Appendix 5.2 Tundra Habitats

Featured Species-associated Tundra Habitats: Arctic, Alpine and Maritime Tundra

Tundra refers to a cold-climate landscape that has vegetation but is devoid of trees. The absence of trees is typically related to regional climatic conditions. Alaska has 3 major types of tundra that can be generally described by the topographical and geographical location in which they occur. They include: 1) Arctic (high latitude) tundra, 2) alpine (high altitude) tundra, and 3) the maritime tundra present on Alaska's western and southwestern coast. The dominant plant species of tundra habitats are sedges, low and dwarf shrubs, and graminoids interspersed with forbs, in addition to mat and cushion-forming plants and scattered bryophytes (nonvascular plants).

Alaska's tundra climates are characterized by a short growing season, long, cold, dark winters, and low precipitation with strong, bitter, dry winds. Snow accumulation, where present, provides an insulating layer to the ground surface benefiting plant and animal communities. The number of plant species on the tundra is few, and their growth is minimal, with most of the biomass concentrated in the root system. Due to the short growing season, plants often reproduce by division, in addition to seed production.

Arctic Tundra

Arctic tundra is generally distributed above the latitudinal tree line in Alaska. This is the area from the crest of the Brooks Range northward to the Arctic Ocean known as the Arctic Slope. The Arctic Slope includes the north side of the mountains, northern foothills, and the flat coastal plain; it is the only truly Arctic biogeographic province in the United States. As a result of the Arctic region's high latitudinal position, it experiences less intense solar radiation and an exaggerated seasonal variation. Arctic tundra persists under cold air conditions originating off the permanent sea ice pack. This air has low moisture-holding capacity combined with minimal precipitation. The dominant vegetation type across the foothills and much of the coastal plain is tussock tundra, with willows in the small drainages, wet sedge tundra in old drained lakes, and *Dryas* tundra on drier ridges. Tussocks are formed of cottongrass and other sedges and forbs, with scattered dwarf shrubs. Prostrate woody shrubs, mosses, sedges, and lichen cover the mountainsides and valleys. The flat areas of the coastal plain are sporadically covered with small thaw lakes and ponds and rock polygons. These landforms are due to a continuous layer of underlying permafrost. Ice-rich permafrost is an important feature of Alaska's landscape that is not found elsewhere in the United States (Batten 1986). Trees are generally unable to establish in Arctic tundra habitats due to an underlying impermeable permafrost layer complemented by thin soils. These thin tundra soils trap moisture, holding it close to the surface, creating a tundra complex of wet and dry habitats. Relative to other locations of the state, regions where Arctic tundra habitat exists receive less annual snow and

rainfall—less than 20 inches annually (Interagency Arctic Research Policy Committee 2002).

Arctic tundra plant communities found in mesic (dry) and hydric (wet) soil conditions include wet graminoid herbaceous types dominated by sedges or grasses. Areas of drier soils along the riverbanks, lakes, and coastal bluffs support dwarf scrub communities.

Typical mesic sedge communities are dominated by the water sedge (*Carex aquatilus*) and tall cottongrass (*Eriophorum angustifolium*). Mosses, usually consisting of *Scorpidium* spp. or *Drepanodadus* spp., may be common. Grass communities are dominated by tundra grass (*Dupontia fischeri*) and alpine foxtail (*Alopecurus alpinus*), with the emergent pendent grass (*Arctophila fulva*) prevailing where surface water is 15–200 cm deep.

Common dwarf scrub communities found in the more xeric (desert-type) soils of the Arctic tundra include entire-leaf mountain-avens (*Dryas integrifolia*), mountain-cranberry (*Vaccinium vitis-idaea*), four-angled cassiope (*Cassiope tetragona*), bearberry (alpine bearberry [*Arctostaphylos alpina*]and red-fruit bearberry [*A. rubra*]), and prostrate willows (netleaf willow [*Salix reticulata*] and skeleton leaf willow [*S. phlebophylla*]).

In addition, mesic graminoid herbaceous communities dominated by tussock-forming sedges are widespread. Typical species include tussock cottongrass (*Eriophorum vaginatum*) and bigelow sedge (*Carex bigelowii*).

Low shrubs, such as dwarf arctic birch (*Betula nana*), crowberry (*Empetrum nigrum*), narrow-leaf Labrador tea (*Ledum decumbens*), and mountain-cranberry (*Vaccinium vitis-idaea*) are frequently present and may be codominant with sedges. Mosses, such as the feather moss, *Hylocomium splendens,* and *Sphagnum* spp., as well as lichens, such as *Cetraria cucullata*, *Cladonia* spp., and reindeer lichen (*Cladina rangiferina*), are common between tussocks. Dwarf scrub communities are dominated by mat-forming *Dryas* species and ericaceous species, for example, blueberry (*Vaccinium* spp.), four-angled cassiope (*Cassiope tetragona*), bearberry (*Arctostaphylos* spp.), and prostrate willows (netleaf willow [*Salix reticulata*] and skeleton leaf willow [*S. phlebophylla*]). Open low scrub communities are codominated by the American green alder (*Alnus crispa*) and willows (Richardson willow [*Salix lanata*], diamond leaf willow [*S. planifoli*], and gray leaf willow [*S. glauca*]). Mosses (*Tomenthypnum nitens* and *Drepanocladus* spp.) may be common.

In the valley and lower hill slope areas, the drier, xeric soils support dwarf scrub communities, while mesic, graminoid, herbaceous communities inhabit the wet to mesic soils. Dwarf scrub communities are dominated by ericaceous species; an example community would consist of alpine bearberry (*Arctostaphylos alpina*), red-fruit berry (*A. rubra*), blueberry (*Vaccinium* spp.), narrow-leaf Labrador tea (*Ledum decumbens*), crowberry (*Empetrum nigrum*), four-angled cassiope (*Cassiope*

tetragona), mountain-avens (white mountain-avens [*Dryas octopetala*] and entire-leaf (*D. integrifolia*]), and willows, such as least willow (*Salix rotundifolia*), arctic willow (*S. arctica*), and polar willow (*S. polaris*).

Herbaceous species (*Carex* spp., for example) and fructicose lichens, such as *Cladina* spp. and *Cetraria* spp., may codominate with shrubs in some of these areas. Graminoid, herbaceous communities of the Arctic tundra are dominated by sedges (e.g., water sedge [*Carex aquatilis*] and bigelow sedge [*C. bigelowii*]) and willows (e.g., diamondleaf willow [*S. planifolia*] and Richardson willow (*S. lanata*]). Mosses (e.g., *Tomenthypnum nitens*, *Distichium capillaceum*, *Drepanocladus* spp., and *Campylium stellatum*) are often abundant (Gallant et al. 1995). Other common mosses making up Arctic tundra vegetation include *Tomentypnum nitens*, ditrichum moss (*Ditrichum flexicaule*), distichium moss (*Distichium capillaceum*), and *Hypnum bambergeri* (Muller et al. 1999; Kade et al. 2005), as well as reindeer mosses (*Cladonia rangiferina*, *C. stellaris*). Cetraria lichens (*Cetraria cucullata*, *C. islandica*) are also prevalent in drier locations.

Arctic tundra G. Carroll, ADF&G

The Arctic tundra is represented by a low diversity of plant species and low plant biomass. These characteristics, combined with a short growing season, slow rates of growth, and vegetative reproduction, result in delayed recovery from disturbance (Oceanographic Institute of Washington 1979).

Arctic Tundra-associated Species

Snowy Owl, *Nyctea scandiaca*
Gyrfalcon, *Falco rusticolus*
Rough-legged Hawk, *Buteo lagopus*
Peregrine Falcon, *Falco peregrinus*
King Eider, *Somateria spectabilis*
Long-tailed Duck (Oldsquaw), *Clangula hyemalis*
Yellow-billed Loon, *Gavia adamsii*
Smith's Longspur, *Calcarius pictus*
Spectacled Eider, *Somateria fischeri*
Steller's Eider, *Polysticta stelleri*
Buff-breasted Sandpiper, *Tryngites subruficollis*
Brown lemming, *Lemmus trimucronatus*

Alpine Tundra

Alpine tundra, McNeil River State Game Refuge D. Tessler, ADF&G

Alpine tundra occurs above tree line elevations in mountain ranges and exposed ridges in Alaska. Major mountain ranges of Alaska include the Alaska, Brooks, and Chugach ranges. Numerous, smaller ranges also occur throughout the state. At these higher elevations, the landscape is increasingly broken by rock outcroppings. Plant communities consist of prostrate, mat and cushion-forming species and shrubby species that are intermittent in their distribution. Barren and lichen-covered rocky areas are dominated by *Dryas* (mountain-avens) and mountain-heath communities. These plants are adapted to the scouring high winds and widely ranging temperatures of high elevation alpine regions. Due to steep slopes and relatively thin soils at the higher elevations, areas of alpine tundra lack trees and may or may not have permafrost.

Alpine tundra transitions at lower elevations to subalpine forests or meadows and treeline habitats. In many areas, the subalpine region is a broad band where small islands of stunted trees are confined to sheltered sites. Subalpine plants represent the first distinctive type of vegetation below the alpine tundra. The transition to alpine tundra begins with communities dominated by shrubs, heaths and related families. Regeneration of alpine tundra plant species is often very slow following damage by fire or other disturbance.

Mountain-heath dwarf shrub communities are dominated by *Phyllodoce* spp. Associated dwarf shrubs include mertens cassiope (*Cassiope mertensiana*), starry cassiope (*C. stelleriana*), luetkea (*Luetkea pectinata*), bog blueberry (*Vaccinium uliginosum)*, and dwarf blueberry (*V. caespitosum*). Many herbs including nootka lupine (*Lupinus nootkatensis*), Sitka valerian (*Valeriana sitchensis*), and roseroot (*Sedum rosea*) may also occur.

Dryas communities are dominated by species of the genus *Dryas* and codominated by dwarf shrubs, ericads, sedges or lichens. Common dwarf shrubs include ericaceous species, such as mountain-cranberry (*Vaccinium vitis-idaea*), bog blueberry (*V. uliginosum*), four-angled cassiope (*Cassiope tetragona*), crowberry (*Empetrum*

nigrum), narrow-leaf Labrador tea (*Ledum decumbens*), alpine bearberry (*Arctostaphylos alpina*), red-fruit bearberry (*A. rubra*) and Alaskan cassiope (*S. lycopodioides*), and prostrate willows, such as netleaf willow (*Salix reticulata*) and skeletonleaf willow (*S. phlebophylla*). Other common dwarf willows include least willow (*S. rotundifolia*), polar willow (*Salix polaris*), and arctic willow (*S. arctica*). Common graminoids and herbs of the alpine *Dryas* tundra include meadow bistort (*Polygonum bistorta*), fescue grass (*Festuca altaica*), woodrushe*s (Luzula* spp.), alpine holygrass (*Hierochloe alpina*), sandwort (*Minuartia* spp.), *Carex microchaeta*, northern single-spike sedge (*C. scirpoidea*), sedge (*Carex* spp.), black oxytrope (*Oxytropis nigrescens*), saxifrage (*Saxifraga* spp.), downy oatgrass (*Trisetum spicatium*), vetch (*Hedysarum* spp.), Arctic bluegrass (*Poa arctica*), and anemone (*Anemone* spp.). Mosses, such as moss-campion (*Silene acaulis* subspecies), *Tomenthypnum nitens* and *Rhacomitrium* spp., *Dicranum* spp., and *Aulacomnium* spp., may be common. Lichens, such as *Cetraria cucullata*, *Cetraria* spp., *Cladina alpetris*, reindeer lichen (*Cladonia rangiferina*), *C. alpestris*, *Sphaerophorus globosus*, *Thamnolia* spp., and *Sterocaulon* spp., may also be common.

Dryas-sedge communities may be codominant with *Carex* spp., such as northern single-spike sedge (*Carex scirpoidea*), short-leaved sedge (*C. misandra*), and bigelow sedge (*C. bigelowii*), as well as *Kobresia myosuroides* and others. Common mosses, including *Tomenthypnum nitens*, *Rhytidium rugosum*, and feathermoss (*Hylocomium splendens*), occur with fructicose lichens, such as *Cladonia* spp. and *Certraria* spp.

Dryas communities codominated by lichens include *Alectoria* spp., *Cetraria* spp., *Cladina* spp., and worm lichen (*Thamnolia vermicularis*). Mosses, including *Tomenthypnum nitens*, *Rhacomitrium* spp., and *Polytrichum* spp., may grow within *Dryas* mats (Vierick et al. 1992; Vierick et al. 1972).

Alpine Tundra-associated Species

Golden Eagle, *Aquila chrysaetos*
Rough-legged Hawk, *Buteo lagopus*
Barrow ground squirrel, *Spermophilus parryii kennicottii*
Alaska marmot, *Marmota broweri*
Glacier Bay marmot, *Marmot caligata vigilis*
Bristle-thighed Curlew, *Numenius tahitiensis*
Gyrfalcon, *Falco rusticolus*

Aleutian and Bering Sea Islands Endemic Species

Rock Ptarmigan (*Lagopus mutus evermanni, L. m. townsendi, L. m. atkhensis*)

Maritime Tundra

Maritime tundra (or heath) is present along the coastal areas of southwestern Alaska and the western Alaska Bering Sea Islands. It is the product of the cool and damp climate generated by the cold waters of the Bering Sea. Seasonal weather patterns produce relatively milder winters, cooler summers and relatively high humidity. A gradual transition occurs from maritime to Arctic tundra in the region of Kotzebue

Sound, and a transition from maritime to alpine tundra occurs where mountains extend into the region. Uplands and mountain slopes support mosses, lichens, and prostrate alpine plants, while lower areas are covered with herbaceous forbs. The latitudinal location, combined with the maritime climate and increased precipitation, generally defines and distinguishes this tundra from Arctic and alpine tundra types.

Maritime tundra is dominated by prostrate heath-scrub type communities interspersed with grass and forb meadows, with willows and alders present in the protected swales. Common heath species include primarily crowberry (*Empetrum nigrum*), along with bog blueberry (*Vaccinium uliginosum*), mountain cranberry (*Vaccinium vitis-idaea*), and alpine azalea (*Loiseleuria procumbens*).

Southwest Aleutian maritime tundra ADF&G

Grass and forb meadows composed of mesic, graminoid, herbaceous communities are dominated by tussock-forming sedges in some areas, or by bluejoint, which forms meadows with codominant herbaceous species, such as sedges (*Carex* spp.), cottongrasses (*Eriophorum* spp.), and fireweed (*Epilobium angustifolium*). Mosses, such as *Pleurozium schreberi*, *Hylocomium splendens*, *Aulacomnium* spp., and *Sphagnum* spp., are abundant with common lichens, including *Cetraria cucullata, C. islandica, Cladonia* spp., reindeer lichen (*Cladina rangiferia*), and *Thamnolia subuliformis*.

Dwarf scrub communities of the maritime tundra are composed of low shrubs, grasses, and lichens. Communities are dominated by mountain-avens (*Dryas octopetala* and *D. integrifolia*) or codominated by a combination of mountain-avens and sedges (northern sickle-spiked sedge [*Carex scirpoidea*], short-leaved sedge (*C. misandra*), and bigelow sedge (*C. bigelowii*]) or mountain-avens and lichen, for example, *Alectoria* spp., *Cetraria* spp., and *Cladina* spp. Other typical shrubs occurring in these communities are prostrate willows (netleaf willow [*Salix reticulata*] and skeletonleaf willow [*S. phlebophylla*]) and ericaceous species, such as four-angled cassiope (*Cassiope tetragona),* crowberry (*Empetrum nigrum*), bearberry (*Arctostaphylos* spp.), mountain-cranberry (*Vaccinium vitis-idaea*), and bog blueberry (*V. uliginosum*). Herbs, such as sedges (*Carex* spp.) and saxifrage (*Saxifraga* spp.),

and mosses, including *Dicranum* spp., *Hypnum* spp., *Polytrichum* spp., *Rhacomitrium* spp., and *Aulacomnium* spp., are common. Lichens, including *Alectoria* spp., *Cladonia* spp., *Cladina* spp., and *Cetraria* spp., are also typical. Other mosses, such as *Tomethypnum nitens*, and *Rhytidium rugosum*, may be common.

Tall scrub communities are dominated by willows, including feltleaf willow (*Salix alaxensis*), diamondleaf willow (*S. planifolia),* and grayleaf willow (*S. glauca*). Also common are alders, such as American green alder (*Alnus crispa*) and Sitka alder (*A. sinuata).* A mix of ericaceous shrubs, for example, crowberry (*Empetrum nigrum*), narrow-leaf Labrador tea (*Ledum decumbens*), mountain-cranberry (*Vaccinium vitis-idaea*), bog blueberry (*V. uliginosum*), and alpine bearberry (*Arctostaphylos alpina*), with dwarf arctic birch (*Betula nana*) may also occur. A thick herbaceous layer is present in some areas consisting of oxytrope (*Oxytropis* spp.), vetch (*Astragalus* spp.), and bluejoint (*Calamagrostis canadensis*). Mosses, such *as Polytrichum* spp., *Hylocomium splendens*, *Hypnum* spp. and *Drepanocladus uncinatus*, may be abundant (Vierick et al. 1992; Vierick et al. 1972).

Maritime Tundra-associated Species

Bristle-thighed Curlew, *Numnius tahitiensis*
Tule White-fronted Goose, *Anser albifrons gambeli*
Spectacled Eider, *Somateria fischeri*
Steller's Eider, *Polysticta stelleri*
King Eider, *Somateria spectabilis*
Pacific Loon, *Gavia pacifica*
Arctic Loon, *G. arctica*
Rock Sandpiper, *Calidris ptilocnemis*
subspecies Pribilof Sandpiper, *C. p. ptilocnemis*
subspecies Aleutian Sandpiper, *C. p. couesi*
subspecies Northern Rock Sandpiper, *C. p. tschuktschorum*

Bering Sea Island Endemic Species

McKay's Bunting, *Plectrophenax hyperboreus*

Bering Sea and Aleutians Endemic Species

Gray-crowned Rosy Finch, *Leucosticte tephrocotis tumbrina*
Winter Wren, *Troglodytes troglodytes meligerus*
T. t. kiskensis
T. t. alascensis
T. t. semidiensis

Southwest Alaska/Bering Sea insular endemic voles, lemmings, and shrews:

Sorex pribilofensis (hydrodromus)
S. jacksoni
Dicrostonyx groenlandicus stevensoni
D. g. unalascensis
D. g. exul
Lemmus trimucronatus harroldi
L. t. nigripes
Microtus abbreviatus abrreviatus
M. a. fisheri
Microtus oeconomus amakensis
M. o. innuitus
M. o. unalascensis
Clethrionomys rutilus albiventer

Ecological Role of Tundra Habitats

Alaska tundra habitats are somewhat unique relative to the contiguous United States. Although tundra is found in the higher elevations of the Lower 48, it is Alaska's Arctic tundra habitat that may be most familiar to the nation. This is primarily due to the high profile of development issues and concerns in the Arctic region, especially as it relates to the future of the Arctic National Wildlife Refuge (ANWR).

Alaska's tundra supports numerous avian migratory species during the spring, summer, fall and winter seasons, providing important breeding, rearing, staging, refugia, and overwintering habitat. It is one of the most productive and abundant habitats for shorebirds in Alaska and supports a diversity of breeding species. In addition, mammalian species, including muskox, caribou, foxes, wolves, bears, arctic ground squirrels, many small rodents, and raptors are widespread across the Arctic tundra. Nomadic caribou depend on tundra vegetation most of the year for survival, including during annual migrations to their calving grounds. Migratory species, such as falcons and terns, also use this habitat. Five species of raptors that regularly breed in the Arctic tundra region include the Peregrine Falcon, Gyrfalcon, Rough-legged Hawk, Short-eared Owl, and Snowy Owl. Raptors specialize in eating the lemmings, voles and hares that in turn are adapted to eating the tundra vegetation. Rock Ptarmigan breed on the Arctic coastal tundra. They make short migrations in winter to the foothills of the south slopes of the Brooks Range where willows, a primary food source, are more abundant (Johnson and Herter 1989). During spring, thousands of ptarmigan move north across the foothills to reach their breeding areas on the tundra. The Yellow-billed Loon is an Arctic tundra breeder that overwinters in the southern coast of the state. The Buff-breasted Sandpiper nests on the tundra of the Arctic coastal plain, while the Rock Sandpiper nests in the heath of the maritime tundra (Bowman 2004).

Rock Ptarmigan and Blue Grouse feed on seeds and berries of tundra vegetation. The Gray-crowned Rosy Finch feeds in the alpine tundra and subalpine meadows of the Aleutians and Bering Sea Islands eating tiny, wind-borne seeds and insects. Smith's Longspurs nest in the alpine tundra eating mostly plants, as well as invertebrates, including spiders, ants, and beetles. Mountain goats, Dall sheep, and brown bears also depend on alpine and subalpine habitats throughout Alaska.

The maritime tundra of the Yukon-Kuskokwim (Y-K) Delta of western Alaska is one of the nation's most important nesting areas for geese, including the Tule White-fronted Goose. Large numbers of ducks, tundra swans, and sandhill cranes also nest on the maritime tundra of western Alaska, particularly on the Y-K River delta. The Spectacled Eider and Steller's Eider, both federally listed as threatened (in 1993 and 1997, respectively) breed here, although Steller's Eider has become increasingly rare in this area. Most of the world's Bristle-thighed Curlews breed on western Alaska's maritime tundra. The USFWS listed the Bristle-thighed Curlew as a species of concern in 1996. McKay's Bunting is endemic to several Bering Sea Islands, where it breeds on the maritime tundra. This habitat is particularly important in sustaining existing healthy populations of this species.

Conservation Status

Alaska's tundra habitat is generally healthy. Localized development will likely continue to result in habitat alteration. Opportunities should be sought that alleviate negative impacts and maintain connectivity, as well as suitable areas of quality habitat important to the sustainability of species.

Tundra habitats are increasingly susceptible to impacts from oil exploration and development, mining, transportation corridors, and associated human activities. This is particularly true in the Arctic North Slope region, where existing, proposed and active state and federal oil and gas leases continue to influence the Arctic ecosystems. Red Dog Mine, an active operation near the village of Kivalina, is currently the world's largest zinc mine.

Projects with potential impacts to jurisdictional tundra located with the state's designated coastal zone are subject to a review process via the ACMP that has historically been designed to avoid, minimize and mitigate impacts to wetland habitats, including tundra. Much of Alaska's tundra habitats are jurisdictional wetlands (see wetlands conservation status) subject to the regulatory authority of the COE under Section 404 of the Clean Water Act. Any placement of fill for road development, work pads, stream crossings, or material site development requires a permit from the COE which triggers a review by federal and state agencies and a public review under NEPA.

Best management practices and policies to avoid, minimize, and mitigate for unavoidable impacts to tundra habitats should be implemented at all levels of government. Cooperative working relationships, combined with expert knowledge regarding tundra habitats, are an important tool for managing and protecting these areas. Identifying and protecting areas important to maintaining fish and wildlife diversity should continue. In addition, citizens should be involved in the development of management agreements for the conservation and sustainable use of fish, wildlife and tundra landscapes.

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