbows, and slow-moving portions of rivers and streams. In large waterbodies, aquatic vegetation tends to be restricted to the littoral region where the penetration of light does not limit growth. Sediment is typically fine grained, organic-rich muck. Waterbodies in the southern Alaska regions, especially smaller lakes and ponds freeze in the winter although permafrost is absent. Permafrost is continuous in the Arctic and nearly continuous in the boreal zone but may be depressed under large waterbodies that are able to retain heat through the winter.

Disturbance:
Freshwater aquatic beds represent early-successional communities that may be replaced by wetland marshes, wet meadows, fens, floating bogs, or permafrost plateaus. Shallow lakes and small ponds freeze to the bottom in the winter; vegetation in larger lakes with sufficient fetch may be damaged by scour of wind-blown and rafted ice. Increase in nutrients, such as nitrogen and phosphorus, may prompt a shift from oligotrophic or mesotrophic to eutrophic conditions and a subsequent change in plant community composition towards fast-growing plant and algal species. Such lakes are particularly susceptible to the establishment of the invasive aquatic waterweed *Elodea canadensis*.

GLACIAL HABITATS

Perennial Snow, Ice, and Glacial Outwash

USNVC Synonyms: North American Glacier & Ice Field and North American Glacial Outwash

Figure F29. Distribution of perennial snow, ice, and glacial outwash in Alaska.

Glaciers, perennial snow fields, and glacial outwash occur on mountain slopes and valleys in the Southeast, Southcentral, Southwest, and Central regions (Figure F29). Perennial snow and ice represent glaciers and ice fields. Glaciers occur on moderately steep to steep mountain slopes and in mountain valleys. Crevasses, seracs, and moulins are common glacial features. On the lower reaches of glaciers there is often a relatively thin veneer of very to extremely cobbly, stony, or bouldery glacier sediments over glacier ice. Ice fields are

Appendix F. Continued.

broad ice-covered areas high in the mountains typically on nearly level to strongly sloping gradients. Soils are generally nonexistent, although glacier ice is sometimes covered by a thin veneer of rocky till. Vegetation is absent except in low-elevation ablation zones, where early-successional species, such as Sitka alder (*Alnus alnobetula* ssp. *sinuata*), can become established on thick till overlying glacial ice.

Glacial outwash consists of recently deglaciated material at the toe of a receding glacier. Surface organics are typically absent or very thin and extremely patchy. Mineral soils are very to extremely gravelly, cobbly, stony, or bouldery loamy sand, and sand and as a result are excessively drained. Depth to bedrock is generally deep. Vegetation is sparsely distributed but can include patches of early successional plants, such as alder shrubs, Drummond's mountain avens *(Dryas drummondii),* lichens, and bryophytes.

Appendix G. Scientific and common names of plant taxa referenced in Chapter 6 and Appendix F, organized by life form. Plant taxonomy follows the *Flora of Alaska* (floraofalaska.org); plant common names follow the U.S. Department of Agriculture (USDA) Plants Database (plants.usda.gov).

Life Form	Scientific Name	Common Name
tree	*Abies lasiocarpa*	subalpine fir
	Alnus rubra	red alder
	Betula kenaica	Kenai birch
	Betula neoalaskana	Alaska birch
	Callitropsis nootkatensis	Alaska cedar
	Larix laricina	tamarack
	Picea × lutzii	Lutz spruce
	Picea glauca	white spruce
	Picea mariana	black spruce
	Picea sitchensis	Sitka spruce
	Pinus contorta var. *contorta*	beach pine
	*Populus balsamifer*a	balsam poplar
	Populus tremuloides	quaking aspen
	Populus trichocarpa	black cottonwood
	Thuja plicata	western red cedar
	Tsuga heterophylla	western hemlock
	Tsuga mertensiana	mountain hemlock
	Alnus alnobetula ssp. fruticosa	Siberian alder
	Alnus alnobetula ssp. sinuata	Sitka alder
	Alnus incana ssp. tenuifolia	thinleaf alder
	Amelanchier alnifolia	Saskatoon serviceberry
	Betula glandulosa	resin birch
	Betula nana	dwarf birch
	Chamaedaphne calyculata	leatherleaf
	Cornus sericea	redosier dogwood
shrub	*Elaeagnus commutata*	silverberry
	Elliottia pyroliflora	copperbush
	Gaultheria shallon	salal
	Juniperus communis	common juniper
	Malus fusca	Oregon crab apple
	Myrica gale	sweetgale
	Oplopanax horridus	devilsclub
	Rhododendron groenlandicum	bog labrador tea
	Rhododendron menziesii	rusty menziesia
	Rhododendron tomentosum ssp. decumbens	marsh labrador tea
	Ribes bracteosum	stink currant
	Rosa acicularis	prickly rose
	Rubus spectabilis	salmonberry
	Salix alaxensis	feltleaf willow
	Salix arbusculoides	littletree willow
	Salix barclayi	Barclay's willow

Appendix G. Continued.

Life Form	Scientific Name	Common Name
shrub	*Salix bebbiana*	Bebb willow
	Salix commutata	undergreen willow
	Salix fuscescens	Alaska bog willow
	Salix glauca	grayleaf willow
	Salix hookeriana	dune willow
	Salix niphoclada	barrenground willow
	Salix pulchra	tealeaf willow
	Salix richardsonii	Richardson's willow
	Salix scouleriana	Scouler's willow
	Salix sitchensis	Sitka willow
	Sambucus racemosa	red elderberry
	Shepherdia canadensis	buffaloberry
	Sorbus scopulina	Greene's mountain ash
	Sorbus sitchensis	western mountain ash
	Spiraea douglasii	rose spirea
	Spiraea stevenii	beauverd spirea
	Vaccinium alaskaense	Alaska blueberry
	Vaccinium ovalifolium	oval-leaf blueberry
	Vaccinium parvifolium	red huckleberry
	Viburnum edule	highbush cranberry
dwarf shrub	*Andromeda polifolia*	bog rosemary
	Arctostaphylos uva-ursi	kinnikinnick
	Arctous alpina	alpine bearberry
	Cassiope lycopodioides	clubmoss mountain heather
	Cassiope mertensiana	western moss heather
	Cassiope tetragona	white arctic mountain heather
	Diapensia obovata	pincushion plant
	Dryas ajanensis	eightpetal mountain-avens
	Dryas alaskensis	Alaskan mountain-avens
	Dryas drummondii	Drummond's mountain-avens
	Dryas integrifolia	entireleaf mountain-avens
	Empetrum nigrum	crowberry
	Harrimanella stelleriana	Alaska bellheather
	Kalmia microphylla	alpine laurel
	Kalmia procumbens	alpine azalea
	Linnaea borealis	twinflower
	Luetkea pectinata	partridgefoot
	Oxycoccus microcarpus	small cranberry
	Phyllodoce aleutica	Aleutian mountainheath
	Phyllodoce glanduliflora	yellow mountainheath
	Salix arctica	Arctic willow
	Salix ovalifolia	oval-leaf willow
	Salix phlebophylla	skeletonleaf willow
	Salix polaris	polar willow

Appendix G. Continued.

Life Form	Scientific Name	Common Name
dwarf shrub	*Salix reticulata*	netleaf willow
	Salix rotundifolia	least willow
	Salix stolonifera	sprouting leaf willow
	Vaccinium caespitosum	dwarf bilberry
	Vaccinium uliginosum	bog blueberry
	Vaccinium vitis-idaea	lingonberry
forb	*Achillea millefolium*	common yarrow
	Achillea millefolium ssp. borealis	boreal yarrow
	Aconitum delphiniifolium	larskspurleaf monkshood
	Aconitum maximum	Kamchatka aconite
	Anemonastrum sibiricum	narcissus anemone
	Angelica gmelinii	seacoast angelica
	Arctanthemum arcticum	arctic daisy
	Artemisia arctica	boreal sagebrush
	Artemisia borealis	field sagewort
	Artemisia frigida	prairie sagewort
	Artemisia kruhsiana ssp. *alaskana*	Alaska wormwood
	Artemisia tilesii	Tilesius' wormwood
	Aruncus dioicus	goatsbeard
	Atriplex gmelinii var. *alaskensis*	Alaska orache
	Bistorta plumosa	meadow bistort
	Bistorta vivipara	alpine bistort
	Bupleurum americanum	American thorowax
	Calla palustris	water arum
	Callitriche spp.	water star-wort
	Campanula lasiocarpa	mountain harebell
	Campanula rotundifolia	bluebell bellflower
	Castilleja unalaschcensis	Alaska Indian paintbrush
	Chamaenerion angustifolium	fireweed
	Chamaenerion latifolium	dwarf fireweed
	Cherleria arctica	arctic stitchwort
	Chrysosplenium wrightii	Wright's golden saxifrage
	Circaea alpina	enchanter's nightshade
	Cochlearia groenlandica	Danish scurvygrass
	Comarum palustre	purple marshlocks
	Conioselinum pacificum	Pacific hemlockparsley
	Coptidium pallasii	Pallas' buttercup
	Coptis aspleniifolia	fernleaf goldthread
	Cornus canadensis	bunchberry dogwood
	Dodecatheon pulchellum	darkthroat shooting star
	Drosera rotundifolia	roundleaf sundew
	Erigeron peregrinus	subalpine fleabane
	Eurybia sibirica	subalpine aster
	Fragaria chiloensis	beach strawberry

Appendix G. Continued.

Life Form	Scientific Name	Common Name
forb	*Fritillaria camschatcensis*	Kamchatka fritillary
	Galium boreale	northern bedstraw
	Galium triflorum	fragrant bedstraw
	Gentianella propinqua	fourpart dwarf gentian
	Geocaulon lividum	false toadfloax
	Geranium erianthum	woolly geranium
	Geum calthifolium	calthaleaf avens
	Geum rossii	Ross' avens
	Hedysarum americanum	alpine sweetvetch
	Heracleum lanatum	common cowparsnip
	Heracleum maximum	cowparsnip
	Heuchera glabra	alpine heuchera
	Hippuris montana	mountain mare's tail
	Hippuris tetraphylla	fourleaf mare's tail
	Hippuris vulgaris	common mare's tail
	Honckenya peploides	seaside sandplant
	Iris setosa	beachhead iris
	Lathyrus japonicus	beach pea
	Lathyrus palustris	marsh pea
	Lemna turionifera	turion duckweed
	Ligusticum scothicum	Scottish licorice-root
	Limosella aquatica	water mudwort
	Lupinus arcticus	Arctic lupine
	Lupinus nootkatensis	Nootka lupine
	Lysichiton americanus	skunkcabbage
	Lysimachia europaea	arctic starflower
	Lysimachia maritima	sea milkwort
	Lythrum salicaria	purple loosestrife (invasive)
	Maianthemum dilatatum	false lily of the valley
	Menyanthes trifoliata	buckbean
	Mertensia maritima	oysterleaf
	Mertensia paniculata	tall bluebells
	Mimulus guttatus	seep monkeyflower
	Myosotis alpestris ssp. asiatica	Asian forget-me-not
	Myriophyllum sibiricum	shortspike watermilfoil
	Nephrophyllidium crista-galli	deercabbage
	Nuphar polysepala	Rocky Mountain pond lily
	Oxyria digyna	alpine mountainsorrel
	Oxytropis bryophila	blackish oxytrope
	Packera hyperborealis	northern groundsel
	Parnassia fimbriata	fringed grass of parnassus
	Parnassia kotzebuei	Kotzebue's grass of Parnassus
	Parnassia palustris	marsh grass of parnassus
	Pedicularis capitata	capitate lousewort

Appendix G. Continued.

Life Form	Scientific Name	Common Name
forb	*Petasites frigidus*	arctic sweet coltsfoot
	Phyllospadix scouleri	Scouler's surfgrass
	Pinguicula vulgaris	butterwort
	Plantago maritima	goose tongue
	Platanthera dilatata	scentbottle
	Polemonium acutiflorum	tall Jacob's ladder
	Polemonium boreale	northern Jacob's ladder
	Potamogeton alpinus	alpine pondweed
	Potamogeton berchtoldii	small pondweed
	Potamogeton foliosus	leafy pondweed
	Potamogeton friesii	Fries' pondweed
	Potamogeton gramineus	variableleaf pondweed
	Potamogeton natans	floating pondweed
	Potamogeton perfoliatus ssp. richardsonii	Richardson's pondweed
	Potamogeton praelongus	whitestem pondweed
	Potamogeton subsibiricus	Yenisei River pondweed
	Potentilla anserina	silverweed cinquefoil
	Potentilla anserina ssp. groenlandica	Pacific silverweed
	Potentilla nana	Arctic cinquefoil
	Potentilla villosa	villous cinquefoil
	Prenanthes alata	western rattlesnakeroot
	Pyrola spp.	wintergreen
	Ranunculus gmelinii	Gmelin's buttercup
	Ranunculus hyperboreus	high northern buttercup
	Ranunculus mongolicus	white water crowfoot
	Ranunculus occidentalis	western buttercup
	Ranunculus trichophyllus	threadleaf crowfoot
	Rhodiola integrifolia	ledge stonecrop
	Rubus arcticus	Arctic raspberry
	Rubus chamaemorus	cloudberry
	Rubus pedatus	strawberryleaf raspberry
	Salicornia maritima	slender grasswort
	Sanguisorba canadensis	Canadian burnet
	Sanguisorba officinalis	great burnet
	Saussurea angustifolia	narrowleaf saw-wort
	Saxifraga aleutica	Aleutian saxifrage
	Saxifraga cernua	nodding saxifrage
	Saxifraga oppositifolia	purple mountain saxifrage
	Saxifraga tricuspidata	three toothed saxifrage
	Senecio lugens	small blacktip ragwort
	Senecio pseudoarnica	seaside ragwort
	Senecio triangularis	arrowleaf ragwort
	Sibbaldia procumbens	creeping sibbaldia

Appendix G. Continued.

Life Form	Scientific Name	Common Name
forb	*Silene acaulis*	moss campion
	Sparganium angustifolium	narrowleaf bur-reed
	Sparganium hyperboreum	northern bur-reed
	Spergularia canadensis	Canadian sandspurry
	Spiranthes romanzoffiana	hooded lady's tresses
	Stellaria humifusa	saltmarsh starwort
	Streptopus amplexifolius	claspleaf twistedstalk
	Stuckenia filiformis	fineleaf pondweed
	Suaeda calceoliformis	Pursh seepweed
	Subularia aquatica	waterawlwort
	Swertia obtusa	felwort
	Tanacetum bipinnatum	Lake Huron tansy
	Tiarella trifoliata	threeleaf foamflower
	Triantha glutinosa	sticky tofieldia
	Typha latifolia	broadleaf cattail
	Utricularia intermedia	bladderwort
	Valeriana capitata	capitate valerian
	Valeriana sitchensis	Sitka valerian
	Veratrum viride	green false hellebore
	Veronica wormskjoldi	American alpine speedwell
	Viola epipsila	dwarf marsh violet
	Viola glabella	pioneer violet
	Wilhelmsia physodes	merckia
	Zostera marina	eelgrass
graminoid	*Arctagrostis latifolia*	wideleaf polargrass
	Arctophila fulva	pendant grass
	Arctopoa eminens	largeflower speargrass
	Bromus pumpellianus	Pumpelly's brome
	Bromus pumpellianus var. *pumpellianus*	Pumpelly's brome
	Calamagrostis canadensis	bluejoint reedgrass
	Calamagrostis deschampsioides	circumpolar reedgrass
	Calamagrostis lapponica	Lapland reedgrass
	Calamagrostis neglecta	slimstem reedgrass
	Calamagrostis nutkaensis	Pacific reedgrass
	Calamagrostis purpurascens	purple reedgrass
	Carex anthoxanthea	grassyslope Arctic sedge
	Carex aquatilis	water sedge
	Carex bigelowii	Bigelow's sedge
	Carex chordorrhiza	creeping sedge
	Carex circinata	coiled sedge
	Carex echinata	star sedge
	Carex flava	yellow sedge
	Carex glareosa	lesser saltmarsh sedge

Appendix G. Continued.

Life Form	Scientific Name	Common Name
graminoid	*Carex gmelini*	Gmelin's sedge
	Carex lasiocarpa	woollyfruit sedge
	Carex limosa	mud sedge
	Carex livida	livid sedge
	Carex lyngbyei	Lyngbye's sedge
	Carex mackenziei	Mackenzie's sedge
	Carex macrocephala	largehead sedge
	Carex macrochaeta	longawn sedge
	Carex maritima	curved sedge
	Carex membranacea	fragile sedge
	Carex microchaeta	smallawned sedge
	Carex micropoda	Pyrenean sedge
	Carex pauciflora	fewflower sedge
	Carex pluriflora	manyflower sedge
	Carex podocarpa	shortstalk sedge
	Carex ramenskii	Ramensk's sedge
	Carex rariflora	looseflower alpine sedge
	Carex rostrata	beaked sedge
	Carex rotundata	round sedge
	Carex rupestris	curly sedge
	Carex saxatilis	rock sedge
	Carex scirpoidea	northern singlespike sedge
	Carex sitchensis	Sitka sedge
	Carex stylosa	variegated sedge
	Carex subspathacea	Hoppner's sedge
	Carex ursina	bear sedge
	Carex utriculata	Northwest Territory sedge
	Deschampsia beringensis	Bering's tufted hairgrass
	Deschampsia cespitosa	tufted hairgrass
	Dupontia fisheri	Fisher's tundragrass
	Eleocharis palustris	common spikerush
	Eleocharis suksdorfiana	Suksdorf's spikerush
	Eriophorum angustifolium	tall cottongrass
	Eriophorum russeolum	red cottongrass
	Eriophorum scheuchzeri	white cottongrass
	Eriophorum vaginatum	tussock cottongrass
	Eriophorum viridicarinatum	thinleaf cotton sedge
	Festuca altaica	Altai fescue
	Festuca baffinensis	Baffin fescue
	Festuca brachyphylla	alpine fescue
	Festuca rubra	red fescue
	Hierochloe alpina	alpine sweetgrass
	Hordeum brachyantherum	meadow barley

Appendix G. Continued.

Life Form	Scientific Name	Common Name
graminoid	*Juncus arcticus*	Arctic rush
	Juncus balticus	Baltic rush
	Juncus bufonius	toad rush
	Juncus mertensianus	Merten's rush
	Koeleria asiatica	Eurasian Junegrass
	Leymus mollis	American dunegrass
	Luzula arcuata	curved woodrush
	Luzula piperi	Piper's woodrush
	Phalaris arundinacea	reed canarygrass (invasive)
	Phippsia algida	icegrass
	Poa arctica	Arctic bluegrass
	Poa macrocalyx	largeglume bluegrass
	Puccinellia andersonii	Anderson's alkaligrass
	Puccinellia arctica	Arctic alkaligrass
	Puccinellia nutkaensis	Nootka alkaligrass
	Puccinellia phryganodes	creeping alkaligrass
	Schoenoplectus tabernaemontani	softstem bulrush
	Trichophorum cespitosum	tufted bulrush
	Triglochin maritima	seaside arrowgrass
	Triglochin palustris	marsh arrowgrass
	Trisetum spicatum	spike trisetum
	Vahlodea latifolia	mountain hairgrass
fern and allies	*Athyrium filix-femina*	lady fern
	Cystopteris montana	mountain bladderfern
	Dryopteris expansa	woodfern
	Equisetum arvense	field horsetail
	Equisetum fluviatile	water horsetail
	Equisetum palustre	marsh horsetail
	Equisetum sylvaticum	woodland horsetail
	Equisetum variegatum	variegated scouringrush
	Gymnocarpium dryopteris	western oakfern
	Isoetes spp.	quillwort
	Phegopteris connectilis	long beechfern
	Struthiopteris spicant	deer fern
bryophyte	*Abietinella abietina*	abietinella moss
	Andreaea blyttii	Blytt's andreaea moss
	Aulacomnium palustre	aulacomnium moss
	Aulacomnium turgidum	turgid aulacomnium moss
	Calliergon spp.	calliergon moss
	Campylium spp.	campylium moss
	Ceratodon purpureus	ceratodon moss
	Dicranum elongatum	elongate dicranum moss
	Drepanocladus spp.	drepanocladus moss

Appendix G. Continued.

Life Form	Scientific Name	Common Name
bryophyte	*Fontinalis antipyretica*	anitifever fontinalis moss
	Hylocomium splendens	splendid feather moss
	Meesia triquetra	meesia moss
	Paludella squarrosa	angled paludella moss
	Philonotis fontana	philontis moss
	Pleurozium schreberi	Schreber's big red stem moss
	Pleurozium spp.	big red stem moss
	Polytrichum juniperinum	polytrichum moss
	Ptilium spp.	ptilium moss
	Racomitrium canescens	racomitrium moss
	Racomitrium lanuginosum	racomitrium moss
	Rhytidiadelphus loreus	goose neck moss
	Rhytidium rugosum	rhytidium moss
	Sarmentypnum sarmentosum	sarmentypnum moss
	Scorpidium revolvens	scorpidium moss
	Scorpidium scorpioides	scorpidium moss
	Sphagnum spp.	sphagnum
	Tomentypnum nitens	tomentypnum moss
liverwort	*Anthelia juratzkana*	N/A
	Gymnomitrion corallioides	N/A
	Marchantia polymorpha	N/A
	Ptilidium ciliare	N/A
	Scapania paludosa	N/A
lichen	*Alectoria nigricans*	witch's hair lichen
	Alectoria ochroleuca	witch's hair lichen
	Alectoria sarmentosa	witch's hair lichen
	Bryoria capillaris	horsehair lichen
	Caloplaca spp.	orange seaside lichen
	Cetraria ericetorum	cetraria lichen
	Cetraria islandica	island cetraria lichen
	Cladonia arbuscula	reindeer lichen
	Cladonia stellaris	star reindeer lichen
	Cladonia uncialis	cup lichen
	Coccotrema maritimum	white seaside lichen
	Dactylina arctica	arctic dactylina lichen
	Flavocetraria cucullata	N/A
	Flavocetraria nivalis	N/A
	Hydropunctaria maura	black seaside lichen
	Masonhalea richardsonii	Richardson's masonhalea lichen
	Nephroma arcticum	arctic kidney lichen
	Ochrolechia frigida	cold crabseye lichen
	Ophioparma lapponica	ophioparma lichen
	Peltigera spp.	felt lichen
	Pertusaria spp.	pore lichen

Appendix G. Continued.

Life Form	Scientific Name	Common Name
lichen	*Ramalina* spp.	cartilage lichen
	Rhizocarpon geographicum	world map lichen
	Siphula ceratites	whitefingers lichen
	Stereocaulon alpinum	alpine snow lichen
	Stereocaulon paschale	snow lichen
	Thamnolia vermicularis	whiteworm lichen
	Umbilicaria hyperborea	navel lichen
	Usnea lapponica	Lapland beard lichen
	Xanthoria	orange seaside lichen
algae: saltwater (seaweed)	*Alaria marginata*	ribbon kelp
	Endocladia muricata	sea moss
	Eualaria fistulosa	dragon kelp
	Fucus distichus	rockweed
	Laminaria spp.	laminarian kelp
	Macrocystis pyrifera	giant kelp
	Nereocystis luetkeana	bull kelp
	Palmaria mollis	red ribbon
	Porphyra spp.	laver
	Sacchaina spp.	brown kelp
	Ulva lactuca	sea lettuce
algae: freshwater	*Chara* spp.	N/A
	Nitella spp.	N/A

Appendix H. Examples of recent and ongoing habitat and wildlife monitoring efforts in Alaska, 2015–2025.

Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Air and Water					
Air Quality	NPS	Air Quality, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.nps.gov/im/cakn/airquality.htm	Central	Ongoing
Air Quality	NPS	Air Quality, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/airquality.htm	Southwest	Ongoing
Air Quality	ConocoPhillips Alaska	Nuiqsut Air Quality Monitoring Program Annual Reports (1999–2024)	https://catalog.northslopescience.org/nl/dataset/2316	Northern	Ongoing
Atmospheric Science	NOAA	Air Resources Laboratory (ARL)	https://www.arl.noaa.gov/research/	Statewide	Ongoing
Hydrology	NPS	Water Quantity, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/waterquantity.htm	Southwest	Ongoing
Lake and Stream Ecology, Vegetation, Soils	LTER Network	Arctic Long-term Ecological Research (LTER) site	https://lternet.edu/site/arctic-lter/	Northern	Ongoing
Lakes	NPS	Shallow Lake Monitoring, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/shallowlakes.htm	Central	Ongoing
River and Stream Hydrology	NPS	Streams and Rivers, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.nps.gov/im/cakn/streams.htm	Central	Ongoing
Rivers and Streams	BLM	Lotic Indicators Hub, Assessment, Inventory, and Monitoring (AIM) program	https://gbp-blm-egis.hub.arcgis.com/datasets/BLM-EGIS::blm-natl-aim-lotic-indicators-hub/about	Statewide	Ongoing
Soundscape	NPS	Soundscapes, Denali National Park	https://www.NPS.gov/dena/learn/nature/soundscape.htm	Central	Ongoing
Streamflow, Water Quality	NPS	Streamflow and Water Quality, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/streamflow.htm	Southeast	Ongoing
Water and Air Quality, Traditional Knowledge	Copper River Native Association	Indian Environmental General Assistance Program (IGAP)	https://crnative.org/what-we-do/tribal-community-services/indian-general-assistance-program/	Southcentral	Ongoing
Water Quality	Bristol Bay Native Corporation	Indian Environmental General Assistance Program (IGAP)	https://bbna.com/our-programs/natural-resources/environmental-program/	Bering Sea, Southwest	Ongoing
Water Quality	Anvik Tribal Council	Indian Environmental General Assistance Program (IGAP)	https://anviktribalcouncil.com/igap.html	Western	Ongoing
Water Quality	ADEC	Water Quality Reports and Watershed Plans	https://dec.alaska.gov/water/water-quality/nonpoint-source-control/water-quality-resources/reports	Statewide	Ongoing
Water Quality	ADEC, EPA	Freshwater Monitoring	https://dec.alaska.gov/water/water-quality/monitoring-and-assessment/watershed-health-and-data-analysis/targeted-monitoring	Statewide	Ongoing

Appendix H. Continued.

Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Water Quality	Yukon River Inter-tribal Watershed Council	Indigenous Observation Network (ION)	https://www.yritwc.org/science	Statewide	Ongoing
Air and Water					
Water Quality	Anchorage Waterways Council	Citizen's Environmental Monitoring Program (CEMP)	https://www.anchoragecreeks.org/projecto-5	Central	Ongoing
Water Temperature	USFWS, ACCS, various Alaska Native tribal groups	Alaska Online Aquatic Temperature Site (AKOATS)	https://accscatalog.uaa.alaska.edu/dataset/akoats	Statewide	Ongoing
Water Temperature	ADEC, ACCS	AKTEMP water temperature database	https://aktemp.uaa.alaska.edu/	Statewide	Ongoing
Land					
Coastal Change	NPS	Geomorphic Coastal Change, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/coastal.htm	Southwest	Ongoing
Coastal Change	NPS	Coastal Shoreline Change, Arctic Inventory and Monitoring Network	https://www.nps.gov/im/arcn/coastalerosion.htm	Northern	Ongoing
Coastal Ecology	NPS	Nearshore Marine Systems, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/nearshore.htm	Southwest	Ongoing
Land Cover	NPS	Terrestrial Landscape Patterns and Dynamics, Arctic Inventory and Monitoring Network	https://www.nps.gov/im/arcn/landscapedynamics.htm	Northern	Ongoing
Land Cover	NPS	Land Cover Change, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/landcover.htm	Southwest	Ongoing
Uplands	BLM	Terrestrial Hub Data Summary, Assessment, Inventory, and Monitoring (AIM) program	https://gbp-blm-egis.hub.arcgis.com/search?groupIds=a67028668c2e402580001d61a5f59389&tags=dryland	Statewide	Ongoing
Wetlands, Floodplains	BLM	Riparian and Wetland Hub Data Summary, Assessment, Inventory, and Monitoring (AIM) program	https://gbp-blm-egis.hub.arcgis.com/datasets/BLM-EGIS::blm-natl-aim-riparian-and-wetland-indicators-hub/about	Statewide	Ongoing
Wetlands	USFWS	Inventory, Mapping, and Digitizing the Wetlands of Alaska's Refuges	https://www.fws.gov/project/inventory-mapping-and-digitizing-wetlands-alaskas-refuges	Statewide	Ongoing
Vegetation					
Alpine Vegetation, Soils	USFWS, NPS, USFS, and others	Global Observation Research Initiative on Alpine Environments (GLORIA)	https://gloria.ac.at/home	Statewide	Ongoing
Land Cover Change	Conservation of Arctic Flora and Fauna (CAFF)	Land Cover Change	https://caff.is/work/projects/land-cover-change/	Circumpolar	Ongoing
Land Cover Change	UAF	Exploring Land Cover Change Through Repeat Photography, Denali National Park	https://denalirepeatphotos.uaf.edu/	Central	Ongoing

Appendix H. Continued.

Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Plant Phenology, NDVI	UAF	Biotic Monitoring, Toolik Field Station	https://www.uaf.edu/toolik/edc/monitoring/biotic/index.php	Northern	Ongoing
Vegetation	NPS	Sensitive Plant Communities, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/sensplants.htm	Southwest	Ongoing
Vegetation	NPS	Terrestrial Vegetation and Soils, Arctic Inventory and Monitoring Network	https://www.nps.gov/im/arcn/vegsoils.htm	Northern	Ongoing
Vegetation	NPS	Vegetation Structure and Composition, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.nps.gov/im/cakn/veg.htm	Central	Ongoing
Vegetation	NPS	Vegetation Composition and Structure, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/veg.htm	Southwest	Ongoing
Vegetation	NPS	Vegetation Structure and Composition, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/veg.htm	Central	Ongoing
Climate Change					
Arctic Shelf Ecosystems	Various	Danielson, S.L., et al. Monitoring Alaskan Arctic Shelf Ecosystems Through Collaborative Observation Networks. Oceanography. April 28, 2022	https://tos.org/oceanography/assets/docs/35-danielson.pdf	Beaufort/Chukchi Seas, Bering Sea	Ongoing
Climate	Alaska Climate Adaptation Science Center	Various	https://akcasc.org/about-us/projects-overview/	Statewide	Ongoing
Climate	NPS	Climate, Arctic Inventory and Monitoring Network	https://www.nps.gov/im/arcn/climate.htm	Northern	Ongoing
Climate	NPS	Climate, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/climate.htm	Central	Ongoing
Climate, Ocean Acidification	UAF	International Arctic Research Center (IARC) Datasets	https://uaf-iarc.org/our-work/data/	Statewide	Ongoing
Climate, Citizen Science, Traditional Ecological Knowledge	Alaska Native Tribe Health Consortium	https://www.leonetwork.org/en/docs/about/about	https://www.anthc.org/what-we-do/climate-initiatives/leo-network/	Statewide	Ongoing
Glaciers	NPS	Glaciers, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/glaciers.htm	Central	Ongoing
Glaciers	NPS	Glacial Dynamics, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/glaciers.htm	Southeast	Ongoing
Glaciers	NPS	Glacial Extent, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/glaciers.htm	Southwest	Ongoing

Appendix H. Continued.

Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Glaciers	UAF and others	McCall Glacier Monitoring	https://drmattnolan.com/mccall	Northern	Ongoing
Marine Ecosystems	NOAA	Arctic-Beaufort and Chukchi seas Regional Action Plan	https://www.fisheries.noaa.gov/news/arctic-beaufort-and-chukchi-seas-regional-action-plan	Beaufort/Chukchi Seas	Ongoing
Marine Ecosystems	NOAA	Alaska-Eastern Bering Sea Regional Action Plan	https://www.fisheries.noaa.gov/climate/alaska-eastern-bering-sea-regional-action-plan	Bering Sea	Ongoing
Marine Ecosystems	NOAA	Alaska-Gulf of Alaska Regional Action Plan	https://www.fisheries.noaa.gov/news/alaska-gulf-alaska-regional-action-plan	Gulf of Alaska	Ongoing
Ocean Acidification	Alaska Ocean Observing System (AOOS)	Long-term Ocean Acidification Moorings	https://aoos.org/project/long-term-ocean-acidification-moorings/	Beaufort/Chukchi Seas, Bering Sea, Gulf of Alaska	Ongoing
Ocean Acidification	NOAA	Ocean Acidification Program	https://oceanacidification.noaa.gov/ocean-acidification-data/	Beaufort/Chukchi Seas, Bering Sea, Gulf of Alaska	Ongoing
Ocean Acidification	UAF	Ocean Acidification Research Center	https://www.uaf.edu/cfos/research/oarc/	Beaufort/Chukchi Seas, Bering Sea, Gulf of Alaska	Ongoing
Permafrost	Arctic Data Center	Circumpolar Active Layer Monitoring Program (CALM)	https://arcticdata.io/catalog/portals/CALM	Circumpolar	Ongoing
Permafrost	NPS	Permafrost, Arctic Inventory and Monitoring Network	https://www.nps.gov/im/arcn/permafrost.htm	Northern	Ongoing
Permafrost	NPS	Permafrost, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/permafrost.htm	Central	Ongoing
Permafrost and Climate	USGS, BLM, USFWS	Real Time Permafrost and Climate Monitoring network in Arctic Alaska	https://alaska.usgs.gov/portal/project.php?project_id=32	Statewide	Ongoing
Sea Ice Biota	Conservation of Arctic Flora and Fauna (CAFF)	Sea-ice Biota Expert Network	https://www.caff.is/work/projects/circumpolar-biodiversity-monitoring-program-cbmp/cbmp-marine-biodiversity-monitoring/sea-ice-biota-expert-network/	Beaufort/Chukchi Seas, Bering Sea	Ongoing
Sea Ice	NOAA	Alaska Sea Ice Program (ASIP)	https://www.weather.gov/afc/ice	Gulf of Alaska, Beaufort/Chukchi Seas, Bering Sea	Ongoing
Sea Ice	Study of Environmental Arctic Change (SEARCH)	Sea Ice for Walrus Outlook (SIWO)	https://www.arcus.org/siwo	Bering Sea, Beaufort/Chukchi Seas	Ongoing
Sea Ice	Alaska Ocean Observing System (AOOS)	Alaska Historical Sea Ice Atlas	https://Alaska Ocean Observing System (AOOS).org/project/alaska-historical-sea-ice-atlas/	Beaufort/Chukchi Seas, Bering Sea, Gulf of Alaska	Complete

Appendix H. Continued.

Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Phenology	NPS	Seasonal Processes, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/phenology.htm	Southwest	Ongoing
Snow and Ice	National Snow and Ice Data Center	National Snow and Ice Data Center	http://nsidc.org/data/masie/	Beaufort/Chukchi Seas, Bering Sea	Ongoing
Snowpack	NPS	Snowpack, Arctic Inventory and Monitoring Network	https://www.nps.gov/im/arcn/snow.htm	Northern	Ongoing
Snowpack	NPS	Snowpack, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/snow.htm	Central	Ongoing
Weather and Climate	NPS	Weather and Climate, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/climate.htm	Southwest	Ongoing
Weather and Climate	NPS	Weather and Climate, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/climate.htm	Southeast	Ongoing
Wildlife Population Trends	Conservation of Arctic Flora and Fauna (CAFF)	Arctic Species Trend Index	https://www.caff.is/work/projects/arctic-species-trend-index/	Circumpolar	Ongoing
Contaminants					
Airborne, Freshwater, Marine Contaminants	NPS	Contaminants, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/contaminants.htm	Southeast	Ongoing
Hydrocarbons	Gulf Watch Alaska	Lingering Oil: Weathering and Tracking	https://gulfwatchalaska.org/monitoring/lingering-oil/lingering-oil-weathering-and-tracking/	Gulf of Alaska, Southcentral	Complete
Hydrocarbons, Mussels	Prince William Sound RCAC	Long-Term Environmental Monitoring (LTEMP)	https://www.pwsrcac.org/programs/environmental-monitoring/ltemp/	Gulf of Alaska	Ongoing
Shellfish, PST	Southeast Alaska Tribal Ocean Research	Shellfish Data and Testing	http://seator.org/	Southeast	Ongoing
Marine and Intertidal					
Biodiversity, Nutrient Cycling	NPS, WCS, and others	Coastal Lagoon Monitoring project	https://library.wcs.org/Scientific-Research/Research-Publications/Publications-Library/ctl/view/mid/40093/pubid/DMX4371200000.aspx	Beaufort/Chukchi Seas	Complete
Ecosystem Monitoring	Gulf Watch Alaska	The Seward Line: Marine Ecosystem Monitoring in the Northern Gulf of Alaska	https://gulfwatchalaska.org/monitoring/environmental-drivers/the-seward-line-marine-ecosystem-monitoring-in-the-northern-gulf-of-alaska/	Southcentral, Gulf of Alaska	Ongoing
Ecosystem Monitoring	National Centers for Coastal Ocean Science	Ecological Assessment for Kachemak Bay	https://coastalscience.noaa.gov/project/ecological-assessment-for-kachemak-bay-alaska-science-tools-to-inform-management/	Southcentral	Complete
Environmental Studies	Bureau of Ocean Energy Management (BOEM)	Environmental Studies for Alaska	https://www.Bureau of Ocean Energy Management.gov/ongoing-environmental-studies/current-environmental-studies	Statewide	Ongoing

Appendix H. Continued.

Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Intertidal Communities	NPS	Intertidal Communities, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/intertidal.htm	Southeast	Ongoing
Intertidal Communities	Gulf Watch Alaska	Intertidal Communities, Nearshore Ecosystems	https://gulfwatchalaska.org/monitoring/nearshore-ecosystems-4/nearshore-intertidal-communities/	Southcentral, Gulf of Alaska	Ongoing
Intertidal Temperature	Gulf Watch Alaska	Intertidal Temperature, Nearshore Ecosystems	https://gulfwatchalaska.org/monitoring/nearshore-ecosystems-4/nearshore-intertidal-temperature/	Southcentral, Gulf of Alaska	Ongoing
Kelp and Eelgrass	NPS	Kelp and Eelgrass, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/kelp.htm	Southwest	Ongoing
Kelp and Eelgrass	USFWS	Eelgrass Abundance and Productivity Monitoring	https://www.fws.gov/project/eelgrass-abundance-and-productivity-monitoring	Southwest	Ongoing
Marine Biotoxin Monitoring	ADEC	Alaska Marine Biotoxin Monitoring and Contingency Plan for Bivalve Shellfish other than Geoducks	https://dec.alaska.gov/eh/fss/shellfish/resources/bivalve-shellfish-biotoxin-monitoring-plan/	Statewide	Ongoing
Marine Predators	NPS	Marine Predators, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/marinepredators.htm	Southeast	Ongoing
Oceanography	Gulf Watch Alaska	Oceanographic Conditions in Lower Cook Inlet and Kachemak Bay	https://gulfwatchalaska.org/monitoring/environmental-drivers/oceanographic-conditions-in-lower-cook-inlet-and-kachemak-bay/	Southcentral, Gulf of Alaska	Ongoing
Oceanography	Gulf Watch Alaska	Oceanographic Conditions in Prince William Sound	https://gulfwatchalaska.org/monitoring/environmental-drivers/oceanographic-conditions-in-prince-william-sound/	Southcentral, Gulf of Alaska	Ongoing
Oceanography	LTER Network	Northern Gulf of Alaska Long-term Ecological Research (LTER) site	https://lternet.edu/site/northern-gulf-alaska/	Gulf of Alaska	Ongoing
Oceanography	NPS	Oceanography, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/oceanography.htm	Southeast	Ongoing
Oceanography, Sea Ice, others	Alaska Ocean Observing System (AOOS)	Ocean Data Explorer	https://portal.aoos.org/	Statewide	Ongoing
Plankton	Conservation of Arctic Flora and Fauna (CAFF)	Plankton Expert Network	https://caff.is/work/projects/circumpolar-biodiversity-monitoring-program-cbmp/cbmp-marine-biodiversity-monitoring/plankton-expert-network/	Circumpolar	Ongoing
Plankton	Gulf Watch Alaska	Continuous Plankton Recorder	https://gulfwatchalaska.org/monitoring/environmental-drivers/continuous-plankton-recorder/	Southcentral, Gulf of Alaska	Ongoing

Appendix H. Continued.

Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Sea Surface Temperatures	NOAA National Centers for Environmental Information	Extended Reconstructed Sea Surface Temperature (ERSST)	https://www.ncei.noaa.gov/news/tracking-sea-surface-temperatures	Bering Sea, Beaufort/Chukchi Seas	Ongoing
Shoreline	NOAA	Alaska Shorezone Project	https://www.fisheries.noaa.gov/alaska/habitat-conservation/alaska-shorezone	Statewide	Complete
Water Chemistry	NPS	Marine Water Chemistry, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/marinechem.htm	Southwest	Ongoing
Water Quality	ADEC, EPA	Marine Water Quality Monitoring	https://dec.alaska.gov/water/water-quality/monitoring-and-assessment/watershed-health-and-data-analysis/ambient-marine-water-quality-monitoring	Statewide	Ongoing
Birds					
Aleutian Tern	USFWS, USFS, and others	Aleutian Tern Surveys	https://www.fws.gov/project/aleutian-tern-surveys	Statewide	Ongoing
American Goshawk	USFWS, DOD	American Goshawk Abundance, Distribution, and Ecology in Southcentral Alaska	https://www.fws.gov/project/american-goshawk-abundance-distribution-and-ecology-south-central-alaska	Southcentral	Ongoing
Bald Eagle	NPS	Bald Eagles, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/baldeagles.htm	Central	Complete
Bar-tailed Godwit	ADF&G, USFWS, USGS	Co-stewardship of the Bar-tailed Godwit	https://www.fws.gov/project/co-stewardship-bar-tailed-godwit	Northern	Ongoing
Black Brant	USFWS, USGS	The Pacific Flyway Winter Brant Survey	https://www.fws.gov/project/pacific-flyway-winter-brant-survey	Statewide	Ongoing
Black Brant	USFWS, USGS	Black Brant Age Ratio Survey	https://www.fws.gov/project/black-brant-age-ratio-survey	Southwest	Ongoing
Black Brant	USFWS, USGS	Fall Brant Photo Survey	https://www.fws.gov/project/fall-brant-photo-survey	Southwest	Ongoing
Black Oystercatcher	NPS	Black Oystercatcher, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/bloy.htm	Southwest	Ongoing
Black Oystercatcher	Gulf Watch Alaska	Near Shore Ecosystem Monitoring	https://gulfwatchalaska.org/monitoring/nearshore-ecosystems-4/nearshore-bloy/	Southcentral, Gulf of Alaska	Ongoing
Black-legged Kitiwake	Conservation of Arctic Flora and Fauna (CAFF)	Circumpolar Seabird Expert Group International Conservation Strategy and Action Plan 2020	https://oaarchive.arctic-council.org/server/api/core/bitstreams/f54e4ff7-f8cb-45e8-b958-fb3241933c2b/content	Circumpolar	Ongoing
Common Murre	USFWS	Monitoring the Common Murre mass mortality in coastal Alaska	https://www.fws.gov/project/monitoring-common-murre-mass-mortality-coastal-alaska	Southcentral, Southeast, Gulf of Alaska	Ongoing

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Dusky Canada Goose	USFWS	Dusky Canada Goose Aerial Breeding Pair Survey	https://www.fws.gov/project/dusky-canada-goose-aerial-breeding-pair-survey	Southcentral	Ongoing
Eiders	ABR, ConocoPhillips Alaska, and others	Eider Surveys (1994–2024)	https://catalog.northslopescience.org/nl/dataset/2336	Northern	Ongoing
Golden Eagle	NPS	Golden Eagles, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/goldeneagles.htm	Central	Complete
Golden Eagle	ADF&G, NPS, USFWS, Hawkwatch	Golden Eagle Abundance in Alaska, Threatened, Endangered, and Diversity Program	https://www.adfg.alaska.gov/index.cfm?adfg=wildlifediversity.projects&project=golden-eagle	Statewide	Complete
Golden Eagle	USFWS	Space Use, Movement, and Survival of Golden Eagles in Alaska	https://www.fws.gov/project/space-use-movement-and-survival-golden-eagles-alaska	Statewide	Ongoing
Gray-headed Chickadee	ADF&G	Gray-headed Chickadee Conservation, Threatened, Endangered, and Diversity Program	https://www.adfg.alaska.gov/index.cfm?adfg=wildlifediversity.projects&project=gray-headed-chickadee	Northern, Western	Ongoing
Harlequin Duck	Gulf Watch Alaska	Harlequin Ducks and Sea Otters	https://gulfwatchalaska.org/monitoring/completed-projects/harlequin-ducks-and-sea-otters/	Southcentral, Gulf of Alaska	Complete
Kittlitz's Murrelet	NPS, ADF&G	Kittlitz's Murrelet, Southeast Alaska Inventory and Monitoring Network (SEAN)	https://www.NPS.gov/im/sean/kimu.htm	Southeast	Ongoing
Landbirds	USGS, USFWS	North American Breeding Bird Survey (BBS)	https://www.usgs.gov/centers/eesc/science/north-american-breeding-bird-survey	Statewide	Ongoing
Landbirds	USFWS, USGS	Alaska Landbird Monitoring Survey (ALMS)	https://www.usgs.gov/centers/alaska-science-center/science/alaska-landbird-monitoring-survey	Statewide	Ongoing
Landbirds	National Audubon Society	Christmas Bird Count	https://www.audubon.org/community-science/christmas-bird-count	Statewide	Ongoing
McKay's Bunting	USFWS, USGS, ADF&G	McKay's Bunting Breeding Surveys	https://www.fws.gov/project/mckays-bunting-breeding-surveys	Bering Sea	Ongoing
Passerines	NPS	Passerines, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/passerines.htm	Central	Ongoing
Peregrine Falcon	NPS	Peregrine Falcons, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/pefa.htm	Central	Ongoing
Pigeon Guillemot	NPS, USFWS	Nearshore Marine Bird Surveys - Kodiak NWR	https://www.fws.gov/project/nearshore-marine-bird-monitoring	Southwest	Ongoing
Raptors	ADF&G	Alaska Raptor Group Metadata Database for Alaska Raptor Projects	https://www.adfg.alaska.gov/index.cfm?adfg=raptormetadata.login	Statewide	Ongoing

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Red Knot	USFWS, ADF&G	Roselaari Red Knot Breeding Project	https://www.fws.gov/project/roselaari-red-knot-breeding-project	Southeast, Gulf of Alaska	Ongoing
Seabirds	University of Washington	Coastal Observation and Seabird Survey Team (COASST)	https://coasst.org/	Southeast	Ongoing
Seabirds	NOAA	Seabird Bycatch Reduction program	https://www.fisheries.noaa.gov/alaska/bycatch/seabird-bycatch-alaska	Beaufort/Chukchi Seas, Bering Sea, Gulf of Alaska	Ongoing
Seabirds	USFWS	Alaska Maritime National Wildlife Refuge	https://www.fws.gov/project/seabird-science-alaska-sized-scale	Southwest, Beaufort/Chukchi Seas, Gulf of Alaska, Bering Sea	Ongoing
Seabirds	USFWS, Axiom Data Science	USFWS Aleutian Island Seabird Vulnerability Assessment	https://www.axiomdatascience.com/projects/seabird-vulnerability-assessment/	Southwest	Ongoing
Seabirds	USFWS and Bureau of Ocean Energy Management (BOEM)	Arctic Marine Bird Survey	https://www.fws.gov/project/arctic-marine-bird-surveys	Beaufort/Chukchi Seas, Bering Sea	Ongoing
Seabirds	Conservation of Arctic Flora and Fauna (CAFF)	CBIRD: Seabird Expert Group	https://www.caff.is/work/projects/cbird/	Circumpolar	Ongoing
Seabirds	Gulf Watch Alaska	Near Shore Ecosystem Monitoring	https://gulfwatchalaska.org/monitoring/nearshore-ecosystems-4/nearshore-marine-birds/	Southcentral, Gulf of Alaska	Ongoing
Seabirds	NPS	Marine Birds, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/marinebirds.htm	Southwest	Ongoing
Seabirds	Gulf Watch Alaska	Pelagic Ecosystem Monitoring	https://gulfwatchalaska.org/monitoring/pelagic-ecosystem/long-term-monitoring-of-seabird-abundance-and-habitat-associations-during-late-fall-and-winter-in-prince-william-sound/	Southcentral, Gulf of Alaska	Ongoing
Seabirds	Gulf Watch Alaska	Prince William Sound Marine Bird Population Trends	https://gulfwatchalaska.org/monitoring/pelagic-ecosystem/pws-marine-bird-population-trends/	Southcentral, Gulf of Alaska	Ongoing
Shorebirds	ABR, ConocoPhillips Alaska, and others	Shorebird Monitoring in the Willow Project Area (2021–2024)	https://catalog.northslopescience.org/dataset/3017	Northern	Ongoing
Shorebirds	USFWS	Shorebird Movements during Migration and on Wintering Grounds	https://www.fws.gov/project/shorebird-migration-tracking	Statewide	Ongoing
Shorebirds	Manomet Conservation Sciences and others	Arctic Shorebird Demographic Network (ASDN)	https://www.manomet.org/project/arctic-shorebird-demographics-network-asdn/	Circumpolar	Ongoing

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Shorebirds	USFWS, ADF&G, and others	Program for Regional and International Shorebird Monitoring (PRISM)	https://www.fws.gov/project/estimating-alaska-shorebird-populations	Western, Northern	Ongoing
Shorebirds	Manomet Conservation Sciences, USGS, UAF, and USFWS	International Shorebird Survey, ANWR and Yukon River Delta	https://www.manomet.org/project/international-shorebird-survey/	Northern, Western	Ongoing
Shorebirds	USFWS	Breeding Ecology of Shorebirds in Utqiaġvik, Alaska	https://www.fws.gov/project/breeding-ecology-shorebirds-utqiagvik-alaska	Northern	Ongoing
Shorebirds	NPS, USGS	Inventory of Alpine and Montane Nesting Shorebirds in Alaska	https://www.usgs.gov/data/data-inventory-montane-nesting-birds-arctic-network-national-parks-alaska	Northern, Western	Complete
Snowy Owl	Owl Research Institute	Snowy Owl Breeding Ecology and Lemming Population Study	https://www.owlresearchinstitute.org/snowy-owl-research	Northern	Ongoing
Waterfowl, Yellow-billed Loon	ABR, ConocoPhillips Alaska, and others	Avian Studies for the Alpine Oilfield (1998–2024)	https://catalog.northslopescience.org/dataset/2321	Northern	Ongoing
Waterfowl	USFWS	Waterfowl Breeding Population and Habitat Survey	https://www.fws.gov/project/waterfowl-breeding-population-and-habitat-survey-alaska	Statewide	Ongoing
Waterfowl	USFWS	Arctic Coastal Plain Aerial Breeding Pair Survey	https://www.fws.gov/project/arctic-coastal-plain-aerial-breeding-pair-survey	Northern	Ongoing
Waterfowl	USFWS	Yukon-Kuskokwim Delta Aerial Breeding Pair Survey	https://www.fws.gov/project/yukon-kuskokwim-delta-aerial-breeding-pair-survey	Western	Ongoing
Wetland Birds	ADF&G	Birds 'n' Bogs (formerly Loon and Grebe Watch program)	https://www.adfg.alaska.gov/index.cfm?adfg=wildlifediversity.citizenscience&project=birds-n-bogs	Southcentral	Ongoing
White-fronted Goose	USFWS	Midcontinent Greater White-fronted Goose Banding in Alaska	https://www.fws.gov/project/midcontinent-greater-white-fronted-goose-banding-alaska	Northern, Central, Western	Ongoing
Yellow-billed Loon	NPS, USFWS	Collaborative Conservation of the Rare Alaskan Yellow-billed Loon	https://www.nps.gov/articles/aps-16-1-17.htm	Western	Ongoing
Marine Mammals					
Beluga Whale	ADF&G	Beluga Whale Research – Bristol Bay and Cook Inlet	https://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.belugaresearch	Beaufort/Chukchi Seas, Gulf of Alaska	Ongoing
Beluga Whale, Citizen Science	NOAA and others	Alaska Beluga Monitoring Program	https://akbmp.org/	Southcentral	Ongoing
Bowhead Whale	ADF&G	Satellite Tracking of Western Arctic Bowhead Whales	https://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.bowhead	Beaufort/Chukchi Seas, Bering Sea	Complete

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Harbor Seal	ADF&G	Harbor Seal Research Projects	https://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.harborsealresearch	Southcentral, Southwest, Gulf of Alaska, Bering Sea	Ongoing
Humpback Whale	Gulf Watch Alaska	Pelagic Ecosystem Monitoring	https://gulfwatchalaska.org/monitoring/pelagic-ecosystem/humpback-whales/	Southcentral, Gulf of Alaska	Ongoing
Ice Seals, Subsistence	ADF&G	Ice Seal Research, Harvest Monitoring	https://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.icesealmonitoring	Northern, Beaufort/Chukchi Seas	Ongoing
Ice Seals	NOAA	Ice Seal Research in Alaska	https://www.fisheries.noaa.gov/alaska/marine-mammal-protection/ice-seal-research-alaska	Northern, Beaufort/Chukchi Seas	Ongoing
Marine Mammals	NOAA	Marine Mammal Stock Assessment Reports	https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock	Beaufort/Chukchi Seas, Bering Sea, Gulf of Alaska	Ongoing
Marine Mammals	ADF&G	Marine Mammal Acoustic Monitoring – Bering Strait	https://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.acoustics	Beaufort/Chukchi Seas, Bering Sea, Gulf of Alaska	Complete
Polar Bear	USFWS, USGS	Summary of Wildlife-Related Research on the Coastal Plain of the Arctic National Wildlife Refuge, Alaska, 2002–17	https://pubs.usgs.gov/of/2018/1003/ofr20181003.pdf	Northern	Complete
Polar Bear	USFWS	Polar Bear Program, Alaska Marine Mammals Management Office	https://www.fws.gov/program/alaska-marine-mammals-management-office/polar-bear-program	Northern, Beaufort/Chukchi Seas	Ongoing
Polar Bear	ADF&G	Polar Bear Research	https://www.adfg.alaska.gov/index.cfm?adfg+polarbear.research	Northern, Beaufort/Chukchi Seas	Ongoing
Sea Otter	USFWS, Alaska Marine Mammals Management Office	Sea Otter Program	https://www.fws.gov/program/alaska-marine-mammals-management-office/alaska-sea-otter-program	Southcentral, Southwest	Ongoing
Sea Otter	Gulf Watch Alaska	Near Shore Ecosystem Monitoring	https://gulfwatchalaska.org/monitoring/nearshore-ecosystems-4/nearshore-sea-otter/	Southcentral, Gulf of Alaska	Ongoing
Sea Otter	NPS	Sea Otters, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/seaotters.htm	Southwest	Ongoing
Steller Sea Lion	ADF&G	Steller Sea Lion Research Projects	https://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.stellerresearch	Bering Sea	Ongoing

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Steller Sea Lion	NOAA	Steller Sea Lion: Science	https://www.fisheries.noaa.gov/species/steller-sea-lion/science	Southwest, Gulf of Alaska, Bering Sea, Southeast	Ongoing
Walrus	USFWS, Alaska Marine Mammals Management Office	Walrus Program	https://www.fws.gov/program/alaska-marine-mammals-management-office/alaska-walrus-program	Beaufort/Chukchi Seas, Bering Sea	Ongoing
Walrus	ADF&G	Walrus Research Projects	https://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.walrusresearch	Beaufort/Chukchi Seas	Complete
Terrestrial Mammals					
Alaska Hare	ADF&G, UAF	Alaska Hare Research	https://www.adfg.alaska.gov/index.cfm?adfg=wildlifediversity.projects&project=alaska-hare	Western	Ongoing
Bats	USGS, Bat Conservation International, USFWS, USFS, BLM, CWS, WCS, ERDC	North American Bat Monitoring Program (NABat)	https://www.nabatmonitoring.org/	Statewide	Ongoing
Bats	ADF&G	Alaska Bat Monitoring Program	https://www.adfg.alaska.gov/index.cfm?adfg=wildlifediversity.projects&project=bats	Southwest, Southeast	Ongoing
Collared Pika	ADF&G and others	Collared Pika, Threatened, Endangered, and Diversity Program	https://www.adfg.alaska.gov/index.cfm?adfg=wildlifediversity.projects&project=collared-pika	Central, Southcentral	Ongoing
Small Mammals	Owl Research Institute	Snowy Owl Breeding Ecology and Lemming Population Study in Barrow	https://www.owlresearchinstitute.org/snowy-owl-research	Northern	Ongoing
Small Mammals	NPS	Small Mammals, Central Alaska Network Inventory and Monitoring Program (CAKN)	https://www.NPS.gov/im/cakn/smammals.htm	Central	Ongoing
Invertebrates					
Clams and Mussels	Gulf Watch Alaska	Bivalves, Near Shore Ecosystem Monitoring	https://gulfwatchalaska.org/monitoring/nearshore-ecosystems-4/nearshore-bivalves/	Southcentral, Gulf of Alaska	Ongoing
Freshwater Invertebrates, Fish, Periphyton, Water Quality	ADF&G	Habitat Research: Biomonitoring	https://www.adfg.alaska.gov/index.cfm?adfg=uselicense.biomonitoring	Western, Southeast, Central	Ongoing
Freshwater Macroinvertebrates	NPS	Using Aquatic Invertebrates to Measure the Health of Stream Ecosystems: New Bioassessment Tools for Alaska's Parklands	https://www.NPS.gov/articles/000/aps-20-1-11.htm	Central, Southcentral	Ongoing

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Marine Invertebrates	NPS	Marine Intertidal Invertebrates, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/marineinverts.htm	Southwest	Ongoing
Pollinators	ACCS and others	Alaska Bee Atlas	https://accs.uaa.alaska.edu/wildlife/ak-bee-atlas/	Statewide	Ongoing
Amphibians and Fish					
Anadromous Fish	ADF&G	Anadromous Waters Catalog	https://www.adfg.alaska.gov/sf/sarr/awc/	Statewide	Ongoing
Anadromous Fish	ABR, MJM Research, ConocoPhillips Alaska, and others	Fish Surveys and Subsistence Reports for Colville River and Vicinity (1985–2024)	https://catalog.northslopescience.org/nl/dataset/2354	Northern	Ongoing
Fisheries, Subsistence	Federal Subsistence Management Program	Fisheries Monitoring Reports	https://www.doi.gov/subsistence/frmp	Statewide	Ongoing
Herring	Gulf Watch Alaska	Herring Research and Monitoring	https://gulfwatchalaska.org/monitoring/herring-2/	Southcentral	Ongoing
Marine Fish	Gulf Watch Alaska	Forage Fish, Pelagic Ecosystem Monitoring	https://gulfwatchalaska.org/monitoring/pelagic-ecosystem/forage-fish-2/	Southcentral, Gulf of Alaska	Ongoing
Marine Fish	NOAA	Alaska Fish Research Surveys for understanding of marine life abundance in Alaska	https://www.fisheries.noaa.gov/alaska/ecosystems/alaska-fish-research-surveys	Statewide	Ongoing
Nearshore Fish	NOAA	National Marine Fisheries Service	https://www.fisheries.noaa.gov/alaska/habitat-conservation/nearshore-fish-atlas-alaska	Statewide	Ongoing
Salmon	NPS	Salmon, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/salmon.htm	Southwest	Ongoing
Amphibians	Alaska Herpetological Society	Stikine Long-term Amphibian Monitoring Program (SLAMP)	https://www.akherpsociety.org/slamp	Southeast	Ongoing
Non-native and Problematic Species					
Harmful Algal Blooms	Alaska Ocean Observing System (AOOS)	Alaska Harmful Algal Bloom Network	https://ahab.aoos.org/	Statewide	Ongoing
Harmful Algal Blooms, Marine Invasive Species, Water Quality	EPA, Craig Tribal Association	Indian Environmental General Assistance Program (IGAP)	http://www.craigtribe.org/environmental-department.html	Southeast	Ongoing
Insect Outbreaks	NPS	Insect Outbreaks, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/insects.htm	Southwest	Ongoing

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Invasive Plants	NPS	Alaska Invasive Plant Management Team (IPMT)	https://www.NPS.gov/subjects/invasive/ak.htm	Southeast	Ongoing
Invasive Species	ADF&G	Technical Guidance and Management Plan for Invasive Northern Pike in Southcentral Alaska	https://www.adfg.alaska.gov/static/species/nonnative/invasive/pike/pdfs/2022_invasive_pike_management_plan.pdf	Southcentral	Ongoing
Invasive Species	ACCS	Alaska Exotic Plant Information Clearinghouse (AKEPIC)	https://accs.uaa.alaska.edu/invasive-species/non-native-plants/	Statewide	Ongoing
Invasive Species	USFWS and others	Early Detection of Invasive Species in Alaska	https://www.fws.gov/project/early-detection-invasive-species-alaska	Statewide	Ongoing
Marine Invasive Species	ADF&G and others	Community-based Early Detection Monitoring for Marine Invasive Species	https://www.adfg.alaska.gov/index.cfm?adfg=invasive.main	Statewide	Ongoing
Marine Invasive Species	Smithsonian Environmental Research Center	Plate Watch (Invasive Tunicate Monitoring)	https://platewatch.nisbase.org/	Statewide	Ongoing
Marine Invasive Species, Harmful Algal Bloom	NOAA, ACCS	Kachemak Bay National Estuarine Research Reserve	https://accs.uaa.alaska.edu/kbnerr/research/	Southcentral	Ongoing
Fire Ecology					
Fire Ecology	Conservation of Arctic Flora and Fauna (CAFF)	Arctic Wildland Fire Ecology Mapping and Monitoring Project (ARCTICFIRE)	https://www.caff.is/work/projects/arctic-wildland-fire-ecology-mapping-and-monitoring-project-arcticfire/	Statewide	Ongoing
Fire Ecology	NPS	Fire Extent and Severity, Arctic Inventory and Monitoring Network	https://www.nps.gov/im/arcn/fire.htm	Northern	Ongoing
Fire Ecology	NPS	Fire Science, Ecology, and Research	https://www.nps.gov/locations/alaska/fire-science-ecology-and-research.htm	Statewide	Ongoing
Fire Monitoring	BLM and others	Alaska Wildland Fire Information Map Series	https://blm-egis.maps.arcgis.com/apps/instant/portfolio/index.html?appid=240bd83e9ba34a63b46f7d18c524cb73&sectionId=924f70cc3ee9419c81a77b46216f65b1	Statewide	Ongoing
Human Use					
Bycatch	NOAA	National Bycatch Report and updates	https://www.fisheries.noaa.gov/resource/document/national-bycatch-report	Gulf of Alaska, Bering Sea, Beaufort/Chukchi Seas	Ongoing
Climate Change, Subsistence, Traditional Knowledge	Aleut International Association	Community Observation Network for Adaptation and Security (CONAS)	https://conas-ak.org/	Circumpolar	Ongoing

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Subject	Agency or Organization	Program	More Information	Biogeographic Region	Research Status
Vegetation, Subsistence, Citizen Science	UAF, Alaska Climate Adaptation Science Center	Alaska Berry Futures	https://sites.google.com/alaska.edu/alaska-berry-futures/home	Statewide	Ongoing
Visitor Use	NPS	Visitor Use, Southwest Alaska Inventory and Monitoring Network (SWAN)	https://www.NPS.gov/im/swan/visitoruse.htm	Southwest	Ongoing
Biodiversity					
Arctic Biodiversity	Conservation of Arctic Flora and Fauna (CAFF)	Arctic Biodiversity Assessment	https://www.caff.is/work/projects/arctic-biodiversity-assessment/	Circumpolar	Ongoing
Ecological Monitoring	USFS	Forest Inventory and Analysis Database, Coastal and Interior Alaska	https://research.fs.usda.gov/pnw/products/dataandtools/tools/pnw-fiadb-forest-inventory-and-analysis-databases	Statewide	Ongoing