3.2 Biological Resources

This section describes the biological resources along the TAPS ROW. The ecosystem structure and vegetation of each ecoregion in the ROW are described, as well as the life history and population-level characteristics of the animals in those systems. For each region along TAPS, the distribution of the prominent plants and animals and the environmental factors that determine these patterns are detailed. Information describing the resources before TAPS construction and since TAPS activity started in 1978 is reviewed. The type and amount of information vary depending on species. Written information specific to the TAPS ROW has been augmented with authors' first-hand experience and interviews of people who have worked with the management and regulation of TAPS.

3.2.1 Special Areas, Special Management Zones, and Zones of Restricted Activity

By H. Whitlaw, R. Ritchie, and J. McKendrick

Special areas and special management zones include zones of restricted activity (ZRAs), areas of critical ecological concern (ACECs), long-term vegetation monitoring and restoration sites, existing and potential research sites, selected fish streams, and critical/sensitive wildlife habitats near TAPS (Table 3.2-1; ADF&G, 1986a, b; ADNR, 1986; APSC, 1993; BLM, 1987a, b, 1989, 1991; BLM and USACE, 1988; Zasada et al., 1981).

All fish streams and peregrine falcon use areas within the TAPS ROW are defined as ZRAs (APSC, 1993) based on Stipulation 2.5.3.1 of the Federal Agreement and Grant of Right-of-Way. In these areas, activities are restricted during all fish spawning and migration periods, and falcon breeding, nesting, and migration periods (BLM, 1987b).

ACECs were proposed in the federal Bureau of Land Management's (BLM's) *Utility Corridor Proposed Resource Management Plan and Final EIS* (BLM, 1989) and established with the management plan's record of decision (BLM, 1991). Non-implemented ACECs are shown as "potential" uses (Table 3.2-1). As with ZRAs, activities are restricted in ACECs to meet protection and management objectives for designated sensitive habitats (e.g., lambing areas, mineral licks, rare plants, nesting habitat, fish habitat, and migration routes).

Historical vegetation-monitoring sites have provided baseline ecological data (these sites are not currently being monitored). Revegetation/restoration sites are used to study the responses of vegetation to construction-related disturbances and oil spills.

Most special areas and special management zones along the TAPS ROW occur north of Fairbanks, primarily north of the Brooks Range. National parks, national wildlife refuges, national wild and scenic rivers, and state recreation areas are addressed in Section 3.3.6.

3.2.2 Vegetation and Wetlands

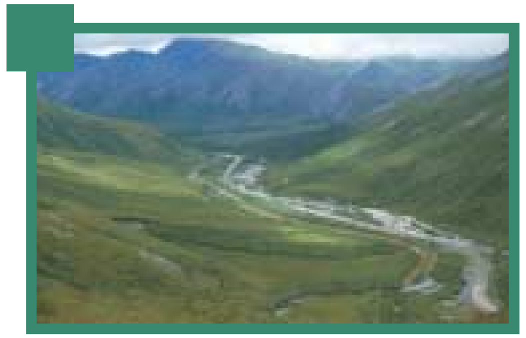
By D. Funk, J. McKendrick, T. Jorgenson, and J. Kidd

The TAPS ROW traverses a variety of ecological regions, ecosystems, and community types ranging from coastal arctic tundra to coastal Western Hemlock-Sitka Spruce forests along its 800-mile (1,288-km) length and from sea level to alpine tundra over a 1,444-m elevation change. This section describes the vegetation and wetland types crossed by the TAPS ROW. Descriptions are organized by ecoregions (Gallant et al., 1995) except that Interior forested lowlands and uplands, Interior highlands, and Interior bottomlands are grouped into a single "Interior Forests" ecoregion for simplicity (Figure 3.2-1). Within each ecoregion, the distribution of the dominant plant communities and the environmental factors that determine these patterns are described.

Vegetation types are classified as wetlands when the soil physical characteristics, hydrology, and dominant plant species composition (as described from the literature) meet the wetland criteria in the *Corps of Engineers Wetlands Delineation Manual* (USACE, 1987a). The status of the dominant species in each vegetation type was assessed us-

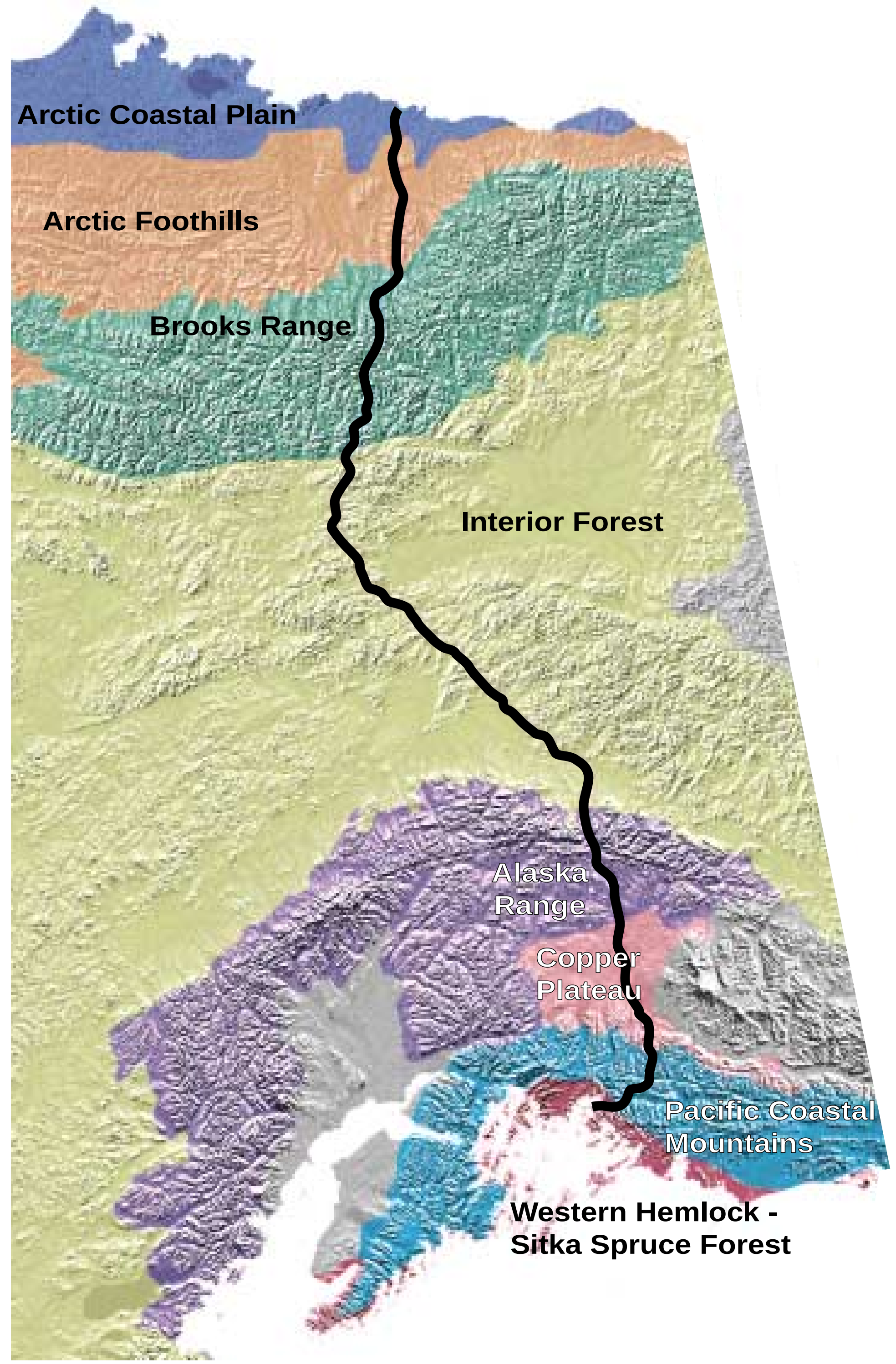
Arctic Coastal Plain: Nearly level plain underlain by continuous thick permafrost. Wet grass and sedge communities dominate. Dwarf scrub communities occur in drier sites where microtopography provides a deeper rooting zone.

Arctic Foothills: Ridges, mesas, and plateaus underlain by thick permafrost. Grass and sedge communities dominate with dwarf scrub on well-drained sites. Open low scrub communities along drainages.



Brooks Range: Steep rugged mountains mostly barren of vegetation and underlain by thick permafrost. Dwarf scrub communities on drier sites and grass and sedge communities on wet and moist sites in lower valleys.

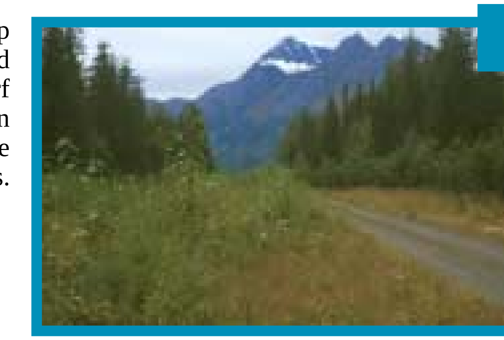
Interior Forest: Rolling lowlands with plateaus and low to high hills, steep rounded ridges and flat to nearly flat bottomlands underlain by discontinuous permafrost. Needleleaf, broadleaf and mixed forest communities dominate with tall scrub communities, low scrub bogs, and scrub-graminoid communities in wettest areas.



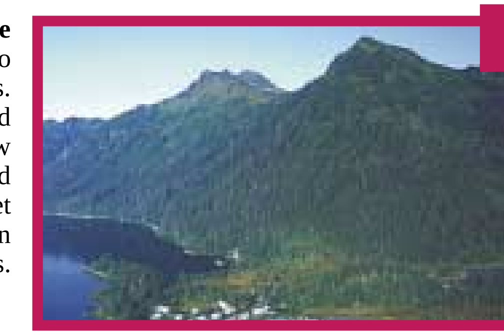
Alaska Range: Steep rugged mountains and broad valleys underlain by discontinuous permafrost. Dwarf scrub communities on dry windswept sites, low scrub and tall scrub communities on moist to mesic sites. Needleleaf forests and woodlands in valleys and lower slopes.

Copper Plateau: Level to gently rolling plain with thin to moderately thick permafrost. Broadleaf forests, tall scrub communities and needleleaf forests on better drained sites. Low scrub bogs and wet graminoid communities in wettest areas.

Pacific Coastal Mountains: Steep rugged mountains with isolated masses of permafrost. Low and dwarf scrub communities where vegetation occurs. Needleleaf forests in some lower drainages.



Western Hemlock - Sitka Spruce Forest: Level to irregular terrain to steep foothills of coastal mountains. Needleleaf broadleaf and mixed forests with tall scrub swamps, low scrub bogs, and wet graminoid herbaceous communities and wet forb herbaceous communities in wet sites.



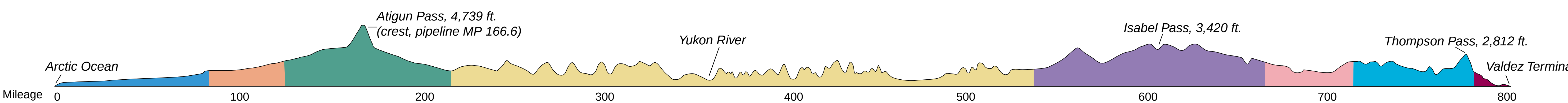


Figure 3.2-1.
Major vegetational zones along TAPS (adapted from Gallant et al., 1995).

Table 3.2-1. *Active and historical special areas, special management zones, and zones of restricted activity (APSC, 1993).*

	Special Areas and Management Zones	Description	TAPS Milepost	Map*
1	Franklin Bluffs Peregrine Falcon ZRA	Concentrated nesting habitat	15-36	1, 2
2	Sagwon Bluffs Peregrine Falcon ZRA	Concentrated nesting habitat	57-61, 59-68	3
3	Vegetation Monitoring Sites**	Long-term monitoring value due to the vegetation database on willows collected by Zasada et al. (1981)	90, 94	4
4	Vegetation Monitoring Site**	Long-term monitoring of vegetation recovery from 7/19/77 oil spill	26	2
5	Slope Mountain Peregrine Falcon ZRA	Concentrated nesting habitat	113-116	5
6	Vegetation Monitoring Site**	Long-term monitoring of vegetation recovery from 1/1/81 spill	115	5
7	Vegetation Monitoring Site**	Long-term monitoring of vegetation response to pipeline construction from a snow pad	120-124	5
8	Toolik Lake Research Natural Area	Research station	122-140	5
9	Galbraith Lake ACEC	Crucial lambing areas and mineral licks for Dall sheep; possible rare and sensitive plants	136-145	5, 6
10	Vegetation Monitoring Site**	Long-term monitoring value due to the vegetation database on willows collected by Zasada et al. (1981)	146	6
11	Revegetation/Restoration Monitoring Site	Long-term monitoring value for revegetation/restoration studies	157	6
12	Sten Creek Restoration	Long-term monitoring value for revegetation/restoration practices	164	6
13	Vegetation Monitoring Site**	Long-term monitoring of vegetation recovery from 6/10/79 spill	166	6
14	West Fork Atigun ACEC	Dall sheep lambing habitat and mineral licks	156-163	6
15	Snowden Mountain ACEC	Dall sheep habitat and mineral lick area	190-200	7
16	Sukakpak Mountain ACEC	Rare or sensitive plants may exist; long-term revegetation monitoring	207-211	7, 8
17	Nugget Creek ACEC	Dall sheep lambing habitat and mineral licks	216-221	8
18	Poss Mountain ACEC	Dall sheep habitat and mineral lick areas	217-219	8
19	Jim River ACEC	Chum and king salmon spawning areas; overwintering habitat for resident and anadromous fish species; raptor habitat	257-280	9, 10
20	Yukon River Peregrine Falcon ZRA	Concentrated nesting habitat for falcons and other raptors	350-355	12
21	Grapefruit Rocks Peregrine Falcon ZRA	Concentrated nesting habitat for Peregrine Falcons and other raptors	417-418	14
22	Vegetation Monitoring Site**	Long-term monitoring of vegetation response to pipeline construction from a snow pad	418	14
23	Vegetation Monitoring Site**	Long-term monitoring of vegetation recovery from 10/11/78 spill	432	15
24	Vegetation Monitoring Site**	Long-term monitoring of vegetation recovery from 2/15/87 sabotage-caused spill	458	15
25	Wildlife Protection	ADNR designation to protect wildlife	490-500	16, 17
26	Delta River (proposed)	Chum salmon spawning area	531-534	18
27	Sandhill Crane Migration Habitat	Potential BLM/DOD designation to protect Sandhill Crane migration habitat	543-559	18
28	Fish Creek	ADNR mineral withdrawal area to protect fish habitat and water supply to hatcheries in the vicinity	612-614	20
29	Mud Lake ACEC (potential)	BLM designation for additional protection of eagle, caribou, moose, bear, sensitive plant, and fish spawning habitat	615-623	20
30	State Fish Hatcheries	Fish Hatcheries No. 1 and 2	615, 618	20
31	Spring Creek	ADNR mineral withdrawal area to protect fish habitat	636-647	21
32	Trumpeter Swan Critical Habitat (potential)	ADNR designation for Trumpeter Swan critical habitat	642-668	21, 22

*TAPS Environmental Atlas (APSC, 1993).
**Most vegetation monitoring sites were established by the University of Alaska Fairbanks.

ing Reed's (1988) *The National List of Plant Species That Occur in Wetlands: Alaska (Region A)*. Table 3.2-2 lists vegetation types, species typical of each type, and the landforms with which types are usually associated. Type names follow Viereck et al.'s (1992) *Alaska Vegetation Classification*. Table 3.2-3 lists the taxonomic names of the plant species. Nomenclature follows Hultén (1968) for vascular plants and Vitt et al. (1988) for nonvascular plants.

3.2.2.1 Arctic Coastal Plain

The northernmost portion of the TAPS ROW lies in the Arctic Coastal Plain ecoregion (Figure 3.2-1). The entire Arctic Coastal Plain is underlain by thick permafrost that impedes drainage and creates saturated soils in most areas. Wetland plant communities of sedges, grasses, and mosses dominate this region. Where changes in relief occur, communities contain dwarf shrubs, cushion plants, lichens and graminoids that are adapted to the better-drained soils (Walker, 1985). Coastal plain soils are mostly fine-grained and extremely ice-rich (Brown, 1968; Brown and Sellman, 1973; Rawlinson, 1993; Shur and Jorgenson, 1998). Large- and small-scale permafrost-related landscape features are important in creating the relief that determines wet, moist, and dry tundra.

Geomorphic and fluvial processes are responsible for opening habitats for colonization and succession on the coastal plain (Billings, 1987). Wind-oriented thaw-lakes cover 20 to 50 percent of the land surface across the region (Gallant et al., 1995). These shallow thaw-lakes (typically 1 to 7 m in depth) follow a cyclic pattern of formation and drainage in response to the degradation and subsequent reforming of ice-rich permafrost (Britton, 1957; Carson and Hussey, 1961; Billings and Peterson, 1980). Following drainage, the wet basins are colonized within a few years by pioneer graminoid plant and moss species (Ovendon, 1986). Vegetation types that commonly establish in drained thaw-lake basins include Sedge-Willow Tundra, Wet Sedge-Herb Meadow Tundra, Wet Sedge Meadow Tundra, and Wet Sedge Grass Meadow Tundra. Wet Sedge-Grass Meadow communities often dominate young thaw-lake basins (Billings and Peterson, 1980; Bliss and Peterson, 1992). Through time, the floristic composition of the basins changes gradually to Wet Sedge Meadow Tundra communities that are typical of older basins (Billings and Peterson, 1980; Funk et al., 1991; Bliss and Peterson, 1992). Plant species composition and successional sequences vary depending on the volume of ice in underlying permafrost, age of the thaw lake when it drains (Billings and Peterson, 1980), and the basin substrate characteristics (Funk et al., 1991). Near the Sagavanirktok River, where the TAPS ROW is located, the deposition of alkaline loess (wind-blown silt) derived from the river channel tends to maintain plant species composition typical of early- and mid-successional communities when compared to more acidic areas (Walker, 1985; Walker and Everett, 1991).

Vegetation patterns are also influenced by microtopographic variation including strangmoor ridges, frost scars, the development of ice-wedge polygons, and naturally induced thermokarst (Peterson and Billings, 1978; Webber, 1978; Walker et al., 1980). These smaller-scale disturbances alter vegetation patterns and create complex plant-community structure (Walker, 1983). Ice wedges are particularly sensitive to disturbance because they form directly below the active layer, which has little capacity to adjust to changes in energy balance at the surface. Once disturbed, ice wedges easily melt, resulting in deep troughs and high-centered polygons (Lawson, 1986; Walker, Cate et al., 1987).

Wet tundra microsites are common, and many of the plant communities along the TAPS ROW in this ecoregion are classified as wetlands (Table 3.2-2). These sites primarily support Wet Sedge Meadow Tundra and Wet Sedge-Grass Meadow (Walker et al., 1980; Walker and Acevedo, 1987). Fresh Grass Marsh communities of pendant grass dominate sites with deeper water (up to 1 m). Moist microsites include polygon rims, tops of poorly developed high-centered polygons, low hummocks, strangmoor ridges, and well-drained terrain along streams. Moist sites drain soon after spring runoff and are dominated by Sedge-Willow Tundra and Sedge-*Dryas* Tundra. Dry sites occur on gravelly soils formed from stream deposits and on margins of old lake-basins and rivers. Soils on dry sites usually have thin to no organic surface horizon and support dwarf scrub communities, particularly Sedge-*Dryas* and *Dryas* Tundra (Walker, 1985).

On the Arctic Coastal Plain outside of the TAPS ROW, there are large gravel bars and sandbars (Bliss and Cantlon, 1957; Bliss and Peterson, 1992) and sand dunes (Peterson and Billings, 1978, 1980) along rivers. Active dunes are largely restricted to river margins (Tedrow and Brown, 1967) and coastal areas, but also occur on the leeward shores of some thaw-lakes (Walker, 1973) and support Dunegrass communities. Open and Closed Low Willow Shrub communities are found on active and inactive floodplains. Seral Herb communities are present in active floodplain sites, riverbanks, and eroding bluffs. Halophytic Sedge Wet Meadow and Halophytic Grass Wet Meadow communities dominate extensive areas of coastal salt marsh (Meyers, 1985; Noel and Funk, 1999). The vegetation of

__Table 3.2-2.__ Vegetation types and associated landforms found in each ecoregion crossed by the TAPS ROW. Vegetation types with an asterisk are also classified as wetlands.

Ecoregion (1)	Landform, Landscape Position (2,3)	Vegetation Type (3)	Dominant Species
Arctic Coastal Plain	Active and inactive floodplains	Open and Closed Low Willow Shrub*	Richardson, Diamondleaf, and Grayleaf Willows, Alpine Milk Vetch, Dwarf Fireweed
	Low-centered polygons, nonpatterned ground	Open Low Willow-Sedge Shrub Tundra*	Diamondleaf Willow, Water Sedge, Arctic Sweet Coltsfoot, Polar Grass
	Active floodplain	Seral Herbs	Dwarf Fireweed, Wormwood, Dwarf Hawk's Beard, Northern Sweetvetch
	Low-centered polygon rims, high-centered polygons, pingos	Sedge-Dryas Tundra (4)	Water Sedge, Bigelow Sedge, Entire-leaf Mountain-avens, White Mountain-avens
	Active sand dunes	Dunegrass	Dunegrass, Dupontia, *Senecio pseudo-amica*
	Thaw lakes and ponds	Fresh Grass Marsh*	Arctic Pendant Grass, Water Sedge
	Drained thaw lakes, nonpatterned ground	Wet Sedge Meadow Tundra*	Tall Cottongrass, Water Sedge, Mosses
Arctic Foothills	Silty colluvium	Open Low Mesic Shrub Birch-Ericaceous Shrub*	Resin Birch, Bog Blueberrry, Mountain-Cranberry, Labroador Tea, Feathermoss
	Silty colluvium	Open Low Willow Shrub*	Richardson, Diamondleaf, and Grayleaf Willows, Alpine Milk Vetch, Dwarf Fireweed
	Alpine sandstone and till slopes and ridges	Dryas and Dryas-Lichen Dwarf	White Mountain-avens, Arctic Willow, Bog Blueberry, *Stereocaulon tomentosum*, Cladonia spp.
	Silt-capped valleys and gentle slopes	Tussock Tundra*	Tussock Cottongrass, Diamondleaf Willow, Bigelow Sedge
	Drained lake basins, valley depressions; lacustrine or fine-grained silts	Wet Sedge Meadow Tundra*	Tall Cottongrass, Water Sedge, Mosses
Brooks Range	Pond margins, streambanks; silt loam over gravel	Open Low Willow-Sedge Shrub Tundra*	Diamondleaf Willow, Water Sedge, Bigelow Sedge, Arctic Sweet Coltsfoot
	Alpine drainages and gelifluction lobes	Willow Dwarf Shrub Tundra	Least and Netleaf Willows, Crowberry Sedges, Lichens
	Flood plain terraces; silt loam over gravel	Open Low Alder-Willow Shrub*	American Green Alder, Diamondleaf Willow, Sedges, Mosses
	Till slopes and ridges	Dryas Dwarf Shrub Tundra	White Mountain-avens, Arctic Willow, Bog Blueberry, Bearberry
	Mid-slope; thin, stony soil	Dryas-Sedge Dwarf Shrub Tundra	White Mountain-avens, Northern Single-spike Sedge and other Sedges, Mosses and Lichens
	Rocky ridges and upper slopes	Ericaceous Dwarf Shrub Tundra	Alpine Bearberry, Mountain-Cranberry, Bog Blueberry, Bigelow Sedge, Alpine Azalea, Lichens
	Drained lake basins, valley depressions	Wet Sedge Meadow Tundra*	Tall Cottongrass, Water Sedge, Mosses
Interior Forests	Well-drained hillsides, treeline, young river terraces	Open and Closed White Spruce Forest	White Spruce, alder, Highbush Cranberry, Twinflower, Prickly Rose, Buffaloberry, Bluejoint, Horsetail
	Well-drained slopes of shallow bedrock, or poorly-drained silts on floodplain terraces or north-facing slopes	Open and Closed Black Spruce Forest (4)	Black Spruce, Resin Birch, Labrador Tea, Bush Cinquefoil, Mountain-Cranberry, Horsetail
	Near treeline or poorly-drained silts on floodplain terraces	Open and Closed Black Spruce-White Spruce Forest (4)	Black Spruce, White Spruce, Labrador Tea, Willows, Feathermosses
	Wet lowlands, shallow permafrost	Open Black Spruce-Tamarack Forest*	Black Spruce, Tamarack, Resin Birch, Labrador Tea, Mosses

(1) Gallant et al. (1995).
(2) Walker (1985).
(3) Viereck et al. (1992).
(4) Can be classified as upland or wetland, depending on soil and hydrologic conditions.

Table 3.2-2 (cont'd). *Vegetation types and associated landforms found in each ecoregion crossed by the TAPS ROW. Vegetation types with an asterisk are also classified as wetlands.*

Ecoregion (1)	Landform, Landscape Position (2,3)	Vegetation Type (3)	Dominant Species
Interior Forests (Cont'd)	Well-drained slopes of shallow bedrock or very poorly drained silts	Black Spruce Woodland*	Black Spruce, Cottongrass, Willows, Sphagnum moss
	Floodplain terraces	Closed Balsam Poplar Forest	Balsam Poplar, Thinleaf Alder, Willows, Prickly Rose
	Upland loess soils	Closed Paper Birch Forest	Paper Birch, Willows, Alder, Labrador Tea
	Well-drained slopes upland slopes, commonly south-facing	Closed Quaking Aspen Forest	Quaking Aspen, Highbush Cranberry, Twinflower
	Very poorly drained lowlands, shallow permafrost	Open Black Spruce Dwarf Tree Scrub*	Black Spruce, Labrador Tea, Tussock Cottongrass, Sphagnum Moss
	Active and young floodplains	Open and Closed Tall Willow Shrub (4)	Feltleaf, Grayleaf, Diamondleaf, Littletree Willows, Bluejoint, Dwarf Fireweed, Meadow Horsetail
	Upland drainageways, seepages	Open Tall Shrub Swamp*	Thinleaf, American Green Alders, Bluejoint
	Non-patterned wetlands with thick organic mat	Open Low Shrub Birch-Ericaceous Shrub Bog*	Resin Birch, Mountain-Cranberrry, Bog Blueberry, Labrador Tea, Sedges, Sphagnum Moss
	Poorly drained silty lowlands to well-drained upland slopes	Bluejoint (4)	Bluejoint
	Lake and pond margins, sloughs; silty or organic soils	Subarctic Lowland Sedge Wet Meadow	Water Sedge, *Carex saxatilis*, Meadow Horsetail
	Sloughs, oxbow lakes, lake margins, silty or organic soils	Fresh Herb Marsh	Swamp Horsetail, Bluckbean, Water Smartweed
Alaska Range	Treeline; inactive floodplains; silts over coarse gravels	Open White Spruce Forest	White Spruce, Alder, Highbush Cranberry, Twinflower, Prickly Rose, Buffaloberry, Bluejoint, Horsetail
	North-facing slopes at treeline	Open Black Spruce-Willow Shrub	Black Spruce, White Spruce, Labrador Tea, Willows, Feathermosses
	Steep to moderate slopes at treeline; silt loams	Open Tall Shrub Birch Willow Shrub	Resin Birch, Diamondleaf, Barratt, and Richardson Willows, Fescue Grass
	Moderately well drained slopes; stony silt loams	Open Mesic Shrub Birch-Ericaceous	Resin Birch, Labrador Tea, Mountain-Cranberry, Bog Blueberry, Crowberry, Fescue Grass
	Steep to moderate slopes at treeline, drainageways	Closed Tall Alder-Willow Shrub*	American Green Alder, Diamondleaf Willow, Sedges, Moss
	Alpine drainages and gelifluction lobes	Willow Dwarf Shrub Tundra	Least and Netleaf Willows, Crowberry, Sedges, Lichens
Copper Plateau	Inactive floodplains; silts over coarse gravels	Open White Spruce Forest	White Spruce, alder, Highbush Cranberry, Twinflower, Prickly Rose, Buffaloberry, Bluejoint, Horsetail
	Poorly-drained lowlands, shallow permafrost	Open Black Spruce Forest (4)	Black Spruce, Resin Birch, Labrador Tea, Bush Cinquefoil, Mountain-Cranberry, Horsetail
	Floodplain terraces	Closed Balsam Poplar Forest	Balsam Poplar, Thinleaf Alder, Willows, Prickly Rose
	Moderately to well-drained upland soils	Closed Paper Birch Forest	Paper Birch, Willows, Alder, Labrador Tea
	Poorly drained lowlands, shallow permafrost	Open Black Spruce Dwarf Tree Scrub*	Black Spruce, Labrador Tea, Tussock Cottongrass, Sphagnum Moss
	Seeps, streambanks; silts with interbedded organics	Close Tall Shrub Swamp*	Thinleaf Alder, Diamondleaf Willow, Water Sedge, Bluejoint
	Non-patterned wetlands with thick organic mat	Open Low Shrub Birch-Ericaceous Shrub Bog*	Resin Birch, Mountain-Cranberry, Bog Blueberry, Labrador Tea, Sedges, Sphagnum Moss

(1) Gallant et al. (1995).
(2) Walker (1985).
(3) Viereck et al. (1992).
(4) Can be classified as upland or wetland, depending on soil and hydrologic conditions.

Table 3.2-2 (cont'd). *Vegetation types and associated landforms found in each ecoregion crossed by the TAPS ROW. Vegetation types with an asterisk are also classified as wetlands.*

Ecoregion (1)	Landform, Landscape Position (2,3)	Vegetation Type (3)	Dominant Species
Copper Plateau (Cont'd)	Lake and pond margins, sloughs; silty or organic soils	Subarctic Lowland Sedge Wet Meadow*	Water Sedge, *Carex saxatilis*, Meadow Horsetail
	Sloughs, oxbow lakes, lake margins; silty or organic soils	Fresh Herb Marsh*	Swamp Horsetail, Buckbean, Water Smartweed
Pacific Coastal Mountains	Upper mountain slopes; shallow, poor to well drained soils	Closed Mountain Hemlock Forest (4)	Mountain Hemlock, Bog and Dwarf Blueberry, Lace Flower, Ferns
	Subalpine slopes, drainages, floodplains; moderately well-drained loams (often stony)	Closed Tall Alder Shrub (4)	American Green Alder, Diamondleaf and Grayleaf Willows, Fescue Grass, Polargrass
	Slope depressions, snowbed communities; thin, stony soils	Closed Low Ericaceous Shrub	Aleutian Mountain Heath, Starry Cassiope, Bog and Dwarf Blueberry
	Alpine slopes, snowbeds; thin, stony soils	Mountain-heath Dwarf Shrub Tundra	Mertens Cassiope, Aleutian Mountain Heath, Bog and Dwarf Blueberry, Crowberry
	Alpine slopes; commonly north-facing; thin, stony soils	Cassiope Dwarf Shrub Tundra	Meadow Horsetail, Variegated Scouring-rush, Yellow Marsh-marigold
	Seepage areas, pond and marsh margins; saturated or semi-permanently flooded silts or sands; shallow organic horizon	Subarctic Lowland Herb Wet Meadow*	Sitka Spruce, Sitka Alder, Bluejoint
Coastal Western Hemlock-Sitka Spruce Forests	Active alluvial fans and floodplains	Open Sitka Spruce Forest	Western Hemlock, Sitka Spruce, Devilsclub, Rusty Menziesia, Salmonberry
	Footslopes, benches, poorly drained soils with relatively thick organic surface layer	Open Western Hemlock - Sitka Spruce Forest	Black Spruce, Resin Birch, Labrador Tea, Bush Cinquefoil, Mountain-Cranberry, Horsetail
	Poorly-drained lowlands on shallow soils, permafrost is absent	Open Black Spruce Forest*	Black Cottonwood, Thinleaf Alder, Salmonberry, Tall Fireweed, Devilsclub
	Floodplains, thin silt loam overlying glacial outwash	Open Black Cottonwood4	Feltleaf, Grayleaf, Diamondleaf, and Littletree Willows, Bluejoint
	Active floodplains	Open and Closed Tall Willow Shrub (4)	Dwarf Fireweed, Meadow Horsetail

(1) Gallant et al. (1995).
(2) Walker (1985).
(3) Viereck et al. (1992).
(4) Can be classified as upland or wetland, depending on soil and hydrologic conditions.

the coastal plain has been thoroughly described in a number of documents including Tieszen (1978); Brown et al. (1980); Walker et al. (1980); Walker (1985); BLM and MMS (1998); USACE (1999, 1997, 1990, 1987, 1984, 1980); and others.

3.2.2.2 Arctic Foothills

The rolling hills and plateaus of the Arctic Foothills are similar to the Arctic Coastal Plain — treeless and underlain by thick permafrost. However, the foothills have more defined drainage patterns and fewer lakes. The most common vegetation type is Tussock Tundra, which dominates old glacial moraines. Dwarf shrub communities occur on the younger rocky moraine ridges, and willow and alder shrub communities occupy active floodplains and small drainages. Inactive floodplains in the region are covered with wet sedge meadows. Plant distribution is largely controlled by drainage patterns and the processes of weathering and deposition (frost creep, gelifluction, erosion, eolian deposition, ice aggradation and thermokarst), which alter surface characteristics in the landscape (Jorgenson, 1984).

In upland areas where ice-rich permafrost has formed in glacial till and colluvium, thermokarst and periglacial features are less common than on the Arctic Coastal Plain. Mass wasting of the gentle slopes is thought to reduce the microtopographic patterns caused by development of polygonal ice wedges (Kreig and Reger, 1982). Additionally, the well-integrated drainage network on the upland slopes creates water tracks from the movement of surface water and groundwater that is above the permafrost (Jorgenson, 1984; Walker, D.A. et al., 1989; Giblin et al., 1991). This

Table 3.2-3. Scientific and common names of dominant plant species found along the TAPS ROW (taxonomy after Hultén, 1968).

Common Name	Scientific Name	Common Name	Scientific Name
Alder	*Alnus spp.*	Lace flower	*Tiarella trifoliata*
Aleutian mountain heath	*Phyllodoce aleutica*	Least willows	*Salix rotundifolia*
Alpine azalea	*Azalea procumbens*	Littletree willow	*Salix arbusculoides*
Alpine bearberry	*Arctostaphylos alpina*	Lyngbye sedge	*Carex lyngbyaei*
Alpine foxtail	*Alopecurus alpinus*	Meadow horsetail	*Equisetum arvense*
Alpine milk vetch	*Astragalus alpinus*	Mertens cassiope	*Cassiope mertensiana*
American green alder	*Alnus crispa*	Mountain hemlock	*Tsuga mertensiana*
Arctic pendant grass	*Arctophila fulva*	Mountain-cranberry	*Vaccinium vitis-idaea*
Arctic sweet coltsfoot	*Petasites frigidus*	Netleaf willow	*Salix reticulata*
Arctic willow	*Salix arctica*	Northern single-spike sedge	*Carex scirpoidea*
Balsam poplar	*Populus balsamifera*	Northern sweetvetch	*Hedysarum alpinum*
Barratt willow	*Salix scouleriana*	Paper birch	*Betula papyrifera*
Bearberry, kinnikinnik	*Arctostaphylos uva-ursi*	Polar grass	*Arctagrostis latifolia*
Bigelow sedge	*Carex bigelowii*	Prickly rose	*Rosa acicularis*
Black cottonwood	*Populus trichocarpa*	Quaking aspen	*Populus tremuloides*
Black spruce	*Picea mariana*	Red fescue	*Festuca rubra*
Bluejoint	*Calamagrostis canadensis*	Resin birch	*Betula glandulosa*
Bog blueberry	*Vaccinium uliginosum*	Richardson willow	*Salix lanata*
Bog rosemary	*Andromeda polifolia*	Rusty menziesia	*Menziesia ferruginea*
Buckbean	*Menyanthes trifoliata*	Salmonberry	*Rubus spectabilis*
Buffaloberry	*Shepherdia canadensis*	Senecio pseudo-arnica	*Senecio pseudo-arnica*
Bush cinquefoil	*Potentilla fruiticosa*	Sitka alder	*Alnus sinuata*
Carex saxatilis	*Carex saxatilis*	Sitka spruce	*Picea sitchensis*
Cladonia spp.	*Cladonia spp.*	Sphagnum moss	*Sphagnum spp.*
Copperbush	*Cladothamnus pyrolaeflorus*	Starry cassiope	*Cassiope stelleriana*
Cow parsnip	*Heracleum lanatum*	Stereocaulon tomentosum	*Stereocaulon tomentosum*
Crowberry	*Empetrum nigrum*	Swamp horsetail	*Equisetum fluviatile*
Devilsclub	*Oplopanax horridus*	Sweetgale	*Myrica gale*
Diamondleaf willow	*Salix planifolia*	Tall Cottongrass	*Eriophorum angustifolium*
Dunegrass	*Elymus arenarius*	Tall fireweed	*Epilobium angustifolium*
Dupontia, tundra grass	*Dupontia fischeri*	Tamarack	*Larix laricina*
Dwarf blueberry	*Vaccinium caespitosum*	Thinleaf alder	*Alnus tenuifolia*
Dwarf dogwood	*Cornus canadensis*	Tussock cottongrass	*Eriophorum vaginatum*
Dwarf fireweed	*Epilobium latifolium*	Twinflower	*Linnaea borealis*
Dwarf hawk's beard	*Crepis nana*	Variegated scouring-rush	*Equisetum variegatum*
Entire-leaf mountain-avens	*Dryas integrifolia*	Water sedge	*Carex aquatilis*
Feltleaf willow	*Salix alexensis*	Water smartweed	*Polygonum amphibium*
Fescue grass	*Festuca altaicia*	Western hemlock	*Tsuga heterophylla*
Grayleaf willow	*Salix glauca*	White mountain-avens	*Dryas octopetala*
Highbush cranberry	*Viburnum edule*	White spruce	*Picea glauca*
Horsetail	*Equisetum spp.*	Wormwood	*Artemisia arctica*
Labrador tea	*Ledum groenlandicum*	Yellow marsh-marigold	*Caltha palustris*

drainage reduces the impoundment of surface water and decreases the potential for ice-wedge melting and thermokarst. The gravelly floodplain of the Sagavanirktok River has soils that are relatively thaw-stable and have little massive ice (Kreig and Reger, 1982).

Most soils are poorly drained, fine-textured silt loams and silty-clay loams (Brown, 1980). However, in areas where glacial till is at or near the surface, coarser rocky mineral substrates are present (Walker, M.D. et al., 1989). Poorly drained soils occur on gentle slopes of loess-covered glacial moraines and support Tussock Tundra (Walker et al., 1994). Moderately well-drained and well-drained gravelly soils occur on ridges and terraces adjacent to the major rivers (Brown, 1980). Either *Dryas*-Lichen or *Dryas* Tundra occurs in these drier, more exposed sites on the upper slopes and ridges (Walker et al., 1994). Along drainages and on active floodplains, Open Low Willow Shrub communities occur, and Wet Sedge Meadow Tundra dominates drained lake basins, valley depressions, and abandoned floodplains.

As on the Arctic Coastal Plain, wetlands dominate much of the terrain adjacent to the TAPS ROW in the Arctic Foothills. The valley bottoms and hill slopes have poorly drained organic silts or clay loam soils with organic horizons 5 to 40 centimeters (cm) thick (Walker, M.D. et al., 1989). In some habitats (usually on upper slopes), the silts overlay till and are thick enough to impede drainage and remain saturated. Upland soils can be found on south-facing sandstone outcrops and on exposed till. Wetland plant communities include Tussock Tundra, Open Low Mixed Shrub-Sedge Tussock Tundra, Open Low Mesic Shrub Birch Ericaceous Shrub, Open Low Willow Shrub, and Wet Sedge Meadow Tundra.

3.2.2.3 Brooks Range

The rugged, deeply dissected mountains of the Brooks Range support sparse vegetation cover because of the steep, easily eroded slopes; shallow soils; high winds; and arctic climate. Vegetation is generally limited to valleys and lower hillsides. There is little soil development on slopes, and valley soils are primarily developed from glacial till. Soils are usually gravelly and may be covered with silty colluvial and residual material from fine-grained sedimentary rocks. Thick permafrost creates shallow thaw depth and poor soil drainage, but the soils are generally thaw-stable (Kreig and Reger, 1982). Steep slopes and high moisture content in the active soil layer cause slope failures that expose large patches of bare rocks and soil (Brown and Kreig, 1983). Frost mounds and heaving, and river channel migration also influence vegetation patterns (Brown et al., 1983). Wildfires are common, ranging in size from less than 1 hectare (ha) to 109,265 ha, (Gabriel and Tande, 1983), and alter vegetation patterns on the south side of the Brooks Range.

Vaccinium and Bearberry Dwarf Shrub Tundra, *Dryas*-Sedge, and *Dryas* Dwarf Shrub Tundra are the most common plant communities (Table 3.2-2) on the upper slopes and ridges of the Brooks Range. Open Low Willow Sedge Shrub Tundra occupies pond margins and stream banks at higher elevations. Drained lake basins and valley depressions support Wet Sedge Meadow Tundra (Cooper, 1986). The TAPS ROW in this region is located primarily in floodplain and in forested valleys. Floodplains support Open Low Alder-Willow Shrub communities on river terraces where silt loams have formed over gravel. Forested sites are described more completely in Section 3.2.2.4.

Wetlands in the Brooks Range are confined to lower slopes where sufficient fine-grained sediments have accumulated along rivers and drainageways. The lowland soils have a relatively thick fibric to hemic organic horizon overlaying a mucky silt loam. Shallow permafrost in these soils restricts drainage. The riparian wetland soils are also poorly drained and typically include a thin organic horizon over a silty or sandy loam, with gravelly sand or coarse cobbles at depth (Rieger et al., 1979). Lowland sites support Wet Sedge Meadow Tundra and Open Low Willow-Sedge Shrub Tundra, while Open Low Alder-Willow Shrub communities dominate riparian wetlands (Cooper, 1986).

3.2.2.4 Interior Forests

The Interior Forests region crossed by the TAPS ROW is a mosaic of forest, grassland, shrubs, bog, and tundra types (Van Cleve et al., 1991). Local vegetation types form primarily in response to slope, aspect, elevation, parent material, and succession after wildfire (Viereck et al., 1986). The dry continental climate and low sun angle create sharp contrasts in the vegetation of north- and south-facing slopes. The presence or absence of permafrost is often correlated with site slope and aspect and is also important in determining vegetation distribution (Viereck et al., 1986). In lowlands, thermokarst features such as high-centered polygons, thaw lakes, and collapse-scar bogs and fens are common in the landscape (Drury, 1956; Racine et al., 1998; Jorgenson et al., 1999). The high ice content of lowland permafrost makes these areas particularly sensitive to disturbance. Fire (Viereck, 1973; Dyrness et al., 1986), climatic warming (Osterkamp et al., 1998; Osterkamp and Romanovsky, 1999), and human-caused disturbance can cause large changes in hydrology, soils, and vegetation.

In Interior Alaska, highly productive Closed Quaking Aspen Forest, Closed Paper Birch Forest, and Closed White Spruce Forest stands occupy south-facing, well-drained slopes (Viereck, 1979; Viereck, 1975). Treeline forests occur at about 750 m in elevation on surrounding hills and are composed of Open and Closed Black Spruce-White Spruce stands. Broadleaf Closed Balsam Poplar Forests and Quaking Aspen Forest dominate mid-successional communities leading to Open or Closed White Spruce Forests on river floodplains where permafrost is absent (Viereck et al., 1986; Adams and Viereck, 1992; Adams 1999). Black Spruce forests are found primarily on north-facing slopes and in wet lowlands where permafrost is near the surface (Viereck, 1975). The soils are saturated and composed of a moderately thick organic layer over a silt loam (Rieger et al., 1979). Open Black Spruce-Tamarack Forest also may occur in lowlands with a shallow active layer. Viereck et al. (1986) divide the forest sites into (1) cold, wet, black spruce sites usually underlain by permafrost and (2) mesic white spruce sites and successional stages leading to white spruce on warm, well-drained, permafrost-free soils.

Frequent fires maintain most forest stands in successional stages limiting mature and climax forest types (Dyrness et al., 1986). Wildfires are common and range in size from 1 ha to more than 300,000 ha (Gabriel and Tande, 1983). The fire season usually lasts from June through early August. Estimates of the natural fire cycle in Alaskan taiga range from 50 to 200 years (Heinselman, 1978; Yarie, 1981; Dyrness et al., 1986). Recently burned areas support early successional herbaceous forb communities dominated by fireweed. Graminoid communities dominated by bluejoint and willow scrub communities follow in succession. Broadleaf forests succeed the willow stage in uplands, on south-facing slopes, or on well-drained river terraces. However, paper birch stands succeed willow on east-, west- and some north-facing slopes and in flat areas. Mixed forest stands occur when spruce becomes established in the broadleaf stands. Forests dominated by spruce eventually replace the mixed stands on many sites (Viereck, 1975; Viereck et al., 1986; Adams and Viereck, 1997).

Open and Closed Black Spruce forests are the most dominant wetland types in the Interior Forests ecoregion along the TAPS ROW, although the floodplain of the Tanana River and smaller streams also support a variety of riparian shrub and graminoid-dominated wetlands (Table 3.2-2). Riparian shrub communities include Open and Closed Tall Willow Shrub and Open Tall Shrub Swamp. Old floodplain terraces with shallow permafrost are occupied by Black Spruce Woodland and several types of open low mesic shrub and bog communities composed of Resin Birch and ericaceous shrubs (Luken and Billings, 1983; Luken, 1984). Wetland graminoid communities include Subarctic Lowland Sedge and Sedge-Shrub Wet Meadows, Fresh Herb Marsh, and Bluejoint and Bluejoint-Herb meadows. Soils in these wet meadow and marsh communities range from very poorly drained histosols to poorly drained silt loams.

3.2.2.5 The Alaska Range

The Alaska Range consists of high, steep mountains separated by broad valleys. Rocky slopes, icefields, and glaciers cover most of the land surface in the region. Slope and aspect largely determine plant community distribution. The windswept upper hillsides and ridgetops have shallow, well-drained, gravelly soils that support alpine dwarf shrub communities. Protected slopes and drainageways support dwarf and tall shrubs, while lower slopes and valleys have open needleleaf forests and woodlands.

Wildfires in the region are infrequent and small (Gabriel and Tande, 1983), with most open habitat created by slope failures, avalanches, and river channel migration. The occurrence of thermokarst landscape features that influence vegetation patterns is limited because permafrost is generally restricted to relatively thaw-stable, coarse-grained alluvial fan, glacial till, glaciofluvial outwash, and thick loess deposits (Kreig and Reger, 1982).

Open Mesic Shrub Birch-Ericaceous Shrub communities occupy moderately drained slopes with stony silt loam soils. Willow Dwarf Shrub Tundra is typical of moist to mesic sites in alpine drainages and on gelifluction lobes. Open Tall Birch-Willow Shrub communities occur on silt loam soils of steep to moderate slopes at treeline. Closed Tall Alder-Willow Shrub communities occur at treeline on steep to moderate slopes, along streambanks, and in drainages. Needleleaf forests and woodlands in the Alaska Range are dominated by Open White Spruce Forest or Open Black Spruce-White Spruce Forest. Open White Spruce Forest occurs at treeline and on inactive floodplains, while Open Black Spruce-White Spruce Forest is generally restricted to treeline stands on north-facing slopes (Viereck et al., 1992).

Wetlands in the Alaska Range along the TAPS ROW are restricted primarily to valley bottoms and lower slopes, although patches of alpine wet meadows are also present. Soils are poorly drained, loamy colluvium over gravelly and stony glacial drift (Rieger et al., 1979). Predominant wetlands include Open and Closed Low Willow and Open Low Alder-Willow Shrub, Open Low Mixed Shrub-Sedge Tussock Tundra, and Mesic Sedge-Grass Meadow Tundra.

3.2.2.6 Copper Plateau

The Copper Plateau is a level to rolling plain in Southcentral Alaska that was the site of a large lake during glacial times (Gallant et al., 1995). Black Spruce Forests are the most common plant communities on the Copper Plateau and are interspersed with shrub-dominated wetlands. Permafrost is discontinuous, warm, and relatively ice-rich. Soils have formed primarily from the glacial deposits and lacustrine sediments that dominate the region (Péwé, 1975; Ferrians et al., 1969; Ferrians et al., 1989). Shallow permafrost creates poorly drained soils. Collapse-scar bogs and thaw lakes are common landscape features, forming in abandoned meltwater channels and depressions associated with glacial morainal deposits. Well-drained soils occur in uplands following wildfires or in gravelly deposits where permafrost is either deep or absent.

Open Black Spruce Forest is typical of poorly drained lowlands that have a shallow permafrost table. In wetter areas these communities give way to Open Black Spruce Dwarf Tree Scrub communities, which include *Sphagnum* moss species and tussock cottongrass. Wetlands also support Open Low Shrub Birch-Ericaceous Shrub bogs that form non-patterned wetlands and develop a thick organic mat. Mosses (particularly *Sphagnum* spp.) are abundant in these sites. Wet graminoid herbaceous communities including Subarctic Lowland Sedge Wet Meadow and Fresh Herb Marsh occupy sloughs, oxbow lakes, and lake and pond margins. Open White Spruce Forests are found on inactive floodplains where silts overlay coarse gravels. Floodplain terraces support Closed Balsam Poplar Forest stands, and moderately to well-drained upland soils support Closed Paper Birch Forest.

The distribution and types of wetlands in the Copper Plateau are comparable to those in the Interior Forests ecoregion, except the wetlands of the Copper Plateau have formed in soils from glacial deposits and lacustrine sediments, rather than from loess and alluvial deposits. Open Black Spruce Forest and woodland dwarf Black Spruce communities are the dominant wetlands along the TAPS ROW, although Open Low Mixed Shrub-Sedge Tussock Bog and Open Low Mesic Shrub Birch-Ericaceous Shrub communities also are common. Soils in these wetlands are poorly drained and frequently underlain by permafrost.

3.2.2.7 Pacific Coastal Mountains

Alpine barrens, glaciers, and icefields cover most of the Pacific Coastal Mountains in Southcentral Alaska. As in the Alaska Range and Interior Forests, aspect and slope influence the distribution of local plant communities. Soils have developed in gravelly glacial till and colluvium. Permafrost is limited to isolated patches in the lowlands, and there are few thermokarst features (Kreig and Reger, 1982). Alpine dwarf and low shrub communities are the most common vegetation types at higher elevations. Tall shrub and forest communities occur at lower elevations in valleys and drainageways.

Mountain-Heath Dwarf Shrub Tundra and Cassiope Dwarf Shrub Tundra occupy the thin, stony alpine soils. Heath communities develop on south-facing slopes and in snowbeds, while Cassiope communities are common on north-facing alpine slopes. Closed Low Ericaceous Shrub communities dominated by copperbush form dense thickets at lower elevations in sites where snowcover persists until late spring. Subalpine slopes, drainages, and floodplains with stony, moderately well-drained, loam soils support Closed Tall Alder Shrub communities. Closed Mountain Hemlock Forests from lower elevations colonize upper mesic sites in protected drainageways.

Wetlands in the Pacific Coastal Mountains are restricted to low mountain passes and valleys. Hydric soils are poorly drained and occur on slopes affected by seepage and drainages. Very poorly drained histosols develop in morainal depressions and outwash plains (Rieger et al., 1979). Wetlands in the seeps and drainageways include Open Tall Alder Shrub and Open Tall Alder-Willow Shrub. Subarctic Lowland Sedge-Shrub Wet Meadow and Subarctic Lowland Herb Wet Meadow wetlands occupy depressions.

3.2.2.8 Coastal Western Hemlock-Sitka Spruce Forests

Coastal Western Hemlock-Sitka Spruce Forests dominate a region of Southcentral and Southeast Alaska consisting of steep footslopes, alluvial fans, floodplains, outwash plains, scattered moraines, river terraces, and river deltas of the Pacific Coastal Mountains (Gallant et al., 1995). The relatively long growing season, high annual precipitation, and mild temperatures of this region support a variety of coastal forest, scrub, and wetland plant communities. Soils near the mountains have formed in gravelly and stony moraine deposits or in volcanic ash over moraine deposits. River delta soils, terraces, alluvial fans, and floodplains have formed in silts and clays subject to flooding and tidal inundation (Crow, 1977; Thilenius, 1995; Boggs, 1997).

Forests are the characteristic plant communities in the region and may be dominated by needleleaf species, broadleaf species, or a mixture of the two. Open Western Hemlock-Sitka Spruce Forest is the most common forest type

growing on footslopes, benches, and poorly drained soils with relatively thick organic surface layers. Mountain hemlock is also common in the northern coastal forests near Valdez (Cooper, 1942) and may dominate stands near treeline (Viereck et al., 1992). Open Sitka Spruce Forest is prevalent on active alluvial fans and floodplains in the region, while Open Black Spruce Forest dominates poorly-drained lowlands with shallow soils. Broadleaf stands of Open Black Cottonwood occupy floodplain sites where thin silt loam soils overlay glacial outwash.

Wetland plant communities along the TAPS ROW establish on hydric soils that have formed in glacial outwash and are rarely influenced by permafrost. These soils typically have a coarse base layer capped with a silt or silt loam of varying thickness (Rieger et al., 1979). In morainal or outwash plain depressions, histosols composed of a thick *Sphagnum* peat over a silty or sandy loam may be present. In glacial outwash areas, seasonal and persistent flooding, respectively, favor open and closed stands of Black Cottonwood forested wetlands, Open and Closed Tall Willow Shrub, and Open Tall Alder-Willow Shrub (Table 3.2-2). Gentle slopes and lowlands having saturated soils support Open Western Hemlock-Sitka Spruce Forest and Sitka Spruce Woodland, and Open Black Spruce and Open Low Shrub Ericaceous Shrub Bog, respectively. Bogs have the highest plant species diversity in the region and include Subarctic Lowland Sedge-Bog Meadow and Subarctic Sedge-Herb Wet Meadow community types.

The islands and mainland of PWS occur in this ecosystem. Crow (1977), Thilenius (1995), and Boggs (1997) have described coastal plant communities of Prince William Sound. In particular, Halophytic Sedge and Halophytic Grass Wet Meadow communities dominate in coastal areas.

3.2.3 Fish

By R. Fechhelm and L. Moulton

The primary sources used in compiling the following descriptions of fish habitat and usage along TAPS are ADF&G (1986a, b, c; 1999a, b, c); BLM (1987a, b); APSC (1993); and the Alyeska Fish Stream Database (APSC, n.d.), which includes information on fish species present in many of the streams along the ROW. Under Alaska Statute 16.05.870(a), ADF&G (1986a, b, c) defines “anadromous fish waterbodies” as those important for spawning, rearing, or migration of anadromous fishes. Anadromous fishes are those species that spawn in fresh water but spend part of their life cycle at sea. They include Arctic cisco, Bering cisco, least cisco, Dolly Varden, rainbow (steelhead) trout, chum salmon, chinook (king) salmon, pink salmon, and coho (silver) salmon

The official federal Authorized Officer’s list of key fish and wildlife areas along TAPS on federally administered lands is found in BLM (1987b). Sensitive habitat in BLM (1987b) is identified based on listings described in BLM (1987a), *Open File Report - TAPS Fish Streams*. This document classifies waterbodies along the pipeline route as either not sensitive, sensitive, or critically sensitive to fish species inhabiting those waterbodies during all or part of the year. These definitions were originally established by BLM based on an overview of the spawning, migration, and rearing activities of important fish species and assemblages along the pipeline route. This classification was also used in the *Environmental Atlas of the Trans Alaska Pipeline System* (APSC, 1993), Appendix C of this Environmental Report can be referred to for stream names and pipeline mileposts.

3.2.3.1 Arctic Slope Drainage

The Arctic Slope Drainage portion (MP 0 to 170) of the pipeline route consists primarily of the Sagavanirktok River and its side channels and tributaries (Figure 3.2-2). The pipeline crosses the headwaters of the Kuparuk River at MP 124 and 126. Thirteen species of fish (plus two incidentals) have been reported in the Sagavanirktok River drainage (Table 3.2-4), the most important of which are Dolly Varden, broad whitefish, Arctic cisco, and grayling. The presence of chum salmon, least cisco, and humpback whitefish is incidental, and these species do not represent large spawning stocks (Craig, 1984). Sport fishing is minimal and largely limited to oil field workers who fish for Dolly Varden and grayling. There is no subsistence or commercial fishery along the river itself. However, juvenile Arctic cisco that overwinter in the lower reaches and delta may eventually be recruited to the Colville River, where they join stocks harvested by both commercial and subsistence fisheries. Far-ranging adult Dolly Varden may also be taken in subsistence fisheries along the coast during summer (Craig, 1989a).

Pump Station 1 (MP 0) is adjacent to the Putuligayuk River, which is classified as an anadromous fish stream in its lower reaches because of the summer presence of Arctic cisco, broad whitefish, and least cisco. The pipeline ROW then parallels the Sagavanirktok River, crossing 48 of its side channels from MP 18 (Low Life Creek) to MP 93. The river and smaller channels are classified as anadromous fish habitat along this entire length primarily because of the presence of Dolly Varden. Side channels also contain

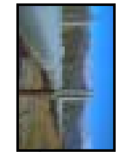


Figure 3.2-2. *Major drainages along the TAPS ROW.*

Table 3.2-4. *Fish species by major drainages along TAPS route.*

Order	Family	Species	Drainages		
			Arctic Slope	Yukon River	Copper River
Petromyzontiformes	Petromyzontidae	Arctic lamprey (*Lampetra japonica*)	No	Yes	No
Cypriniformes	Cyprinidae	Lake chub (*Couesius plumbeus*)	No	Yes	No
	Catostomidae	Longnose sucker (*Catostomus catostomus*)	Yes	Yes	Yes
Salmoniformes	Esocidae	Northern pike (*Esox lucius*)	No	Yes	No
	Umbridae	Alaska blackfish (*Dallia pectoralis*)	No	Yes	No
	Osmeridae	Pond smelt (*Hypomesus olidus*)	No	No	Yes
	Salmonidae	Arctic cisco (*Coregonus autumnalis*)*	Yes	No	No
		Arctic grayling (*Thymallus arcticus*)	Yes	Yes	Yes
		Bering cisco (*Coregonus laurettae*)*	No	Yes	No
		Broad whitefish (*Coregonus nasus*)	Yes	Yes	No
		Chinook (king) salmon (*Oncorhynchus tshawytscha*)*	Incidental	Yes	Yes
		Chum (dog) salmon (*Oncorhynchus keta*)*	Incidental	Yes	Yes
		Coho (silver) salmon (*Oncorhynchus kisutch*)*	No	Yes	Yes
		Dolly Varden** (*Salvelinus malma*)*	Yes	Yes	Yes
		Inconnu (*Stenodus leucichthys*)	No	Yes	No
		Humpback whitefish (*Coregonus pidschian*)	Yes	Yes	No
		Lake trout (*Salvelinus namaycush*)	Yes	No	Yes
		Lake whitefish (*Coregonus clupeaformis*)	No	No	Yes
		Least cisco (*Coregonus sardinella*)*	Yes	Yes	No
		Pygmy whitefish (*Prosopium coulteri*)	No	No	Yes
		Pink (humpback) salmon (*Oncorhynchus gorbuscha*)*	Yes	No	Yes
		Rainbow (steelhead) trout (*Oncorhynchus mykiss*)*	No	No	Yes
		Round whitefish (*Prosopium cylindraceum*)	Yes	Yes	Yes
		Sockeye (red) salmon (*Oncorhynchus nerka*)*	No	Yes	Yes
Gadiformes	Gadidae	Burbot (*Lota lota*)	Yes	Yes	Yes
Scorpaeniformes	Cottidae	Slimy sculpin (*Cottus cognatus*)	Yes	Yes	Yes
Gasterosteiformes	Gasterosteidae	Ninespine stickleback (*Pungitius pungitius*)	Yes	No	Yes

* Denote anadromous species.
**Fish of the genus *Salvelinus* caught in North Slope drainages and along the Beaufort Sea coast before the mid-1980s were identified as the western Arctic Bering Sea form of the Arctic char (*S. alpinus*). Morrow (1980) and Behnke (1980, 1984) contended that these fish are northern forms of Dolly Varden (*S. malma*), and current consensus conforms to this taxonomic designation. Thus, no Arctic char are listed along TAPS.

grayling, ninespine stickleback, round whitefish, and slimy sculpin and are considered sensitive during the May-to-October open-water season. The main channel is considered sensitive year-round since it may provide rearing and overwintering areas for all species. The main river is critically sensitive from May through June because of grayling spawning and from August through October because of Dolly Varden migration and spawning.

None of the streams or rivers from MP 93 to the Brooks Range (MP 170) is classified as anadromous fish habitat. TAPS crosses numerous tributary creeks from Spoiled Mary Creek (MP 75) to Oksrukuyik Creek (MP 103), all of which are classified as sensitive from May to October because they provide summer foraging habitat for a number of species including grayling and Dolly Varden. They are also critically sensitive in spring and fall because of grayling and Dolly Varden spawning. As in the lower reaches, the main channel of the Sagavanirktok River into which these tributaries empty is sensitive year-round and critically sensitive in spring (May-June) and fall (August-October).

Several creeks along the pipeline ROW from Thieles Trickle (MP 113) to Galbraith Lake Tributary (MP 138) support grayling and non-anadromous Dolly Varden during the sensitive summer period from May through October. TAPS crosses the East Fork of the Kuparuk River at MP 124 and the Kuparuk River at MP 126. The Kuparuk River is an anadromous fish stream downstream but not in this area of the TAPS ROW. From MP 142 to 143, the pipeline crosses the Atigun River and several access streams to Tee Lake. These waters contain Dolly Varden, grayling, burbot, lake trout, slimy sculpin, and round whitefish and are critically sensitive throughout the summer from May to October. They also provide overwintering habitat and are sensitive from November through December.

All of the streams crossed by the pipeline from Vanish Creek (MP 145) through the Atigun River floodplain (MP 157-165) are sensitive during the open-water summer, providing habitat for Dolly Varden, grayling, burbot, slimy sculpin, and round whitefish.

Fish have been studied extensively outside of the TAPS ROW on the Arctic Coastal Plain. Fish populations of the Arctic Coastal Plain and nearshore region of the Beaufort Sea provide an important subsistence resource for local residents (Craig, 1989a) and support commercial and sport harvests (BLM and MMS, 1998; Howe et al., 1998). Fish populations near existing and planned developments, and the effects of the developments on fishes and fish habitat, have been extensively investigated since the mid-1970s (Furniss, 1975; Craig and McCart, 1975; Bendock, 1979a; Craig and Haldorson, 1981; Griffiths and Gallaway, 1982; Critchlow, 1983; Gallaway et al., 1983; Griffiths et al., 1983; Woodward-Clyde Consultants, 1983; Craig, 1984; Moulton et al., 1986; Envirosphere, 1987; Fechhelm and Fissel, 1988; Hemming, 1988-1996; Hemming et al., 1989; Fechhelm and Griffiths, 1990; Fechhelm et al., 1989, 1992, 1999; LGL, 1990-1996). Summaries of these studies are included in recent reviews and EIS documents, including USACE (1980, 1984), ARCO Alaska et al. (1996), BLM and MMS (1998), and Truett and Johnson (2000).

Important fish species in the Arctic Coastal Plain and nearshore Beaufort Sea include Arctic grayling, Dolly Varden char, Arctic cisco, least cisco, and broad whitefish. Arctic grayling are a freshwater species, while the others can include both anadromous and freshwater populations. The following species descriptions are from Gallaway and Fechhelm (2000) and Moulton and George (2000).

Arctic grayling is the second most widespread freshwater fish, after ninespine stickleback, on the coastal plain, occurring in both stream systems and lakes (Moulton and George, 2000). Grayling typically spend the winters in deep areas in larger rivers such as the Colville, Kuparuk, Sagavanirktok, and Canning. During or after spring breakup, adult grayling move into tributary streams for spawning. Streams with sand or gravel substrates seem to be most heavily used. After spawning, adults disperse to summer feeding areas. Grayling embryos hatch after approximately three weeks. Young-of-the-year (age 0) grayling feed in the tributary streams until late summer, then move into the main river for wintering. Juveniles, which do not participate in the spawning migrations, move in spring from wintering areas into small streams, lakes, or shallow areas in the main river to find suitable feeding areas.

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Photo 3.2-1. *Arctic grayling.*

Dolly Varden char spawn in many of the mountain streams emptying into the Beaufort Sea between and including the Colville and Mackenzie rivers (Craig and McCart, 1974, 1975; Smith and Glesne, 1982; Craig, 1977a, b; Daum et al., 1984; Craig, 1984; Everett and Wilmot, 1987). This species is not found in coastal plain streams west of the Colville, possibly because these drainages lack perennial springs (Craig, 1984). The Sagavanirktok River is thought to contain the largest Dolly Varden population(s) on the North Slope (McCart et al., 1972). Juveniles remain in their natal streams for several years before their first seaward migration (Craig, 1977a, b; 1989b).

Dolly Varden char are powerful swimmers that migrate considerable distances along the coast during the summer. Although spawners are believed to maintain fidelity to their natal streams, non-spawners may overwinter in non-natal drainages (Glova and McCart, 1974; Craig, 1977a; DeCicco, 1985, 1990, 1992, 1997). The transitory nature of Dolly Varden in the nearshore zone during the open-water season confounds population estimates based on local catch rates or mark/recapture studies (Gallaway and Fechhelm, 2000).

Nearly all summer studies conducted in the nearshore zone report collecting substantial numbers of large Arctic cisco (Craig and Mann, 1974; Griffiths et al., 1975, 1977; West and Wiswar, 1985; Wiswar and West, 1987; Griffiths, 1983; Fruge et al., 1989; Underwood et al., 1995). Arctic cisco found in the Alaskan Beaufort Sea are believed to originate from spawning grounds in the Mackenzie River system of Canada (Gallaway et al., 1983, 1989). In spring, newly hatched young-of-the-year (age 0) are flushed downriver into ice-free coastal waters adjacent to the Mackenzie Delta. Some young-of-the-year are transported westward to Alaska by wind-driven coastal currents (Gallaway et al., 1983; Fechhelm and Fissel, 1988; Moulton, 1989; Fechhelm and Griffiths, 1990; Schmidt et al., 1991; Underwood et al., 1995; Colonell and Gallaway,

1997). In summers with strong and persistent east winds, enhanced westward transport can carry fish to Alaska's Colville River, where they take up winter residence. They remain in the Colville River until the onset of sexual maturity at about age 7, at which point they migrate back to the Mackenzie River to spawn (Gallaway et al., 1983).

The meteorologically driven recruitment process plays a major role in determining the age structure of Arctic cisco populations in Alaska. Summers of strong, persistent east winds are associated with strong year classes in the Colville/Sagavanirktok region (Cannon et al., 1987a; Moulton, 1989; Glass et al., 1990; Reub et al., 1991; LGL, 1992, 1994a; Griffiths et al., 1996). These year classes maintain a presence in the region that can be tracked as fish grow to ages harvested by the commercial and subsistence fisheries operating in the Colville River (Moulton et al., 1992, 1993; Moulton and Field, 1988, 1991, 1994; Moulton, 1994, 1995).

Least cisco have both migratory and freshwater resident populations on the Arctic Coastal Plain. The diadromous least cisco has a discontinuous distribution in the coastal Beaufort Sea (Craig and McCart, 1975; Craig, 1984, 1989b). Western populations are associated with the Colville River and smaller tundra rivers to the west, whereas eastern populations are associated mainly with the Mackenzie River. The vast distance between these freshwater systems apparently isolates the migratory populations from each other.

Little is known about westward dispersal of Colville River least cisco during summer, but adult fish that disperse eastward are known to travel considerable distances down the coast. Substantial numbers of large least cisco are typically collected in the Prudhoe Bay/Sagavanirktok Delta region. High abundance has also been reported for studies in Foggy Island Bay (Cannon et al., 1987a; Glass et al., 1990) and as far as Mikkelsen Bay (Fechhelm et al., 1996), about 120 km east of the Colville River. Relatively few large least cisco reach Camden Bay, located some 200 km east of the Colville River (Underwood et al., 1995).

The eastward dispersal of juvenile least cisco during summer appears to be a function of wind-driven coastal currents (Fechhelm et al., 1994). West winds in early summer (primarily July) create easterly flowing currents in Simpson Lagoon that enhance the eastward dispersal of small fish. In summers of substantial west winds (about one year out of every two), large numbers of juvenile least cisco are collected in the Prudhoe Bay/Sagavanirktok Delta region (Griffiths et al., 1983; Moulton et al., 1986; LGL, 1992, 1993). In years lacking substantial July west-wind events, few small least cisco reach the east end of Simpson Lagoon (Cannon et al., 1987a; Glass et al., 1990; Reub et al., 1991; Fechhelm et al., 1994; LGL, 1994b; Griffiths et al., 1995).

As with least cisco, the diadromous broad whitefish has two population centers in the Beaufort Sea region — the Colville River and westward, and the Mackenzie River drainage. Unlike the situation with least cisco and Arctic cisco, however, the Sagavanirktok River supports a spawning and overwintering population of broad whitefish.

Of the four dominant diadromous species, broad whitefish are the most restricted in terms of their summer dispersal from overwintering rivers. Young fish (age 2 and younger) from the Sagavanirktok River population tend to remain near the low-salinity waters of the delta for much of the open-water season (Gallaway and Fechhelm, 2000). There has been speculation that salinity intolerance may be the reason for this limited summer distribution. Older broad whitefish (age 3 and older) disperse farther from their natal rivers (Gallaway and Fechhelm, 2000), regularly moving between the Sagavanirktok and Colville rivers (Moulton et al., 1986; Cannon et al., 1987b; Moulton and Field, 1994) through Simpson Lagoon. Broad whitefish catches reported for the eastern Alaskan Beaufort Sea have been nominal to nil (Griffiths, 1983; West and Wiswar, 1985; Wiswar and West, 1987; Fruge et al., 1989; Underwood et al., 1995).

Broad whitefish use a variety of habitats through their life cycle. Spawning occurs in deep portions of large rivers in fall. In the Mackenzie River, they spawn in the lower river just upstream of the marine influence. The anadromous population in the Colville appears to show a similar pattern, with spawning in the main river upstream of the delta. Bendock and Burr (1986) identified a pre-spawning migration in August, but did not know if the fish were freshwater residents or part of the anadromous population. Lake-spawning populations have not been identified.

During the spring flood, age-0 and juvenile broad whitefish enter a variety of available habitats, including seasonally flooded lakes, lakes connected to stream systems, river channels, and coastal areas. Fish using perched lakes remain in the lake until they reach maturity, then return to the river in the spring of the year they will spawn. Broad whitefish that do not enter perched lakes either enter the coastal region and adjacent small drainages to feed — thus assuming an anadromous pattern — or remain in the river system and feed in low-velocity channels, tapped lakes, or drainage lakes. In fall, they leave the shallow feeding areas and return to deep wintering areas in the main river or lakes. Maturity is first reached at age 9, with most maturing at age 10 to 12 (Bendock and Burr, 1984, 1986).

3.2.3.2 Yukon Drainage

Nineteen species of fish are found in the Yukon Drainage (MP 170 to 605); of these, grayling, Dolly Varden, and chum, coho, and chinook salmon are important along TAPS (Table 3.2-4). Other common species include whitefishes, slimy sculpin, longnose sucker, northern pike, and burbot.

Commercial and subsistence fishing in the Yukon drainage is primarily for chinook, chum, and coho salmon. Along the pipeline, the heaviest fishing occurs in the Yukon River main stem and around Fairbanks. Sport fishing north of the Yukon River is largely restricted to lakes and streams accessible from the Dalton Highway (ADF&G, 1986b). Sport fishing effort is relatively light because of the region's isolation. Grayling is the most heavily harvested species, and small numbers of whitefish, lake trout, and burbot are also taken. South of the Yukon River, the area around Fairbanks supports one of the largest sport fisheries in the state, with grayling accounting for over 50 percent of the take. Additional species taken include northern pike, whitefish, burbot, lake trout, Dolly Varden, and chinook, chum, and coho salmon (ADF&G, 1986b). Some of the heaviest sport fishing occurs in the Chena, Salcha, and Delta rivers.

Grayling, slimy sculpin, and possibly Dolly Varden use the North Fork of the Chandalar River (MP 170-173), which is the first drainage crossed by the pipeline on the south slopes of the Brooks Range. It is sensitive during summer open water from May through October and critically sensitive in spring and fall because of grayling and possibly Dolly Varden spawning.

South from the Brooks Range, the pipeline follows the course of the Dietrich River and the Middle Fork of the Koyukuk River from MP 175 to 247. The Dietrich River drainage is inhabited by Dolly Varden, grayling, burbot, round whitefish, longnose sucker, and slimy sculpin. Known overwintering areas occur intermittently along the Dietrich River from MP 179 to 193 and are critically sensitive year round. The river's tributaries are sensitive habitat during open water (May-October). Although none of the water bodies within the Dietrich River system is classified as anadromous, discharge flows into the Middle Fork of the Koyukuk River, which is anadromous. The Middle Fork of the Koyukuk and several of its tributaries from MP 205 to 247 support stocks of Dolly Varden, chum and chinook salmon, grayling, and other species. The river is critically sensitive rearing habitat year-round, and most remaining tributaries and sloughs are sensitive from April through October. The pipeline crosses the mouths of two major anadromous-fish tributaries — Hammond River (MP 222) and Slade Creek (MP 238), which are sensitive during the open water period.

South of MP 247, the pipeline crosses several streams that provide habitat for chum and chinook salmon, including the South Fork of the Koyukuk River (MP 256), Jim River (MP 268, 271), Douglas Creek (MP 270), Prospect Creek (MP 277), Yukon River (MP 353), Minnie Creek (MP 226), and Marion Creek (MP 233). These streams are critically sensitive all year. Other non-anadromous streams that support grayling and numerous minor species are sensitive from April through October. Although no anadromous fish streams exist between Prospect Creek and the Yukon River, Bonanza Creek (MP 284, 286) and Fish Creek (MP 295) empty into the South Fork of the Koyukuk River, which is anadromous. The Kanuti River (MP 303) provides anadromous-fish habitat near its mouth.

There are no anadromous fish streams along the 185 miles (296 km) of TAPS between the Yukon and Chatanika (MP 438) rivers. Most streams in this region support grayling and numerous other species including whitefishes, slimy sculpin, longnose sucker, northern pike, and burbot. These water bodies are sensitive from May through October. The Tolovana River (MP 399) supports anadromous fish about 25 miles (40 km) downstream of TAPS (APSC, 1993).

From the Chatanika to Tanana rivers, the pipeline crosses several major anadromous streams including the Chatanika River (MP 438), Chena River (MP 460), Little Salcha River (MP 491), Salcha River (MP 496), Redmond Creek (MP 500), Shaw Creek (MP 520), and the Tanana River (MP 531). This region contains some of the most productive salmon spawning and rearing grounds in Interior Alaska and supports extensive commercial and subsistence fisheries. A major chum-salmon spawning area is located just downstream of the MP 531 crossing at the confluence of the Tanana and Delta rivers. The Chatanika, Chena, Salcha, and Tanana rivers and Shaw Creek provide critically sensitive year-round habitat for salmon and whitefish. Washington Creek (MP 432), Moose Creek (MP 471-473), and the Little Salcha River provide critically sensitive overwintering habitat from November through April, and sensitive habitat the rest of the year.

No anadromous fish streams are found between the Tanana River (MP 531) and Sable Pass (MP 605). Most of the creeks crossed by the pipeline ROW empty into the Delta River, which supports anadromous fish near its confluence with the Tanana River. The Delta River provides sensitive habitat for grayling and whitefish from May through October, and there is a year-round sensitive area at MP 592. The only stream emptying into the Delta River with sensitive habitat is Phelan Creek; perennial springs

provide year-round habitat for grayling and whitefish. Both the Delta River and Phelan Creek are considered critically sensitive during spring and fall.

3.2.3.3 Copper River Drainage

Seventeen species of fish are found within the Copper River Drainage portion (MP 606 to 800) of the pipeline ROW (Table 3.2-4). Although all five species of salmon are found in the drainage, sockeye and coho salmon are the most dominant species; chinook salmon comprise relatively small runs, and pink and chum salmon runs are very small (ADF&G, 1986c). The Copper River is the major producer of sockeye salmon in the Prince William Sound region. Many sockeye and coho salmon spawn in the lower portion of the Copper River drainage, below the point where the Copper River and TAPS diverge. Other important species include grayling, Dolly Varden, rainbow (steelhead) trout, whitefish, sculpin, burbot, suckers, and smelt.

The Copper River commercial driftnet fisheries for sockeye and coho salmon are some of the most productive in the Prince William Sound region (ADF&G, 1986c). The fisheries occur in conjunction with the major runs: May to late July for sockeye, and early August to early September for coho. The Gulkana River Sockeye Salmon Enhancement Project, which is located along the pipeline in the upper Copper River drainage, is the only major sockeye hatchery in the region and is a dominant factor enhancing the commercial catch. Sockeye and chum salmon support recreational fisheries throughout the Copper River drainage. Recreational fisheries for grayling occur during summer in the area, particularly in the Gulkana River. Dolly Varden are taken where available along the TAPS route; however, most of the harvest is incidental to salmon fisheries (ADF&G, 1986c). There is a minor sport fishery for rainbow (steelhead) trout where available in the area, with fishing being heaviest in the Gulkana River area.

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Photo 3.2-2. *Sockeye salmon.*

The Gulkana River (MP 655) is a major anadromous fish stream supporting a large recreational fishery. In addition to supporting stocks of chinook and sockeye salmon, grayling, and steelhead trout, the river contains at least seven other species. The Gulkana River is sensitive year-round and critically sensitive through summer feeding and spawning periods from May through October. The Gulkana River Sockeye Salmon Enhancement Project hatchery is located at MP 615 and MP 618, an area that is critically sensitive during the incubation period from midsummer through spring (APSC, 1993).

Between the Gulkana River and the Tonsina River (MP 723), a distance of 58 miles (92.8 km), the pipeline directly crosses only two anadromous fish streams: the Tazlina (MP 687) and Klutina (MP 697) rivers. Both rivers provide migratory and spawning habitat for chinook and sockeye salmon and steelhead trout, with coho salmon also occurring in the Klutina River. Other species found in both streams include grayling, Dolly Varden, burbot, and whitefish. These rivers are sensitive from spring through late fall and critically sensitive during the open-water months from May to October. Along this stretch, the pipeline crosses or runs near 11 other streams, all of which are used by grayling. Although none is classified as anadromous by ADF&G, Bear Creek (MP 672), Dry Creek (MP 680), and Squirrel Creek (MP 717) are anadromous within several miles downstream of the pipeline where they support chinook salmon stocks. These streams are sensitive for grayling during the open-water feeding season and critically sensitive in May-June when grayling are spawning.

From the initial crossing of the Tonsina River (MP 723) until the final crossing of the Little Tonsina River (MP 734), TAPS encounters a continuous series of sensitive anadromous fish habitats. The Tonsina River supports stocks of chinook, coho, and sockeye salmon; grayling; Dolly Varden; and several other species. It is classified as sensitive from April through November and critically sensitive during the open-water migration, spawning, and rearing period from June through October. The ROW passes through the Little Tonsina Flats (MP 731-732), a large wetland area that provides foraging habitat for chinook and coho salmon, Dolly Varden, grayling, and slimy sculpin; however, it is considered sensitive only in August and September. Slate Creek (MP 732) and the Little Tonsina River are anadromous fish streams that also support coho and chinook salmon, Dolly Varden, and grayling. The Little Tonsina also contains sockeye salmon, whitefish, and burbot. Both rivers are sensitive through most of the year and provide critically sensitive overwintering habitat from October through February.

No anadromous fish streams exist between the Little Tonsina River (MP 734) and MP 780, where the pipeline begins paralleling the Lowe River. The streams and creeks along this length of the ROW contain Dolly Varden and are sensitive overwintering areas from January through March and critically sensitive during the spawning and overwintering period from August through December.

From the Lowe River crossing (MP 780) to the terminus of the pipeline at Port Valdez (MP 800), nearly all tributaries, streams, and creeks are considered anadromous fish habitat. They contain pink, sockeye, coho, and occasionally chum salmon and Dolly Varden. These water bodies are the exclusive domain of these anadromous species, and secondary species are rare. All of these streams and tributaries are sensitive year round and are critically sensitive from late summer through much of the winter in conjunction with spawning and overwintering.

3.2.3.4 Prince William Sound and Tanker Routes

Prince William Sound supports major populations of marine and anadromous fish that form the basis of major commercial, subsistence, and sport fisheries. Sockeye salmon, pink salmon, coho salmon, chinook salmon, chum salmon, and Pacific herring have provided the greatest commercial harvest value in recent years (Morstad et al., 1999). Pacific halibut, sablefish, and other marine species are also harvested (Bechtol, 1995). Sockeye salmon are the most harvested species in the subsistence fishery, with the other salmon species also providing important harvests (Morstad et al., 1999). Salmon and halibut also support a large sport fishery, with an estimated 130,000 person-days fished in 1997 (Howe et al., 1998).

Rice et al. (1996) and Wells et al. (1995) have described effects to fish populations in Prince William Sound from the 1989 *Exxon Valdez* oil spill. Studies on initial effects and subsequent recovery of fish populations following the spill have not resulted in consensus on the extent of damage and recovery rate. Studies conducted by the *Exxon Valdez* Oil Spill Trustee Council indicated initial damage to Pacific herring, pink salmon, Dolly Varden char, and cutthroat trout (Rice et al., 1996). Although the level of recovery is not clear, pink salmon, Dolly Varden char, and cutthroat trout now support commercial and sport fisheries. After a record harvest in 1992, the Pacific herring population collapsed and has remained depressed, with reduced or no commercial harvest (Morstad et al., 1999). Monitoring of both Pacific herring and pink salmon continues.

Pink salmon were considered particularly vulnerable to contamination from the Valdez Marine Terminal and from oil spills in the Sound because a large portion of the wild population spawns in the intertidal region of the spawning streams (Noerenberg, 1963; Helle et al., 1964; Helle, 1970). Pink salmon are the most abundant salmon species in Prince William Sound, with the wild population averaging 6.65 million fish (range 2.20 to 14.41 million) from 1989 to 1998 (Morstad et al., 1999). During this time, four major hatcheries have added an annual average of 20.76 million fish (range 4.85 to 31.82 million). Together, these populations have supported a commercial harvest averaging 25.11 million pink salmon over the same period.

Three other species of Pacific salmon (sockeye, coho, and chum) also play an important role in the Prince William Sound ecosystem. Sockeye salmon enter a number of systems throughout the Sound, with a small run entering Robe Lake near Valdez. Other systems with historically significant runs include Eshamy and Coghill lakes in the western Sound (Morstad et al., 1999). Coho salmon also enter the Robe Lake system and are spread widely through the Sound. A hatchery run developed at the Solomon Gulch Hatchery at Valdez supports a large sport fishery in August. From 1988 to 1997, the sport coho harvest averaged 32,000 fish, with the annual average exceeding 50,000 fish since 1995 (Howe et al., 1998). Chum salmon are also spread widely through the Sound and are important to the commercial harvest. The chum salmon harvest is also bolstered by a hatchery run. They are now the second most numerous species in the salmon harvest (Morstad et al., 1999).

Dolly Varden support an important sport fishery in Prince William Sound, with an average harvest of 3,259 fish from 1988 to 1997 (Howe et al., 1998). The Dolly Varden in the Sound are considered anadromous and have a complex life cycle involving repeated annual migrations between freshwater rivers or lakes and the sea. Dolly Varden alevins emerge from spawning stream gravel in May and remain in the stream for 2 to 4 years (Armstrong, 1970). In the Sound, most smolts leave spawning streams in May and June at ages 2, 3, and 4 to feed in saltwater and are generally thought to return to overwinter in freshwater streams in the fall. Numerous variations in life history exist for fish spawned in watersheds with lakes and those without lakes (Armstrong and Morrow, 1980); however, each spring, adult and immature fish again migrate from freshwater systems to feed in saltwater. Mature fish return to their natal streams at age 7 to 9 to spawn in the fall. These migration patterns make management complex because individual stocks are difficult to recognize and each stream or lake system may contain mixed stocks of Dolly Varden originating from streams over a vast area (Armstrong, 1984). Additionally, recent analyses have shown that Dolly Varden contradict the accepted pattern of return to lakes each fall. In tagging studies throughout Southcentral Alaska, including Prince William Sound, Bernard et al. (1995) found that 14 to 58 percent may spend the entire winter at sea.

Pacific herring support a diverse commercial fishery in Prince William Sound, with five different fisheries target-

ing different aspects of the herring population through the year. Prior to spawning, a sac roe fishery harvests unspawned females. After spawning, herring roe are harvested on kelp. In the fall, a fishery harvests herring for food and bait (Morstad et al., 1999). The herring fisheries are conducted mainly along western Montague Island, with the food and bait fishery also occurring near Knowles Head and Red Head north of Port Gravina (Sharp et al., 1996). In recent years, the harvest has been highly variable, with all-time record harvests in 1991-92 and complete fishery closures in 1994-96. The stock collapsed in 1993 following an outbreak of viral hemorrhagic septicemia (VHS), and the fishery has been sporadic since (Sharp et al., 1996).

Rockfish support both commercial and sport harvests in the Sound (Bechtol, 1995; Howe et al., 1998). The annual sport harvest of rockfish averaged 13,209 fish between 1988 and 1997 (Howe et al., 1998), while the commercial harvest averaged 214,966 pounds from 1988 to 1994 (Bechtol, 1995; average weight not available to convert pounds to number of fish). The rockfish group is composed of several species, all of which are long-lived and slow to mature. These traits cause them to be especially vulnerable to over-harvest, and management strategies are constantly evolving to avoid stock depletion (Bechtol, 1995).

The sensitivities of fish resources and habitats along the tanker route to the U.S. West Coast are similar to those described for Prince William Sound, with many of the same species of salmon, herring, and other marine and anadromous fishes being important to the local economies and ecosystems. BLM and MMS (1998) described the current status of six salmon populations, one cutthroat trout, and 11 steelhead trout populations from the Columbia River Basin, Oregon and California, all of which are listed or proposed for listing as endangered or threatened species. Since that time, four additional salmon populations in Washington have been listed, and three populations of bull trout have been proposed for listing (FWS, 1998b; NOAA, 1999a). In addition, seven populations of marine fishes from Puget Sound have been proposed for listing: Pacific herring, Pacific cod, Pacific hake, walleye pollock, brown rockfish, copper rockfish, and quillback rockfish (NOAA, 1999b).

3.2.4 Birds

By B. Anderson, R. Day, S. Johnson, R. Ritchie, and D. Troy

Many birds are highly mobile and migratory, and many species that breed on the North Slope and overwinter in Prince William Sound also migrate through the TAPS ROW and adjacent areas. Consequently, the discussion of birds in this report takes a broad view.

Birds found along the TAPS ROW can be divided into five major groups: waterfowl, raptors, shorebirds, seabirds, and passerines and other birds. Most are migratory and use the ROW only during the spring and summer months, but some species occur year-round. Population estimates for most species along the TAPS ROW are generally unavailable, but are noted when possible. Quantitative assessments cannot be made on bird populations, but qualitative interpretations are possible. Scientific names for all species discussed below are provided in Table 3.2-5.

Birds are abundant in the North Gulf of Alaska Coast/ Prince William Sound region. The avifauna of this region is described by Gabrielson and Lincoln (1959), Isleib and Kessel [1973 (1979 reprinting with addendum)], Gould et al. (1982), and DeGange and Sanger (1987). Habitats used by these species are described in Isleib and Kessel (1973). At least 278 species of birds have been recorded in the tanker routes (Gabrielson and Lincoln, 1959; Isleib and Kessel, 1973; DeGange and Sanger, 1987). Agler and Kendall (1997) estimated that approximately 246,000 ± 41,000 marine-oriented birds (includes waterbirds, seabirds, and shorebirds) occurred in Prince William Sound in summer 1996 and that approximately 253,000 ± 35,000 occurred there in winter 1996. Large numbers of marine-oriented birds also occur in and around the Kenai Peninsula. Smaller numbers are associated with the Copper River Delta, although it is important to migrating shorebirds; perhaps as many as 20,000,000 shorebirds migrate through the region (Isleib, 1979).

3.2.4.1 Waterfowl

The TAPS route supports a diverse group of waterfowl, including loons, swans, geese, Sandhill Cranes, and ducks. The status, distribution, and abundance of waterfowl vary along the ROW based on species range, life history, and habitat requirements. Of the 57 species of waterfowl known to occur in Alaska, 39 species are found along the ROW and 33 of those species breed there.

Loons

Four species of loons (Yellow-billed, Pacific, Common, and Red-throated loons) breed near the TAPS ROW. North of the Chugach Mountains, loons are present only from May through October, whereas several species (Yellow-billed, Common, and Pacific loons) overwinter in the Prince William Sound area. In winter, Red-throated Loons also may be found in the coastal waters of Alaska, particularly in the Southeast. Breeding phenology for all loons is

Table 3.2-5. *Common and scientific names and status of bird species found along the TAPS ROW, on the North Slope, and in Prince William Sound. B = breeder, B? = possible breeder, M = migrant, R = resident (usually includes breeding), S = summer visitor, W = winter visitor (accidentals or vagrants were not included in the list); status along TAPS ROW varies among regions. Sources: TAPS ROW: Gabrielson and Lincoln (1959), Kessel and Gibson (1978), and sources in text; ANS: Johnson and Herter (1989): PWS: Isleib and Kessel (1973). Species names follow American Ornithologists' Union (1998, 2000).*

Common Name	Scientific Name	TAPS ROW	North Slope	PWS
WATERFOWL & WATERBIRDS				
Red-throated Loon	*Gavia stellata*	B	B	W
Pacific Loon	*Gavia pacifica*	B	B	R
Common Loon	*Gavia immer*	B	—	R
Yellow-billed Loon	*Gavia adamsii*	B	B	W
Horned Grebe	*Podiceps auritus*	B	—	R
Red-necked Grebe	*Podiceps grisegena*	B	B	R
Greater White-fronted Goose	*Anser albifrons*	B	B	M
Snow Goose	*Chen caerulescens*	M	B	M
Canada Goose	*Branta canadensis*	B	B	M
Brant	*Branta bernicla*	B	B	M
Trumpeter Swan	*Cygnus buccinator*	B	—	M
Tundra Swan	*Cygnus columbianus*	M	B	M
Gadwall	*Anas strepera*	B	M	R
American Wigeon	*Anas americana*	B	B	R
Mallard	*Anas platyrhynchos*	B	B	R
Blue-winged Teal	*Anas discors*	M	—	S
Northern Shoveler	*Anas clypeata*	B	B	M
Northern Pintail	*Anas acuta*	B	B	R
Green-winged Teal	*Anas crecca*	B	B	R
Canvasback	*Aythya valisineria*	B	M	S
Redhead	*Aythya americana*	B	—	—
Ring-necked Duck	*Aythya collaris*	B	—	S
Greater Scaup	*Aythya marila*	B	B	R
Lesser Scaup	*Aythya affinis*	B	B	—
Steller's Eider	*Polysticta stelleri*	—	B	W
Spectacled Eider	*Somateria fischeri*	—	B	—
King Eider	*Somateria spectabilis*	—	B	—
Common Eider	*Somateria mollissima*	—	B	—
Harlequin Duck	*Histrionicus histrionicus*	B	—	R
Surf Scoter	*Melanitta perspicillata*	B	—	R
White-winged Scoter	*Loxia leucoptera*	B	—	R
Black Scoter	*Melanitta nigra*	B	M	R
Long-tailed Duck (Oldsquaw)	*Clangula hyemalis*	B	B	W
Bufflehead	*Bucephala albeola*	B	—	R
Common Goldeneye	*Bucephala clangula*	B	—	R
Barrow's Goldeneye	*Bucephala islandica*	B	—	R
Common Merganser	*Mergus merganser*	B	—	R
Red-breasted Merganser	*Mergus serrator*	B	B	R
Sandhill Crane	*Grus canadensis*	B	B	M
SEABIRDS				
Northern Fulmar	*Fulmarus glacialis*	—	—	S
Sooty Shearwater	*Puffinus griseus*	—	—	M
Short-tailed Shearwater	*Puffinus tenuirostris*	—	—	M
Fork-tailed Storm-Petrel	*Oceanodroma furcata*	—	—	S
Double-crested Cormorant	*Phalacrocorax auritus*	—	—	W
Red-faced Cormorant	*Phalacrocorax urile*	—	—	W
Pelagic Cormorant	*Phalacrocorax pelagicus*	—	—	R
Pomarine Jaeger	*Stercorarius pomarinus*	B	M	M
Parasitic Jaeger	*Stercorarius parasiticus*	B	B	B
Long-tailed Jaeger	*Stercorarius longicaudus*	B	B	M
Bonaparte's Gull	*Larus philadelphia*	B	—	B
Mew Gull	*Larus canus*	B	—	R
Herring Gull	*Larus argentatus*	B	—	B
Thayer's Gull	*Larus thayeri*	—	M	W

Table 3.2-5 (cont'd). *Common and scientific names and status of bird species found along the TAPS ROW, on the North Slope, and in Prince William Sound. B = breeder, B? = possible breeder, M = migrant, R = resident (usually includes breeding), S = summer visitor, W = winter visitor (accidentals or vagrants were not included in the list); status along TAPS ROW varies among regions.*

Common Name	Scientific Name	TAPS ROW	North Slope	PWS
SEABIRDS (Cont'd)				
Slaty-backed Gull	*Larus schistisagus*	—	M	—
Glaucous-winged Gull	*Larus glaucescens*	R	—	R
Glaucous Gull	*Larus hyperboreus*	B	B	W
Sabine's Gull	*Xema sabini*	B	B	—
Black-legged Kittiwake	*Rissa tridactyla*	S	—	B
Ross's Gull	*Rhodostethia rosea*	—	M	—
Ivory Gull	*Pagophila eburnea*	—	M	—
Caspian Tern	*Sternia caspia*	—	—	B?
Arctic Tern	*Sterna paradisaea*	B	B	B
Aleutian Tern	*Sterna aleutica*	—	—	S
Common Murre	*Uria aalge*	—	—	B
Black Guillemot	*Cepphus grylle*	—	B	—
Pigeon Guillemot	*Cepphus columba*	B	—	R
Marbled Murrelet	*Brachyramphus marmoratus*	B	—	R
Kittlitz's Murrelet	*Brachyramphus brevirostris*	B	—	R
Ancient Murrelet	*Synthliboramphus antiquus*	—	—	S
Cassin's Auklet	*Ptychoramphus aleuticus*	—	—	S
Parakeet Auklet	*Aethia psittacula*	—	—	B
Rhinoceros Auklet	*Cerorhinca monocerata*	—	—	S
Horned Puffin	*Fratercula corniculata*	—	—	B
Tufted Puffin	*Fratercula cirrhata*	—	—	B
RAPTORS				
Osprey	*Pandion haliaetus*	B	—	M
Bald Eagle	*Haliaeetus leucocephalus*	B	—	R
Northern Harrier	*Circus cyaneus*	B	—	M
Sharp-shinned Hawk	*Accipiter striatus*	B	—	B
Northern Goshawk	*Accipiter gentilis*	R	—	R
Swainson's Hawk	*Buteo swainsoni*	M	—	—
Red-tailed Hawk	*Buteo jamaicensis*	B	—	B?
Rough-legged Hawk	*Buteo lagopus*	B	B	M
Golden Eagle	*Aquila chrysaetos*	B	B	B
American Kestrel	*Falco sparverius*	B	—	B
Merlin	*Falco columbarius*	B	—	—
Gyrfalcon	*Falco rusticolus*	R	R	R
Peregrine Falcon	*Falco peregrinus*	R	B	B
Great Horned Owl	*Bubo virginianus*	R	—	R
Snowy Owl	*Nyctea scandiaca*	B	B	—
Northern Hawk Owl	*Surnia ulula*	R	—	—
Great Gray Owl	*Strix nebulosa*	R	—	—
Short-eared Owl	*Asio flammeus*	R	B	M
Boreal Owl	*Aegolius funereus*	R	—	—
Northern Saw-whet Owl	*Aegolius acadicus*	R	—	R
GROUSE				
Ruffed Grouse	*Bonasa umbellus*	R	—	—
Spruce Grouse	*Falcipennis canadensis*	R	—	R
Willow Ptarmigan	*Lagopus lagopus*	R	R	W
Rock Ptarmigan	*Lagopus mutus*	R	R	W
White-tailed Ptarmigan	*Lagopus leucurus*	R	—	W
Sharp-tailed Grouse	*Tympanuchus phasianellus*	R	—	—
SHOREBIRDS				
Black-bellied Plover	*Pluvialis squatarola*	B	B	M
American Golden-Plover	*Pluvialis dominica*	—	—	M
Pacific Golden-Plover	*Pluvialis fulva*	B	B	M
Semipalmated Plover	*Charadrius semipalmatus*	B	B	B
Killdeer	*Charadrius vociferus*	B	—	—

Table 3.2-5 (cont'd). *Common and scientific names and status of bird species found along the TAPS ROW, on the North Slope, and in Prince William Sound. B = breeder, B? = possible breeder, M = migrant, R = resident (usually includes breeding), S = summer visitor, W = winter visitor (accidentals or vagrants were not included in the list); status along TAPS ROW varies among regions.*

Common Name	Scientific Name	TAPS ROW	North Slope	PWS
SHOREBIRDS (Cont'd)				
Black Oystercatcher	*Haematopus bachmani*	—	—	B
Greater Yellowlegs	*Tringa melanoleuca*	B	—	B
Lesser Yellowlegs	*Tringa flavipes*	B	—	B
Solitary Sandpiper	*Tringa solitaria*	B	—	—
Wandering Tattler	*Heteroscelus incanus*	B	—	B
Spotted Sandpiper	*Actitis macularia*	B	—	B
Upland Sandpiper	*Bartramia longicauda*	B	—	—
Whimbrel	*Numenius phaeopus*	B	—	M
Hudsonian Godwit	*Limosa haemastica*	B	M	—
Bar-tailed Godwit	*Limosa lapponica*	B	M	M
Ruddy Turnstone	*Arenaria interpres*	—	B	—
Black Turnstone	*Arenaria melanocephala*	—	—	W
Surfbird	*Aphriza virgata*	B	—	W
Red Knot	*Calidris cauntus*	—	—	M
Sanderling	*Calidris alba*	M	M	M
Semipalmated Sandpiper	*Calidris pusilla*	B	B	—
Western Sandpiper	*Calidris mauri*	B	B?	M
Least Sandpiper	*Calidris minutilla*	B	—	B
White-rumped Sandpiper	*Calidris fuscicollis*	B	B	—
Baird's Sandpiper	*Calidris bairdii*	B	B	—
Pectoral Sandpiper	*Calidris melanotos*	B	B	M
Sharp-tailed Sandpiper	*Calidris acuminata*	M	—	M
Rock Sandpiper	*Calidris ptilocnemis*	—	—	W
Dunlin	*Calidris alpina*	B	B	M
Stilt Sandpiper	*Calidris himantopus*	B	B	—
Buff-breasted Sandpiper	*Tryngites subruficollis*	B	B	—
Ruff	*Philomachus pugnax*	—	B	—
Short-billed Dowitcher	*Limnodromus griseus*	—	—	M
Long-billed Dowitcher	*Limnodromus scolopaceus*	B	B	M
Common Snipe	*Gallinago gallinago*	B	B	B
Red-necked Phalarope	*Phalaropus lobatus*	B	B	M
Red Phalarope	*Phalaropus fulicaria*	B	B	M
SONGBIRDS & OTHER BIRDS				
Great Blue Heron	*Ardea herodias*	—	—	R
Rufous Hummingbird	*Selasphorus rufus*	B	—	B
Belted Kingfisher	*Ceryle alcyon*	B	—	R
Yellow-bellied Sapsucker	*Sphyrapicus varius*	B	—	—
Downy Woodpecker	*Picoides pubescens*	R	—	R
Hairy Woodpecker	*Picoides villosus*	R	—	R
Three-toed Woodpecker	*Picoides tridactylus*	R	—	R
Black-backed Woodpecker	*Picoides arcticus*	R	—	—
Northern Flicker	*Colaptes auratus*	B	—	B
Olive-sided Flycatcher	*Contopus cooperi*	B	—	—
Western Wood-Pewee	*Contopus sordidulus*	B	—	B
Alder Flycatcher	*Empidonax alnorum*	B	—	—
Hammond's Flycatcher	*Empidonax hammondii*	B	—	—
Say's Phoebe	*Sayornis saya*	B	—	—
Northern Shrike	*Lanius excubitor*	B	—	—
Gray Jay	*Perisoreus canadensis*	B	—	—
Steller's Jay	*Cyanocitta stelleri*	B	—	R
Black-billed Magpie	*Pica hudsonia*	B	—	R
Northwestern Crow	*Corvus caurinus*	R	—	R
Common Raven	*Corvus corax*	R	R	R
Horned Lark	*Eremophila alpestris*	B	—	—
Tree Swallow	*Tachycineta bicolor*	B	—	B
Violet-green Swallow	*Tachycineta thalassina*	B	—	B

Table 3.2-5 (cont'd). *Common and scientific names and status of bird species found along the TAPS ROW, on the North Slope, and in Prince William Sound. B = breeder, B? = possible breeder, M = migrant, R = resident (usually includes breeding), S = summer visitor, W = winter visitor (accidentals or vagrants were not included in the list); status along TAPS ROW varies among regions.*

Common Name	Scientific Name	TAPS ROW	North Slope	PWS
SONGBIRDS & OTHER BIRDS (Cont'd)				
Bank Swallow	*Riparia riparia*	B	—	B
Cliff Swallow	*Petrochelidon pyrrhonota*	B	—	—
Black-capped Chickadee	*Poecile atricapilla*	R	—	R
Chestnut-backed Chickadee	*Poecile rufescens*	R	—	R
Boreal Chickadee	*Poecile hudsonia*	R	—	—
Gray-headed Chickadee	*Poecile cincta*	R	—	—
Red-breasted Nuthatch	*Sitta canadensis*	R	—	R
Brown Creeper	*Certhia americana*	R	—	R
Winter Wren	*Troglodytes troglodytes*	—	—	R
American Dipper	*Cinclus mexicanus*	R	—	R
Golden-crowned Kinglet	*Regulus satrapa*	B	—	B
Ruby-crowned Kinglet	*Regulus calendula*	B	—	B
Arctic Warbler	*Phylloscopus borealis*	B	—	—
Bluethroat	*Luscinia svecica*	B	—	—
Northern Wheatear	*Oenanthe oenanthe*	B	—	—
Mountain Bluebird	*Sialia currucoides*	B	—	—
Townsend's Solitaire	*Myadestes townsendi*	B	—	—
Gray-cheeked Thrush	*Catharus minimus*	B	—	—
Swainson's Thrush	*Catharus ustulatus*	B	—	—
Hermit Thrush	*Catharus guttatus*	B	—	B
American Robin	*Turdus migratorius*	B	—	R
Varied Thrush	*Ixoreus naevius*	B	—	R
European Starling	*Sturnus vulgaris*	B	—	—
Yellow Wagtail	*Motacilla flava*	B	B	—
American Pipit	*Anthus rubescens*	B	—	—
Bohemian Waxwing	*Bombycilla garrulus*	B	—	—
Orange-crowned Warbler	*Vermivora celata*	B	—	B
Yellow Warbler	*Dendroica petechia*	B	—	B
Yellow-rumped Warbler	*Dendroica coronata*	B	—	B
Townsend's Warbler	*Dendroica townsendi*	B	—	B
Blackpoll Warbler	*Dendroica striata*	B	—	—
Northern Waterthrush	*Seiurus noveboracensis*	B	—	—
Wilson's Warbler	*Wilsonia pusilla*	B	—	—
American Tree Sparrow	*Spizella arborea*	B	—	—
Chipping Sparrow	*Spizella passerina*	B	—	—
Savannah Sparrow	*Passerculus sandwichensis*	B	B	B
Fox Sparrow	*Passerella iliaca*	B	—	—
Song Sparrow	*Melospiza melodia*	R	—	R
Lincoln's Sparrow	*Melospiza lincolnii*	B	—	—
White-crowned Sparrow	*Zonotrichia leucophrys*	B	—	B
Golden-crowned Sparrow	*Zonotrichia atricapilla*	B	—	B
Dark-eyed Junco	*Junco hyemalis*	B	—	B
Lapland Longspur	*Calcarius lapponicus*	B	B	—
Smith's Longspur	*Calcarius pictus*	B	B	—
Snow Bunting	*Plectrophenax nivalis*	B	B	W
Red-winged Blackbird	*Agelaius phoeniceus*	B	—	—
Rusty Blackbird	*Euphagus carolinus*	B	—	—
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*	B	—	—
Pine Grosbeak	*Pinicola enucleator*	R	—	R
Red Crossbill	*Loxia curvirostra*	R	—	R
White-winged Crossbill	*Zonotrichia albicollis*	R	—	R
Common Redpoll	*Carduelis flammea*	R	B	R
Hoary Redpoll	*Carduelis hornemanni*	M	B	W
Pine Siskin	*Carduelis pinus*	R	—	R

similar, with eggs being incubated in June, young reared in July-early September, and departure from the nesting grounds by late September. Statewide population estimates for these species range from 2,636 Yellow-billed Loons to about 70,000 Pacific Loons (Groves et al., 1996).

Yellow-billed Loons occur during summer only at the northern end of the TAPS ROW and are uncommon breeders on the Arctic Coastal Plain, where they primarily breed on the Colville River Delta and in the National Petroleum Reserve-Alaska (NPR-A) (Chipp/Alaktak rivers) (Sjolander and Agren, 1976; Johnson and Herter, 1989). During spring migration, Yellow-billed Loons use lakes with open water along the Dalton Highway. A few Yellow-billed Loons have occasionally nested in the vicinity of the ROW (Sage, 1971, 1974; ABR, Inc., unpublished data). Deep-water lakes and ponds were found to be of highest value to nesting and brood-rearing Yellow-billed Loons on the Colville River Delta (Johnson et al., 1997).

Common Loons are uncommon breeders along the TAPS ROW. They nest primarily south of the Brooks Range (Gabrielson and Lincoln, 1959; Groves et al., 1996). This species nests on boreal lakes, generally one pair per lake. Wintering birds occur at the southern end of the ROW near Valdez and in Prince William Sound.

Pacific Loons are common breeders at the northern end of the ROW and in lakes south of the Brooks Range (Gabrielson and Lincoln, 1959; Johnson and Herter, 1989). Pacific Loons arrive on the coastal plain in late May once open water appears, and move to nesting lakes as they thaw in early June. Pacific Loons nest on lakes about half the size of those used by Yellow-billed Loons (Johnson and Herter, 1989; McIntyre, 1994), and use ponds with emergent vegetation (sedges and grasses) for brood-rearing (Bergman and Derksen, 1977; Rothe et al., 1983; Johnson and Herter, 1989; Kertell, 1994).

Red-throated Loons are common breeders at the northern end of the TAPS ROW on the coastal plain and also can be found along the ROW between the Brooks Range and Chugach Mountains (Gabrielson and Lincoln, 1959; Johnson and Herter, 1989). Red-throated Loons nest on smaller, shallower ponds than those used by other loons (Johnson and Herter, 1989; Smith, Byrne et al., 1993, 1994; Dickson, 1994; Johnson et al., 1996). On the coastal plain, Red-throated Loons use not only isolated ponds with emergent vegetation, but also basin wetland complexes, especially during brood-rearing (Bergman et al., 1977; Derksen et al., 1981). Presumably due to the small size and shallowness of their nesting lakes on the coastal plain, Red-throated Loons, unlike other loons, fly to nearshore marine waters to hunt fishes for their young (Bergman and Derksen, 1977).

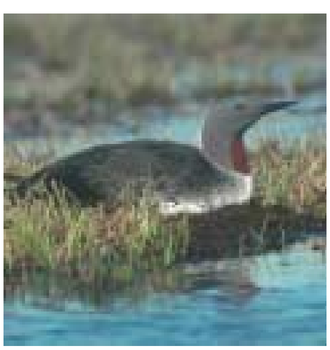

BP Exploration

Photo 3.2-3. *Red-throated Loon.*

Tundra and Trumpeter Swans

Tundra Swans are common breeders across the Arctic Coastal Plain of Alaska and at the northern end of the TAPS ROW, where they are present from late May to mid-September (Johnson and Herter, 1989). Tundra Swans nest in relatively low densities across the entire coastal plain, but occur in highest densities on the major river deltas (Colville, Sagavanirktok, and Canning) (Johnson et al., 1998; Anderson et al., 1999). Some Tundra Swans migrate north over the Brooks Range in spring and may stage briefly in the TAPS ROW along the Dalton Highway, but some also arrive on the Arctic Coastal Plain from the east, having traveled up the Mackenzie River valley in the Yukon (Johnson and Herter, 1989). Tundra Swans nest along the northern part of the TAPS ROW during the breeding season (late May-September). Swans are most sensitive to disturbance during nesting (May-early July), when both adults attend the nest, and during brood-rearing (July-September), when both adults and young are flightless for several weeks. During brood-rearing, Tundra Swans occur frequently in habitats that support stands of the emergent grass *Arctophila fulva*, which is a primary food for both adults and young (Bergman et al., 1977; Derksen et al., 1981). A few Tundra Swans breed along the TAPS ROW south of the Brooks Range, but Trumpeter Swans are more abundant in those sections of the ROW.


BP Exploration

Photo 3.2-4. *Tundra Swans.*

Trumpeter Swans are uncommon to common breeders along the TAPS ROW from south of the Brooks Range to the terminus at Valdez (Gabrielson and Lincoln, 1959). Several areas have been identified as nesting and brood-rearing areas for Trumpeter Swans along the ROW between MP 645 and 716 (APSC, 1993). This region encompasses the drainages of the Gulkana, Copper, and Klutina rivers and adjacent wetlands with numerous ponds that support nesting swans. Nest locations identified during the last statewide aerial survey in 1995 are presented in the *Alaska Trumpeter Swan Atlas* (Conant et al., 1996). The 1995 estimate for the statewide population of Trumpeter Swans

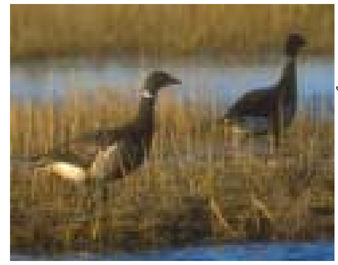
was 15,823, of which approximately 59 percent were in the Gulkana and Lower Tanana land units, which encompass much of the southern TAPS ROW (Groves and Conant, 1998). The ROW also intersects major migration routes for Trumpeter and Tundra swans near Delta Junction in the upper Tanana River valley, near Gulkana, and along the Copper River (Cooper et al., 1991).

Geese

Canada Geese, Greater White-fronted Geese, Snow Geese, and Brant nest on the Arctic Coastal Plain and in the northern section of the TAPS ROW (Johnson and Herter, 1989). Geese are present along the ROW from approximately mid-May to early September each year. They winter primarily outside Alaska. The distribution of each species varies and is influenced by their different nesting habits. Canada and Greater White-fronted geese are common breeders around Pump Station 1 and the northern end of the TAPS ROW, where they nest in isolated pairs on the tundra or on small islands in lakes and ponds. In contrast, Brant and Snow Geese are less common breeders in the northern end of TAPS. They nest in colonies of a few to several hundred pairs at traditional coastal sites in the Prudhoe Bay area (Johnson, 1991, 2000a; Murphy and Anderson, 1993; Stickney et al., 1994; Sedinger and Stickney, 2000). During spring migration, Canada, Greater White-fronted, and Snow geese aggregate in snow-free habitats along the Dalton Highway as far south as Atigun Pass. Brant migrate to the oil fields from the west and are rarely found along the Dalton Highway south of the oil fields during spring. Goose-nesting concentration areas have been identified along the ROW between MP 0 and MP 78 (APSC, 1993). The Atigun Pass area is used as a corridor by geese during fall migration.

Canada Geese are patchily distributed across the Arctic Coastal Plain and reach their highest densities in the Prudhoe Bay area (Johnson and Herter, 1989). On the coastal plain, Canada Geese prefer to nest on small islands in ponds and lakes that provide safety from predators (Murphy and Anderson, 1993). This species is also a common breeder south of the Brooks Range, in the Yukon and Tanana flats, and into the Copper River area (Gabrielson and Lincoln, 1959).

Greater White-fronted Geese are the most common breeding geese on the Arctic Coastal Plain, declining in abundance to the east of Prudhoe Bay (Johnson and Herter, 1989). Unlike Canada Geese, this species nests on the tundra, often away from ponds or lakes. Greater White-fronted Geese are uncommon breeders south of the Brooks Range along TAPS, but some nest on the Yukon Flats and Minto Flats (Gabrielson and Lincoln, 1959).



Declan Tray

Photo 3.2-5. *Brant pair.*

Brant are strongly associated with coastal habitat types during nesting and brood-rearing and occur in only a few locations along the TAPS ROW on the Arctic Coastal Plain. A small nesting colony of less than 10 pairs of Brant is located about 5 km southwest of Pump Station 1, and a colony of less than 25 pairs is located about 4 km northeast of the pump station (Stickney et al., 1994). Larger Brant colonies of 25 to 100 or more pairs are located near the coast in Prudhoe Bay and on Howe Island (Stickney et al., 1994). Scattered pairs of Brant probably also nest within the ROW near Pump Station 1 (Stickney et al., 1994; Sedinger and Stickney, 2000). Brood-rearing Brant tend to concentrate along the coast in the North Slope oil fields, but a small brood group frequently has been seen inland in the Lake Colleen area east of Pump Station 1 (Stickney et al., 1994; Sedinger and Stickney, 2000; ABR, Inc., unpubl. data). Brant do not breed or occur regularly along the TAPS ROW south of the coastal plain, but small numbers may move through Valdez during spring migration.

Until the mid to late 1990s, Snow Geese nested primarily in a single large colony of 300 to 500 pairs on Howe Island in the outer Sagavanirktok River delta and only rarely nested in isolated pairs on the tundra (Johnson, 1991, 2000a). In recent years, other small Snow Goose colonies have become established in the Colville River delta and in NPR-A (Johnson, 2000a). No nests are known in the vicinity of Pump Station 1 or the ROW, but Snow Geese regularly stage during spring migration in areas of early snowmelt that occur in the “dust shadow” of the Dalton Highway and along the Sagavanirktok River from Sagwon north. (Dust produced by traffic on the gravel highway falls out on the snow downwind of the road and causes earlier snowmelt and thus open ground in those areas.)

Sandhill Crane

Sandhill Cranes are rare breeders at the northern end of the TAPS ROW, but are more common breeders between the Brooks Range and Chugach Mountains (Gabrielson and Lincoln, 1959; Johnson and Herter, 1989). The TAPS ROW intersects the major migration route of Sandhill Cranes in Interior Alaska along the Tanana River at Delta Junction (Kessel, 1984; Cooper et al., 1991); 200,000 to 300,000 cranes pass through this area during spring and fall migration each year as they move between their breeding areas in western Alaska and Siberia and their wintering areas in the southwestern U.S.

Ducks

Eighteen species of ducks have been recorded on the Arctic Coastal Plain at the northern end of TAPS, and an additional six species occur south of the Brooks Range (Table 3.2-5). Ducks along the ROW can be divided into arctic-nesting species, boreal-nesting species, and Pacific coastal-nesting species. The arctic-nesting species include Long-tailed Duck (formerly knows as Oldsquaw), Northern Pintail, and eiders (Common, King, Spectacled, and Steller's eiders). Boreal-nesting species include the common dabbling ducks, such as Mallard and Green-winged Teal, and diving ducks, such as White-winged Scoter and Canvasback (Table 3.2-5). An important Pacific coastal-nesting species is the Harlequin Duck (Lanctot et al., 1999; see Section 3.2.7).

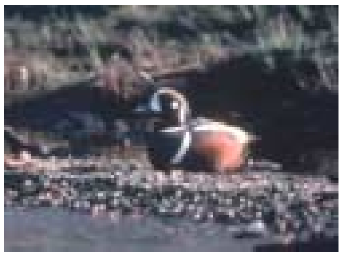

R. Lanctot

Photo 3.2-6. *Harlequin Duck.*

Long-tailed Duck is the most widely distributed of the arctic-nesting species on the Arctic Coastal Plain, whereas the distribution of eiders is more patchy (Johnson and Herter, 1989). Northern Pintails are locally abundant in many locations on the coastal plain and breed in low numbers, but are generally more common breeders in the boreal region of the state (Johnson and Herter, 1989). Common Eiders breed primarily on barrier islands along the Beaufort Sea coast and thus do not occur within the TAPS ROW, but King and Spectacled eiders are relatively common nesters on tundra in the Prudhoe Bay region (Johnson and Herter, 1989; TERA, 1997). King Eiders nest along the northern end of the TAPS ROW, in the vicinity of Pump Station 1. Spectacled and Steller's eiders, both threatened species, are discussed in Section 3.2.7.

Prince William Sound and Tanker Routes

At least 53 species of waterbirds (loons, grebes, herons, waterfowl, and cranes) have been recorded in the North Gulf of Alaska Coast/Prince William Sound region (Gabrielson and Lincoln, 1959; Isleib and Kessel, 1973; DeGange and Sanger, 1987). Of these species, 25 may breed in the region, and one is considered endangered by FWS and the State of Alaska (Steller's Eider: Alaska breeding population only; although this is the population listed, the geographic origin of Steller's Eiders in PWS is unknown). The North Gulf of Alaska Coast/Prince William Sound region is important to waterbirds for nesting, especially on the Copper River Delta, although some seaducks also nest along rockier shorelines. Prince William Sound is an important overwintering area for seaducks, especially scoters, Harlequin Ducks, goldeneyes, and mergansers.

3.2.4.2 Raptors

Nineteen species of raptors regularly occur along the TAPS ROW (Table 3.2-5). Four species are cliff-nesting raptors that have received substantial attention from regulatory agencies: Peregrine Falcon (discussed in Section 3.2.7), Rough-legged Hawk, Gyrfalcon, and Golden Eagle. Two other raptors, the Bald Eagle and the Northern Goshawk, have been identified as species sensitive to disturbance during TAPS ROW developments (Ritchie, 1999, pers. comm.). Bald and Golden eagles receive special protection under the federal Eagle Protection Act (50 CFR 22). All species of raptors occurring along the TAPS ROW also are protected under the Migratory Bird Treaty Act (50 CFR 10 and 21). Schempf (1989) describes the range and habitat use of Alaskan raptors.

Hawks, Falcons, and Eagles

Rough-legged Hawks nest along drainages in the northern foothills of the Brooks Range, and regularly occur along TAPS from Franklin Bluffs to Galbraith Lake. Their abundance and productivity reflect annual cycles in the abundance of their major prey, lemmings. When prey are abundant, Rough-legged Hawks have used artificial substrates for nesting and have taken advantage of suboptimal sites (Ritchie, 1991). Their seasonal use is similar to that of the Peregrine Falcon (see Section 3.2.7).

Gyrfalcons are resident and use traditional cliff nest sites (Cade, 1960), which they may attend during winter. Gyrfalcons occur in mountainous areas along TAPS, from north of the Brooks Range along the Sagavanirktok River to the Alaska Range. Seventeen nest sites were identified within 3 km of the TAPS alignment in the early 1970s (White et al., 1977). Gyrfalcons also have been found nesting on top of the pipeline VSMs in old raven nests (Ritchie, 1991).

Golden Eagles occupy mountainous habitats similar to those of Gyrfalcons, but regularly nest in other habitats, including cliffs along the Yukon and Tanana rivers. They can be found along TAPS from Slope Mountain to the coastal mountains near Valdez. Over 60 territories were identified during aerial surveys along the TAPS route in the early 1970s (White et al., 1977).

Bald Eagles are a common breeding raptor in Interior Alaska, primarily nesting in large cottonwood trees near drainages south of the Yukon River. Nest sites occur near TAPS on the Tanana, Gulkana, Copper, and Lowe rivers and their tributaries (Ritchie and Ambrose, 1996). Most Bald Eagles migrate to winter ranges along the coast and depend on open water for fish prey. A few Bald Eagles winter in Interior Alaska near the junction of the Tanana and Delta rivers (Ritchie and Ambrose, 1987).

The Northern Goshawk, a resident species, nests along the TAPS ROW as far north as the South Fork of the Koyukuk River. Goshawks nest primarily in deciduous woodlands in Interior Alaska, but nesting activities and productivity are erratic, reflecting the cyclic abundance of major prey (McGowan, 1975). The Queen Charlotte race of the Northern Goshawk in Southeast Alaska is of concern to the U.S. Fish and Wildlife Service (FWS, 1996a), and the Northern Goshawk is listed as a species of special concern by the State of Alaska (ADF&G, 1996).

The U.S. Forest Service Region 10 (Alaska) considers ospreys sensitive to disturbance (AKNHP, 2000). They rarely occur along TAPS but are known to nest in the Tanana and Susitna valleys in Interior Alaska (Schempf, 1989). Observations in the Copper River Basin suggest that they may also nest there (Cooper et al., 1991). Other raptor species such as Northern Harrier and American Kestrel occur along the TAPS ROW and are relatively common where nesting habitat is available.

Owls

Snowy Owls are common on the Arctic Coastal Plain (Pitelka, 1974; Johnson and Herter, 1989), and when their primary microtine food (lemmings) is abundant, they can be found nesting near TAPS. In years when lemming numbers are low, Snowy Owls may be present but not breed or may not be present on the coastal plain and near TAPS. Short-eared Owls also nest on the ground in tundra habitats along the TAPS ROW. Other owls in Alaska, such as Great Horned Owl and Boreal Owl, are primarily woodland species distributed along the ROW in forest habitats south of the Brooks Range.

Prince William Sound and Tanker Routes

At least 22 species of raptors have been recorded in the North Gulf of Alaska Coast/Prince William Sound region (Gabrielson and Lincoln, 1959; Isleib and Kessel, 1973); however, the 9 species of owls are terrestrial and not marine. Of these 22 species, 16 either possibly, probably, or definitely breed in the region, and at least 2 are sensitive species (i.e., federally endangered or threatened, state species of special concern, or FWS Region 10 sensitive species): Osprey and the *pealei* subspecies of Peregrine Falcon. It is unknown whether two other subspecies of Peregrine Falcon that recently were delisted (*anatum* and *tundrius*) migrate through the region (Anderson et al., 1988). The Bald Eagle clearly is one of the most abundant raptors of this region, and over 8,000 birds nest and winter there (Bernatowicz et al., 1996).

3.2.4.3 Shorebirds

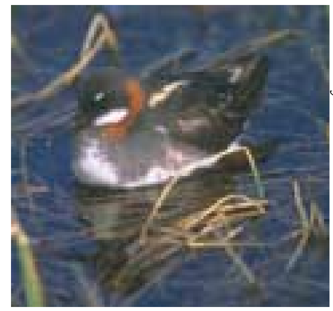

Declan Troy

Photo 3.2-7. *Red-necked Phalarope.*

The Arctic Coastal Plain is an important breeding area for many species of shorebirds, approximately 20 of which occur on the central North Slope (Troy, 2000). Considerable research describing distribution and abundance has taken place in the Prudhoe Bay area (Johnson and Herter, 1989; Troy, 2000.) However, relatively little work on shorebirds has occurred along most of the TAPS ROW. Nesting shorebirds were studied along TAPS at MP 12 and near Franklin Bluffs (Hanson and Eberhardt, 1982). In the Prudhoe Bay oil field, species composition and abundance of shorebirds are influenced by tundra characteristics (habitat), proximity to the coast (a sharp environmental gradient occurs with distance to coast), and location on an east-west axis.

The most numerous species nesting along the TAPS ROW on the Arctic Coastal Plain are two *Calidris* sandpipers (e.g., Pectoral Sandpiper and Semipalmated Sandpiper) and Red-necked Phalarope (Hanson and Eberhardt, 1981). Available information suggests that nesting abundance peaks on the southern coastal plain approximately 25 km south of Pump Station 1 and then decreases rapidly towards the foothills of the Brooks Range. In the foothills region, the most numerous breeding shorebirds are American Golden-Plover, Pectoral Sandpiper, and Buff-breasted Sandpiper (Hanson and Eberhardt, 1981). The nearly extinct Eskimo Curlew may have nested in this zone (see Section 3.2.7.1). Some species, such as American Golden-Plover, Bar-tailed Godwit, Whimbrel, and Buff-breasted Sandpiper, appear to occur at their peak densities in the southern coastal plain/foothills region. Little information on shorebird abundance is available for the TAPS ROW through the Brooks Range. Sage (1974) summarized bird observations in the Atigun and upper Sagavanirktok river valleys and reported 17 species of shorebirds, but most were infrequently encountered. The most widespread species appear to be American Golden-Plover, and Baird's

Table 3.2-6. *Relative abundance of shorebirds (birds/route) by ecoregion. Based on breeding-bird survey (BBS) routes within 50 km of the TAPS ROW (from USGS, 1999). The BBS is a large-scale survey of North American birds. It is a roadside survey conducted during the peak of the nesting season. Each route is 24.5 miles long, with a total of 50 stops located at 0.5-mile intervals along the route. A three-minute point count is conducted at each stop, during which the observer records all birds heard or seen within 0.25 mile of the stop (Sauer et al., 1999). The relative abundances reported below are the weighted averages [birds/(years x routes)] of number of birds per route by ecozone.*

			Interior Forests					
	Arctic Foothills	Brooks Range	Forested Lowlands & Uplands	Bottomlands	Highlands	Alaska Range	Copper Plateau	Pacific Coastal Mountains
Number of Routes	1	2	5	3	2	3	3	2
Routes*Years	6	12	27	21	9	16	26	14
American Golden-Plover	2.5	2.8	0.0	0.0	0.0	1.7	0.0	0.0
Semipalmated Plover	0.5	0.0	0.0	0.8	0.0	2.4	0.5	0.7
Killdeer	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Greater Yellowlegs	0.0	0.0	0.0	0.2	0.0	1.3	0.1	0.0
Lesser Yellowlegs	0.2	1.1	1.5	4.9	2.4	2.9	11.5	2.9
Unidentified Yellowlegs	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Solitary Sandpiper	0.0	0.0	0.3	0.2	1.6	0.0	2.1	0.2
Spotted Sandpiper	0.0	0.1	0.0	6.1	1.3	0.3	0.7	0.7
Upland Sandpiper	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Whimbrel	0.2	0.3	0.3	0.0	0.0	3.2	0.0	0.0
Ruddy Turnstone	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Semipalmated Sandpiper	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Least Sandpiper	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0
Common Snipe	3.3	1.3	2.2	4.9	0.6	6.8	5.8	4.3
Red-necked Phalarope	0.0	0.9	0.0	0.0	0.0	6.7	0.4	2.4
Total Shorebirds	6.8	6.4	4.5	16.9	5.9	26.4	21.4	11.2

and Least sandpipers. Breeding bird surveys (USGS, 1999) from the Brooks Range ecoregion suggest low densities of shorebirds comprised of species more typically found farther south rather than those found in regions to the north (Table 3.2-6).

No information is available on shorebirds in the TAPS ROW during the post-breeding period. However, based on trends from the Prudhoe Bay oil field and other portions of the North Slope, most shorebirds would be expected to be closer to the coast, rather than inland near TAPS (Myers and Pitelka, 1980; Connors et al., 1979; TERA, 1994). This pattern would be even more pronounced after nesting, when shorebirds tend to shift from nesting areas to coastal areas. However, some species increase in abundance inland in the oil field and for an unknown distance along the TAPS route, and additional species are found on the southern coastal plain and foothills.

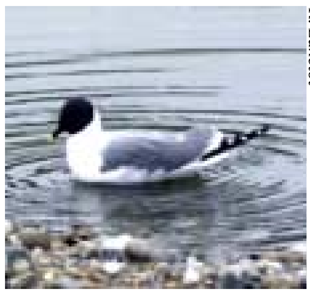
Quantitative data on shorebird distribution and abundance along the section of the TAPS ROW from the Brooks Range to Valdez are limited. The most standardized coverage comes from breeding-bird surveys (USGS, 1999) (Table 3.2-6). This description is preliminary because no ecoregion was well-covered by the surveys (maximum 5). The shorebird community south of the Brooks Range differs markedly from that to the north. In contrast to the *Calidris* sandpipers that dominate the tundra, the boreal forest zone is characterized by Tringinae shorebirds, such as yellowlegs. These birds occur in and around small lakes and fens, and in the case of Spotted Sandpiper, along rivers. Some arctic species, such as American Golden-Plover and Whimbrel, occur in alpine tundra. The most widespread shorebirds along the entire ROW south of the Brooks Range (and locally to the north) are Lesser Yellowlegs and Common Snipe (Table 3.2-6).

Shorebird abundance along this portion of TAPS appears to be highest in and south of the Alaska Range. One species of interest is the Upland Sandpiper, because it is considered threatened or endangered in some states, although not in Alaska. It occurs in subalpine areas along the southern slope of the Brooks Range, in open habitats of the Interior (such as near Delta), and in the Alaska Range (Anderson et al., 2000).

At least 45 species of shorebirds have been recorded in the North Gulf of Alaska Coast/Prince William Sound region (Gabrielson and Lincoln, 1959; Isleib and Kessel, 1973; Isleib, 1979; Senner, 1979; DeGange and Sanger,

1987; Gibson and Kessel, 1989). Of these, only 11 may breed in the region, indicating the importance of the region for migration rather than for nesting. No species are federally threatened or endangered, or are state species of special concern. The Copper River Delta, however, is a migratory stopover site of great importance to shorebirds (part of the Western Hemisphere Shorebird Reserve Network), and large proportions of the world populations of several species and subspecies (e.g., Western Sandpiper, *roselaari* subspecies of Red Knot, *pacifica* subspecies of Dunlin, *beringiae* subspecies of Marbled Godwit, Black Turnstone, Surfbird) traverse this region.

3.2.4.4 Seabirds



R. Lanctot

Photo 3.2-8. *Sabine's Gull.*

Fourteen species of seabirds regularly occur in the vicinity of the TAPS ROW: Pomarine, Parasitic, and Long-tailed jaegers; Bonaparte's, Mew, Herring, Sabine's, Glaucous, and Glaucous-winged gulls; Black-legged Kittiwake; Arctic Tern; Pigeon Guillemot; and Marbled and Kittlitz's murrelets (Gabrielson and Lincoln, 1959; Isleib and Kessel, 1973; Johnson and Herter, 1989). Eleven of these species are larids (jaegers, gulls, and terns), and three are alcids (Pigeon Guillemot and the murrelets).

At the northern end of the ROW, Pomarine and Parasitic jaegers prey on small birds (shorebirds and passerines) and small mammals (primarily lemmings) on the Arctic Coastal Plain. The Long-tailed Jaeger is a predator of small mammals and bird eggs. It nests on the North Slope and in alpine areas of the Brooks Range and Alaska Range along TAPS. Only Parasitic and Long-tailed jaegers are likely to be found nesting along the ROW, mainly north of the Brooks Range.

The Glaucous Gull is an arctic-nesting gull that occurs primarily on the Arctic Coastal Plain (Johnson and Herter, 1989). It winters mainly in the Bering Sea and occurs in smaller numbers in the Gulf of Alaska. In contrast, the Glaucous-winged Gull occurs only in the vicinity of the Valdez Marine Terminal. Bonaparte's, Mew, and Herring gulls nest throughout Interior Alaska along the TAPS ROW, with all three species migrating to the Pacific Coast during the winter. Bonaparte's and Mew gulls nest in trees, and Mew and Herring gulls nest in small colonies on gravel bars and on small, protected islands in lakes. Arctic Terns and Sabine's Gulls nest in scattered small colonies across the Arctic Coastal Plain on islands and polygonal tundra. Arctic Terns also nest throughout the Interior and along the southern coast on gravel bars and rocky islands in the vicinity of the Valdez Terminal. Arctic Terns undergo the longest annual migration of any bird species, spending the boreal winter in the Antarctic and returning to the Northern Hemisphere to nest every year.

The Pigeon Guillemot, Marbled Murrelet, and Kittlitz's Murrelet are alcids that occur in the vicinity of the Valdez Terminal. Guillemots may nest in rock crevices along the shorelines of the terminal, whereas the murrelets probably nest inland around the terminal, in trees (Marbled Murrelet), and on mountain tops (Kittlitz's Murrelet). A fourth species, the Black Guillemot, is a winter vagrant in scattered locations of Interior Alaska, including the vicinity of the TAPS ROW near Paxson. It breeds along the Beaufort Sea coast in the vicinity of the North Slope oil fields.

At least 47 species of seabirds (tubenoses, cormorants, larids, and alcids) have been recorded in the North Gulf of Alaska Coast/Prince William Sound region (Isleib and Kessel, 1973; Gould et al., 1982; DeGange and Sanger, 1987). Of these species, 28 may breed in the region (Figure 3.2-3, Table 3.2-7), and one is considered endangered by FWS (Short-tailed Albatross). In addition, Prince William Sound represents a significant portion of the world's population of both Marbled and Kittlitz's murrelets (Agler et al., 1998). The region is especially important to nesting gulls and alcids, particularly in Prince William Sound and on the Kenai Peninsula. However, numbers of wintering birds are much lower than numbers of summering birds. The total estimated population of breeding seabirds in this region is almost 1,000,000 birds (Table 3.2-7). The total population of seabirds in the North Gulf of Alaska Coast/Prince William Sound region may approach 1,500,000 to 2,000,000 birds during summer, when the breeding number is added to the large number of non-breeding albatrosses and Sooty and Short-tailed shearwaters summering from colonies farther south and non-breeding Northern Fulmars, storm-petrels, gulls, and alcids from Alaska (Isleib and Kessel, 1973).

3.2.4.5 Passerines and Other Birds

Passerines

Passerines (songbirds) are the largest group of birds that occur along the TAPS ROW, both in terms of numbers and species (Gabrielson and Lincoln, 1959). The ROW includes almost all habitats occupied by passerines in the state. Of the 174 species of passerines that have been recorded in

Alaska (Gibson, 1999), at least 70 probably regularly occur along TAPS (Gabrielson and Lincoln, 1959). The Boreal Partners in Flight Working Group (1999) recently identified "priority" species of landbirds in various biogeographic regions of Alaska (Table 3.2-8). These species are considered priorities based on their ranks for a series of criteria including whether Alaska contains most of the global population, if they are exclusively a boreal-breeding population, if there are negative population trends, if there are threats during non-breeding season, and if there is negative response to forest cover loss on breeding and wintering grounds. Many of these priority species are neotropical migrants (birds that winter in Central or South America) and have been considered species of concern by the State of Alaska (ADF&G, 1993, 1998). Most of these species also occur in habitats along the TAPS ROW.

Migrant passerines arrive in habitats along TAPS during late April-early June and begin breeding soon after arrival. Most young fledge by August, and southward migration begins soon thereafter. The breeding season for most resident passerines begins earlier — often by early April — and thus young are generally fledged by early summer.

At the northern end of TAPS, only a few species (Common Raven, redpolls, American Dipper) are residents (do not migrate), and the Common Raven is closely associated with areas of human habitation (Johnson and Herter, 1989). Ravens occasionally nest near the coast, primarily on buildings and other structures, including large buildings in the Prudhoe Bay and Kuparuk oil fields (Johnson and Herter, 1989; Ritchie, 1991; Day, 1998). Most passerines migrate to the Arctic Coastal Plain from wintering areas in temperate and tropical regions in North and South America, and a few species migrate from southern Asia. Over 30 species of passerines have been recorded on the coastal plain, and at least 8 are known or probable breeders (Johnson and Herter, 1989) (Table 3.2-5). The most abundant breeding species on the coastal plain is the Lapland Longspur (Johnson and Herter, 1989; TERA, 1993b), with average breeding densities of 21 nests/square kilometer (km^2). Other common breeding species on the coastal plain are the Common and Hoary redpolls, Snow

J. Lukin

Photo 3.2-9. *Common Raven.*

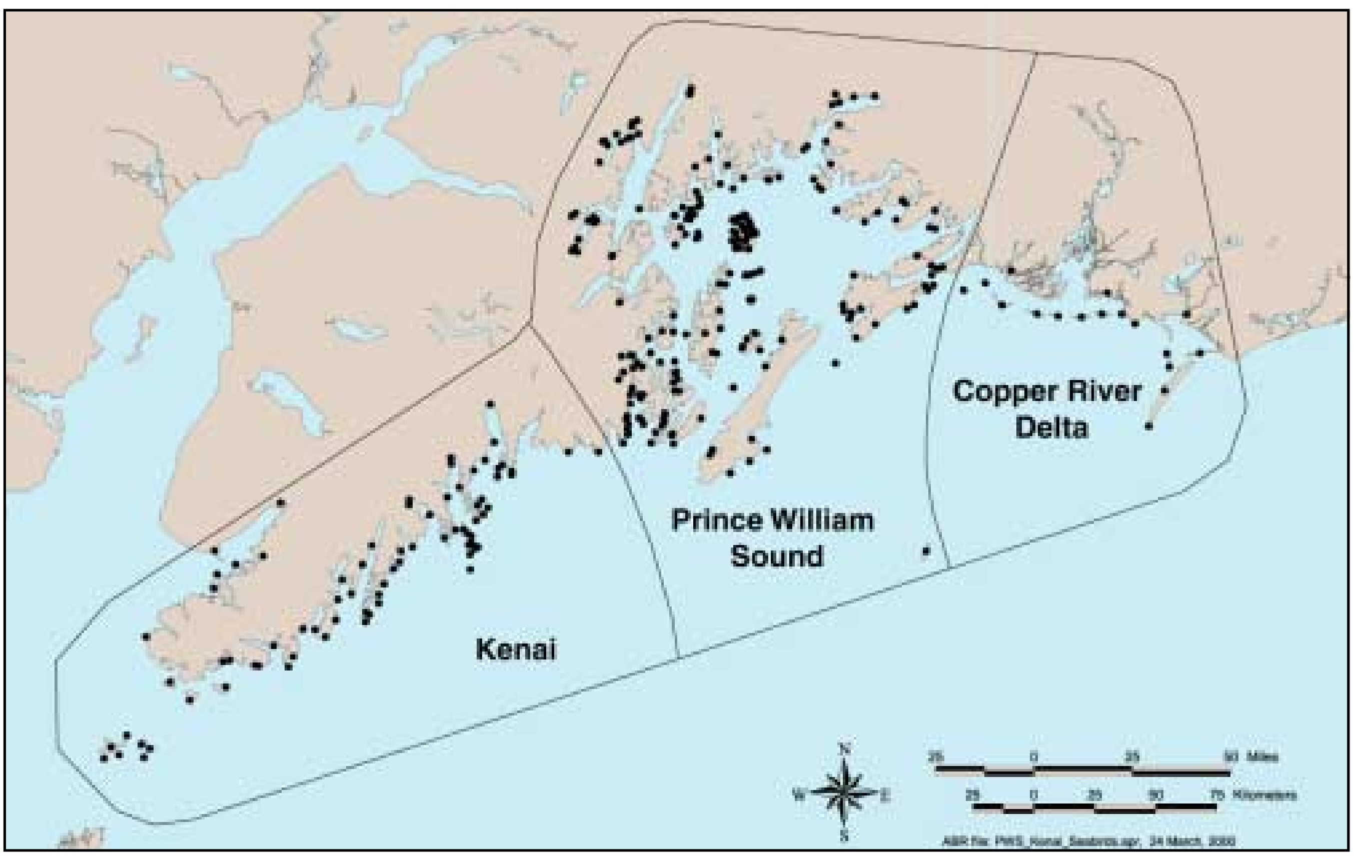


Figure 3.2-3*. Locations of seabird colonies in the North Gulf Coast/Prince William Sound region (Source: see Table 3.2-7).*

Table 3.2-7. *Seabird breeding populations in the vicinity of tanker routes in the North Gulf of Alaska Coast/Prince William Sound region. Colony locations are plotted on Figure 3.2-3. See Table 3.2-5 for scientific names of species.*

Species	Kenai Peninsula (a)	Prince William Sound Area (b)	Prince William Sound Area (c)	Copper River Delta (d)	Total (e)
Northern Fulmar	136	1,584 ± 948	–	–	1,720
Fork-tailed Storm-Petrel	150,000	15,822 ± 11,451	2,060	–	165,822
Leach's Storm-Petrel	Present	400	–	–	400+
Double-crested Cormorant	114	74 ± 110	74	266	454
Red-faced Cormorant	988	11 ± 18	14	166	1,168
Pelagic Cormorant	2,546	263 ± 225	7,880	220	10,646
Unidentified cormorant	765	–	–	–	765
Parasitic Jaeger	–	Present	–	Present	Present
Bonaparte's Gull	–	1,620 ± 1,343	–	Present	1,620+
Mew Gull	206	14,164 ± 5,526	87	820	15,190
Herring Gull	–	–	–	Present	Present
Glaucous-winged Gull	18,058	25,095 ± 6,547	7,630	16,390	59,543
Black-legged Kittiwake	81,324	48,227 ± 18,882	173,256	27,676	282,256
Caspian Tern	–	–	–	Present	Present
Arctic Tern	338	4,852 ± 1,656	1,748	600	5,790
Aleutian Tern	105	320 ± 549	–	5,328	5,753
Common Murre	80,044	2,751 ± 2,151	11,580	11,320	102,944
Thick-billed Murre	328	53 ± 93	100	–	428
Unidentified murre	2,394	–	–	–	2,394
Pigeon Guillemot	802	2,982 ± 905	2,430	–	3,784
Marbled Murrelet	Present	63,455 ± 16,043	–	Present	63,455+
Kittlitz's Murrelet	Present	1,280 ± 1,364	–	Present?	1,280+
Ancient Murrelet	702	188 ± 185	–	–	890
Cassin's Auklet	Present	Present	–	–	Present
Parakeet Auklet	809	809 ± 419	938	–	1,747
Rhinoceros Auklet	2,707	5,000	–	–	7,707
Horned Puffin	10,809	499 ± 391	436	8	11,316
Tufted Puffin	164,999	5,049 ± 2,126	20,951	8,510	194,460
Total	518,174+	352,054+	229,184+	71,304+	941,532+

(a) Data from *Alaska Seabird Colony Catalog* (FWS, 1999b).
(b) Data from Agler and Kendall (1997) for Prince William Sound.
(c) Data from *Alaska Seabird Colony Catalog* (FWS, 1999c) for Prince William Sound and Middleton Island.
(d) Data from *Alaska Seabird Colony Catalog* (FWS, 1999d).
(e) Total includes larger of two numbers presented for Prince William Sound.

Bunting, and Yellow Wagtail (Johnson and Herter, 1989; Johnson et al., 2000). The number of breeding species increases in the foothills, where more shrub habitats are available (Johnson and Herter, 1989). The most numerous passerines in the foothills are Savannah Sparrow, Yellow Wagtail, American Tree Sparrow, Lapland Longspur, and White-crowned Sparrow (Gabrielson and Lincoln, 1959). The Bluethroat, an Asian migrant, is a rare breeder in the shrub-lined drainages near Pump Station 2, where the bird attracts human visitors on wildlife tours traveling the Dalton Highway. Many of the passerines found in the foothills also occur in the Brooks Range, but as a whole, passerines are less numerous there. Another palearctic migrant, the Northern Wheatear, nests in alpine areas along the TAPS ROW and winters in Africa (Johnson and Herter, 1989).

Breeding bird communities of primarily passerines have been studied in the vicinity of TAPS near Fairbanks (Spindler, 1976), Fort Wainwright and Fort Greely (Benson, 1999; Anderson et al., 2000), Gulkana (Cooper et al., 1988), and at various breeding-bird survey routes on the Copper Plateau (USGS, 1999). In general, the numbers of

Table 3.2-8. *Priority bird species and their status by biogeographic regions occurring along the TAPS ROW (Boreal Partners in Flight Working Group, 1999). Biogeographic regions are those of Kessel and Gibson (1978). Scientific names for species are in Table 3.2-5.*

	Biogeographic Region (a) and Status (b)		
Priority Species	**Northern**	**Central**	**Southcoastal**
Gyrfalcon	R	R	—
White-tailed Ptarmigan	—	R	—
Sharp-tailed Grouse	—	R	—
Snowy Owl	B	—	—
Great Gray Owl	—	R	—
Boreal Owl	—	R	—
Rufous Hummingbird	—	—	B
Red-breasted Sapsucker	—	—	R
Black-backed Woodpecker	—	R	B
Olive-sided Flycatcher	—	B	—
Hammond's Flycatcher	—	B	—
Pacific-slope Flycatcher	—	—	—
Northern Shrike	—	B	—
Northwestern Crow	—	—	R
Chestnut-backed Chickadee	—	—	R
American Dipper	—	R	—
Gray-cheeked Thrush	B	B	B
Varied Thrush	—	B	B
Bohemian Waxwing	—	R	—
Townsend's Warbler	—	B	B
Blackpoll Warbler	—	B	B
Golden-crowned Sparrow	—	B	B
Smith's Longspur	B	B	—
Rusty Blackbird	—	B	—
White-winged Crossbill	—	R	—
Hoary Redpoll	B	—	—

(a) Corresponding major vegetational zones for the biogeographic regions: Northern = Arctic Coastal Plain, Arctic Foothills, Brooks Range; Central = Interior Forests, Alaska Range, Copper Plateau; Southcoastal = Pacific Coastal Mountains, Western Hemlock-Sitka Spruce Forests
(b) Status is R = resident breeding species or B = migrant breeding species; dash indicates it does not occur regularly in that region.

resident and migrant breeding birds increase in the more southern sections of the TAPS ROW, with upwards of 20 species breeding in some of the Interior forest habitats (Spindler, 1976; Benson, 1999; Anderson et al., 2000). White-crowned Sparrows and Dark-eyed Juncos are ubiquitous, occurring commonly in all ecoregions south of the Brooks Range. Alder Flycatcher, Swainson's Thrush, and American Robin are similarly widespread but less numerous in the Alaska Range. Other characteristic passerines by ecoregion are as follows:

- **Interior Forests:** Orange-crowned, Yellow-rumped, and Wilson's warblers.
- **Alaska Range:** American Tree Sparrow; Cliff Swallow; Wilson's and Arctic warblers.
- **Copper Plateau:** Cliff Swallow; Yellow-rumped and Wilson's warblers.
- **Pacific Coastal Mountains:** Orange-crowed, Yellow-rumped, and Wilson's warblers; Hermit Thrush.

At least 111 species of other bird species — involving a widely ranging group that includes both non-passerine groups and all passerine species — have been recorded in the North Gulf of Alaska Coast/Prince William Sound region (Gabrielson and Lincoln, 1959; Isleib and Kessel, 1973). Of these species, 63 may breed somewhere in the region, and at least 4 are state species of special concern: Olive-sided Flycatcher, Gray-cheeked Thrush, and Townsend's and Blackpoll warblers. All four of these species are found in terrestrial and not marine habitats.

Other Birds

Other birds found along the TAPS ROW include grouse and ptarmigan, Rufous Hummingbird, Belted Kingfisher, and six species of woodpeckers. Few quantitative studies have been conducted on these species, other than grouse and ptarmigan, which are game species.

Three species of ptarmigan (Rock, Willow, and White-tailed) are residents along TAPS. The first two species are common from the Arctic Coastal Plain to the Chugach Mountains, whereas White-tailed Ptarmigan are restricted primarily to the Thompson Pass area of the Chugach Mountains (Gabrielson and Lincoln, 1959; Kessel and Gibson, 1978). Although most Rock and Willow ptarmigan make a short migration to the Arctic Foothills and the Brooks Range in winter (Irving et al., 1967; Johnson and Herter, 1989), some remain year-round on the coastal plain. In spring as they again move northward to the coastal plain, these two species commonly use open tundra in the dust shadows of the Dalton Highway. Forest-dwelling grouse (Ruffed and Spruce) occur along the ROW between the Brooks Range and the Chugach Mountains, and Sharp-tailed Grouse occur in more open, grassy habitats between Fairbanks and Glennallen (Gabrielson and Lincoln, 1959).

3.2.5 Terrestrial Mammals

By W. Ballard, H. Whitlaw, B. Lawhead, B. Burgess, S. Murphy, and M. Cronin

This section describes the distribution, numbers, and other characteristics of terrestrial mammals in the vicinity of the TAPS ROW, on the Alaska North Slope, and in the Prince William Sound region (Table 3.2-9). It is important to note that the *population* or the *herd* (for caribou or bison) is the unit of management for wildlife in Alaska. However, populations are often difficult to define due to emigration

Table 3.2-9. *Terrestrial mammal species, game management unit or herd, and recent population/herd status near TAPS ROW.*

Common Name	Scientific Name	Game Management Unit (GMU) or Herd	Recent Population/Herd Status
Moose	*Alces alces*	GMU 6	Low density; stable since 1960
		GMU 13	Currently at high density and stable; below management objectives
		GMU 20A	Currently stable or increasing slightly; population increased between 1976 and 1994
		GMU 20B	Currently increasing; increase began in 1980
		GMU 20D	Currently stable or increasing slightly; increase began in the early 1980s; low density; below management objectives
		GMU 24	Currently stable; low density
		GMU 26B	Currently declining and at low density; increased between 1950 and 1980; stable during late 1980s
Caribou	*Rangifer tarandus*	Nelchina Herd	Currently declining or stable at low numbers; increased between 1977 and 1996
		Delta Herd	Currently stable; declined between 1969 and 1975; increased between 1976 and 1989; declined between 1990 and 1993
		Ray Mountains Herd	Population trend unknown
		White Mountains Herd	Recognized as a distinct herd in early 1980s; currently stable or slowly increasing
		Central Arctic Herd	Currently stable; increased between 1975 and 1992
		Western Arctic Herd	Currently decreasing slightly; increased from 1976 to 1996
Muskoxen	*Ovibos moschatus*	GMUs 26B and 26C	Currently stable or increasing slightly; increase began with reintroduction in 1969
Bison	*Bison bison bison*	Delta Herd	Currently stable; stable since the mid 1980s
		Copper River Herd	Currently stable or increasing slightly
Dall Sheep	*Ovis dalli*	GMUs 11 and 13D (Chugach Mountains)	Current population trend is unknown; increased between late 1980s and the mid 1990s
		GMUs 13B, 20A and 20D (Delta Controlled Use Area)	Currently stable or declining slightly
		GMUs 24 and 26B (Brooks Range)	Currently declining slightly or stable; increased between 1970s and mid 1980s
Deer	*Odocoileus hemionus sitkensis*	GMU 6	Currently stable
Mountain goat	*Oreamnos americanus*	GMU 6	Currently stable; stable since 1990
		GMU 11	Population trend unknown
		GMU 13D	Currently stable or declining slightly
Brown bear	*Ursus arctos*	GMU 6	Stable or declining slightly since 1989
(grizzly bear)		GMU 13	Declining since 1980 due to ADF&G bear reduction efforts
		GMU 20	Currently stable or declining; decline initiated in 1981 due to ADF&G bear-reduction efforts
		GMU 24	Currently stable or increasing slightly
		GMU 26B	Currently stable or increasing slightly
Black bear	*Ursus americanus*	GMU 6	Currently stable
		GMU 13	Currently stable or increasing slightly
		GMU 20	Population trend unknown
Wolf	*Canis lupus*	GMU 6	Population trend unknown
		GMU 13	Currently stable or increasing slightly
		GMU 20	Currently stable
		GMU 24	Currently stable or increasing slightly
		GMU 26B	Currently stable

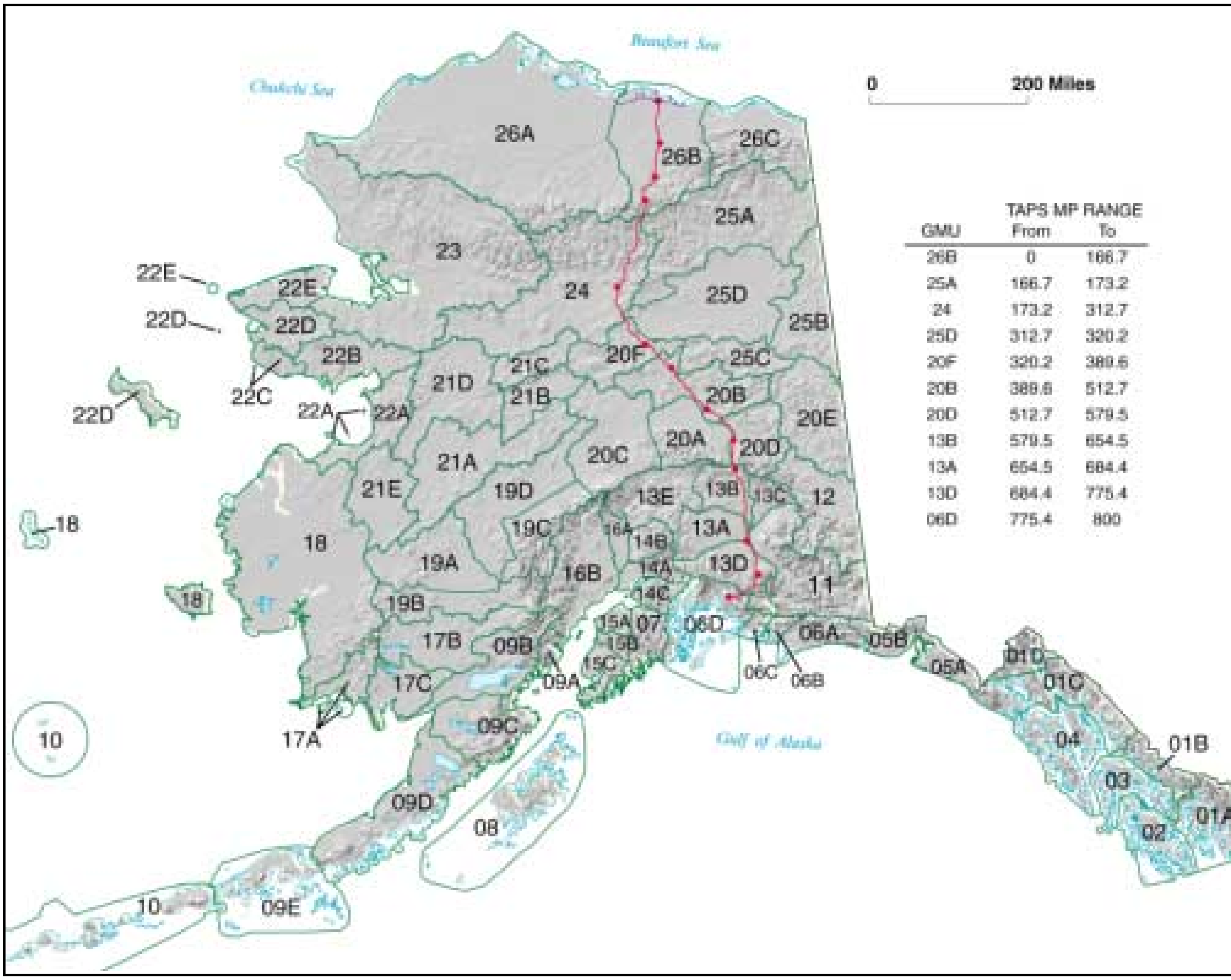


Figure 3.2-4. *State of Alaska game management unit map.*

and immigration among populations, and variation in range use and distribution. As a result, the ADF&G Division of Wildlife Conservation delineated biologically relevant game management units (GMUs) (Figure 3.2-4). ADF&G regularly conducts research projects on wildlife populations in GMUs to better understand processes and patterns in Alaskan ecosystems. Besides these research projects, ADF&G management staff produces annual survey-inventory reports designed to track the status of wildlife populations in each GMU (Miller, 1997). These reports provided much of the information presented in this section. The status of each terrestrial wildlife species in the GMUs through which the TAPS ROW passes is described. Information on these species specific to the ROW is sparse and sometimes anecdotal. Available information is integrated in Sections 4.3.2.5 and 4.4.2.5.

Alyeska Security helicopter flights provide records of terrestrial mammal observations along the ROW. However, flight procedures and data documentation have not been consistent from year to year. Therefore, although the data on the tables on the following pages cannot be used to compare populations from year to year, they do indicate that mammals regularly use the TAPS ROW. Between January 1991 and August 1996, observations of wildlife in the ROW were recorded between MP 150 and 800. Wildlife observations for MP 0 through 150 are not available. Flights were typically conducted in a helicopter at 90 knots and an altitude of 200 feet (ft) above ground level. Observations were made within the field of view of the observers while traveling along the ROW. More frequent flights were made during the first four years than for 1995 and 1996. The program was terminated on July 31, 1996.

During the flights, an onboard observer recorded wildlife sightings by species, milepost, and activity. In some cases, moose and caribou calves and bear cubs were identified, but generally only the species and numbers of ani-

mals, and not sex or age, were recorded. The five and one-half years of continuous data demonstrate that various birds and mammals regularly use the TAPS ROW. However, the data should be considered as indicative of general use of the ROW and not a formal census or an experiment. Identification of sex and age (e.g., calf moose or caribou or bear cubs) was opportunistic, and the level of effort per length of the ROW was not standardized. Thus, these data cannot be used for quantitative comparisons with other areas, but they provide a general assessment of wildlife use of the TAPS ROW. The raw data are recorded on field data sheets and a computer file, and are available from APSC.

Table 3.2-10 lists the large mammals observed by year during the Alyeska Security flights. Tables 3.2-11 through 3.2-16 tabulate the observations of six species by calendar month. The relatively low numbers for all species in 1995 and 1996 reflect the reduced frequency of flights and observer presence in those years. Other animals regularly sighted include snowshoe hares, squirrels, porcupines, horses, passerine birds, ptarmigan, grouse, geese, Sandhill Cranes and hawks.

Moose were the most common and consistently found mammal along TAPS (Table 3.2-11), although the numbers of animals vary considerably among years. Many moose cows with calves, including twin calves, were observed. The data suggest that moose continue to use traditional wintering and calving grounds. Note the sudden increase of moose numbers in May, coinciding with the calving period, following a declining trend for January through April. Of 3,113 moose observed in January and February, 76 percent were within 5 miles of traditional winter habitat, as identified in APSC (1993). Likewise, of 1,271 moose observed in May, 53 percent were found in 22 percent of the ROW within 10 miles of traditional calving grounds, as identified in the same source. Activities most often recorded for moose were feeding and resting (80 percent combined), as the helicopter flew overhead. These animals seem to have habituated to regular helicopter activity.

Other observations by Alyeska personnel indicate habituation of moose to TAPS. For example, in March 1978, Holland (1978) counted moose tracks along a section of TAPS between Shaw Creek and Rosa Ridge. Holland (1978) noted that “There were several signs of moose walking directly under the pipe for spans of 60 ft. Vegetation partially exposed directly under the pipe, appeared to serve as an attractive (sic) to the moose…Signs of grazing were evident in many locations as indicated by areas of hoofed out snow... One can only assume that the elevated pipe is presenting little to no determent (sic) to moose movement. In fact, it appears that the moose are utilizing the workpad more extensively this year than in past years and this is probably a result of less and less Alyeska utilization of the workpad.”

These observations suggest the elevated pipeline intercepts snow or forms a windbreak resulting in less snow and more exposed vegetation directly under the pipe in some areas. This may attract moose in winter. In addition, these observations in 1978 suggest that as construction activity declined from the early 1970s, moose use of the ROW increased. Moose also use buried sections of TAPS in the spring, because snow melts earlier there, making vegetation available (Trudgen, 1999, pers. comm.).

Alyeska Security flight data indicate that caribou were also common along the ROW throughout the year (Table 3.2-12). Observations of caribou cows with calves were common. The data indicate that caribou continue to use a traditional migration route while transecting the TAPS and Richardson Highway in GMU 13. Of 1,206 caribou observed in May, 89 percent were found in 12 percent of the ROW within 10 miles of the traditional migration route of the Nelchina Caribou Herd, as indicated in APSC (1993). Likewise, of 2,040 caribou observed in October, 83 percent were in the same 12 percent of the ROW within 10 miles of the traditional migration route. Nelchina caribou have been observed moving under elevated TAPS pipe (Trudgen, 1999, pers. comm.). During the first months of 1993, large groups of caribou, presumably of the Fortymile and Delta herds, congregated around MP 450 and 600, respectively (Table 3.2-12). Sixty-five percent of the caribou recorded during helicopter overflights were feeding and resting.

Bison are common just south of Delta Junction where the TAPS traverses the Delta River and Richardson Highway. Of 1,618 total bison observed, 90 percent were found in 2 percent of the ROW within a traditional travel and use area, as indicated in APSC (1993). Movements were recorded primarily in spring and late summer (Table 3.2-13). In 1992 and 1994, a few Dall sheep were observed using the ROW at the northern limit of the Security surveillance flights in the Atigun Pass area.

Predators, including black bears, grizzly bears, and wolves, are also frequently seen in the TAPS ROW (Table 3.2-10). Wolverines, lynx, fox, and coyote were observed less frequently. Bear sows with cubs were commonly observed. This includes several observations of both black and grizzly bears with twin or triplet cubs. The observed presence of bears and wolves along the ROW was tabulated by calendar month in Tables 3.2-14 through 3.2-16. Active feeding on moose and other unidentified prey by wolves, coyotes, foxes, lynx, hawks, and bears was recorded. Whether this was from active predation or scavenging is not

Table 3.2-10. *Species observations within the TAPS ROW as recorded during Alyeska Security flight surveillance (effort not consistent throughout study with a marked decrease in 1995 and 1996).*

	1991	1992	1993	1994	1995	1996 (a)
Bison	361	273	444	270	109	161
Bear (species unknown)	6	21	3	3	0	0
Black bear	97	84	77	47	21	4
Caribou	785	3,191	5,433	626	458	444
Coyote	39	32	22	9	1	2
Dall sheep	0	21	0	12	0	0
Fox	22	16	20	5	8	0
Grizzly bear	78	38	52	17	27	0
Lynx	1	2	3	4	1	1
Moose	2,628	2,886	2,563	2,050	726	248
Wolf	68	142	129	84	12	4
Wolverine	0	0	2	0	0	0
Total	4,085	6,706	8,748	3,127	1,363	864

a. Observer program terminated July 31, 1996.

Table 3.2-11. *Moose observations along the TAPS ROW by month and year as recorded during Alyeska Security flight surveillance (effort not consistent throughout study with a marked decrease in 1995 and 1996).*

	1991	1992	1993	1994	1995	1996 (a)	Total
January	423	469	292	267	105	32	1,588 (b)
February	397	483	230	246	104	65	1,525 (b)
March	284	330	198	172	81	56	1,121
April	245	134	160	90	71	29	729
May	271	329	285	252	94	40	1,271 (c)
June	110	195	72	69	23	13	482
July	81	132	126	90	47	13	489
August	42	84	112	85	38	-	361
September	139	126	261	100	62	-	688
October	176	118	206	130	56	-	686
November	154	176	411	242	16	-	999
December	306	310	210	307	29	-	1,162
Total	2,628	2,886	2,563	2,050	726	248	11,101

a. Observer program terminated July 31, 1996.
b. Strong presence of moose around traditional wintering areas.
c. Strong presence of moose around traditional calving areas.

Table 3.2-12. *Caribou observations along the TAPS ROW by month and year as recorded during Alyeska Security flight surveillance (effort not consistent throughout study with a marked decrease in 1995 and 1996).*

	1991	1992	1993 (a)	1994	1995	1996 (b)	Total
January	0	3	894	20	51	10	
February	0	68	1,165	45	0	0	1,278
March	21	163	1,591	36	0	5	1,816
April	40	72	616	118	9	21	876
May	548	157	226	145	111	19	1,206 (c)
June	56	101	3	15	0	2	177
July	6	5	109	2	14	387	523
August	40	93	81	10	15	-	239
September	1	323	236	48	0	-	608
October	12	1,363	378	147	140	-	2,040 (c)
November	27	453	68	40	1	-	589
December	34	390	66	0	117	-	607
Total	785	3,191	5,433	626	458	444	10,937

a. Large groups congregating around MP 450 and 600 during January, February, and March 1993.
b. Observer program terminated July 31, 1996.
c. Strong presence of caribou around a traditional migration route during May and October.

Table 3.2-13. *Bison observations along the TAPS ROW by month and year as recorded during Alyeska Security flight surveillance (effort not consistent throughout study with a marked decrease in 1995 and 1996).*

	1991	1992	1993	1994	1995	1996 (a)	Total
January	0	0	2	0	0	0	2
February	83	0	64	0	0	0	147
March	85	12	198	28	1	4	328 (b)
April	55	31	77	148	16	33	360 (b)
May	75	34	0	0	0	0	
June	5	13	0	2	0	0	
July	58	172	53	0	92	124	499 (b)
August	0	1	50	92	0	-	143 (b)
September	0	0	0	0	0	-	0
October	0	10	0	0	0	-	10
November	0	0	0	0	0	-	0
December	0	0	0	0	0	-	0
Total	361	273	444	270	109	161	1,618

a. Observer program terminated July 31, 1996.
b. Strong presence of bison within a traditional travel route in March, April, July and August.

Table 3.2-14. *Wolf observations along the TAPS ROW by month and year as recorded during Alyeska Security flight surveillance (effort not consistent throughout study with a marked decrease in 1995 and 1996).*

	1991	1992	1993	1994	1995	1996 (a)	Total
January	13	2	0	15	0	4	34
February	4	9	16	10	1	0	40
March	9	68 (b)	16	3	6	0	102
April	10	13	2	6	2	0	33
May	2	4	6	3	0	0	15
June	1	1	2	5	1	0	10
July	2	3	4	4	0	0	13
August	1	3	5	2	0	-	11
September	5	0	5	0	1	-	11
October	15	16	42	6	0	-	79
November	4	5	23	21	0	-	53
December	2	18	8	9	1	-	38
Total	68	142	129	84	12	4	439

a. Observer program terminated July 31, 1996.
b. Single pack of ten wolves recorded once on 7 March and twice on 8 March travelling north from MP 432 until seen stationary at MP 422.

Table 3.2-15. *Black bear observations along the TAPS ROW by month and year as recorded during Alyeska Security flight surveillance (effort not consistent throughout study with a marked decrease in 1995 and 1996).*

	1991	1992	1993	1994	1995	1996 (a)	Total
January	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0
April	3	0	4	0	3	0	10
May	41	17	42	24	4	1	129 (b)
June	10	14	6	9	3	2	44
July	22	16	7	6	3	1	55
August	20	20	12	8	5	-	65
September	0	13	3	0	3	-	19
October	1	4	3	0	0	-	8
November	0	0	0	0	0	-	0
December	0	0	0	0	0	-	0
Total	97	84	77	47	21	4	330

a. Observer program terminated July 31, 1996.
b. Spring emergents concentrated between MP 280-295, 340-403, and 720-790 amidst some traditional and some non-traditional use areas.

Table 3.2-16. *Brown (grizzly) bear observations along the TAPS ROW by month and year as recorded during Alyeska Security flight surveillance (effort not consistent throughout study with a marked decrease in 1995 and 1996).*

	1991	1992	1993	1994	1995	1996 (a)	Total
January	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0
April	2	0	0	0	1	0	3
May	54	10	34	3	12	0	113 (b)
June	10	7	4	4	5	0	30
July	5	2	10	2	5	0	24
August	0	9	0	0	2	-	11
September	1	8	1	7	2	-	19
October	6	2	3	1	0	-	12
November	0	0	0	0	0	-	0
December	0	0	0	0	0	-	0
Total	78	38	52	17	27	0	212

a. Observer program terminated July 31, 1996.
b. Spring emergents concentrated between P/L MP 160-305 and 610-700 amidst some traditional and some non-traditional use areas.

known, but both are likely. Details on animals' activities are in the raw data set from Alyeska security flights.

The APSC wildlife observation program has documented that wildlife regularly use the TAPS ROW on a year-round basis. It is likely that animals used habitats within the ROW, in addition to passing through the area.

3.2.5.1 Moose

Population History and Status

Moose are present in the vicinity of the TAPS ROW throughout its entire length. The following discussion is organized into three sections based on geography and state GMU boundaries: Southcentral (GMUs 6 and 13), Interior (GMUs 20 and 24), and Northern (GMU 26B) (Figure 3.2-5). In general, moose populations have fluctuated in response to various factors. Populations in most of the GMUs the ROW crosses are limited primarily by predation and weather. Hunting, accidental mortalities (e.g., vehicle collisions), and habitat quality also influence moose populations to various degrees.

J. Lukin

Photo 3.2-10. *Cow moose.*

Southcentral. In GMU 6 at the southern end of the TAPS ROW, moose are generally limited to the lower 40 km of the Lowe River valley, less than 8 km from the TAPS ROW (APSC, 1995a). This small population has not extended its range since at least 1960, and currently numbers about 60 animals (Hicks, 1996a).

Moose in GMU 13 have fluctuated in numbers since the early 1900s. The first major population increase in recent times occurred in the 1940s and 1950s, peaking in the early 1960s in response to frequent wildfires, low predator numbers due to extensive federal predator control, and relatively low harvest by humans (Ballard et al., 1987, 1991; Tobey, 1996a). Since the 1960s, moose declined to low levels around 1975 as a result of severe winters, predation, and fire suppression. They then increased to relatively high numbers around 1987 in response to predator control and mild winters, and declined again to stable levels around 1991 as a result of severe winters and increased predation (Ballard et al., 1991; Tobey, 1996a). Recent herd-census data in GMU 13 were 25 to 30 percent below management objectives (Hicks, 1998b), but at generally high density nonetheless (Testa, 1999). Moose populations in this area are limited by weather; predation by wolves, brown bears, and black bears; and range conditions primarily related to fire suppression (Ballard et al., 1987, 1991; Collins, 1999; Testa, 1999). An estimated 50 moose per year are killed in GMU 13 by collisions with motor vehicles (Sinnott, 1999, pers. comm.).

Interior. In Interior Alaska, moose populations have followed similar trends to those in Southcentral. All GMUs in this area (20A, 20B and 20D) had relatively low numbers of moose in the 1940s and early 1950s. Populations increased in the late 1950s and early 1960s in response to federal predator-control programs, and in some areas to extensive wildfires (GMU 20B) and/or mild winters (20D) (Gasaway et al., 1983; Boertje et al., 1996; DuBois, 1996a; Dale, 1996b).

Moose in GMU 20A reached high densities estimated at

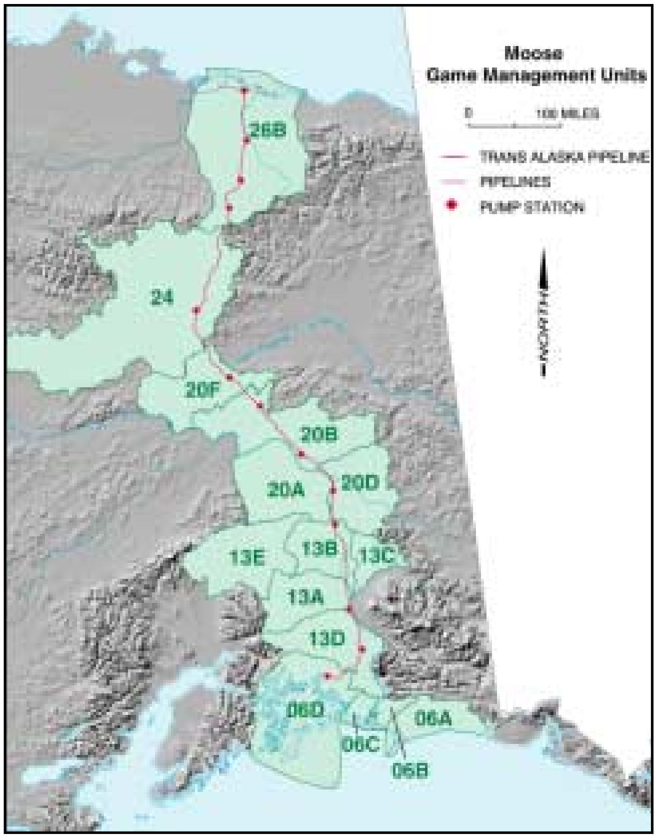


Figure 3.2-5. Game management unit map for moose along TAPS.

1.5 to 2.0/km^2 in the mid-1960s (Boertje et al., 1996). A rapid population decline about 1970 followed this peak, probably in response to a series of severe winters, high harvests by humans, wolf predation, and habitat overutilization (McNay, 1989). Moose were at their lowest numbers by the mid-1970s, but subsequently increased in response to a wolf reduction program during 1976-1981 (Gasaway et al., 1983). Between 1976 and 1994, a series of censuses and population estimates showed an increase in moose numbers: 3,511 in 1978, 11,072 in 1992, and 13,300 in 1994 (McNay, 1993; Hicks, 1995a). In 1997, moose numbers in GMU 20 were high at approximately 1.3/km^2 (Boertje et al., 1999). The population in GMU 20A is currently stable or increasing slightly (Dale, 1996a). Predation limits this population (Boertje et al., 1996), although harvest by humans, and forage and nutrition may also play a role in certain years (Boertje et al., 1999).

After the predator-control-related increase in the 1950s, moose populations in GMU 20B declined between the late 1960s and late 1970s following a series of severe winters, increasing wolf numbers, and excessive harvest by humans (Gasaway et al., 1983; Dale, 1996b). From 1980 to the present, the population has increased due to wolf control (1980-86) and restrictive hunting regulations. In 1990, moose numbers in this unit were estimated at 9,800. Moose/vehicle and moose/train collisions are important sources of mortality in GMU 20B; strategies to reduce these deaths include increased public awareness and education (Dale, 1996b). An estimated 50 moose per year are killed by motor vehicle collisions in GMU 20 (all subunits) (Sinnott, 1999, pers. comm.).

In the mid-1960s, moose numbers in GMU 20D were relatively high but declined through the early 1970s following severe winters (DuBois, 1996a). Population growth after the decline was slow and limited due to overharvest and to predation by wolves, brown bears, and black bears. In the early 1980s, moose numbers began to increase in response to wolf control and a series of mild winters. By 1995, the population in GMU 20D had not achieved management objectives (DuBois, 1996a).

Moose colonized GMU 24 during the 1930s-1950s and population growth was relatively slow. With the initiation of the federal predator-control program in the late 1950s, the population in this unit grew steadily, peaked in the mid-1970s, and declined shortly thereafter (Osborne, 1993). In 1989, the population estimate for the central area of GMU 24 was 3,000 to 4,000 moose (Osborne, 1989).

Northern. North of the Brooks Range, moose were scarce during the first half of the century (LeResche et al., 1974; Coady, 1980). Numbers in GMU 26B eventually increased from the mid-1950s to the early 1980s in response to predator-control programs and reductions in harvest by humans around 1950 (Stephenson, 1993). The population in GMU 26B was estimated to be stable in the mid-1980s at approximately 700 moose, with an estimated density of 0.50 moose/km^2 in 1986-87 (Nowlin, 1989; Stephenson, 1996a).

In 1990, the unit's population peaked at 0.58 moose/km^2, or approximately 1,000 to 1,200 animals, while a "significant" population decline was detected in 1992, perhaps due to poor habitat conditions (Stephenson, 1996a). The decline has continued with population estimates of 0.41 moose/km^2 in 1994-95 and 0.15/km^2 in 1995-96 (Stephenson, 1996a). Stephenson (1996a, p. 475) reported, "Population surveys in 1994 indicated numbers had declined by approximately 40 percent compared to surveys in the late 1980s. 1995 surveys indicated moose numbers declined by 60 percent since 1994, with an overall decline of 75 percent since the late 1980s. The reasons for the dramatic decline are not well understood, but available evidence indicates predation, insect harassment, and range deterioration may all be factors. Calf survival and recruitment have been extremely low in the last few years. Unless conditions improve, moose populations on the North Slope will probably persist at low density."

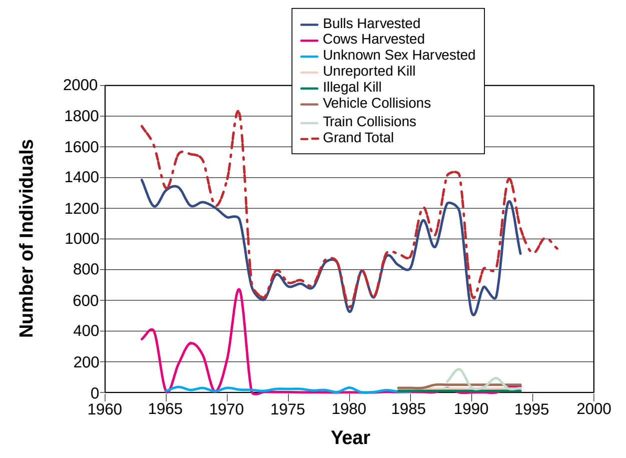
Stephenson (1993) indicated that habitat severely limited the number of moose that could be sustained and harvested in GMU 26B, and that although harvest by humans was not a factor in initiating or maintaining the early 1990s decline, it was the limiting factor that ADF&G could control. Roadkills have not been identified at this time as a significant limiting factor on moose in GMU 26B (Sinnott, 1999, pers. comm.).

Harvest by Humans and Population Management

Southcentral. The harvest and population-management goals for moose in the three Southcentral GMUs in the vicinity of TAPS are very different from each other. Near Valdez, where the population has remained small since the 1960s, the total harvest from 1960 through 1994 was approximately 34 moose (Hicks, 1996a). No moose were harvested during either 1994-95 or 1997-98 (Hicks, 1998a).

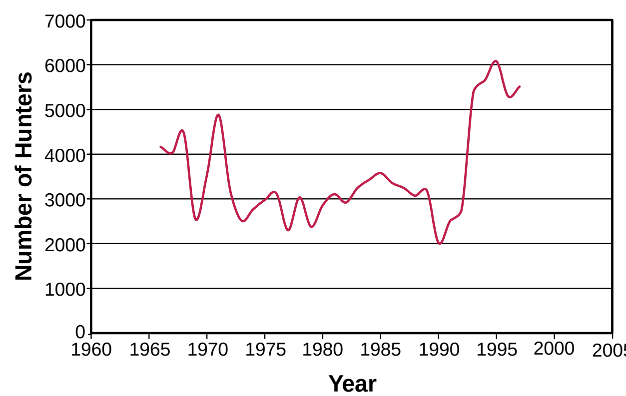
In contrast, GMU 13 has historically been one of the most important hunting areas in Alaska because of easy road access and proximity to human population centers (Ballard et al., 1991; Tobey, 1996a). As moose populations declined in this unit between the late 1960s and 1975, season lengths were reduced and regulations restricted to reduce total harvest (Figure 3.2-6) (Tobey, 1996a). An attempt to liberalize the restrictions (brief cow harvest and extended bull season) in response to the 1987 population peak was cancelled after one year because of severe winter weather. It is expected that harvest numbers will decline due to poor calf recruitment (Hicks, 1998b). Annual hunting pressure (i.e., hunter numbers) in GMU 13 has increased since the 1960s (Figure 3.2-7). Hunting pressure was most likely influenced by hunting restrictions in adjacent federally managed areas. In 1976, the ADF&G management goal for this area was to provide the greatest opportunity to participate in hunting moose. Current management objectives call for increasing the moose population to 20,000 to 30,000 adults and for annual harvests between 1,200 and 2,000 moose (Hicks, 1998b).

Interior. Moose harvests and regulations in Interior GMUs have been determined primarily in response to fluctuations in population numbers. In GMU 20A the highest average annual harvest of 617 moose was recorded during and slightly after a population peak in 1969-74 (McNay, 1989). Previously, the annual harvest averaged 311 in 1963-69. Between 1975 and 1978, in response to declining moose numbers, ADF&G restricted harvests to bulls only, resulting in a reduced average annual harvest of only 64 moose. These restrictions contributed to the subsequent population increase, and between 1983 and 1994, the average moose harvest rose to 365 annually (Dale, 1996a). In 1996-97, a cow season was initiated for the first time in almost 30 years (Hicks, 1997a). The 1978-95 management objectives for GMU 20A included direction to achieve and maintain a November population of between 10,000 and 12,000 adult moose by 1995, and to allow a cow harvest when the population was above 10,000 adults. By 1993, State objectives had been met.



Source: Tobey (1996a)

Figure 3.2-6. *Moose mortality chart for GMU 13.*



Source: Tobey (1996a)

Figure 3.2-7. *Moose hunter numbers for GMU 13.*

In GMU 20B, hunting pressure has traditionally been high because of its proximity to Fairbanks and extensive road systems (Dale, 1996b). Annual harvests have ranged from 299 to 438 bulls since 1984. Management objectives for GMU 20B include direction to manage for a population of 10,000 adult and yearling moose by 1993, and to sustain an annual harvest of 300 to 400 bulls until the population

objective is reached. Although the harvest objectives have been met since the mid-1980s, the population objective has not yet been achieved (Dale, 1996b).

GMU 20D is relatively remote, and hunting pressure is highest in the unit's more easily accessible portions such as Delta Junction and vicinity (DuBois, 1996a). Before the 1970s, the hunting season was long, and harvest of both bulls and cows was legal. The season was closed during 1971-73 because the population declined, and reopened in 1974 with restricted permit-only hunting regulations (McIlroy, 1974). The season has gradually been liberalized with increasing moose numbers in 1975-88 (DuBois, 1996a). From 1988 to present, changes have been made in the regulations to stabilize the harvest and moose numbers, and to improve the age/sex structure of the population. In the vicinity of the TAPS ROW, current management goals of 3,000 moose in the northern portion of the unit and 2,500 moose in the southwestern portion have not been met (DuBois, 1996a).

Moose hunting in GMUs 24 and 26B is influenced by the presence of the Dalton Highway. The highway was opened for commercial use (including hunting guides) in 1978 and opened to the general public in 1995 (Osborne, 1989; Stephenson, 1996a). The Dalton Highway Corridor Management Area (DHCMA) extends 8 km from each side of the Dalton Highway from the Yukon River north to the Prudhoe Bay Closed Area. The DHCMA is closed to sport hunting with rifles, but game may be taken with bow and arrow. No motorized vehicles, except aircraft, boats and licensed highway vehicles, may be used to transport game or hunters within the DHCMA. All hunters traveling on the Dalton Highway must stop at check stations operated by ADF&G within the DHCMA.

During the past 25 years, moose harvests have ranged from 44 to 134 annually in GMU 24; harvests did not exceed 100 until 1980 (Osborne, 1989). Biologists believe that harvests increased because more local hunters were aware of reporting requirements, reporting compliance increased, and improved access was available with the opening of the Dalton Highway to commercial uses. In response to population fluctuations, seasons in GMU 24 have been relatively liberal until recently, when antler restrictions to harvest older bulls were implemented (Osborne, 1989). Hunting pressure and numbers of moose harvested along the Dalton Highway have increased since its opening in 1978. In 1996, hunting pressure along the highway had stabilized at approximately 119 hunters and 54 moose harvested per year (Hicks, 1996b). The determination of actual harvests in GMU 24 has been a continual challenge for ADF&G biologists. In 1989, illegal and unreported harvests were hampering moose management, and the actual harvest was estimated to be twice the reported harvest. Management objectives for GMU 24 include direction to determine harvests and to increase the moose population north of Bettles, excluding Gates of the Arctic National Park, to 3,000 to 3,500 adults (Hicks, 1996b).

Northern. As the moose population in GMU 26B increased between the early 1970s and late 1980s, harvest season and restrictions remained liberal (1978-87 any-moose season) (Stephenson, 1993, 1996a). In the late 1970s, harvests increased with increased use of the Dalton Highway, but in 1980 following implementation of the DHCMA, hunting pressure shifted somewhat to GMU 26A (Melchoir, 1980). Between 1986 and 1995, annual moose harvests in GMU 26B ranged from 25 in 1990-91 to 52 in 1986-87 (Stephenson, 1996a). During 1987-94, regulations were changed to any-bull in response to reduced population growth and changes in age/sex composition. These regulation changes apparently reduced the harvest to a sustainable level in the DHCMA and in the remainder of GMU 26B (Stephenson, 1996a). However, antler restrictions were imposed in 1994 in response to the detected population decline, and the season in GMU 26B was closed in 1996 (James, 1996). The concentrated nature of moose distribution (primarily in riparian areas) and open habitat create the potential for excessive harvest in accessible areas (Stephenson, 1993).

Distribution and Habitat Use

Southcentral. In GMU 6 the small moose population is restricted to the lower 40 km of the Lowe River, just north of Valdez (APSC, 1995a). Moose winter and calving concentration areas occur in the vicinities of the Lowe and Tiekel river valleys adjacent to TAPS (APSC, 1993).

In GMU 13, the moose population has remained below habitat carrying capacity since the 1960s (Tobey, 1996a). Initial analyses presented by Ballard et al. (1985) indicated that spruce and willow vegetation types were preferred habitats in GMU 13. Ballard et al. (1991) determined that moose in Southcentral Alaska preferred lower-elevation sites during winter due to shallow snow depths. They also reported that moose were widely distributed over GMU 13 during summer. In all seasons, factors such as browse quantity, snow depth, elevation, thermal and escape cover, traditional use, slope, and aspect influenced where moose were located (Ballard et al., 1991).

Moose movement studies have been conducted in GMU 13 in relation to the TAPS ROW. Van Ballenberghe (1978) and Eide et al. (1986) both reported that migratory and nonmigratory moose populations came in contact with the

ROW. In addition, Ballard et al. (1991) identified three periods of movement (movement to rutting, and autumn and spring migrations) and seasonal and total home range sizes for moose in GMU 13 near TAPS.

Along a 110-km portion of the ROW between Glennallen and Paxson, Van Ballenberghe (1978) identified moose populations and population segments adjacent to portions of TAPS. He also identified and described the seasonal ranges of these populations, in addition to the extent, timing, and duration of migratory movements between the ranges. Migratory moose tagged in the eastern Alphabet Hills west of TAPS during autumn moved south or southeast during early winter to their winter range, and returned traveling north or northwest along the same routes during spring to their summer range in the Alphabet Hills (Van Ballenberghe, 1978). Moose tagged during autumn in the upper Gakona River east of TAPS migrated south or southeast during movements to winter range, and then north or northwest in spring to return to the traditionally used summer and autumn ranges of the river. These movements crossed TAPS and the adjacent Richardson Highway. Van Ballenberghe (1978) also documented nonmigratory moose in both populations.

Within the 110-km stretch of TAPS studied by Van Ballenberghe (1978), Eide et al. (1986) determined that the 60.4-km segment from the buried Glenn Highway crossing near Glennallen to the buried Richardson Highway crossing at Hogan Hill was the best moose habitat during the first year of pipeline operation (based on the number of moose crossings [n = 533] in this section).

Interior. Moose in the Interior GMUs generally have not been limited by habitat availability or quality, but rather by winter weather and predation (Gasaway et al., 1983; Boertje et al., 1996). Habitat (i.e., forage quality and availability) may have been overutilized in the 1960s when populations were high. Habitat assessments have not been regularly conducted in these units; however, a 1994 wildfire burned 22,400 acres in GMU 20D and probably improved habitat conditions in that area.

Moose are distributed throughout GMUs 20A, 20B, and 20D, although densities are dependent on season and available habitat. Gasaway et al. (1983) documented that the Interior moose population in the TAPS vicinity was composed of both migratory and nonmigratory segments. Moose encountered TAPS during seasonal migrations and during their regular daily movements. Migratory radio-collared adults typically moved in February-April to the Tanana Flats, where cows calved in May. They remained there during summer and returned during August-October to adjacent hills and mountains (Gasaway et al., 1983). Nonmigratory moose were common in the Tanana Flats and southwestern mountains (Gasaway et al., 1983).

During February and March 1982 and 1983, Sopuck and Vernam (1986a, b) investigated the distribution and movements of nonmigratory resident moose adjacent to the TAPS ROW between Pump Station 8 and Big Delta. Within a 15-km-wide corridor centered on the pipeline, over 75 percent of groups observed during aerial surveys and 75 percent of moose trails observed were within 500 m of a stream. Most (49 percent) of these trails were in shrub and burned/disturbed habitats (Sopuck and Vernam, 1986a, b). Observed trails near TAPS were thought to be used for travel between feeding in shrub habitats and riparian willow habitats and bedding sites in conifer and deciduous/mixed-wood areas.

Northern. Habitat use and distribution in GMUs 24 and 26B are more highly dependent on the availability of riparian areas than in the Southcentral and Interior regions. TAPS-specific distribution and habitat use are not available in these northern GMUs. Moose are generally found in many habitats in these areas, except for high, steep, rocky slopes (BLM, 1989). Lowland bogs are important components of summer range in providing habitat for calving concentration areas.

Conditions in the Koyukuk River lowlands in GMU 24 are good and provide abundant winter habitat. In addition, frequent lightning-caused fires result in good browse conditions. Browse availability has not limited moose populations in this area (Osborne, 1989, 1993).

Farther north, moose are relatively recent residents of the North Slope, and their habitat use and distribution are seasonal. During some years, moose range to the coast during the summer (Noel and Olsen, 1999a, b), yet during the winter are limited to inland riparian and shrub habitats (Coady, 1980). In other years, habitat use is limited primarily to riparian areas on a year-round basis (Mould, 1980).

3.2.5.2 Caribou

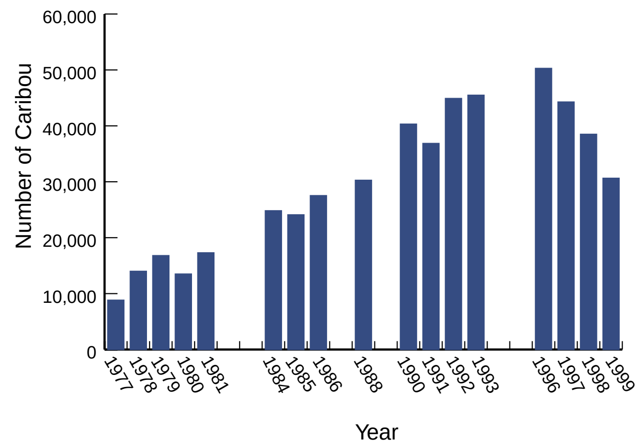
The Nelchina, Delta, Central Arctic, and Western Arctic caribou herds regularly encounter the TAPS ROW in portions of their summer or winter ranges, or during migrations to seasonal ranges. Several other herds also occur in the vicinity of TAPS and the Dalton Highway (i.e., the Ray Mountains and White Mountains herds), and may encounter the ROW. Although the Mentasta, Macomb, and Fortymile herds occur near TAPS, their ranges do not overlap the ROW and they are not addressed here. The traditional ranges of the Teshepuk Lake and Porcupine herds on the North Slope do not include the TAPS ROW, but they are

near the North Slope oil fields. See Figure 3.2-8 for a graphic representation of caribou herd distribution in the vicinity of the TAPS ROW. It is important to note that caribou herds are defined by calving grounds, and herds may not be totally independent. They may have overlapping fall or winter ranges and exchange animals (Cronin et al., 1997, 1998). Thus, the term *herd* is used rather than *population.*

Herd History and Status

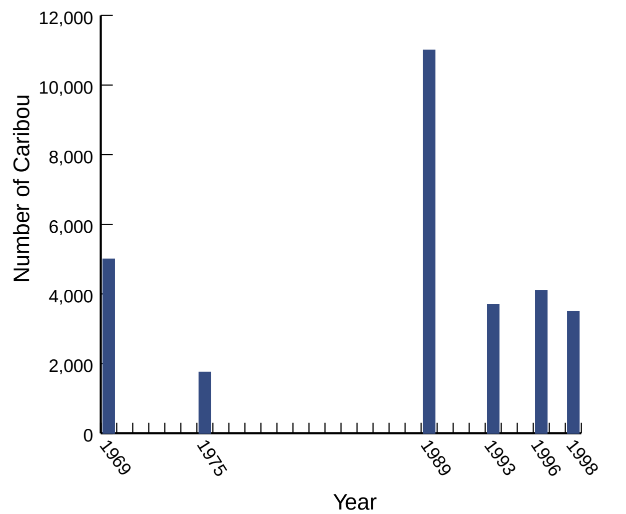
Nelchina Herd. During the late 1940s, the Nelchina Caribou Herd (NCH) was estimated at 5,000 to 15,000 animals (Lieb, 1989). The herd increased during the 1950s and 1960s, reached approximately 71,000 caribou by 1962 (Siniff and Skoog, 1964; Skoog, 1968), and then declined to possibly less than 10,000 by 1972 (Bos, 1975). The population decline was attributed to heavy hunter harvests (Skoog, 1968; Bos, 1975), in addition to wolf predation and unfavorable weather conditions (Van Ballenberghe, 1985; Bergerud and Ballard, 1988, 1989). From 1977 to 1983, the NCH again increased from 14,000 to 25,000 animals (Pitcher, 1984), and continued to increase to an estimated high of 50,280 by 1995-96 (McDonald, 1996) (Figure 3.2-9). By 1999, the herd had declined to about 31,365 adults (McDonald, 2000). During the past four years, the NCH has fluctuated in response to forage and weather conditions, predation, and increased harvests by humans. The current management objective for the NCH is to stabilize the herd to 35,000 to 40,000 caribou by harvesting the annual growth increment (McDonald, 2000).

Delta Herd. The Delta Caribou Herd (DCH) decreased from 5,000 animals in 1969 to approximately 1,500 to 2,000 in 1975, increased to nearly 11,000 in 1989, and then declined to about 3,700 caribou in 1993 (Davis et al., 1991; ADF&G unpubl. data cited in Eagan, 1995) (Figure 3.2-10). The initial herd increase was a result of wolf control between 1975 and 1982, combined with favorable weather conditions (Gasaway et al., 1983; Boertje et al., 1996). The decline in the early 1990s was thought to result from synergistic interactions of adverse weather and wolf predation. Range conditions apparently did not limit the growth of this high-density herd (Boertje et al., 1996). In 1996 the DCH had increased to about 4,100 (James, 1997a) in response to renewed wolf-control efforts by ADF&G (Boertje et al., 1996), and the herd stabilized at just over 3,500 based on the 1997-98 census results (Dale, 1997a; Valkenburg et al., 1999). Results of long-term research on the DCH and adjacent caribou herds suggest that adverse weather can cause decreased production of calves and increased vulnerability to predation over a wide range of caribou densities (Boertje et al., 1996; Valkenburg, 1997).



Sources: McDonald (1996, 2000), ADF&G (1999)

Figure 3.2-9. *Nechina Caribou Herd population estimates.*



Sources: Davis et al. (1991), Eagan (1995), James (1997a), Valkenburg et al. (1999)

Figure 3.2-10. *Delta Caribou Herd population estimates.*

Ray Mountains Herd. Robinson (1988) generated a herd estimate of 500 caribou for the Ray Mountains Herd (RMH) based on a survey of all known upland ranges. In 1994 the herd was estimated at 1,000 to 1,500 caribou (Osborne, 1995). In June 1995, counts from photographs of aggregated RMH caribou calculated herd size to be 1,737 caribou (Woolington, 1997a). The current herd trend is unknown, and Woolington (1997a) suggested that predation was probably the main limiting factor for RMH caribou. Hunting harvest currently does not appear to affect the growth of this herd (Hicks, 1997b).

White Mountains Herd. The White Mountains Herd

(WMH) was recognized as distinct from the Fortymile Herd in the early 1980s (Valkenburg, 1988; Boudreau, 1997). A BLM survey completed in 1992 estimated 832 caribou, while a 1996 ADF&G survey estimated 1,200 to 1,400, indicating that the herd is stable or slowly increasing (Boudreau, 1997). Factors limiting growth of the WMH have not been identified. The ADF&G herd management objectives are to allow continued growth and natural regulation of the WMH; these goals are being met (Nowlin, 1998a).


Warren Ballard

Photo 3.2-11. *CAH caribou in North Slope oil field.*

Central Arctic Herd. The Central Arctic Herd (CAH) was first identified as a discrete herd in the mid-1970s (Cameron and Whitten, 1979). The CAH grew from an estimated 5,000 caribou in 1975 to over 23,000 in 1992 (Cameron and Whitten, 1979, 1980; Whitten and Cameron, 1983b; Garner and Reynolds, 1986; Whitten, 1988; Fancy et al., 1992; Valkenburg, 1993; ADF&G files cited in Woolington, 1997b) (Figure 3.2-11). Rates of herd growth were highest between 1975 and 1985, and then declined between 1988 and 1992, although the CAH continued to grow during the entire period (1975-94 logistic growth rate was 0.249; Cronin, Ballard et al., 1998). In 1989, BLM (1989, p. 3-8) recognized the CAH as "currently one of the fastest growing herds in Alaska." As the CAH stabilized, the 1995 post-calving herd estimate of 18,100 (Woolington, 1997b) declined from the 1992 estimate of 23,000. Cameron (1993) suggested that the herd may have reached or exceeded habitat carrying capacity. In 1997, the CAH had increased to 19,700 caribou (Cronin et al., in press), and in 2000, the herd further increased to 27,128 (Lenart, 2000).

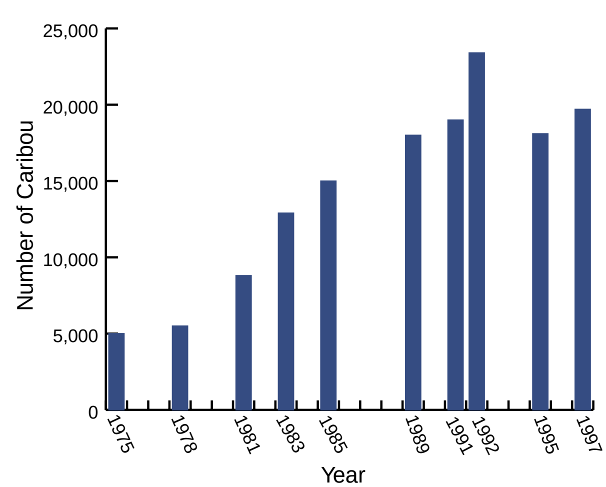
Factors limiting CAH growth have not been fully investigated, and the effects of wolf and brown bear predation on the CAH are unknown (Woolington, 1997b). Summer mortality of caribou, particularly calves, is probably low because the summer range has few wolves. Wolves may prey upon CAH caribou during winter while they are in the Brooks Range (Woolington, 1997b). Oil field development and relatively low harvests by humans do not appear to have limited the growth of the CAH (see Section 4.3.2.5).

Western Arctic Herd. The Western Arctic Herd (WAH) is the largest herd in the state and numbers about 463,000 caribou (Dau, 1997). In the early 1970s, the WAH was estimated at approximately 243,000 caribou, but this peak was followed by a dramatic decline to about 75,000 animals in the mid-1970s. From 1976 to 1993, the herd grew rapidly, with a logistic growth rate of 0.182 (Dau, 1997; Cronin, Ballard et al., 1998). More recently, Dau (1997) suggested that the rapid growth rate was slowing down. Sources of mortality for WAH caribou include predation, starvation, disease, accidents, and hunting (Ballard et al., 1997; Dau, 1997). The WAH and the CAH may overlap on winter ranges (Figure 3.2-8).

Teshekpuk Lake Herd (TLH). During 1978-82, the Teshekpuk Lake Herd (TLH) was estimated at approximately 3,000 to 4,000 animals (Carroll, 1995). The first comprehensive census in 1984 totaled 11,822 caribou, and subsequent counts increased steadily to 27,686 in 1993. The herd probably peaked in 1992, before high levels of mortality occurred in the winter of 1992-93 (Carroll, 1995). The 1995 count was 25,076 (Bente, 1997), 9 percent lower than in 1993.

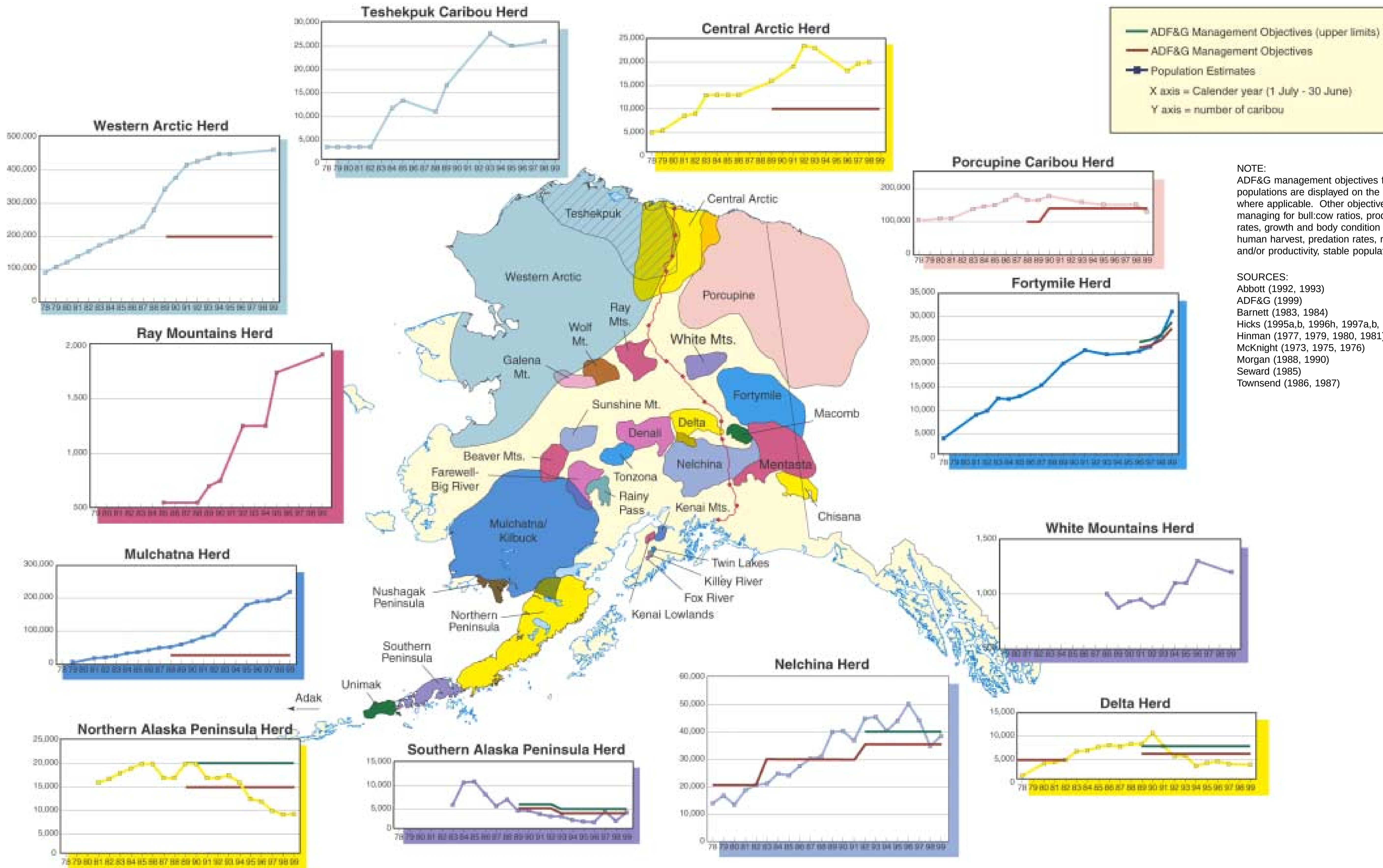
Harvest by Humans and Population Management

Nelchina Herd. The NCH has historically been one of the most important caribou herds in the state because of its proximity for hunting to large population centers and because the herd is easily accessible by road (Lieb, 1989). Between 1954 and 1993, hunters harvested a total of at least 131,000 caribou from the NCH (Tobey, 1995a). From 1955 to 1971, harvests were liberal, with bag limits varying between two and four caribou and seasons fluctuating between two and seven months. After the herd decline in 1971, the bag limit was reduced to one caribou, and seasons were reduced to 15 to 40 days. However, these restrictions continued to allow harvests exceeding ADF&G



Sources: Cronin, Ballard et al. (1998).

Figure 3.2-11. *Central Arctic Herd population estimates.*



NOTE:
ADF&G management objectives for selected populations are displayed on the charts where applicable. Other objectives include managing for bull:cow ratios, productivity rates, growth and body condition parameters, human harvest, predation rates, range size and/or productivity, stable populations, etc.

SOURCES:
Abbott (1992, 1993)
ADF&G (1999)
Barnett (1983, 1984)
Hicks (1995a,b, 1996h, 1997a,b, 1998, 1999)
Hinman (1977, 1979, 1980, 1981)
McKnight (1973, 1975, 1976)
Morgan (1988, 1990)
Seward (1985)
Townsend (1986, 1987)

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Figure 3.2-8.
ADF&G caribou herd map with population estimates.

harvest objectives during some years between 1972 and 1976. Since 1977, permit-only hunting has restricted harvesting of NCH caribou. Between 1984-85 and 1996-97, the annual caribou harvest from the NCH has varied from 989 to 5,279 (Tobey, 1995a; McDonald, 1997) (Figure 3.2-12). During this time, ADF&G has used hunting as a tool to manage NCH numbers.

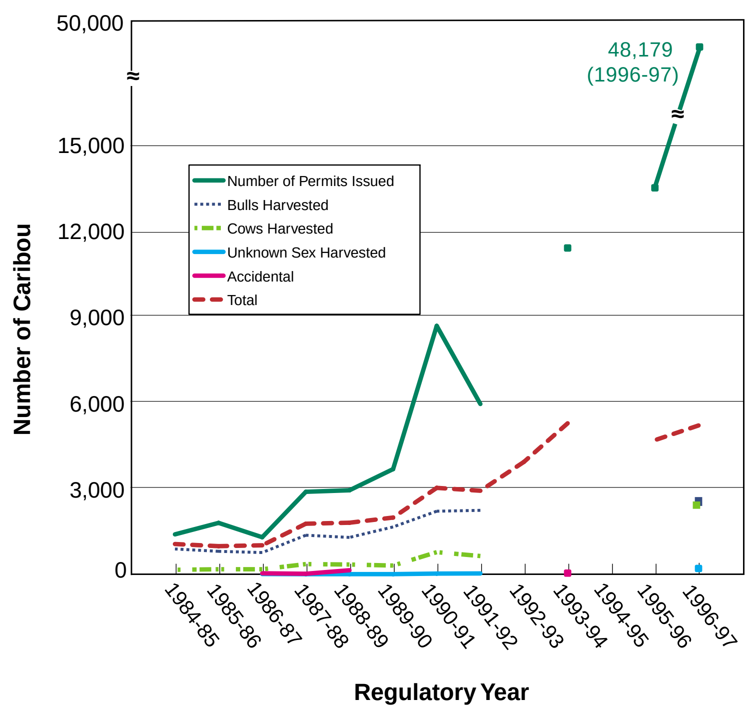
Delta Herd. DCH harvests ranged from 104 to 1,302 caribou between 1980 and 1991 (Boertje et al., 1996). The season was closed in 1992 in response to reduced herd numbers (Eagan, 1995). In 1996 a limited drawing of 75 permits was approved, and under this system, harvests have ranged between 25 and 35 caribou (Nowlin, 1998a).

Ray Mountains Herd. Osborne (1995) indicated that the RMH was lightly hunted because few people knew about the herd and it was largely inaccessible during the hunting season. Until 1984-85, RMH caribou were hunted under the same regulations governing the WAH. After that date, the season and bag limits were changed in an effort to prevent overharvest near the Dalton Highway (Woolington, 1997a). Harvest from the RMH is low, averaging fewer than 10 caribou/year over the last 10 years (Woolington, 1997a; Nowlin, 1998a). In 1989, BLM (1989) indicated that most of the reported harvest of RMH caribou occurred along the Dalton Highway.

White Mountains Herd. WMH harvests are below sustainable yield levels and have ranged from 6 to 21 since 1985 (James, 1997a; Boudreau, 1997; Nowlin, 1998a). Boudreau (1997) suggested that remoteness and inaccessibility were the major contributors to the low harvest. Increasing hunting opportunities and improving the likelihood that hunters will participate in this hunt are ADF&G management objectives for the WMH (Boudreau, 1997). Between 1987 and 1996, hunting was restricted to drawing permits, but opportunities for winter caribou hunting increased in 1997 with the conversion to registration permit hunts (Nowlin, 1998a). The number of hunters has increased since 1985 (range 6 to 150) (Boudreau, 1997).

Central Arctic Herd. Between the mid-1970s and early 1980s, the harvest of CAH caribou was low (1976-80 estimated harvest of 50 to 100 caribou/year) and restricted by registration-permit hunting only (Whitten, 1981). Whitten, (1981, pp. 60-62) indicated that during this period, “the TAPS haul road was open only to industrial traffic and to local miners, hunting guides, or cabin owners who have property or business interests along the road. Access for general public hunting was not allowed. Nevertheless, the harvest reports show that some caribou hunters were able to gain access to the road. Big game hunting within 8 km (5 miles) of the road was permissible by bow and arrow only.”

Including estimates of unreported harvest, the annual harvest of CAH caribou increased from 50 to 100 caribou



Sources: Tobey (1995a), McDonald (1997).

Figure 3.2-12. *Nelchina Caribou Herd mortality causes and harvest permits issued.*

in 1980 (Whitten, 1981) to 762 to 862 caribou in 1986 (Woolington, 1997b). In response to CAH growth during this period, the season and bag limit were liberalized for the 1983-84 season (Golden, 1989). However, in 1986 more restrictive regulations were adopted to curtail the increasing harvest trend (Valkenburg, 1993). As a result, the 1987-91 average annual harvest was 340 caribou (range 196 to 386; Woolington, 1997b), noticeably lower than the 1986 harvest of 762 to 862 caribou. Golden (1989, p. 170) concluded that "the rise in harvest of CAH caribou was due to easy access hunters had to caribou along the Dalton Highway. Restriction of highway vehicles traveling north of Disaster Creek was poorly enforced, and prohibitions on ORV [off-road vehicle] travel from the road were unenforceable."

In 1991, interest in hunting CAH caribou increased (1991 estimated harvest of 508 to 608 caribou), particularly within the Dalton Highway Corridor Management Area (DHCMA), "largely because of reduced opportunities to hunt caribou in the Delta, Macomb and Fortymile herds" (Woolington, 1997b, p. 224). Since the 1991 harvest peak, the annual number of caribou taken from the CAH has steadily declined (Woolington, 1997b), and the 1992-98 average annual harvest was 450 caribou (Woolington, 1997b; James, 1997a; Nowlin, 1998a). See Section 4.3.2.5 for the history of public access along the Dalton Highway.

Most of the harvest of CAH caribou occurs in GMU 26B (Woolington, 1997b). Therefore, in addition to the ADF&G season and bag limit restrictions for the management unit, additional regulations affecting CAH harvests include both state and federal laws within the DHCMA. The DHCMA extends 8 km (5 miles) on either side of the Dalton Highway between the Yukon River and the Prudhoe Bay Closed Area. It is closed to hunting except with bow and arrow. Archery hunters must possess a valid International Bow Hunter Education Program card when hunting in the corridor (Woolington, 1997b). In addition, the use of motorized vehicles for non-subsistence hunting is prohibited within the DHCMA, and all hunters must stop at ADF&G check stations in the management area. Most hunters using firearms in GMU 26B use aircraft, highway vehicles, and/or boats for access (Woolington, 1997b).

Western Arctic Herd. Currently, subsistence harvests by local hunters who live west of the Dalton Highway and north of the Yukon River total approximately 20,000 WAH caribou annually. In addition, non-local hunters take about 1,000 to 3,000 WAH caribou annually (Dau, 1997). Almost all harvest by non-local hunters occurs between late August and late October, when the WAH may be in the vicinity of the Dalton Highway. Subsistence harvest occurs throughout the year.

Teshekpuk Lake Herd (TLH). Caribou from the TLH are harvested primarily by subsistence hunters from the North Slope villages of Nuiqsut, Atqasuk, Barrow, Wainwright, and Anaktuvuk Pass, with annual harvests from 800 to more than 2,500 (Carroll, 1995); the sport harvest is low (Philo et al., 1993).

Distribution and Habitat Use

Nelchina Herd. The NCH is a migratory herd which moves between spring/summer and autumn/winter ranges. These movements require crossing the Richardson Highway and the TAPS ROW (Eide et al., 1986). NCH caribou typically calve west of TAPS in the eastern Talkeetna Mountains on traditionally used calving areas, and westward movements to calving grounds usually occur between March and May (Eide et al., 1986). After calving, NCH caribou disperse to summer range, which includes other areas of the eastern Talkeetna Mountains, the north side of the Susitna River, and the Alphabet Hills. During autumn, caribou may be spread among all of the aforementioned areas, including the Lake Louise Flats and the Gakona and Chistochina river drainages. In October, NCH caribou typically begin migration to winter range, moving eastward across the TAPS ROW and the Richardson Highway. When caribou numbers were low, most caribou wintered on the Lake Louise Flats and east to the upper Copper River drainages of GMU 11. However, in recent years, 50 to 70 percent of NCH caribou have wintered farther east in neighboring GMU 12 and even as far as the Yukon Territory (Tobey, 1995a). In winter, NCH caribou mix with animals from the Mentasta Caribou Herd (Tobey, 1995a).

Delta Herd. Between the 1950s and the mid-1980s, DCH caribou traditionally used calving areas between the Delta River and the little Delta River in southeastern GMU 20A west of the TAPS ROW and south of Big Delta (Davis et al., 1991; Eagan, 1995). As the herd increased from 1980 to 1987, calving areas expanded south to the northern foothills of the Alaska Range between Dry Creek and the Delta River (Valkenburg et al., 1988). After the DCH declined in the early 1990s, range size of the herd also declined slightly, although southern expansion of the calving area continued (Valkenburg, 1997). During the autumn and winter, DCH caribou traditionally migrate west from the calving grounds (APSC, 1993; Eagan, 1995). Although most Delta caribou continue this pattern, some were observed east of the Delta River, and the TAPS ROW and Richardson Highway, in the areas of Iowa Creek and Donnelly Dome beginning in the early 1990s (APSC, 1993; Eagan, 1995; Valkenburg, 1997; Valkenburg et al., 1999).

Ray Mountains Herd. The RMH is the easternmost of three small herds (including Galena Mountain and Wolf Mountain) that exist in the Kokrines Hills and the Ray Mountains, north of the Yukon River between Galena and the Dalton Highway (Woolington, 1997a) (Figure 3.2-9). The origin of these herds is unknown, and although some local residents believe these animals are feral reindeer, available evidence indicates that they are caribou that may have originated from the Western Arctic Herd, which occasionally winters in this area (Cronin et al., 1995; Osborne, 1995).

The RMH calves primarily on the south side of the Ray Mountains in the upper Tozitna River drainages (Woolington, 1997a). During fall and winter, the herd moves to the north side of the Ray Mountains, primarily in the Kanuti-Kilolitna drainage (Woolington, 1997a). During autumn, RMH caribou have occasionally been observed in the vicinity of the TAPS ROW near Pump Station 5 (APSC, 1993) and the Dalton Highway at Old Man, and near Caribou Mountain (Woolington, 1997a). Movements and survival of RMH caribou are monitored through cooperative telemetry studies involving ADF&G, BLM and FWS.

White Mountains Herd. The WMH was delineated in the early 1980s after the Fortymile Herd declined (around the 1960s) and abandoned the traditional White Mountains calving area (Davis and LeResche, 1978). Public reports and observations by biologists, however, documented and confirmed the existence of a caribou herd that used the White Mountains on a year-round basis (Valkenburg, 1988). The resident WMH was recognized on this basis, and the herd uses a distinct calving area (Boudreau, 1997).

All seasonal WMH habitats and ranges are east (approximately 32 km at a minimum) of the TAPS ROW and Dalton Highway. There are no reports of WMH caribou crossing the pipeline or the highway. However, as illustrated by other Alaskan caribou herds, if this population increases, seasonal ranges may expand and the WMH may then encounter the TAPS ROW and the Dalton Highway. WMH calving areas are generally in the higher elevations of the White Mountains in selected drainages east of Beaver Creek, although scattered calving also occurs west of Beaver Creek (Durtsche and Hobgood, 1990). In autumn (August or September), WMH caribou move northwest crossing Beaver Creek and arrive on their winter range in the upper Hess and Victoria creek drainages, and the upper Tolovana River drainage (Boudreau, 1997). Radio-collared caribou are tracked as part of a cooperative project between ADF&G and BLM, and these data are used to determine the identity and distribution of caribou in the White Mountains. Much of the area used by the WMH is managed by the BLM as the White Mountains National Recreation Area. ADF&G management objectives for the WMH include a statement to ensure that increased recreational use and mining development do not adversely affect the WMH. Boudreau (1997, p. 201) concluded that "protection of key seasonal ranges from mining and recreational development should be considered during any land-use planning…"

Central Arctic Herd. Caribou of the CAH migrate north each spring from their winter range in the Brooks Range and its northern foothills to calving grounds and summer range on the Arctic Coastal Plain between the Canning and Colville rivers. Although small numbers of the CAH spend the winter on the coastal plain, the region encompassing the existing oil fields is not considered important winter range (Carruthers et al., 1987; Murphy and Lawhead, 2000). Census data indicate that about half of the CAH tends to spend the calving and insect seasons of late May to mid-August west of the Sagavanirktok River, including the area with existing oil-field development, and half ranges east of the Sagavanirktok River (Lawhead, 1988). Regular interchange of animals probably occurs between the east and west ranges (Cronin et al., 1997).

BP Exploration (Alaska) Inc.

Photo 3.2-12. *Caribou on North Slope.*

Pregnant cows move north toward the calving grounds in April and May (Cameron and Whitten, 1979), accompanied by barren cows and many yearlings. Bulls and other yearlings follow later. Although pregnant cows of the CAH disperse widely across the coastal plain during calving (Curatolo and Reges, 1984; Whitten and Cameron, 1985), calving tends to be more concentrated within 30 miles of the sea coast in the area of the Kuparuk and Milne Point oil fields and in the area south of Bullen Point (Whitten and Cameron, 1985; Lawhead and Cameron, 1988). Calving begins in late May and normally peaks near the end of the first week of June (Curatolo and Reges, 1984; Whitten and Cameron, 1985; Lawhead and Cameron, 1988). Virtually all births occur within a three-week period, and each pregnant cow bears a single calf.

Between late June (2 to 3 weeks after calving) and early August, the dominant influence on caribou movements is harassment by mosquitoes (≥5 *Aedes* spp.) and oestrid flies (warble fly *Hypoderma tarandi*, nose-bot or nostril fly *Cephenemyia trompe*) (White et al., 1975; Roby, 1978;

Dau, 1986). Warm, calm summer days in the Arctic result in high levels of insect activity, and Fancy (1986) reported that insect harassment could cause a negative balance in daily energy budgets of lactating females. Thus, it has been hypothesized that summers with above-average insect activity may result in energetic stress that adversely affects the ability of females to bear calves the following spring (White, 1983; Cameron et al., 1993; Cameron, 1994).

Mosquito-harassed caribou on the coastal plain coalesce into large groups and move upwind (generally northward) to reach relief habitats, which include cool and windy coastal beaches, low bluffs, sparsely vegetated river bars and deltas, and oil field gravel roads and pads (White et al., 1975; Roby, 1978; Dau, 1986; Lawhead, 1988; Pollard et al., 1996b). Caribou in the western range of the herd frequently encounter oil-field infrastructure during these movements (White et al., 1975; Curatolo and Murphy, 1986; Murphy and Curatolo, 1987; Pollard et al., 1996a; Cronin, Amstrup et al., 1998). The location of mosquito-relief habitat varies with weather conditions (primarily air temperature and wind speed), and mosquito-harassed caribou appear to move only as far as necessary to reach insect-free conditions on any given day (Lawhead, 1988). When mosquito harassment abates, caribou move from the coast to inland areas thought to have better forage (Smith, 1996).

By mid-July, oestrid flies begin to exert strong effects on caribou movements and behavior on the outer coastal plain (Dau, 1986; Lawhead, 1988). Larval infestations of these parasites can be detrimental to the general health and fecundity of caribou (Kelsall, 1968; Thomas and Kiliaan, 1990), and caribou react strongly to the adult flies, often apparently ignoring other stimuli (Espmark, 1968; Karter and Folstad, 1989). Group bonds break down during fly harassment as small unstable groups or individual caribou move in a highly variable, seemingly random fashion seeking relief habitats (Espmark, 1968; Roby, 1978; Lawhead, 1988). These habitats include a variety of unvegetated and elevated sites, such as river bars, mud flats, dunes, pingos, and gravel pads and roads in the oil fields (White et al., 1975; Roby, 1978; Dau, 1986; Pollard et al., 1996b). Caribou of the CAH begin to migrate south from summer range during the fly season in August (Roby, 1978; Lawhead, 1988).

Western Arctic Herd. WAH caribou calve in the Utukok Hills in the northwestern portion of the Brooks Range near Eagle Creek, and on the inner Arctic Coastal Plain. Approximately 2 weeks after calving, the herd begins to move south and west, and these movements are often described as an arc through the Lisburne Hills and then eastward through the De Long Mountains and Brooks Range. During the summer and fall, caribou disperse farther southeast within the northern portions of their range. During September and October, WAH caribou migrate as far south as the Seward Peninsula onto winter range, and as far east as the TAPS ROW (APSC, 1993; Woolington, 1997b).

Teshekpuk Lake Herd (TLH). Caribou from the TLH winter over a wide range from the Arctic Coastal Plain to the Seward Peninsula, south of the Brooks Range (Philo et al., 1993; Carroll, 1995). In some years, a portion of the herd winters on the coastal plain (Philo et al., 1993). The calving grounds and summer range of the TLH are on the Arctic Coastal Plain (Philo et al., 1993; Carroll, 1995). The principal calving grounds are located around Teshekpuk Lake, and the summer range extends across the coastal plain west of the Colville River delta (Philo et al., 1993; Carroll, 1995). The TLH ranges west of existing oil-field infrastructure, which now extends as far west as the Colville River delta (Alpine Development Project), although insect-induced movements occasionally bring animals onto the delta in midsummer (Philo et al., 1993). The calving and summer ranges of the herd are overlapped by recent oil and gas exploration leases in the northeastern part of NPR-A (BLM and MMS, 1998).

3.2.5.3 Muskoxen

Population History and Status

Muskoxen were extirpated from Alaska by the early 1900s (Woolington, 1997; Reynolds, 1998). They were reestablished in the state when muskoxen from Greenland were introduced in 1935-36 to Nunivak Island off Alaska's west coast (Reynolds, 1998). In 1969-70, 64 animals from Nunivak Island were released on or near Barter Island on the coastal plain of the Arctic National Wildlife Refuge, and at the Kavik River, approximately 25 km west of ANWR (Reynolds, 1998; Woolington, 1997; BLM, 1988; Jingfors and Klein, 1982). The total number of muskoxen on the Arctic Coastal Plain has increased steadily since reintroduction, and at least 800 muskoxen now inhabit the area (Reynolds, 1998; Woolington, 1997) (Figure 3.2-13).

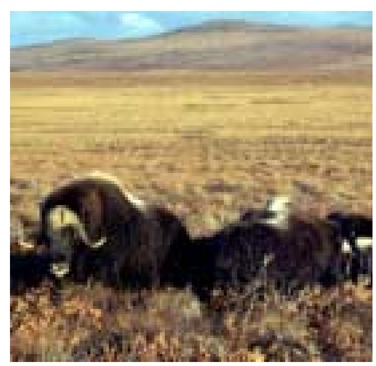

Warren Ballard

Photo 3.2-13. *Muskoxen.*

From 1977 through 1981, the muskox population in the Arctic National Wildlife Refuge (ANWR) increased at an

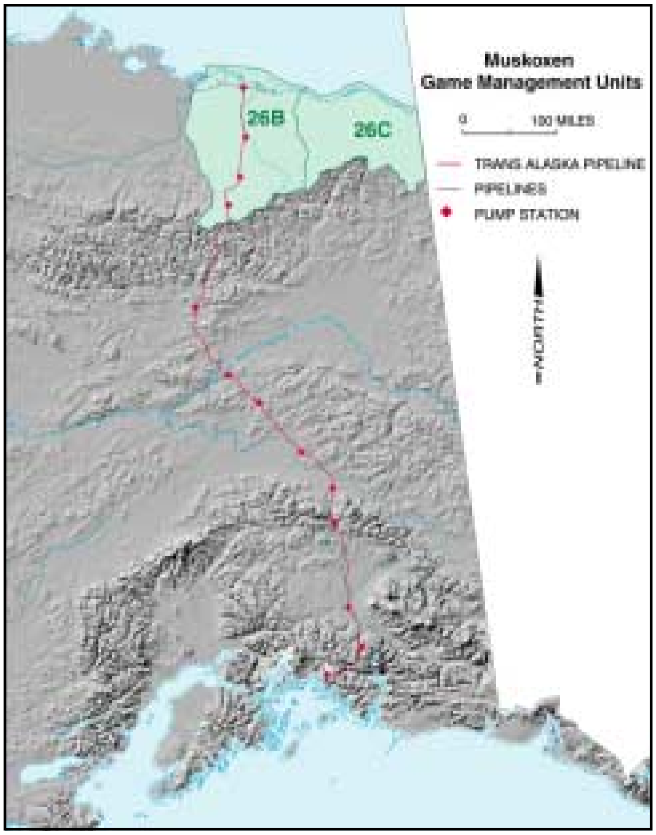


Figure 3.2-13. *Game management unit map for muskoxen along TAPS.*

annual growth rate (*r*) of 0.24. During 1982-86, the population growth rate declined to 0.14 (Reynolds, 1998). After 1986, the number of muskoxen in ANWR declined, stabilizing at approximately 300 individuals. Reynolds (1998) suggested that this decline was related to decreases in calf production, dispersal of mixed-sex groups into other regions, and reduced survival due to predation by brown bears (Gunn and Miller, 1982; Case and Stevenson, 1991; Clarkson and Liepins, 1993) and gray wolves; declining forage availability from intraspecific competition; and weather.

Westward dispersal of muskoxen from ANWR began in the early 1980s, with individual bulls and small numbers of mixed-sex groups being observed as far west as the Kuparuk and Prudhoe Bay oil fields (BLM and USACE, 1988; USACE, 1997; Reynolds, 1998). Dispersal in large numbers was first recorded in 1986-87 and continued sporadically through 1994-95 (Reynolds, 1998). In 1986 as many as 18 muskoxen were repeatedly observed along the Sagavanirktok River north of Franklin Bluffs (BLM and USACE, 1988). In addition, muskoxen have been seen near the Dalton Highway and as far south as Pump Station 3 (Thompson, 1999, pers. comm.). Movements of radio-collared females in ANWR confirmed the westward expansion of muskoxen from the regions they first occupied (Reynolds, 1998). Muskoxen populations in areas west of ANWR have grown since 1986 (1986-90 $r = 0.55$; 1990-95 $r = 0.15$) and are currently stable (Reynolds, 1998). In 1996 "…91 animals were recorded west of the TAPS near the Colville River (Whitten, 1997, pers. comm.)" (BLM and MMS, 1998, p III-B-43). At present, the total distribution of muskoxen on the Arctic Coastal Plain covers a linear distance of approximately 500 km, extending from the Colville River west of Prudhoe Bay to beyond the Babbage River in northwest Canada (Reynolds, 1998). A breeding population has become established in the Itkillik-Colville rivers area (Johnson et al., 1996). No geographical barriers to range expansion exist along the Arctic Coast, and the potential range for muskoxen is extensive (Smith, 1984). For muskoxen to have expanded their range from ANWR to the Colville River, some animals had to cross the TAPS ROW or travel through the oil fields on the North Slope.

Harvest by Humans and Population Management

Management of the North Slope's muskoxen population falls under both federal (FWS) and state (ADF&G) jurisdictions (Woolington, 1997; Hicks, 1998c). Both agencies perform and participate in aerial population counts and composition surveys in addition to managing annual hunts. The number of hunting permits issued in GMU 26B and 26C has increased over the past 15 years (5 in 1986-87, 15 in 1995-96), and harvests have ranged from 5 to 10 bulls/year. The current management objective limits the annual harvest to less than 20 bulls in order to ensure that muskoxen dispersal and population growth are not limited by hunting (Hicks, 1998c).

Distribution and Habitat Use

During the snow-free season, muskoxen generally use moist habitats and associated lush meadow and riparian vegetation (Klein, 2000; BLM, 1988). The most important summer habitats on the Arctic Coastal Plain are riparian, upland shrub, and moist sedge-shrub meadows, which provide preferred willow, forb, and sedge species (Robus, 1984; Johnson et al., 1996; BLM and MMS, 1998). Muskoxen use upland tussock areas and riparian drainages as calving habitat between late April and late June (Reynolds, 1984; APSC, 1993; USACE, 1997).

Between late November and the end of February, muskoxen frequently use riparian and dry tundra habitats such as ridges and bluffs. Winter forage depends largely on snow depth and hardness (Klein, 2000). In late winter, muskoxen feed on windblown vegetated bluffs that have shallow snow cover (Wilson and Klein, 1991; Klein et al., 1993; USACE, 1997). On the coastal plain, these areas are distributed in narrow bands along creeks, rivers, and the coastline. During winter, muskoxen remain in localized areas and reduce their movements and activity; once they move to a winter area, they seldom leave it unless disturbed (Wilson and Klein, 1991). The potential exists for muskoxen to compete with caribou for available seasonal forage and habitats (Klein and Bay, 1994; BLM, 1988; Thomas and Edmonds, 1984; Wilkinson et al., 1976); however, research in this area has not documented adverse effects of competition.

Winter range and calving areas are seasonally important habitats, and avoidance of these habitats by humans has been recommended (Wilson and Klein, 1991; Reynolds, 1998). Muskoxen use areas near the TAPS ROW seasonally and during migrations (APSC, 1993).

3.2.5.4 Bison

Herd History and Status

Bison were extinct in Alaska prior to settlement by European, but they were reintroduced to Alaska in 1928. There are two bison herds in the vicinity of the TAPS ROW — the Delta herd and the Copper River herd. The Delta herd ranges from Donnelly Dome to Big Delta in GMUs 20D and 20A, and the Copper River herd is distributed east of the Copper River in the northwestern portion of GMU 11 (APSC, 1993) (Figure 3.2-14).

Delta Herd. In 1928, 23 plains bison were transplanted to the Delta River/Big Delta area from the National Bison Range in Montana (DuBois and Rogers, 1999). The Delta bison herd grew to more than 500 animals during the early 1950s, and then declined to a low of approximately 225 animals between 1950 and 1960 in response to winter severity, limited available forage in late-succession habitats, and overpopulation (ADF&G, 1976). Since 1983, pre-calving populations have ranged from 275 in 1987-88 to 392 in 1993-94 (BLM and USACE, 1988; Taylor, 1994a). The most recent pre-calving herd estimate for the Delta herd was 361 bison (Hicks, 1998d). Pre-calving herd objectives have gradually increased since the mid-1970s (250 in 1976, 325 during mid-1980s to 1993, and 360 from 1993 to present) as the herd increased and stabilized (ADF&G, 1976; Taylor,

Shawn Haskell

Photo 3.2-14. *Bison.*

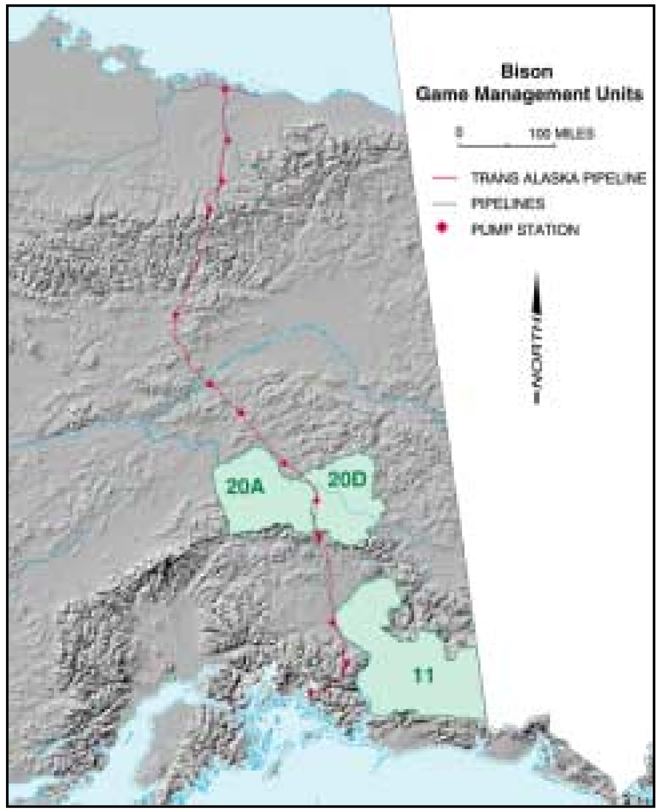


Figure 3.2-14. *Game management unit map for bison along TAPS.*

1994a; Hicks, 1998d; DuBois and Rogers, 1999).

The most important limiting factor for this herd is harvest by humans (Taylor, 1994a; DuBois and Rogers, 1999). Natural mortality has not been quantified for the Delta herd, although Taylor (1994a) suggested that it is probably low. There are no records of predation on Delta bison, although wolves, brown and black bears, and coyotes occur in the area. Drowning, hunting-wounding losses, and accidents are other potential limiting factors, but winter severity is not a major mortality factor (Taylor, 1994a; DuBois and Rogers, 1999). The greatest potential for non-hunting mortality to Delta bison is disease transmitted from domestic livestock in the area (Taylor, 1994a). In addition to natural mortality, Kiker and Fielder (1980) reported that fewer than 10 individuals are killed annually in vehicle collisions. Most collisions occurred at known crossing sites along local highways and roads, although Delta bison have established many trails and may cross transportation corridors in many areas.

Copper River Herd. This bison herd originated from 17 individuals translocated from the Delta herd in 1950 (Tobey, 1998). The herd was relatively stable at over 100 animals during the late 1960s and 1970s, following a population increase in the 1950s (Tobey, 1981a, 1998). During the early 1980s, the herd declined slightly, but stabilized

and grew to an estimated 90 bison in 1988. Bison were adversely affected by the severe winter of 1988-89, which caused a 27 percent decline in the population (Tobey, 1998). Herd size increased slightly in the early 1990s to approximately 65 to 70 bison, and since that time, herd estimates have ranged from 75 to 87 individuals (McDonald, 1998a; Tobey, 1994a, 1998). The management objective for Copper River bison is to maintain the herd at a minimum of 60 overwintering adults (Tobey, 1998). Limiting factors on this herd include winter severity (i.e., snow depth) and the potential for winter starvation; accidental death (e.g., falling off steep bluffs that border the Copper River; drowning due to winter ice conditions and/or crossing attempts); and harvest by humans (Tobey, 1998). Predation by wolves, black bears, and brown bears is likely in this area; however, research into predation rates on Copper River bison has not been conducted.

Harvest by Humans and Population Management

Delta Herd. Harvest of the Delta bison herd by humans began in 1950. Delta bison hunts are one of the most popular permit-drawing hunts in the state, with over 15,000 people applying in recent years for approximately 100 to 130 permits (Taylor, 1994a; DuBois and Rogers, 1999). Since the hunt's inception, the number of permits issued, applicant numbers, and total harvest have all increased (Taylor, 1994a). ADF&G has successfully used hunting as the primary tool for managing the size and composition of the Delta herd for the past 30 years (Taylor, 1994a; DuBois and Rogers, 1999). The number of bison annually harvested since 1986 ranges from 6 in 1986-87 to 109 in 1993-94 (DuBois, 1998).

Copper River Herd. The last Copper River bison hunt was held during 1988, when seven bison were harvested (Tobey, 1998). Historically, this hunt has been popular with local rural residents. Based on census and herd-composition data, McDonald (1998a) recommended reopening the Copper River bison hunt in years with good calf production to allow harvest opportunities while the herd is high.

Distribution and Habitat Use

Delta Herd. Delta bison are migratory, moving alone or in groups of up to 50 animals, and seasonally use various portions of their annual home range (DuBois, 1995; DuBois and Rogers, 1999). Personnel from ADF&G and the Delta Junction Bison Range (DJBR) monitor the movements of radio-collared bison to determine bison/agriculture conflicts (Hicks, 1998d). The Delta herd normally travels to the floodplain of the Delta River from mid-February to March, crossing the Richardson Highway and the TAPS ROW. In early spring (April-May), cows move to secluded meadows in close proximity to the Delta River, where they calve (Hemming and Morehouse, 1976; APSC, 1993; DuBois and Rogers, 1999). This area is west of the TAPS ROW between Pump Stations 9 and 10. During the summer, the herd ranges along the Delta River floodplain and adjacent uplands, southwest of Delta Junction between Black Rapids Glacier and the mouth of the river (DuBois and Rogers, 1999). Bison are frequently visible during this period from the Richardson Highway.

In July, August, or September, the herd migrates from the Delta River, again crossing the TAPS ROW and the Richardson Highway, onto the DJBR and private agricultural lands, where they stay for the majority of the fall and winter (DuBois and Rogers, 1999). With development of agriculture in the 1950s, bison began using farms extensively during the fall and winter. The state developed the DJBR in 1979 to perpetuate free-ranging bison by providing adequate winter range and to alter seasonal movements of bison to reduce bison/agriculture conflicts (DuBois and Rogers, 1999).

Bison are grazing animals, and in the Delta area only limited amounts of preferred foods such as grasses and sedges are available along rivers and in recent burns (Campbell and Hinkes, 1983; Berger, 1996; DuBois and Rogers, 1999). The availability of winter forage was an important limiting factor for the Delta bison (ADF&G, 1976), but agriculture (e.g., barley production) has augmented natural forage for bison.

Copper River Herd. The Copper River herd ranges in the area of the Dadina and Chetaslina rivers, although the original animals were translocated farther north in GMU 11 (Tobey, 1998). Current bison range is bounded by the Dadina River on the north, the Copper River on the west, the Kotsina River to the south, and the Wrangell Mountains to the east. Most of the range is black spruce forest, with bison frequenting swamps, sedge openings, grass bluffs, and river bars (Tobey, 1998). Seasonal distributions include intensive use of the Copper River floodplain and bluffs during winter and spring, while bison move to higher elevations along selected rivers to feed on plants during green-up (Tobey, 1998). Habitat assessment studies have not been conducted on the Copper River bison range; however, "field observations of … preferred feeding locations such as the Copper River bluffs show evidence of heavy use and reduced forage production" (Tobey, 1998, p. 4).

Before 1990, there were very few reports of Copper River bison crossing the river, and observations of animals along the west bank of the Copper River in GMU 13 were infrequent (Tobey, 1998). Recently, however, bison have been reported grazing in hay and crop fields in the Kenny Lake area west of the Copper River and just east of the TAPS ROW. Tobey (1998) raised the concern that serious conflicts with farmers could arise if many bison cross the river and make extensive use of Kenny Lake farms.

3.2.5.5 Dall Sheep

Warren Ballard

Photo 3.2-15. *Dall sheep.*

Dall sheep are found in the vicinity of the TAPS ROW in the Chugach Mountains (GMUs 11 and 13D), the Alaska Range (Delta Controlled Use Area in GMUs 13B, 20A and 20D), and the Brooks Range (GMUs 24 and 26B) (Figure 3.2-15). Because sheep are generally nonmigratory, populations that are not in the immediate vicinity of the TAPS ROW are not addressed here (i.e., populations in the South Wrangell Mountains, the Tok Management Area, and the Tanana Hills).

Population History and Status

Chugach Mountains (GMUs 11 and 13D). In 1949, there were an estimated 600 sheep in the Chugach Mountains of GMUs 11 and 13D (Scott et al., 1950 cited in Sinnott, 1996a). The Chugach Mountains sheep population increased until the mid-1980s and then declined in the late 1980s due to severe winters and possibly because sheep populations had exceeded range carrying capacity (Sinnott, 1996a). In 1990-91, the population in GMU 13D was estimated at 1,450 sheep (Harkness, 1993), and in the mid-1990s, Sinnott (1996a) extrapolated that there were as many as 2,000 to 3,000 sheep in the subunit. In the early 1990s, there were approximately 400 sheep in the GMU 11 portion of the Chugach Mountains. The current status of the Chugach Mountains population is uncertain. Factors potentially limiting sheep populations in this area include winter severity and predation by wolves, coyotes, bears, wolverines, and golden eagles (Sinnott, 1996a).

Delta Controlled Use Area (GMUs 13B, 20A and 20D). In 1980, D.M. Johnson (1982) estimated that the Delta Controlled Use Area (DCUA), renamed in 1981 from the Delta Management Area, contained approximately 1,500 sheep and that the population "may have declined somewhat in recent years" (Johnson, D.M., 1982, p. 70). He speculated that "if the population is experiencing a long-term decline," non-hunting sheep mortality in the management area should be examined (Johnson, D.M., 1982, p. 70). Trend counts in the Granite Mountain count area of the DCUA indicate that the sheep population was stable between 1975 and 1993, although it may have declined since then (DuBois, 1996b). The 1995 aerial census indicated approximately 1,400 to 1,900 sheep in the DCUA (DuBois, 1996b). Although wolves, brown bears, black bears, and golden eagles are found in the DCUA and presumably prey on sheep, predation rates are unknown (DuBois, 1996b). Winter severity is an important factor for other sheep populations in Alaska, but DuBois (1996b) indicated that it was not limiting sheep numbers in the DCUA.

Brooks Range (GMUs 24 and 26B). Dall sheep are found throughout the Brooks Range and adjacent foothills east, west, and in the vicinity of the TAPS ROW; and densities are generally highest in the northern drainages (BLM, 1989; Stephenson, 1996b). Sheep in the Brooks Range east of the Dalton Highway (including the Dalton Highway Corridor Management Area) were "generally abundant in the last several decades," and recent available data, anecdotal reports, and hunter observations suggest "relatively high populations during the 1980s, followed by declines in numbers in recent years" (ca. late 1980s and early 1990s) (Stephenson, 1996b, p. 148). Poor recruitment due to se-

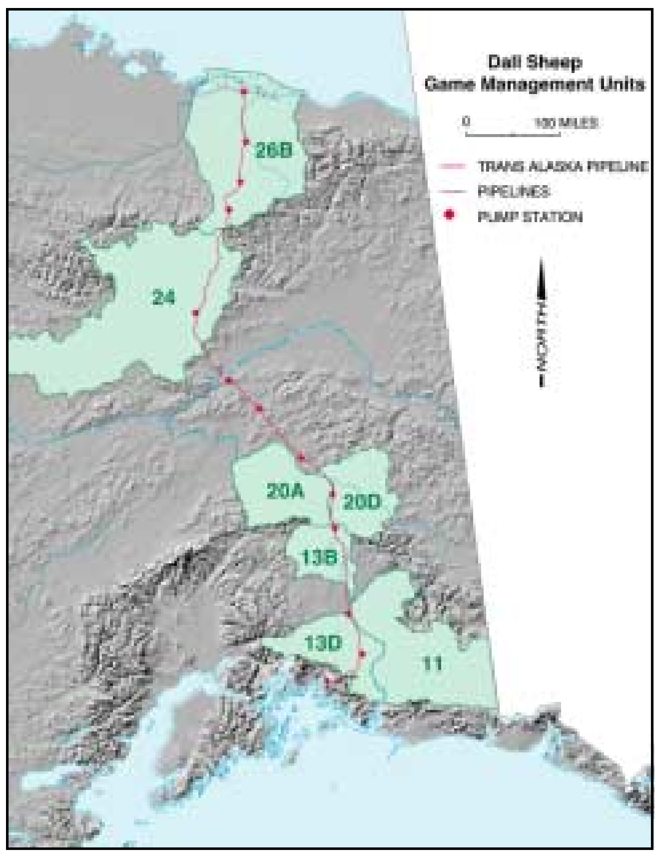


Figure 3.2-15. *Game management unit map for Dall sheep along TAPS.*

vere weather, and the possibility of increased predation may have contributed to this decline (Stephenson, 1996b). Most recently, Heimer (1985) estimated 13,000 sheep in the eastern Brooks Range. BLM (1989) estimated that there were 30,000 sheep throughout the entire Brooks Range and referenced Jakimchuk et al. (1984) in reporting 545 sheep between the Atigun and Sagavanirktok rivers. Systematic aerial surveys have not been completed since Heimer (1985)'s survey, and sheep populations have been tracked with trend data collected during ground composition counts since 1985 (Stephenson, 1996b). Trend counts in the Atigun drainage have remained relatively stable (range 236 to 493), with peak numbers being recorded in 1990-91 (Stephenson, 1996b). Causes of natural mortality and other factors potentially limiting the eastern Brooks Range sheep population are not available.

In the western Brooks Range within Gates of the Arctic National Park and west of the Dalton Highway Corridor Management Area, the sheep population showed signs of growth between 1982 and 1987 (Adams, 1988, cited in Osborne, 1996). Singer (1984 cited in Osborne, 1996) estimated that there were 4,417 sheep in the park. Although no population estimates have been calculated since then, Osborne (1996, p. 159) suggested "available data indicate there are now fewer sheep in the park than in the 1980s."

Harvest by Humans and Population Management

Chugach Mountains (GMUs 11 and 13D). Annual harvest of rams with full-curl horns is currently assumed to comprise about 3 percent of the total population in GMU 13D (Sinnott, 1996a). Since 1990, harvests, hunter numbers, and hunter success rates have been increasing (Sinnott, 1996a). A total of 44 to 88 sheep have been harvested annually in GMU 13D since 1987 (Harkness, 1993; Sinnott, 1996a). A portion of the sheep population in GMU 13D exists in the Tonsina Controlled Use Area, which is bounded on the east by the Copper River and on the west by the Richardson Highway and the TAPS ROW. ADF&G restricts big game hunting and access in this area. Hunting in GMU 11 is limited to local subsistence hunters under federal regulations (Harkness, 1993). In 1997-98, the total harvest for the Chugach Mountains was 171 sheep (McDonald, 1998b).

Delta Controlled Use Area (GMUs 13B, 20A, and 20D). Sheep in the DCUA are managed by both ADF&G and the federal government, each having its own management and harvest objectives (DuBois, 1996b). As a result, the consumptive-use objective for the DCUA is to provide opportunities to hunt under aesthetically pleasing conditions (DuBois, 1996b). Sheep seasons and harvest were originally liberal, but have become more restrictive with increases in hunting pressure and improved knowledge of sheep management requirements. In 1977, hunters killed 78 rams in the DCUA, even though the harvest objective was 40 rams (Larsen, 1979). Consequently, sheep hunting in the DCUA was restricted by drawing permit in 1978 (60 permits issued), and the harvest was reduced to 31 rams in 1978. The number of permits issued was increased in 1982 to 150 (DuBois, 1996b), and total harvests have ranged from 28 to 50 since 1987 (DuBois, 1996b; Nowlin, 1998b).

Brooks Range (GMUs 24 and 26B). Stephenson (1996b) reported that human use (i.e., hunting, viewing, and photography) of sheep in the eastern Brooks Range increased steadily during the 1980s, but stabilized through the 1990s. He indicated that this area experienced a long-term increase in hunter numbers and harvest beginning in the early 1970s, but that numbers of hunters have decreased in recent years. Sheep harvests reached their peak in 1990-91 with 268 sheep harvested, and declined to 122 sheep harvested in 1993-94 (Stephenson, 1996b). This decline may have been due in part to a decline in sheep numbers and to more restrictive harvest regulations involving implementation of a draw permit system in certain areas and harvesting only full-curl rams.

In the western Brooks Range, sheep are managed in Gates of the Arctic National Park (not in the TAPS ROW) under federal laws that mandate subsistence use (Osborne, 1996). ADF&G's primary management goal in this area is to maintain and enhance the sheep population and its habitat in concert with other components of the ecosystem. Since 1988, ADF&G has managed the park subsistence hunt. Before 1981, the entire area of GMU 24 east and west of the Dalton Highway was open to general sheep hunting; the average harvest during this time was 50 rams/year (Osborne, 1996). The 1989-94 average harvest was 47 sheep, including subsistence harvest, which averaged 23 sheep.

Distribution and Habitat Use

Chugach Mountains (GMUs 11 and 13D). Sheep are found throughout the Chugach Mountains. In GMU 13D, they are most abundant between the Nelchina and Klutina glaciers west of the TAPS ROW, and are also present in the Tonsina Controlled Use Area adjacent to the ROW (Tobey, 1996c). Sheep are found in mountainous areas below 3,000 m in elevation, although concentrations vary among drainages. During the winter, sheep in the Chugach Mountains are found in relatively snow-free areas and on windblown ridges above 900 m in elevation. Winter range is probably the most important seasonal habitat, and snow depth and hardness, rather than forage quantity and quality, are essential components. In the spring from mid-May through the end of June, lambing areas are widely scattered and are often found in steep terrain with southern exposure. APSC (1993) identified a lambing area about 1.5 to 3.0 km west of TAPS and Tonsina.

Delta Controlled Use Area (GMUs 13B, 20A and 20D). The DCUA is located at the north end of Isabel Pass in the Alaska Range. ADF&G biologists have marked sheep in the area with visual collars, although summaries of sighting reports are not available at this time (DuBois, 1996b). Within the DCUA, APSC (1993) identified lambing and mineral lick areas adjacent to and within 15 km of the TAPS ROW. These areas occur both east and west of the pipeline, north of Pump Station 10 (APSC, 1993). Habitat use in the DCUA is not summarized, although it is known that stable sheep winter range is provided by the area's moderate climate including high winds, warm temperatures, and low snow depths. DuBois (1996b) indicated that sheep habitat appears sufficient to support the population at current levels, and suggested that the "2 greatest threats to sheep habitat in the DCUA are mining activities and military exercises on state land" (DuBois, 1996b, p. 81).

Brooks Range (GMUs 24 and 26B). In the eastern Brooks Range, highest densities of sheep occur in the northern drainages that provide favorable weather and habitat conditions during winter (Stephenson, 1996b). Drainages such as the Junjik, East Fork Chandalar, and Hulahula rivers may also inhibit sheep movements, resulting in discrete subpopulations in the Brooks Range. In the vicinity of the TAPS ROW, APSC (1993; Maps 5-8) identified several lambing areas and mineral licks between Pump Stations 4 and 5. These areas occur both east and west of the pipeline (<13 km), in addition to overlapping the ROW in selected areas. Sheep movement zones associated with lambing areas have been identified west of the ROW near Chandalar and Atigun Pass, and sheep may occasionally cross the Dalton Highway in these areas (APSC, 1993). The BLM Poss Mountain, Snowden Mountain, and Galbraith Lake ACECs, which are designated to protect Dall sheep habitat and mineral lick areas, occur in the Brooks Range near TAPS and the Dalton Highway, and are used year-round (BLM, 1989) (see Section 3.2.1).

3.2.5.6 Deer

Population History and Status

Deer have inhabited northern Southeast Alaska since their emigration from southern refugia following the Pleistocene epoch (Klein, 1965). The Sitka black-tailed deer population in the vicinity of the TAPS ROW (GMU 6, Figure 3.2-16) resulted from introductions to two islands in Prince William Sound during 1916 through 1923 (Griese, 1989a; Burris and McKnight, 1973). In 1916, eight deer were captured near Sitka, Alaska, and released on Hawkins and Hinchinbrook islands. Between 1917 and 1923, an additional 16 deer were released (Griese, 1989a). Following introductions, deer quickly increased in number and spread to other islands and the mainland. Since the introduction, the population in GMU 6 has peaked and declined several times in response to various limiting factors (Robards, 1952; Reynolds, 1979). Deer currently exist in all areas of GMU 6 (Griese, 1989a) and are at the northern limits of their range; the population in this unit is stable (Nowlin, 1995a).

Shawn Haskell

Photo 3.2-16. *Sitka black-tailed deer.*

Highest deer densities occur on islands and lowest densities on the mainland in areas surrounding Prince William Sound. Density decreases rapidly with distance inland from

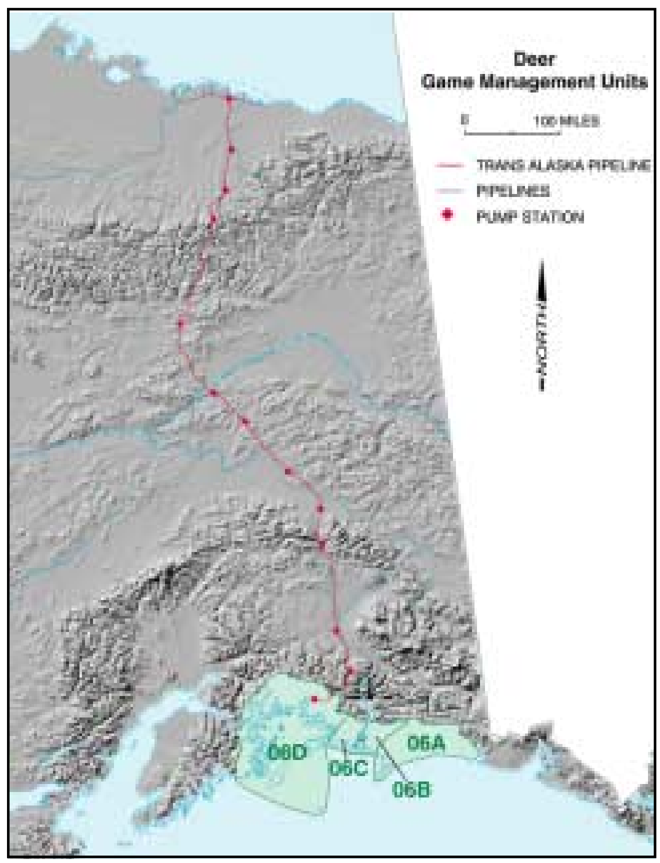


Figure 3.2-16. *Game management unit map for deer along TAPS.*

the Sound (Nowlin, 1995a). Estimates of deer population size are not available for GMU 6, nor for areas in the vicinity of TAPS. As an index of population trends, pellet-group data indicated that all survey locations in GMU 6 had low to moderate deer densities in the early 1990s (Nowlin, 1995a).

Deer have occasionally been reported in the lower Copper River Basin during mild winters when climatic conditions favor temporary range expansion (Roberson, 1986; APSC, 1993). From 1985 through 1989, populations increased to approximately 8,000 to 12,000 deer in GMU 6; subsequent severe winters may have reduced the population from these levels (Griese, 1989a; Nowlin, 1993a). Factors that limit deer distribution, habitat use, and population numbers in southern portions of Alaska include snow depths and duration (Roberson, 1986; Griese, 1989a); wolf predation (Griese, 1991a); mature conifer-forest habitat that provides deer wintering areas (Reynolds, 1979; Shishido, 1986; Nowlin, 1993a); clear-cutting and selective timber management practices (Nowlin, 1995a; Kirchhoff, 1997; Farmer et al., 1998); and hunting (Nowlin, 1993a).

Harvest by Humans and Population Management

Estimated annual harvests in GMU 6 before 1978 ranged between 500 and 1,500 deer (Reynolds, 1979). Nowlin (1995a) indicated that harvests increased after 1978 and peaked at 3,000 in 1987. In 1989 the annual harvest dropped to 1,952 (Griese, 1991a). From 1989 to 1997, annual deer harvests in GMU 6 have ranged from 1,378 to 2,580 (Nowlin, 1995a; Hicks, 1995b, 1996c, 1997c, 1998e). The state management objective is to maintain a deer population that is able to sustain an annual harvest of 1,500 deer, and this objective is being met (Hicks, 1998e). Bag limits and restrictions on season length for doe harvests have been used as a management strategy to reduce harvests and allow deer-population growth following severe winters (Griese, 1989a; Nowlin, 1993a). Nowlin (1993a) suggested that hunting was an important source of mortality, particularly during severe winters when deer concentrate at lower elevations and are more vulnerable to hunters using boats for access.

Habitat Use and Distribution

Old-growth forest is critical deer-wintering habitat during deep snow years (Reynolds, 1979; Shishido, 1986; Nowlin, 1993a). These areas provide shelter and feeding habitats (APSC, 1993). These mature conifer forests are also used during non-winter months (Farmer et al., 1998). During summer and fall, deer also use disturbed slide areas in alpine zones, and feed along the margins of muskeg openings interspersed within climax spruce-hemlock forests (APSC, 1993). Although deer may be present in the vicinity of the southern end of the ROW, critical deer habitat has not been identified along the ROW (APSC, 1993).

3.2.5.7 Mountain Goats

Mountain goats are found near the TAPS ROW south of the Alaska Range in GMUs 6, 11, and 13D (Figure 3.2-17).

Population History and Status

GMU 6. Mountain goats are endemic to the mainland and several islands in GMU 6 (Nowlin, 1996a). In 1952, the goat population in GMU 6 was estimated at 4,350 animals (Nowlin, 1996a). Anecdotal data in ADF&G files suggest that the population was reduced due to overharvests by military personnel stationed in Whittier (ca. 1940s) and in Seward (ca. 1950s) (Nowlin, 1996a). Between 1970 and the mid-1980s, goat numbers fluctuated in the Prince William Sound area as a result of severe winters, predation, and hunter harvest (Reynolds, 1981a).

Aerial mountain-goat population surveys began in 1969,

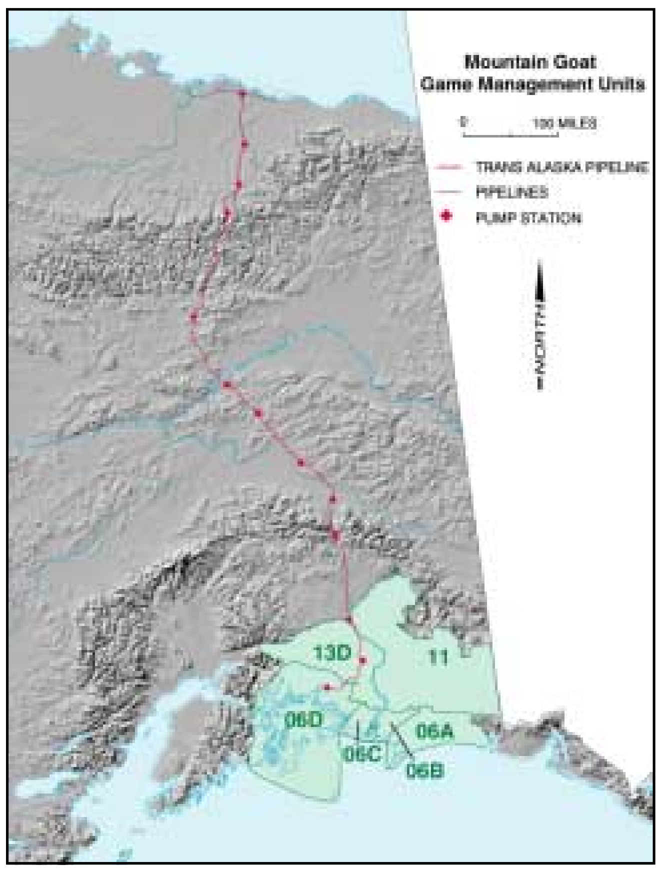


Figure 3.2-17. *Game management unit map for mountain goats along TAPS.*

although they were not standardized until 1986. Since the mid-1980s, mountain goats in Subunit 6D, which is bisected by the TAPS ROW, have increased to the west of TAPS and the Richardson Highway, yet have declined to the east (Nowlin, 1996a). In the entire GMU 6, goat populations declined for at least 5 years before 1993 and were estimated at 3,100 to 3,700 in 1988-89 (Griese, 1990; Nowlin, 1994). Subsequent population estimates were 2,700 to 3,300 in 1990-91 and 2,400 to 2,800 in 1992-93 (Nowlin, 1994). Most recently, the goat population in GMU 6 was estimated at 2,790 (Nowlin, 1996a).

Goat populations in GMU 6 are limited by winter severity and snow depth (Adams and Bailey, 1982; Swenson, 1985); predation (Nowlin, 1996a); and availability of winter habitats provided by old-growth forests (Fox et al., 1989). Nowlin (1996a, p. 55) concluded that "future habitat loss due to clearcut logging is expected in GMU 6D (East)…"

GMU 11. In GMU 11, mountain goats are surveyed and inventoried in only one count area: MacColl Ridge east of the TAPS ROW (Tobey, 1996d). Aerial goat-survey data in the vicinity of TAPS have been collected opportunistically in conjunction with other counts (Tobey, 1996d). Interpretation of annual survey data is confounded because it is difficult to separate actual population fluctuations from survey variability (Tobey, 1996d). As a result, the population history of goats in GMU 11 is not readily available. Currently, biologists estimate that 700 mountain goats inhabit the unit and that there are approximately 300 animals south of the Chitina River near TAPS (Tobey, 1996d).

GMU 13D. The first mountain-goat survey in GMU 13D was done in 1959, and periodic surveys have since been completed (Sinnott, 1996b). Since the mid-1980s, the goat population in the northwestern Chugach Mountains has increased slightly. Mountain goats in GMU 13D declined during the 1970s due to severe winter weather, and since then have slowly increased. Between 1993 and 1995, goat numbers in the GMU 13D count area declined by 17 percent, but Hicks (1998f) cautioned that these counts are often a reflection of survey variability rather than an actual decline, and that the population is likely stable. The population in GMU 13D was most recently estimated at 175 in 1994-95 (Sinnott, 1996b). Before 1995, the management objective for GMU 13 was to maintain a prehunting population of at least 100 goats. Because the goat population in GMU 13D is limited by winter weather and predation (Sinnott, 1996b), objectives were recently changed to maintain viable populations controlled largely by available habitat, climatic conditions, and predation (Hicks, 1998f).

Harvest by Humans and Population Management

GMU 6. Before 1975, mountain-goat hunting seasons were liberal (Nowlin, 1994). As populations in GMU 6 fluctuated, seasons and bag limits were reduced; and in 1986, goats were placed on restricted-registration permit harvest. Biologists recognized that goats, unlike other ungulates, had to be managed on the basis of relatively small geographic units. Mountain goat populations in permit areas are surveyed for population trend and mortality data, and harvest levels are set at 2 to 6 percent of the estimated population (Nowlin, 1994). ADF&G biologists use this method to keep hunting from causing population declines.

Goat harvests in GMU 6 reached a high of 182 in 1983-84 and a low of 41 in 1989-90 (Nowlin, 1994). As a result of the conservative registration hunts, 50 goats were harvested during 1991-92 and 1992-93, which were well below the calculated allowable harvests of 73 and 69, respectively. Population and management objectives for GMU 6 have varied since the 1980s as biologists considered population trends in subunits and management areas, levels of wolf predation, and habitat and logging issues. Currently, the goat population and harvest objectives for GMU 6 are being met (Hicks, 1998g).

GMU 11. Prior to 1972, mountain goat seasons and bag limits were liberal, and harvests were low, although not recorded (Tobey, 1994b, 1996d). Season lengths and bag limits were reduced in the mid-1970s because of increasing hunting pressure and harvests (Tobey, 1996d). In 1980, goat hunting in GMU 11 was placed on the restricted-registration permit system because of the creation of Wrangell-St. Elias National Park and Preserve. Because only subsistence hunting by local residents was allowed in park areas, all other hunters were concentrated on preserve lands (Tobey, 1994b). In 1990, the federal government took over management of subsistence hunting and determined that there was no historical use of goats for subsistence in GMU 11; consequently, the park was closed to goat hunting. Currently, goat hunting is restricted to preserve lands (Tobey, 1996b). In these areas, mountain goats have sustained annual harvest rates of 10 percent of the observed population (Tobey, 1996d). Harvests in GMU 11 are restricted to no more than 35 goats per year (Tobey, 1994b).

GMU 13D. During the 1960s, seasons and bag limits were liberal, and although seasons were reduced over the following decade, the two-goat limit existed until 1975 (Sinnott, 1994). Because of the population decline in the 1970s, the goat season in GMU 13D was closed in 1978. It reopened in 1987 under the restricted-drawing permit system (Sinnott, 1994). Since 1990, fewer than 10 goats have

been harvested each year from GMU 13D (Sinnott, 1996b).

Distribution and Habitat Use

GMU 6. Mountain goats are distributed throughout GMU 6. Near TAPS, goats in Subunit 6D (East and West) use habitats near Thompson Pass (APSC, 1993), where they are found in very rugged and broken terrain with cliffs, ledges, pinnacles, and talus slopes. Occasionally, goats will disperse and move across selected drainages and/or highways. Old-growth forest provides important winter habitat for mountain goats in GMU 6 and other coastal areas of Southeast Alaska (Schoen and Kirchhoff, 1982; Fox et al., 1989; Nowlin, 1996a). During the summer, goats frequent high alpine mountains, where they eat grasses, sedges, and low shrubs (APSC, 1993). Although female goats seek isolated areas to give birth to kids, the availability of winter habitat is the most important seasonal requirement for mountain goats.

GMU 11. The Wrangell and Chugach Mountains are part of the northernmost extension of mountain goat range in Alaska, and goat habitat in these areas is limited (Tobey, 1996d). Near the TAPS ROW in GMU 11, mountain goats are distributed south of the Chitina River in that portion of the Chugach Mountains from the Copper River east to the Canadian border (Tobey, 1996d). This area directly east of and adjacent to the TAPS ROW may provide the most suitable goat habitat in the unit (Tobey, 1996d). East-west movements occur (Tobey, 1996d), and goats in GMU 11 may mix with goats west of TAPS in GMU 13D. Additional information on movements is limited, and major rutting and kidding areas are unknown (Tobey, 1996d). During the winter, goats in GMU 11 are often in areas of lower elevations with shallower snow.

GMU 13D. In GMU 13D, mountain goats are primarily found in the Chugach Mountains adjacent to and west of the TAPS ROW (Sinnott, 1996b). This area is the northernmost edge of mountain goat range in Alaska, and habitat is marginal. During summer, goats feed on open grassy slopes often adjacent to glaciers or snowfields, and seek relief from heat in dense shrub cover, on icefields and glaciers, or under rocky outcrops (Sinnott, 1996b). During winter, goats use steep, timbered hillsides and windblown slopes. Little information is available on precise winter distributions and habitat use, and on kidding and rutting areas (Sinnott, 1996b).

3.2.5.8 Brown (Grizzly) Bear

Brown (grizzly) bears are present in all GMUs that the TAPS ROW crosses (Figure 3.2-18) and on the Alaska North Slope. The following discussions are organized into three sections based on geography and state GMU boundaries: Southcentral (GMUs 6 and 13), Interior (GMUs 20 and 24), and Northern (GMU 26B).

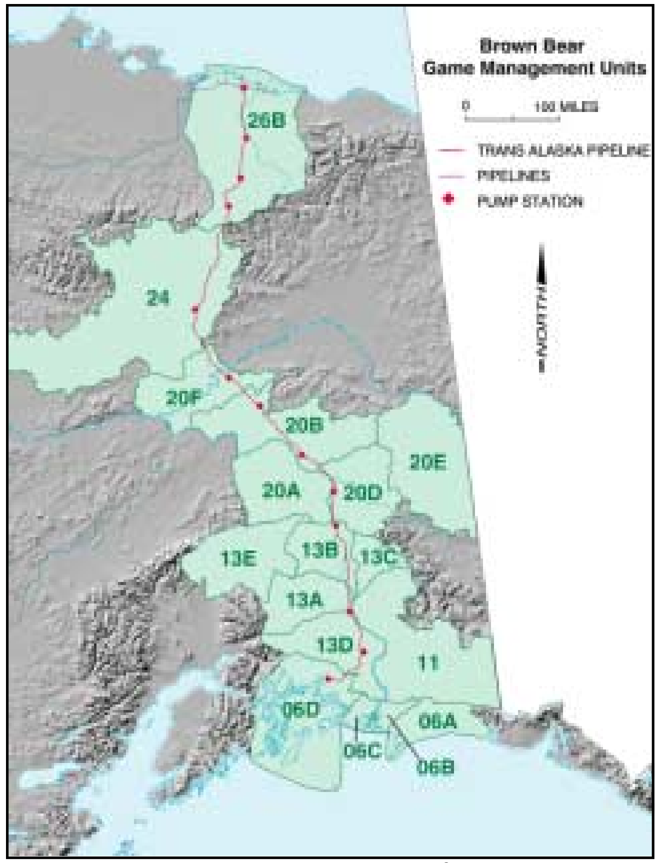


Figure 3.2-18. Game management unit map for brown bears along TAPS.

Population History and Status

Southcentral. Brown bears occur throughout the area south of the Alaska Range. In the vicinity of the TAPS ROW, they are present in GMUs 6, 11, and 13. Nowlin (1995b) estimated the GMU 6 brown-bear population to be 739 bears, the highest proportion of which was in GMU 6D (280 bears). Within this subunit, 116 bears were estimated to be in mainland management areas near TAPS (Rude River-Ellamar and Valdez Arm areas) (Nowlin, 1995b). These population estimates translate into a relatively low mainland brown-bear density of <40 bears/1,000 km^2 (Nowlin, 1995b). The GMU 6D population has been stable or declining

Warren Ballard

Photo 3.2-17. *Brown bear.*

slightly since 1989, primarily because of overharvests in the Rude River-Ellamar area (Nowlin, 1995b). This decline comes after an all-time high population in GMU 6 (Griese, 1989b). Before 1980, sufficient data to determine brown bear status or population trends were not available for GMU 6 (Reynolds, H.V., 1981a). Sources of brown bear mortality include legal and illegal harvest, defense of life and property (DLP) kills, accidents, and non-hunting and natural causes (Nowlin, 1995b; McDonald, 1998c).

Brown bears were numerous in GMU 13 until 1948-53 when the federal poisoning programs directed at controlling wolves inadvertently killed large numbers of bears (Spraker et al., 1981; Ballard et al., 1991). When wolf-control activities ceased, brown bear numbers in GMU 13 increased, and by the mid- to late 1970s, they were again abundant (estimated population of 1,500) and at relatively high densities for an Interior Alaskan bear population (Ballard et al., 1980; Tobey, 1981b, 1995b). Population growth stabilized about 1980, when harvest rates increased (Tobey, 1995b).

Although the exact number of brown bears in GMU 13 is not known, several population estimates were made between the late 1970s and the mid-1990s. Miller and Ballard (1982) estimated bear densities at 1/41.5 km^2 in the upper Susitna River in 1979, while Miller et al. (1987) estimated densities at 1/36.3 km^2 in an adjacent area in 1985. These estimates were extrapolated to the remainder of GMU 13 and resulted in a population estimate of 1,400 to 1,600 bears. In 1987, Miller (1988) re-estimated the bear population in the upper Susitna River at 1/95.8 km^2, suggesting that the population had declined by about 50 percent (Tobey, 1995b). McDonald (1998c) concluded that determining a population trend for brown bears in GMU 13 was difficult. During 1980-90, brown-bear harvest regulations in this unit were designed to cause declines in brown bear density in order to increase moose and caribou calf survivorship and moose availability for harvest by hunters (Miller and Ballard, 1992; Miller, 1993; Miller, 1997). In 1995 this bear reduction effort was accelerated with the adoption of the most liberal brown-bear hunting regulations in Alaska (Miller, 1997). Miller (1993) estimated that bear numbers in GMU 13 have been reduced by 23 to 48 percent since 1980 as a result of liberalized hunting seasons.

In addition to legal sport harvest, brown bear mortality in GMU 13 also occurs as a result of DLP kills (i.e., nuisance bears), illegal harvest, and predation by other bears (Tobey, 1995b). An average 2.8 nuisance bears per year were killed between 1961 and 1993, with an increase to an average of 5 per year between 1990 and 1993 as a result of confrontations at private home sites and mining claims (Tobey, 1995b). Miller and Chihuly (1987) documented that more bears were killed in defense of life and property at remote sites than in any other site category. Tobey (1995b) indicated that the number of remote cabin sites in GMU 13 had increased during the past 15 years and if that trend continued, the number of nuisance bears killed would also increase.

Interior. Prior to 1980, little information was available on brown-bear population size, movements, or distribution in GMU 20, although incidental observations and other indices suggested that the population was moderate in number and increasing in most areas (Jennings, 1981). Since 1981, brown bears in the western portion of the unit (northern Alaska Range in GMU 20A) have been studied during a long-term research project designed in phases to gather baseline population information, to measure the response of brown bear populations to high rates of human-caused mortality, and to then assess population recovery (Reynolds and Hechtel, 1986, 1992; Reynolds, H.V., 1997, 1999). H.V. Reynolds (1997) concluded that although density estimates were unchanged in the study area between 1981 and 1992 (based on mark/recapture survey techniques), annual direct-count estimates indicated that the population had declined by more than 30 percent. Densities in this area are currently estimated at 14 to 17 bears/1000 km^2 (Eagan, 1996).

Within the remaining areas of GMU 20, Eagan (1996) reported low bear densities (1 to 3 bears/1000 km^2) in the Tanana Flats (GMU 20A), the western portion of GMU 20B, and the northeastern portion of GMU 20F due to poor or moderate habitat conditions, high human density, and good hunter access. Moderate densities of 5 to 10 bears/1000 km^2 were reported for the Tozitna River drainage and Ray Mountains in GMU 20F, in the eastern portion of GMU 20B, and south of the Tanana River in GMU 20D (Eagan, 1996; DuBois, 1995). Eagan (1996) extrapolated these densities and estimated that there were 446 to 782 brown bears of all ages in the management area (except 20D), resulting in a density of 6 bears/1000 km^2. DuBois (1995) estimated 76 to 86 total bears in GMU 20D south of the Tanana River. The status of this population is equivocal, and although heavy harvests may cause numbers to decline, Dubois (1993) reported that local residents and hunters thought the population was increasing. Brown bear mortality in GMU 20 occurs as a result of harvest by humans (legal, illegal, and DLP kills) and predation by other brown bears (Eagan, 1996; DuBois, 1995). Since 1990, a total of 10 to 15 bears have been killed in DLP incidents, and approximately 10 were killed illegally (Eagan, 1996; DuBois, 1995).

H.V. Reynolds (1981b) indicated that brown bear num-

bers in GMU 24 were stable or growing. In 1986, H.G. Reynolds (1987) estimated 165 to 225 bears in the northern portions of GMU 24. In 1987, the number of bears in GMU 24 was estimated to be 770 to 930, with the majority of the animals (320 to 480) in Gates of the Arctic National Park (Reynolds, H.G., 1989). In 1991, the GMU 24 brown-bear population was stable or slowly increasing (Osborne, 1991). Human-related mortality is the primary cause of death for bears in GMU 24; one to two bears are killed annually in DLP-related incidents.

Northern. H.V. Reynolds (1981b) indicated that brown bears in GMU 26B were beginning to recover from a population decline in the 1960s that was due to aircraft-supported hunting associated with guiding (Stephenson, 1995). Brown bear numbers in GMU 26B have increased since 1977, densities are currently high, and the population is stable (Stephenson, 1995). In 1993, there were an estimated 262 brown bears in GMU 26B and 1,817 in the eastern Brooks Range and upper Yukon River area (Stephenson, 1995). One or two brown bears are killed each year in DLP incidents in GMU 26B. Relatively little is known about natural mortality of brown bears in this unit (Stephenson, 1995).

Harvest by Humans and Population Management

Southcentral. Between 1961 and 1986, the average annual harvest of brown bears in GMU 6 was 32 bears (range 14 to 63) (Nowlin, 1995b). During this period about 3 percent of the annual harvest was attributed to bears killed illegally or in defense of life or property (i.e., nuisance bears) (Griese, 1991b). During 1987-92, the average yearly harvest rose to 50 bears (range 40 to 60), and most of the increased harvest was from the Prince William Sound area (Nowlin, 1995b). Harvests in 1992-93 (44 bears) and 1993-94 (22 bears) were below average; the majority of these harvests came from GMU 6D (26 in 1992-93 and 15 in 1993-94). Between 1987 and 1994, about 13 percent of the total estimated brown-bear kill was attributed to illegal kill and 4 percent to non-hunting mortality (Nowlin, 1995b). Average harvest between 1995 and 1998 was 16 bears per year (McDonald, 1998c). Reduced harvests in GMU 6 since 1992-93 have been a result of restrictions to harvest regulations and of spring weather conditions (Nowlin, 1995b).

Brown bear harvests have increased in GMU 13 since the early 1960s. Average annual harvests were 39 bears between 1961 and 1969, 58 bears between 1970 and 1979, and 109 bears between 1980 and 1987 (Tobey, 1995b). Miller (1988) calculated a sustainable harvest rate for GMU 13 bears of 5.7 percent per year. Since 1987, harvest rates have exceeded this quota by an average of 14 bears per year (Tobey, 1995b). Between 1989 and 1994, seasons and bag limits became more restrictive (one bear every four years), and the average annual harvest was 86 bears (range 66 to 111) (Tobey, 1995b). Since 1995, harvests have averaged 117 bears per year (range 109 to 123) (McDonald, 1998c). Before 1980, the management objective for GMU 13 brown bears was to maintain a sustained-yield harvest while providing the greatest opportunity to participate in hunting of brown bears (Tobey, 1991a). Seasons were short and there was no spring season.

Following research on bear/moose relationships which indicated that brown bears were significant predators of calf and adult moose (Ballard et al., 1981; Ballard and Larsen, 1987; Ballard et al., 1990; Ballard and Miller, 1990), bear hunting seasons in GMU 13 were liberalized to purposefully reduce bear numbers (Miller and Ballard, 1992; Miller, 1997). After 1980, spring seasons were added and the bag limit was changed from one bear every four years to one per year (Tobey, 1991a). In 1987 the one-bear-per-four-year bag limit was reinstated, and the season length was reduced in 1990 to further lower the harvest of adult female brown bears. In fall 1995, the most liberal bear-hunting regulations for GMU 13 were implemented, changing the bag limit from one bear per four years to one every year, and eliminating the need for resident brown-bear hunters to purchase a tag (Miller, 1997). The intent of these regulations was to "…augment brown bear harvests by encouraging incidental and nondiscriminatory harvests…" by moose and caribou hunters (Miller, 1997, p. 3).

Interior. Before 1981, objectives in GMU 20 were to harvest 3 percent of bears greater than 2 years of age (McNay, 1990). However, in 1981, Reynolds and Hechtel (1986) began their long-term research on the effects of high (>10 percent of the population) harvest by humans on brown-bear population dynamics. Management objectives at that time were to manage harvests to sustain a mean annual exploitation rate of 10 to 15 percent of the estimated population greater than 2 years of age in Subunit 20A. For the remainder of the management area, objectives were to provide a stable population with a mean annual harvest of 30 bears.

In 1988, bear harvests were well below sustained-yield levels, except in the harvest research area of Subunit 20A, and management objectives were being met (McNay, 1990). H.V. Reynolds (1993) recommended that beginning in fall of 1992, mean harvest rates be reduced to 6 to 8 percent of bears older than 2 years to allow the population to recover. Since 1990, harvests in GMU 20 (except 20D) have been stable, with an annual mean of 33 bears. In 1995, brown bear harvests in GMU 20D south of the Tanana River exceeded the harvest objective, with more than 10 percent of the estimated population being taken by humans (DuBois, 1995). Between 1985 and 1994, the average harvest in this area was 8 bears per year.

Osborne (1991) reported that between 1961 and 1987, annual harvests in GMU 24 rarely exceeded 15 brown bears, except in the early 1970s when bear hunting was closed on the Alaska Peninsula, creating additional pressure in the remainder of the state, particularly in GMU 24. During this period, harvests reached a high of 31 bears annually. During 1977, in response to evidence of overharvest in the Brooks Range, brown bear hunting was placed on drawing permit; in 1985, this system was replaced with a more liberal registration hunt; and in 1990, all permits were eliminated (Taylor, 1993b). Between 1987 and 1993, annual harvests averaged 17 bears, including estimates of unreported and illegal kills (Taylor, 1993b). Based on an estimated sustainable harvest rate of 4 percent, Taylor (1993b) reported that a harvest of 31 to 37 bears could be sustained in GMU 24.

Northern. In response to overharvests in the mid-1960s, hunting of brown bears was closed in 1971-72 (Stephenson, 1995). Since that time, conservative management and a variety of regulations such as drawing-permit hunts have been used to limit harvests and increase population numbers. As the population has increased, the number of permits issued has increased. Beginning in 1987-88, drawing permits were required only for nonresident hunters in GMU 26B, and in 1997, permits were eliminated for all hunters in the unit. The nonresident permit system was reinstated in 1998-99 (Nowlin, 1998c). Between 1988 and 1993, annual harvests averaged 13.5 bears in GMU 26B.

Distribution and Habitat Use

Southcentral. In GMU 6, brown bears are common on the mainland east of the Columbia Glacier and on several islands in Prince William Sound (Griese, 1991b). In these coastal areas, bears emerge from dens in late March (depending on weather conditions) and during spring from mid-April to late July are found in grassland areas such as grass flats, sedge meadows, and saltwater bogs (APSC, 1995a). Brown bears feed on salmon from mid-May through August and use both salmon and berries during the fall from September through early November. Denning begins in late October, with most bears denned by mid-December (APSC, 1995a).

Brown bears in GMU 6 use old-growth forests during spring and early summer (upland forests) and riparian areas within old-growth forests during late summer (Schoen and Beier, 1990). Nowlin (1995b) and Griese (1991b) concluded that logging in these habitats threatens brown-bear abundance and distribution, in addition to providing access roads and increasing human activity. They also expressed concern regarding potential increases in bear/human interactions that may result in bear mortality.

After emergence from dens in the spring, from mid-April through mid-May, most brown bears (except females with cubs-of-the-year) in GMU 13 move down to river bottoms to feed on sprouting plants and overwintered berries, and to scavenge the carcasses of ungulates killed during the winter (Ballard et al., 1982; Miller, 1987; Tobey, 1995b). During the spring, females with cubs are at higher elevations, which reduces contact with other bears. During summer and fall, bear distribution and movements are determined by the presence of salmon and by moose and caribou distributions (Miller, 1987; Tobey, 1995b). Ballard et al. (1982) reported that brown bears in the Nelchina Basin entered dens in late October.

The number of remote cabins and homesites in GMU 13 has increased "substantially" over the past 15 years, and brown bears in the unit are becoming more common in these areas (Tobey, 1995b, p. 127). Miller (1988) documented that bears avoided mining operations at Valdez Creek, although Tobey (1995b) also indicated that nuisance bears were becoming more common at mining claims. Tobey (1995b, p. 127) concluded that "development in remote areas in Unit 13 could reduce brown bear habitat in the unit." Bear/human conflicts and divergent public attitudes towards bears are currently important non-regulatory management concerns (Tobey, 1995b).

Interior. In the vicinity of the TAPS ROW, highest brown-bear densities in GMU 20 occur in the Alaska Range portions of Subunit 20A (Eagan, 1996; Reynolds, H.V., 1997). Medium-density areas include upland forest and tundra habitats at elevations between 150 and 450 m (Eagan, 1996), and those areas of GMU 20D south of the Tanana River (DuBois, 1995). Areas of low brown-bear density contained "significant" human development, areas with poorly drained soils, and permafrost/black spruce parts of the unit (Eagan, 1996, p. 194). APSC (1993) indicated that there were brown-bear spring and "berry-use" areas near TAPS in southern portions of GMU 20.

In GMU 24, brown bears occur throughout the entire area, including the Dalton Highway and TAPS ROW, with higher numbers in the more mountainous areas (Osborne, 1991). No other habitat-use or general-movement patterns have been documented (Reynolds, H.G., 1989).

Northern. Brown bears are distributed throughout GMU 26B; highest densities are in the foothills of the

Brooks Range, while the lowest densities are found on the coastal plain of the North Slope (Stephenson, 1995). APSC (1993) reported brown-bear spring and "berry-use" concentration areas in GMU 26B near TAPS and the Dalton Highway.

Shideler and Hechtel (2000) described brown-bear use of oil fields during 1990-97. Before oil-field development, bears were not common in the oil-field area; however, by 1997 there were 60 to 70 bears in the oil-field study areas (density = 4.0/1,000 km^2). Relatively high densities of arctic ground squirrels, relatively abundant denning habitat, and access to anthropogenic food sources (i.e., garbage) apparently have allowed the bear population to increase to relatively high densities in comparison to other Arctic Coastal Plain habitats. The bears in the oil-field areas do not constitute an isolated population, and there is movement of animals and gene flow among different areas of the North Slope (Cronin et al., 1999).

Most of the bears in the oil-field complex den in natural dens, but some use man-made structures. For example, one bear denned in a pipe casing in the oil field. Shideler and Hechtel (2000) reported that feeding strategies of oil-field bears were similar to other North Slope areas that do not contain oil fields, although 21 percent of radio-collared bears supplemented their diets with anthropogenic food sources in the oil fields. They concluded that overall, bear habitat was more productive in the oil fields than in other North Slope bear-study areas.

Bears with access to anthropogenic food sources in oil fields have relatively large average litter sizes and low cub mortality compared to other bear populations on the Arctic Coastal Plain (Shideler and Hechtel, 2000). However, relatively high subadult and adult mortality offset these benefits. Of 10 deaths, only one occurred in the oil-field complex, when a vehicle hit that bear. Other mortalities included seven bears being killed by hunters or as DLP kills. Only two of the seven kills were officially listed as DLPs, but speculation was that these food-conditioned bears approached camps and were not wary of hunters. Two other bears died of apparently natural but undetermined causes at den sites. Shideler and Hechtel (2000) suggested that oil-field bears which had become habituated to the presence of humans were consequently more vulnerable to harvests by humans when they moved away from the oil fields.

Brown bears in the oil-field complex prey on and scavenge a variety of species including their diet-staple arctic ground squirrels and other microtines, Snow Goose eggs and nestlings, other waterfowl, arctic fox pups excavated from dens, muskoxen calves, and caribou calves (see Shideler and Hechtel, 2000, and references therein). During intensive caribou-calving-ground aerial surveys east and west of the Sagavanirktok River in 1986-90, only a few bears in the oil-field region were seen feeding on dead calves (Shideler, pers. comm., in Shideler and Hechtel, 2000). More recently, brown bears have been observed in the Kuparuk oil field during caribou calving but have seldom been seen foraging on caribou; most bears were associated with anthropogenic food sources (Shideler and Hechtel, 2000).

Shideler and Hechtel (2000) indicated that agency and industry regulations such as prohibition of hunting and firearms within the oil fields, education about bear safety and training in how to handle bear problems, and strict regulations against the feeding of bears had successfully reduced the effects of oil fields on bears. Bear-proof garbage containers are currently being installed in the oil-field complex, and access to the North Slope Borough garbage landfill has been eliminated with chain link and electric fencing. Concerns have been expressed about the impacts of these actions on the bear population. Shideler and Hechtel (2000) anticipated short-term increases in mortality of bears habituated to anthropogenic food sources, but in the long term they expected the bear population would be characteristic of natural populations not exposed to oil fields.

Brown bears have also been associated with anthropogenic food sources in areas other than North Slope oil fields (Shideler and Hechtel, 2000; Harting, 1987). Schullery (1980) reviewed the history of the brown bear/garbage situation in Yellowstone National Park since the late 1800s. Craighead (1980) documented garbage-related bear movements in the park between 1959 and 1970, and the last of the open-pit garbage dumps inside the park were closed in 1970 (Harting, 1987). Extensive controversy surrounded these closures and continues to the present, but is beyond the scope of this review. Other areas that have experienced problems with garbage and bears include Glacier National Park in Montana, Banff and Jasper National Parks in Canada, Katmai National Monument and Denali National Park in Alaska, and Bridger-Teton National Forest (see Harting, 1987 and references therein).

3.2.5.9 Black Bear

Black bears are present in all GMUs that the TAPS ROW crosses, except in the northern GMUs 24 and 26B (Figure 3.2-19). The following discussions are organized based on geography and state GMU boundaries: Southcentral (GMUs 6 and 13) and Interior (GMU 20).

Population History and Status

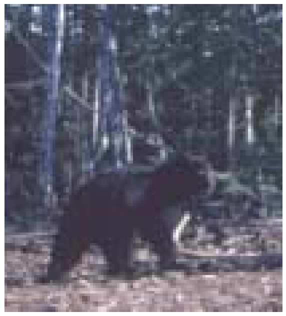


Photo 3.2-18. *Black bear.*

Southcentral. In the late 1960s, McIlroy (1970) estimated 0.4 to 5.4 black bears/km^2 near Valdez. He also reported that data on harvests, hunter success, and increasing effort per bear hunted suggested that the black bear population in the Valdez Arm area was declining. However, J.R. Reynolds (1981b, p. 21) stated that before 1981, “sufficient data to determine current status or trend of black bears in Unit 6 were not available.” The black bear population in GMU 6 has not been estimated recently, and McDonald (1998d) indicated that the population could sustain the current harvest. Griese (1989c) suggested that trends in black bear harvest are thought to track population trends; black bear numbers in GMU 6 may be stable. In addition to harvest by legal and illegal kills, other factors that may influence black bear numbers in GMU 6 are food abundance, adverse weather, habitat quality and quantity, and competition and predation by brown bears (Griese, 1989c; Nowlin, 1996b).

In 1981, Tobey (1981b) reported that black bears were abundant in suitable habitat in GMU 13. Miller and McAllister (1981, cited in Tobey, 1981b) estimated 1 bear/4.1 km^2 in forested areas of the Susitna River drainage, and in 1985, Miller (1987) estimated 1 bear/1.7 km^2 in the same area. This study area was west of the TAPS ROW and considered marginal habitat and therefore not representative of densities in more favorable habitats in GMU 13 (Tobey, 1996e). Density estimates for black bears in optimal habitat in GMU 13 have not been conducted, and a population estimate is not available for the unit (Tobey, 1996e). Tobey (1989) reported that public reports and miscellaneous sightings indicated that black bears were numerous in GMU 13, and at that time the population appeared to be increasing. Currently, the black bear population in GMU 13 is stable (McDonald, 1998d). In the mid-1980s, predation by brown bears was an important source of natural black-bear mortality (Miller, 1987).

Interior and Northern. Black bears are currently found throughout the Interior in GMU 20, numbering approximately 2,000 to 4,000 (Boudreau, 1996; DuBois, 1996c). Before 1988, few data were available on black bear abundance in the unit (Jennings, 1981; Boudreau, 1996). Hechtel (1991) reported 0.07 adult black bears/km^2 in the Tanana Valley. This density estimate has been extrapolated to the remaining portions of GMU 20, resulting in population estimates of 750 to 1,200 bears in GMU 20B, 400 to 700 bears in GMU 20F, and 750 bears in GMU 20D (Boudreau, 1996; DuBois, 1996c). Population-trend information is not available for GMU 20; however, management objectives are being met (Beasley and McNay, 1989; Boudreau, 1996; DuBois, 1996c). In 1987, Beasley and McNay (1989) concluded that black bear populations in the Interior were stable at moderate densities. Black bear mortality in this area results from harvest by humans (legal, illegal, and DLP kills), predation by brown bears, food shortages that affect cub and yearling survival, and flooding of natal dens (Alt, 1984; Boudreau, 1996; DuBois, 1996c).

Black bear also occur along the north portion of TAPS in GMU 24 and occasionally in southern GMU 26B.

Harvest by Humans and Population Management

Southcentral. In GMU 6, trends in black bear harvest are thought to track population trends (Griese, 1989c), although harvests may also be correlated with hunting effort (McIlroy, 1970). Beginning in 1973, all black bears harvested in Alaska were to be sealed (hide and skull presented

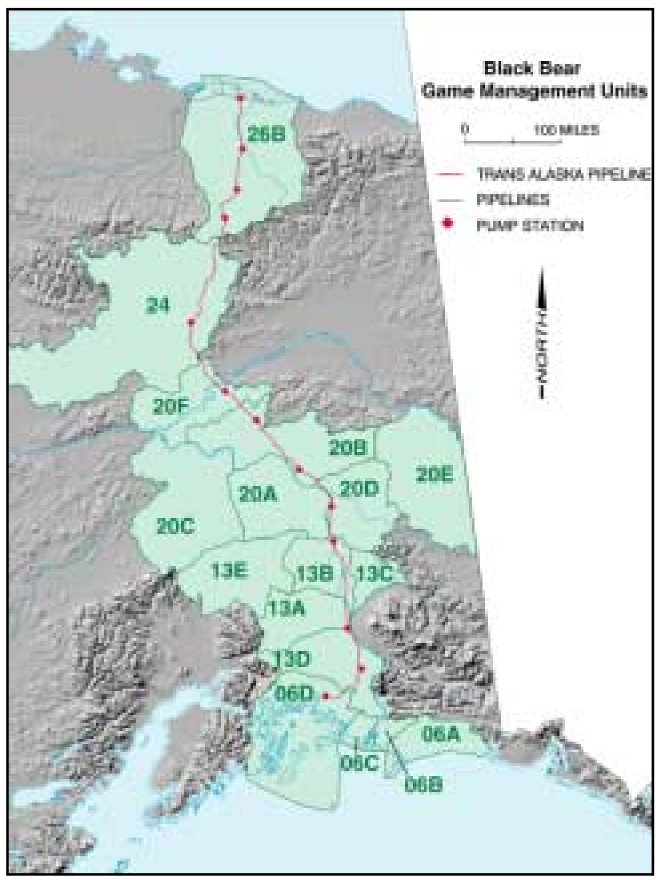


Figure 3.2-19. *Game management unit map for black bears along TAPS.*

for inspection) by an official state representative. Prior to 1973, bear harvests in GMU 6 were largely unreported; Robards (1954) reported “nil” harvest in the early 1950s, while McIlroy (1970) reported over 100 bears harvested during 1965 and 1966. Nowlin (1996b) reported that sealing records indicated an average annual take of 118 black bears between 1973 and 1983, with an increase to 241 between 1984 and 1991 (1986 peak of 279 sealed bears). Since 1991, the average black-bear harvest, including non-hunting mortality and estimates of unreported and illegal kills, in this unit was 227 (range 110 to 304) (Nowlin, 1996b; McDonald, 1998d). Current harvests are above management objectives (Nowlin, 1996b), and a six-month season for all hunters and a bag limit of one per year have been in effect in GMU 6 since 1969 (Griese, 1989c; Nowlin, 1996b). Most hunters come from Anchorage and Fairbanks (Nowlin, 1993b), and more than 70 percent of the harvest occurs in GMU 6D, the subunit containing TAPS.

Although black bear harvests in GMU 13 were not recorded until 1973 when sealing became mandatory, Tobey (1989) estimated that harvests averaged 62 black bears per year between 1970 and 1979 and increased to 83 per year from 1980 to 1983. He attributed higher harvests to increased interest and popularity in black bears as a big game species. During the 1980s, GMU 13 black-bear management objectives were to maintain the existing population of bears, and hunting was open 365 days per year with a bag limit of 3 bears (Tobey, 1989). Recent management objectives call for the black bear population to be largely unaffected by harvest by humans and state that the annual harvest should average less than 125 bears (McDonald, 1998d). Since 1988, harvests including non-hunting mortality, and estimates of unreported and illegal kills have averaged 75 black bears per year (range 53 to 197) (Tobey, 1996e; McDonald, 1998d). Because of a declining percentage of male bears in annual harvests, Tobey (1989) recommended that the bag limit be reduced to one bear. However, as of 1998, seasons and bag limits remained unchanged, and all management objectives had been met (McDonald, 1998d).

Interior. Harvest data were not available before 1974 in GMU 20. Between 1984 and 1995, an average of 210 black bears (range 124 to 303) were taken from GMU 20 (Boudreau, 1996; DuBois, 1996c). Most bear harvest in GMU 20 occurs in the road-accessible portions of GMU 20B, although Boudreau (1996) indicated that hunters are traveling farther away from the road system and from Fairbanks to hunt black bears. In addition, nonresident military hunters can hunt without a tag or license if they hunt on military land. Boudreau (1996, p. 143) concluded that “…military land such as the Yukon Maneuver Area in Unit 20B and the Fort Wainwright land in Unit 20A are hunted intensively. Approximately half of the bear harvest is by military personnel.” Most harvest in GMU 20D occurs south of the Tanana River (DuBois, 1996c). Management goals in GMU 20 are being met. These goals are to protect, maintain, and enhance the black bear population and its habitat in concert with other components of the ecosystem; to provide the greatest sustained opportunity to participate in hunting black bears; and to protect human life and property in human/bear interactions.

Distribution and Habitat Use

Southcentral. The highest concentrations of black bears in GMU 6 occur in Subunit 6D, which includes Valdez Arm (Griese, 1989c). During the non-denning period, black bears use coniferous forest and alder-dominated mountain slopes. Where black bear distributions overlap those of brown bears, black bear densities are lower than in areas where only black bears occur (Griese, 1989c). Nowlin (1996b) indicated that relatively high hunting pressure has probably reduced bear numbers near population centers. APSC (1993) identified black-bear concentration areas near the ROW in GMU 6.

In GMU 13, Tobey (1989) indicated that black bears were numerous in those areas with suitable forest habitats and that habitat had probably increased in the unit since the 1950s because of extensive fire-suppression policies. Bears use forested habitats during the summer, and during spring and fall move into shrub zones to feed on berries and succulent vegetation (Miller, 1987; Tobey, 1996e). Habitats along the Susitna River are marginal for black bears and are not considered representative of the unit (Miller, 1987; Tobey, 1989). In relation to TAPS, black bears are most numerous in Subunit 13D, and APSC (1993) identified black-bear concentration areas near the ROW in GMU 13.

Interior. In GMU 20, black bears are at the northern limit of their range in Alaska. They are distributed throughout the entire unit, including those areas in the vicinity of the TAPS ROW and highways. During spring, bears use moist lowlands, where early-growing vegetation is the bulk of their diet (Hatler, 1967, cited in Boudreau, 1996). In the fall, bears feed primarily on berries found in open meadows or alpine areas. In GMU 20D, black bears are essentially absent from the most heavily populated areas and treeless alpine habitat (DuBois, 1996c). APSC (1993) identified black-bear concentration areas near the ROW in GMU 20.

3.2.5.10 Wolf

Wolves are present in all GMUs that the TAPS ROW crosses (Figure 3.2-20). The following is organized into three sections based on geography and state GMU boundaries: Southcentral (GMUs 6 and 13), Interior (GMUs 20A, 20B, 20C, 20F, and 24), and Northern (GMU 26B).

Population History and Status

Southcentral. Wolves have existed in low numbers in GMU 6 since the turn of the century (Griese, 1989d). The numbers have gradually increased since the early 1950s, most likely in response to increased ungulate prey (i.e., deer translocated to islands in Prince William Sound; see Section 3.2.5.6) and cessation of federal wolf-poisoning efforts (ca. 1940s and 1950s) (Nowlin, 1997). There are approximately 47 to 61 wolves in eight packs in GMU 6 (McDonald, 1998e), and although little is known about the wolf population in GMU 6D (specifically Valdez Arm), Nowlin (1997) suggested that it contained 10 to 15 wolves in 3 packs.

Ballard et al. (1987) reviewed the history of wolves in GMU 13 through 1982. During the late 1940s and early 1950s, extensive wolf control by the federal government reduced wolf populations to extremely low levels, with an estimated 12 wolves in GMU 13 in 1953. Following cessation of wolf control, numbers increased quickly and reached a high of 350 to 450 by 1965. In 1967, the population declined to less than 300 wolves in response to hunting pressure and low moose numbers. Wolves increased quickly between 1968 and 1975, reaching a second peak of 426. In 1982, numbers were again reduced to 109 wolves during spring due to harvest management policies designed to reduce wolf predation on moose and caribou. These policies included wolf control and intensive hunting and trapping pressure, including same-day airborne hunting (Ballard et al., 1987) (Figure 3.2-21).


Warren Ballard

Photo 3.2-19. *Wolf.*

After 1982, wolf numbers increased in GMU 13 in response to changes in hunting and trapping seasons and bag limits, methods of allowable harvest, and mild weather conditions. By autumn, wolf numbers were estimated at 400 (Tobey, 1991b). Since the early 1990s, autumn pre-harvest wolf numbers have ranged from 310 to 472, while spring post-harvest numbers ranged from 160 to 260 (Tobey, 1997) (Figure 3.2-21). The fall 1997 wolf population in GMU 13 was estimated to be 360 to 400 wolves in 45 to 55 packs (McDonald, 1998e). Wolves in GMU 13 are not limited by prey availability because "moose numbers are moderate and caribou numbers are high" (McDonald, 1998e, p. 8). Hunting is the primary cause of mortality in GMU 13, although ADF&G is unable to "reduce the wolf population

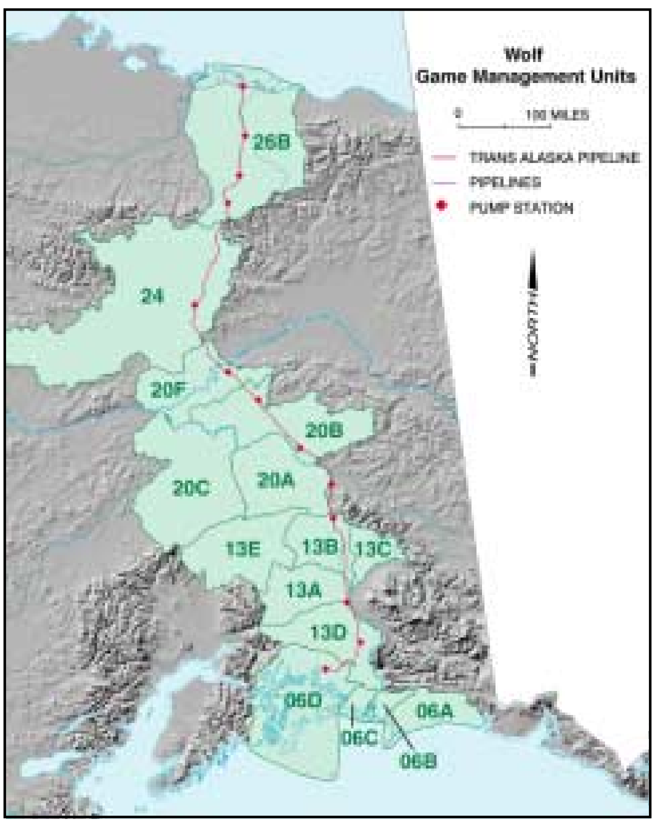
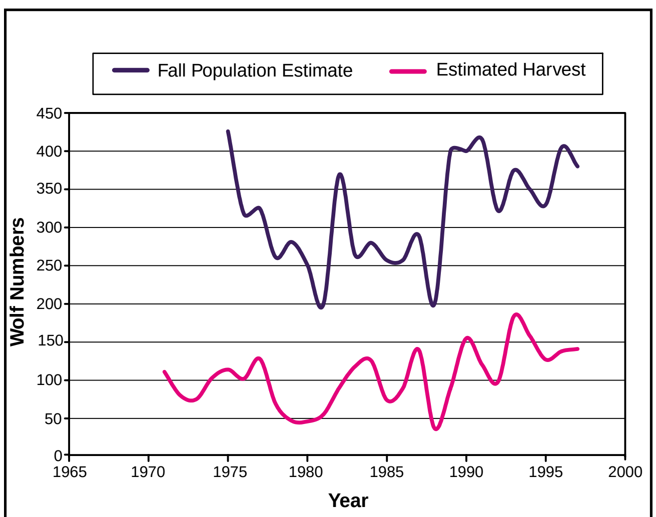


Figure 3.2-20. *Game management unit map for wolves along TAPS.*



Sources: Ballard et al. (1987), Tobey (1997).

Figure 3.2-21. *Fall wolf-population estimates/harvests, GMU 13.*

to meet wolf management objectives for intensive management” (Tobey, 1997, p. 67). Other sources of wolf mortality include predation by other wolves, accidents, injuries, starvation, and drowning (Ballard et al., 1987; Tobey, 1997)

Interior. Wolves in Interior Alaska, as in most other parts of the state, were numerous in the late 1940s and early 1950s, but by the late 1950s were reduced to low numbers due to federal wolf-control programs (Gasaway et al., 1983). Wolf control ended in 1960, and numbers increased through the 1960s, peaking in the early 1970s. Gasaway et al. (1983) estimated 170 to 260 wolves in GMU 20A between 1963 and 1975. Wolf control was again initiated in autumn 1975 in an effort to increase moose and caribou populations. During the next five years, wolf numbers in GMU 20A were reduced by 70 to 80 percent, and by 55 to 60 percent for an additional two years (Boertje et al., 1996). After control efforts ended in the spring of 1982, wolf populations in the unit increased to pre-control levels (Boertje et al., 1996). In 1993, there were an estimated 250 to 275 wolves in GMU 20A in 30 to 34 packs (Dale, 1997b). During this time, the Delta Caribou Herd declined from 10,700 to 3,600 due to unfavorable weather and predation, precipitating the wolf-control program from October 1993 through November 1994 (Dale, 1997b). In fall 1995, there were an estimated 180 to 210 wolves in GMU 20A in 25 to 35 packs, and 750 to 1,070 wolves in 85 to 144 packs in the lower Tanana Valley (Dale, 1997b). Wolves in GMU 20A are not limited by prey availability (Stephenson et al., 1995).

Wolf populations in GMU 24 have fluctuated over time in response to the availability of prey and to wolf-control activities (Woolington and McNay, 1997). Wolf numbers were historically low in the Brooks Range because ungulate densities were low (Campbell, 1974 cited in Woolington and McNay, 1997). As prey numbers increased during the 1950s, wolf populations in GMU 24 also increased, peaking during the mid-1950s. Federal wolf-control efforts subsequently reduced wolf numbers in the unit, reducing the effect of wolf predation on local moose populations and thus increasing the available prey base. With the cessation of predator control in April 1982 and increased prey abundance, wolves in GMU 24 increased. Between 1988 and 1996, annual wolf-population estimates ranged from 390 to 540 animals in 50 to 70 packs (Woolington and McNay, 1997). In the southern portions of GMU 24, wolf numbers “are as high as at any known time” (Woolington and McNay, 1997, p. 164).

Northern. Wolves are present throughout the Brooks Range and in those areas of the Arctic Coastal Plain where resident prey abundance is sufficient to support their numbers (Stephenson, 1997). ADF&G and FWS personnel have intermittently surveyed wolf populations in GMU 26. In fall 1995, 150 to 215 wolves in 22 to 32 packs were estimated to be in GMUs 26B and 26C, and this population is currently stable (Stephenson, 1997). Factors limiting wolf population growth in GMU 26B include availability of ungulate prey, predation by other wolves, and rabies (Zarnke and Ballard, 1987; Ballard and Krausman, 1997).

Harvest by Humans and Population Management

Southcentral. Before 1982, hunting and trapping seasons were liberal, and same-day airborne hunting was permitted for wolves in GMU 13 (Ballard et al., 1987). After 1982, bag limits and hunting and trapping regulations were restricted (same-day airborne hunting was eliminated in 1988). In the early 1990s, regulations and harvest methods were again liberalized to achieve the GMU 13 wolf-management objective of maintaining a post-hunting and -trapping spring wolf population of 175 to 225 (Tobey, 1997). In 1995, GMU 13 was designated an intensive management area, with the primary objective of increasing harvest of moose and caribou by humans (Tobey, 1997). The spring wolf-population objective was reduced to 135 to 165 wolves. In 1997 there was no bag limit on wolf harvests by hunting and trapping in GMU 13, and same-day airborne hunting was allowed with a registration permit (Stephenson et al., 1995; Tobey, 1997).

Annual wolf harvests from 1971 to 1998 have ranged from a low of 37 during 1988-89 when methods of harvest were greatly restricted, to a high of 184 during 1993-94 when deep snows provided excellent wolf-tracking conditions for same-day airborne hunters (Figure 3.2-21).

Interior. During the 1970s, the ADF&G wolf management objectives for the Interior GMUs including 20A were to reduce wolf numbers to allow increases in moose and caribou populations. Between 1975 and 1981, total wolf harvest in GMU 20A from public hunters and ADF&G control efforts averaged 48 per year (range 13 to 145) (Boertje et al., 1996). After wolf control in 1982-92, the public harvested an average of 36 wolves per year (range 14 to 67), with highest harvests occurring during periods of severe winter weather (1990-92). Renewed ADF&G wolf control increased the annual harvest to 162 wolves during 1993-94 and 66 during 1994-95 (Boertje et al., 1996). Since that time, wolf harvests have remained stable at approximately 50 per year (Dale, 1997b). The number of hunters and trappers has also remained relatively stable.

Between 1988 and 1995, reported wolf harvests in GMU 24 averaged 76 animals each year (range 30 to 119). Most wolves harvested in this unit are probably taken from the southern portion (Woolington and McNay, 1997).

Northern. Wolf harvests by hunting and trapping in GMU 26B averaged 16 animals per year (range 3 to 31) between 1987 and 1997. Peak harvests occurred in 1992 and 1993, but are currently stable at less than 10 wolves per year (Stephenson, 1997; James, 1997b). In GMU 26B, wolves are harvested from various locations near TAPS from the Atigun River north to Sagwon (Stephenson, 1997). Wolf hunting is permitted only with bow and arrow in the Dalton Highway Corridor Management Area; trapping is allowed in the DHCMA. Actual harvests are probably higher than reported harvests because local hunters do not consistently comply with sealing requirements (Ballard et al., 1997).

Distribution and Habitat Use

Southcentral. Ballard et al. (1987) studied radio-collared wolves during the 1970s and 1980s in GMU 13. They determined that distribution and movement patterns of wolves in GMU 13 were dependent on prey availability. They also found that wolf territory size was primarily a function of moose density and that wolves do not follow migrating caribou out of pack territory. Many of the wolf territories described by Ballard et al. (1987) were bisected by the TAPS ROW and the Richardson Highway.

Interior. Gasaway et al. (1983) documented and described wolf distribution in GMU 20A. In 1976, 5 of 23 packs in the unit had territories directly adjacent to the Richardson Highway and TAPS ROW between Fairbanks and Big Delta. Although migratory moose in the study area crossed the ROW and highway during seasonal movements, Gasaway et al. (1983) did not say if wolves followed them. Ballard and Gipson (2000) also illustrated wolf pack distribution in GMU 20A, with several packs maintaining territories near the TAPS ROW.

Wolves are found throughout GMU 24 in all habitat types and near human settlements (Woolington and McNay, 1997). Their distribution is also dependent on the availability of prey. Highest wolf densities are found in the northern and southern portions of the unit rather than in the central area, which has the lowest density of resident ungulates (Woolington and McNay, 1997).

Northern. Wolves are present throughout GMU 26B in areas where the densities of resident ungulate prey will support their numbers (Stephenson, 1997). Highest wolf densities are found in the Brooks Range and its foothills. Garner and Reynolds (1986) monitored radio-collared wolves in ANWR and as far west as GMU 26B. They determined that these wolves did not follow caribou to winter range, but remained in the same pack territories all year. Radio-collared wolves on the coastal plain seasonally preyed on the most available ungulate species: caribou during spring and summer, and moose and Dall sheep during winter (Garner and Reynolds, 1986). Little is known about wolf habitat use in the foothills of the Brooks Range and on the coastal plain. APSC (1993) documented two wolf-den sites near TAPS — one at Atigun Pass and the other just north of Pump Station 3. Both sites are mapped in river drainages adjacent to TAPS and the Dalton Highway.

3.2.5.11 Furbearers and Small Mammals

Excluding introduced rodents, 39 species of furbearers and small mammals occur along the TAPS ROW: 7 species of shrews, little brown bat, snowshoe hare, collared pika, 6 species of squirrels and marmots, beaver, 11 species of voles and mice, porcupine, 2 species of foxes, coyote, 6 species of weasels, and lynx (Table 3.2-17). Small mammals are ecologically important as primary consumers of vegetation and as prey of larger mammals and raptorial birds. Several species — including the Alaska tiny shrew (Dokuchaev, 1997), the water shrew (Cook et al., 1997), and the long-tailed vole — are rare or little studied. The Alaska tiny shrew, Alaska marmot, and the collared pika are species endemic to Alaska or the North.

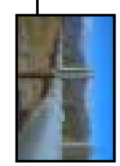
No terrestrial mammals in Alaska are listed as threatened or endangered. However, the lynx is a sensitive species (formerly a C2 species and listed as a threatened species in the contiguous 48 states; 65 FR 16052). Along with the river otter, the lynx is listed in Appendix II of the Convention on International Trade in Endangered Species (CITES).

In general, the species of greatest relevance to this project are those that are harvested by humans for fur or food. Therefore, the remainder of this section focuses on 12 species of furbearers that are regularly harvested or that potentially would be affected by specific management activities or impacts other than harvest: beaver, muskrat, coyote, arctic fox, red fox, marten, short-tailed weasel, least weasel, mink, wolverine, river otter, and lynx.

Abundance and harvest statistics are available, primarily from ADF&G survey and inventory reports, for six species of furbearers (including wolves) whose harvested furs must be sealed. Population information is lacking for the other species. The TAPS ROW passes through portions of seven game management units: GMU 26 (North Slope), GMU 25 (Upper Yukon), GMU 24 (Koyukuk River), GMU 20 (Tanana Valley), GMU 13 (Nelchina Basin), GMU 11 (Wrangell Mountains), and GMU 6 (Prince William Sound). ADF&G manages the harvest of furbearers with both hunting and trapping regulations. Beaver, coyote, arc-

Table 3.2-17. *Furbearers and small mammals that have been recorded in Alaska, including the TAPS ROW, North Slope oil fields, and shipping corridor (within Alaska) in which they are known to occur regularly. This list is based on University of Alaska Museum checklist (Jarrell et al., 1998), which includes indigenous, feral, and accidentally introduced species based on refereed literature or specimens at the University of Alaska Museum. Except where noted, names are from Wilson and Reeder (1993). "x" indicates species present; "*" indicates species documented but presently rare (or absent) in range indicated; "?" indicates species possibly present but status unknown.*

		TAPS ROUTE									
Common Name	Scientific Name	Arctic Coastal Plain	Arctic Foothills	Brooks Range	Interior Forest	Alaska Range	Copper Plateau	Pacific Coastal Mts.	Western Hemlock-Sitka Spruce Forest	North Slope Oil Fields	Shipping Corridor
Common, or Masked, Shrew	*Sorex cinereus*	x	x	x	x	x	x	x	x	x	
Barrenground Shrew	*Sorex ugyunak*	x	x							x	
Dusky, or Wandering, Shrew	*Sorex monticolus*			x	x	x	x	x	x		
Water Shrew	*Sorex palustris*				x	x	x	x	x		
Tundra Shrew	*Sorex tundrensis*	x	x	x	x	x	x	?	?	x	
Pygmy Shrew	*Sorex hoyi*				x	x	x	x			
Alaska Tiny Shrew	*Sorex yukonicus*		?	?	x	?	x	?	?		
Little Brown Bat	*Myotis lucifugus*				x	x	x	x	x		
Collared Pika	*Ochotona collaris*			x	x	x	x				
Snowshoe Hare	*Lepus americanus*	x	x	x	x	x	x	x	x	x	
Woodchuck	*Marmota monax*				x						
Alaska Marmot	*Marmota broweri*		x	x							
Hoary Marmot	*Marmota caligata*				x	x	x	x	x		
Arctic Ground Squirrel	*Spermophilus parryii*	x	x	x	x	x	x	x		x	
Red Squirrel	*Tamiasciurus hudsonicus*			x	x	x	x	x	x		
Northern Flying Squirrel	*Glaucomys sabrinus*				x	x	x				
Beaver	*Castor canadensis*				x	x	x	x	x		
Northern Red-Backed Vole	*Clethrionomys rutilus*	x	x	x	x	x	x	x	x	x	
Meadow Vole	*Microtus pennsylvanicus*			x	x	x	x	x	x		
Tundra Vole	*Microtus oeconomus*	x	x	x	x	x	x	x	x	x	
Long-Tailed Vole	*Microtus longicaudus*				x	?					
Yellow-Cheeked, or Taiga, Vole	*Microtus xanthognathus*				x	x	?				
Singing Vole	*Microtus miurus*	x	x	x		x	x	x	x	x	
Muskrat	*Ondatra zibethicus*				x	x	x	x	x		
Brown Lemming	*Lemmus trimucronatus*	x	x	x	x	x				x	
Northern Bog Lemming	*Synaptomys borealis*				x	x	x	x	x		
Collared Lemming	*Dicrostonyx groenlandicus*	x	x	x	*	*				x	
Meadow Jumping Mouse	*Zapus hudsonius*				x	x	x	x	x		
Porcupine	*Erethizon dorsatum*	*	x	x	x	x	x	x	x		
Coyote	*Canis latrans*	x	x	x	x	x	x	x	x	x	
Arctic Fox	*Alopex lagopus*	x	x	*						x	
Red Fox	*Vulpes vulpes*	x	x	x	x	x	x	x	x	x	
Marten	*Martes americana*			x	x	x	x	x	x		
Short-Tailed Weasel, or Ermine	*Mustela erminea*	x	x	x	x	x	x	x	x	x	
Least Weasel	*Mustela nivalis*	x	x	x	x	x	x	x	x	x	
Mink	*Mustela vison*	*	*	x	x	x	x	x	x	*	x
Wolverine	*Gulo gulo*	x	x	x	x	x	x	x	x	x	
River Otter	*Lontra canadensis*		*	*	x	x	x	x	x		x
Lynx	*Lynx canadensis*		*	x	x	x	x	x	x		



tic and red fox, lynx, wolverine, river otter, marten, mink, weasels, muskrat, squirrels and marmots, and hare (all classified as “furbearers” in Alaska Trapping Regulations, No. 40, for 1999-2000 season) may be harvested with a trapping license. Furbearers may be taken with traps or snares, or shot with a firearm, unless specifically prohibited. Coyote, arctic and red foxes, lynx, squirrels and marmots, and hares (all classified as “fur animals” in Alaska Trapping Regulations) may also be harvested with a hunting license. Individual bag limits are cumulative if both harvest methods (hunting and trapping) and licenses (hunting and trapping) are used.

An ADF&G representative must seal pelts of species considered sensitive to overharvest: lynx, beaver, river otter, wolverine, and wolf taken anywhere in Alaska, and marten trapped in certain GMUs or subunits. The primary purpose of sealing is to gather more detailed information about the harvest.

ADF&G manages harvest through bag limits and manipulation of the legal seasons for each species in each GMU or subunit (Table 3.2-18). Current bag limits with a hunting license for coyote, foxes, and lynx are either 2 or 10, depending on the GMU. With a trapping license, there are no bag limits for these three species. Along the pipeline, beaver harvest is controlled by bag limits in GMU 26 (bag limit 0); GMU 25 (bag limit 50, except in Subunit 25C); portions of GMU 20 (bag limit 0 in Subunit 20B, bag limit 25 in Subunits 20D and 20E); and GMU 11 (bag limit 30). For all other species except lynx and wolverine, there are no bag limits along the ROW and the trapping season is more than 100 days long. Trapping and hunting seasons are less than 100 days for lynx in GMUs 6, 11, 13, and 20 (hunting only) and for wolverine in GMUs 11 and 13.

Beaver

Beavers are the largest native rodents in North America (Hall, 1981) and are found in suitable habitats throughout Alaska, except on the Arctic Coastal Plain (Jenkins and Busher, 1979). Beavers occur exclusively in association with woody vegetation and fresh water — including streams and large rivers, impoundments, and lakes — from sea level to the alpine zone where aspen is available. Beavers are generally crepuscular and nocturnal. They eat a variety of woody and herbaceous plants, but their distribution appears to be limited by the winter availability of woody plant species, particularly cottonwood, aspen, willows, and alders.

Beaver are monogamous and produce one litter per year, typically 3 or 4 young (range 1 to 9). Beaver live in extended family groups (colonies) that typically contain 4 to 6 animals in mid-winter, comprising an adult pair with their kits from the previous spring, plus yearlings and occasionally young adults. In most areas, trapping is the main factor limiting the number of beavers per colony (Hill, 1982). Members of a colony contribute to the construction and maintenance of the lodge, dams, and food caches that sustain them through winter. The most common problems associated with beavers and their dams are flooding of roads and fields and raising of water tables, damage to timber by flooding and cutting, and damage to dikes, ditches, and dams. The beaver is an ecologically important species that dramatically alters drainage patterns and enhances aquatic productivity. Beavers may cause problems with TAPS, including flooding and washouts (Trudgen, 1999, pers. comm.)

Muskrat

Muskrats are found in suitable aquatic habitats throughout Alaska south of the Brooks Range (Hall, 1981). Muskrats are associated with standing or slowly flowing aquatic habitats containing vegetation, including coastal marshes and freshwater marshes near lakes, sloughs, streams, and rivers (Perry, 1982). They eat shoots, roots, bulbs, tubers, stems, and leaves of aquatic plants. Muskrats do not store large quantities of food, and in cold environments they require access to plant parts beneath the ice. Water levels and ice thickness greatly influence habitat availability, and changes in food availability caused by fluctuation in water or ice can force muskrats to move. Muskrats live in bank dens or in ponds with constant water level and abundant construction materials, and build houses of pond vegetation (Willner et al., 1980). An elaborate system of canals leads from the house to feeding sites known as “feeders” and “push-ups.”

Muskrat populations fluctuate widely and often appear cyclic over periods of 6 to 14 years (Perry, 1982). Muskrats have a high reproductive potential and generally a short life span. Populations are strongly affected by disease and predation, although climatic factors (particularly changes in water levels and ice thickness) and food availability may cause the most conspicuous changes in population size. During periods of high population, muskrats may consume vegetation until both food and cover are destroyed and dispersal and death by starvation result (Perry, 1982).

Coyote

Coyotes are thought to have arrived in Alaska during historic times, and their range in the state is expanding (Manville and Young, 1965; Bekoff, 1977; Cornelius, 1978). They are not abundant in Alaska and occur mainly

Table 3.2-18. *Alaska hunting and trapping seasons for furbearers and small mammals.*

	GMU 26 (North Slope)			GMU 25 (Upper Yukon)		
	Bag Limit	Season	No. Days	Bag Limit	Season	No. Days
Trapping						
Beaver	0	No open season		50a	Nov 1 - Apr 15	227
Coyote	No limit	Nov 1 - Apr 15	227	No limit	Nov 1 - Mar 31	212
Arctic Fox	No limit	Nov 1 - Apr 15	227			
Red Fox	No limit	Nov 1 - Apr 15	227	No limit	Nov 1 - Feb 28	181
Lynx	No limit	Nov 1 - Apr 15	227	No limit	Nov 1 - Feb 28	181
Marten	No limit	Nov 1 - Apr 15	227	No limit	Nov 1 - Feb 28	181
Mink and Weasels	No limit	Nov 1 - Jan 31	92	No limit	Nov 1 - Feb 28	181
Muskrat	No limit	Nov 1 - Jun 10	222	No limit	Nov 1 - Jun 10	222
River Otter	No limit	Nov 1 - Apr 15	227	No limit	Nov 1 - Apr 15	227
Squirrels and Marmots	No limit	No closed season	365	No limit	No closed season	365
Wolverine	No limit	Nov 1 - Apr 15	227	No limit	Nov 1 - Mar 31c	212
Hare	No limit	No closed season	365	No limit	No closed season	365
Hunting						
Coyote	2	Sep 1 - Apr 30	242	10	Sep 1 - Apr 30	242
Arctic Fox	2	Sep 1 - Apr 30	242			
Red Fox	10	Sep 1 - Mar 15	196	10	Sep 1 - Mar 15	196
Lynx	2	Nov 1 - Apr 15	227	2	Nov 1 - Feb 28b	181
Squirrels and Marmots	No limit	No closed season	365	No limit	No closed season	365
Hare	No limit	No closed season	365	No limit	No closed season	365

	GMU 24 (Koyukuk River)			GMU 20 (Tanana Valley)		
	Bag Limit	Season	No. Days	Bag Limit	Season	No. Days
Trapping						
Beaver	No limit	Nov 1 - Jun 10	191	No limitd	Nov 1 - Apr 15	227
Coyote	No limit	Nov 1 - Mar 31	212	No limit	Nov 1 - Mar 31	212
Arctic Fox						
Red Fox	No limit	Nov 1 - Feb 28	181	No limit	Nov 1 - Feb 28	181
Lynx	No limit	Nov 1 - Feb 28	181	No limit	Nov 1 - Feb 28e	181
Marten	No limit	Nov 1 - Feb 28	181	No limit	Nov 1 - Feb 28	181
Mink and Weasels	No limit	Nov 1 - Feb 28	181	No limit	Nov 1 - Feb 28	181
Muskrat	No limit	Nov 1 - Jun 10	222	No limit	Nov 1 - Jun 10g	222
River Otter	No limit	Nov 1 - Apr 15	227	No limit	Nov 1 - Apr 15	227
Squirrels and Marmots	No limit	No closed season	365	No limit	No closed season	365
Wolverine	No limit	Nov 1 - Mar 31	212	No limit	Nov 1 - Feb 28	181
Hare	No limit	No closed season	365	No limit	No closed season	365
Hunting						
Coyote	10	Sep 1 - Apr 30	242	10	Sep 1 - Apr 30	242
Arctic Fox						
Red Fox	10	Sep 1 - Mar 15	196	2	Sep 1 - Mar 15	196
Lynx	2	Nov 1 - Feb 28	181	2	Dec 1 - Jan 31f	31
Squirrels and Marmots	No limit	No closed season	365	No limit	No closed season	365
Hare	No limit	No closed season	365	No limit	No closed season	365

Table 3.2-18 (Cont'd). *Alaska hunting and trapping seasons for furbearers and small mammals.*

	GMU 13 - Glennallen			GMU 11 - Wrangell Mts.		
	Bag Limit	Season	No. Days	Bag Limit	Season	No. Days
Trapping						
Beaver	No limit	Oct 10 - May 15	217	30	Nov 10 - Apr 30	171
Coyote	No limit	Nov 10 - Mar 31	141	No limit	Nov 10 - Mar 31	141
Arctic Fox		No season			No season	
Red Fox	No limit	Nov 10 - Feb 28	110	No limit	Nov 10 - Feb 28	110
Lynx	No limit	Dec 1 - Feb 15	77	No limit	Dec 1 - Feb 15	77
Marten	No limit	Nov 10 - Feb 28h	110	No limit	Nov 10 - Feb 28	110
Mink and Weasels	No limit	Nov 10 - Feb 28	110	No limit	Nov 10 - Feb 28	110
Muskrat	No limit	Nov 10 - Jun 10	212	No limit	Nov 10 - Jun 10	212
River Otter	No limit	Nov 10 - Mar 31	141	No limit	Nov 10 - Mar 31	141
Squirrels and Marmots	No limit	No closed season	365	No limit	No closed season	365
Wolverine	No limit	Nov 10 - Jan 31	82	No limit	Nov 10 - Jan 31	82
Hare	No limit	No closed season	365	No limit	No closed season	365
Hunting						
Coyote	2	Sep 1 - Apr 30	242	2	Sep 1 - Apr 30	242
Arctic Fox		No season			No season	
Red Fox	2	Sep 1 - Feb 15	168	2	Sep 1 - Feb 15	168
Lynx	2	Nov 10 - Jan 31	82	2	Nov 10 - Jan 31	82
Squirrels and Marmots	No limit	No closed season	365	No limit	No closed season	365
Hare	No limit	No closed season	365	No limit	No closed season	365

	GMU 6 - PWS		
	Bag Limit	Season	No. Days
Trapping			
Beaver	No limit	Dec 1 - Apr 30	151
Coyote	No limit	Nov 10 - Mar 31i	141
Arctic Fox		No season	
Red Fox	No limit	Nov 10 - Feb 28	110
Lynx	No limit	Jan 1 - Feb 15	46
Marten	No limit	Nov 10 - Feb 28	110
Mink and Weasels	No limit	Nov 10 - Jan 31	82
Muskrat	No limit	Nov 10 - Jun 10	212
River Otter	No limit	Nov 10 - Mar 31	141
Squirrels and Marmots	No limit	No closed season	365
Wolverine	No limit	Nov 10 - Feb 28	110
Hare	No limit	No closed season	365
Hunting			
Coyote	2	Sep 1 - Apr 30	242
Arctic Fox		No season	
Red Fox	0	No open season	0
Lynx	0	No open season	0
Squirrels and Marmots	No limit	No closed season	365
Hare	No limit	No closed season	365

NOTES

a. Except 25C, no limit
b. Except 25C, December 1 - January 31
c. Except 25C, November 1 - February 28
d. Except closed in some of 20B and limit 25 in 20D and 20E.
e. Except December 1 - February 28 in 20A, 20B, 20D, 20E, and part of 20C.
f. Except November 1 - March 15 in 20E.
g. Except September 20 - June 10 in 20E.
h. Except November 10 - December 31 in 13E.
i. Except November 10 - Apr 30 in 6C

in the southern portions of the state in areas where wolves have been reduced or eliminated. However, they have been observed along the entire length of the TAPS ROW (Bee and Hall, 1956; Manville and Young, 1965; Hall, 1981). Coyotes are most abundant in the most populated areas of Alaska — i.e., Kenai Peninsula, Southcentral Alaska, Copper River Basin (Cornelius, 1978). Coyotes are highly adaptable, denning in a variety of habitats and eating a wide variety of animals and plants (Bekoff, 1982). The basic social unit is the mated pair, although packs do occur. Breeding pairs use dens.

Arctic Fox

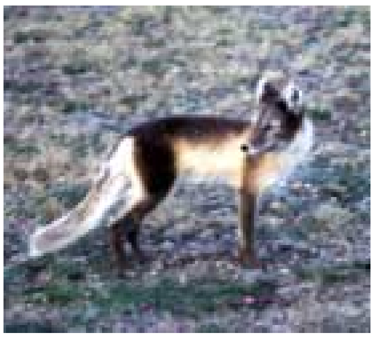

Warren Ballard

Photo 3.2-20. *Arctic fox.*

Arctic foxes occur throughout arctic tundra habitats in western and northern Alaska (Underwood and Mosher, 1982). Along the TAPS ROW, they occur regularly only on the North Slope of the Brooks Range (Bee and Hall, 1956; Hall, 1981). In this area, arctic foxes feed primarily on lemmings and voles. Arctic fox populations are cyclic and highly variable seasonally (Chesemore, 1975). Populations decline during periods of low microtine-rodent abundance. Arctic foxes feed heavily on carrion in winter and on nesting birds and their eggs during the short avian breeding season. When food is scarce (annually during winter in most areas), arctic foxes wander widely. Dense aggregations can occur in winter at large marine-mammal carcasses and at village dumps, where garbage is available (Chesemore, 1975). Arctic foxes are highly adaptable and readily habituate to human activities when not harassed. They readily consume human foods or garbage and quickly learn to exploit these resources (Burgess, Rose et al., 1993).

Arctic foxes are monogamous and monestrous. Dens are occupied by a single breeding pair and used for pup-rearing. Dens are typically excavated into low mounds on the tundra, and arctic foxes prefer sites that have a history of use. However, they are capable of denning under skirted buildings, in abandoned human structures and utilidors, and even in abandoned vehicles (Burgess, 2000). The density of arctic fox dens in the Prudhoe Bay area (1 den/12-13 km^2) is higher than adjacent areas on the North Slope (about 1 den/30-40 km^2) (Burgess, 2000). Litter sizes are large, typically 6 to 12 pups, but the number of young produced varies considerably from year to year and is highly correlated with lemming density. Arctic foxes are the main vector of rabies in the Arctic (Winkler, 1975; Crandell, 1975). Although Cowan (1949) suggested otherwise, rabies does not appear to regulate population size in foxes (Elton, 1942; Rausch, 1958; Follmann et al., 1988; Artois et al., 1991) but rather is a symptom of inadequate food availability in a reservoir species. Rabies outbreaks are often associated with periods of high-density arctic fox populations.

Red Fox

Red foxes occur throughout Alaska and along TAPS, except south of the Chugach Mountains in the Prince William Sound area (Hall, 1981). However, they are uncommon on the North Slope except near major rivers and river deltas (Eberhardt, 1977). Small mammals, birds, berries, and insects comprise the bulk of the diet of the red fox (Samuel and Nelson, 1982; Eberhardt, 1977). Red foxes are monogamous and monestrous, and typically both the male and female remain in one area and cooperate in raising the pups. Dens are excavated into low mounds or stream banks.

Weasels

Six species in the family Mustelidae (weasels) occur along the TAPS ROW. Four species of commercial value in the fur industry are discussed here: wolverine, river otter, marten, and mink. Ermine (short-tailed weasels) and least weasels, which are common along all of TAPS (Hall, 1981), feed primarily on microtines and generally are not sought by trappers because of their small size and low commercial demand.

Wolverines are wide-ranging carnivores that occupy forests and tundra along TAPS (Manville and Young, 1965; Pasitschniak-Arts and Larivière, 1995). Pelts of wolverine are prized for parka trim and cold-weather clothing. Prey include small and large mammals, carrion, birds, eggs, and insects (Magoun, 1985; Pasitschniak-Arts and Larivière, 1995). Population densities of wolverines generally are low. On the Arctic Coastal Plain, wolverines have larger home ranges (average 626 km^2 for males; Magoun, 1985) and are more dispersed than in forested areas in Southcentral Alaska (average 535 km^2 for males; Whitman et al., 1986), probably as a result of differing prey availability. Wolverines tend to inhabit remote areas and may be more impacted by habitat loss and human predation than other furbearer species (Hornocker and Hash, 1981).

River otters are restricted to aquatic and marine shoreline habitats and generally decline in numbers with increasing latitude (Larivière and Walton, 1998). Nonetheless, otters are found in low numbers along streams on the Arctic Coastal Plain (Magoun and Valkenberg, 1977) and are present along the TAPS ROW. River otters are listed in Appendix II of the Convention on International Trade in Endangered Species, which requires permits for international sale of pelts, principally because of low populations in the contiguous 48 states. River otters feed on a variety of fish and marine invertebrates. Small mammals, birds, and eggs are also occasionally used for food (Larsen, 1983).

Marten are restricted to forested areas throughout Alaska (Clark et al., 1987), including the TAPS ROW. They generally require coarse woody debris or trees to provide shelter and pathways under snow (Buskirk, 1983; Paragi et al., 1996). Dens and resting sites are made in hollow trees, squirrel nests and middens, and under tree roots, logs, rocks, and snow. Marten are relatively easy to trap and depending on pelt prices, are heavily exploited by trappers. Marten primarily eat small mammals, but also use birds, fish, carrion, insects, fruits, and human food when available (Buskirk and MacDonald, 1984; Ben-David et al., 1997).

Mink inhabit the shores of streams, lakes, and coastlines of the boreal forest in Alaska (Larivière, 1999). They are uncommon to rare along streams on the Arctic Coastal Plain (Bee and Hall, 1956) but occur throughout the TAPS ROW. Mink prey primarily on animals associated with water, including fish, terrestrial and marine invertebrates, birds, and to a lesser degree, small mammals (Harbo, 1958; Johnson, 1985). Mink attain their highest densities on marine coastlines such as those in Southeast Alaska (20/linear mi; Harbo, 1958), compared with Interior streams, which support lower densities (2.2/mi^2; Harbo, 1958).

Lynx

Lynx occur throughout the boreal region of North America, including Alaska (Tumlison, 1987), and occur along the TAPS ROW from the Brooks Range south. They are very rare on the North Slope (Rausch, 1953; Bee and Hall, 1956). Lynx are found most often in forested habitats (mixed spruce-hardwood forests, open spruce muskegs, and aspen-spruce woodlands); occasionally in shrub habitats; and rarely in open habitats (Berrie, 1973; Stephenson, 1986; Perham, 1995).

The primary prey of lynx is the snowshoe hare, which fluctuates in abundance on an approximate 10-year cycle in Interior Alaska (Wolff, 1980; Mowat et al., 1999). When hares are not abundant, lynx select alternate prey including grouse, ptarmigan, red squirrels, and microtine rodents (Kesterson, 1988; Perham, 1995). The reproductive success and thus population size of lynx are tied closely to the population size and density of snowshoe hares (O'Connor, 1984; Mowat et al., 1999).

Lynx may be susceptible to overharvest because they are fairly easy to trap and their populations decline to low levels during periods of prey scarcity (e.g., Bailey et al., 1986). Lynx populations are managed closely by ADF&G to restrict harvest when populations are low, thereby enhancing population recovery as hare numbers rise. The lynx was formerly a federal Category 2 candidate species, primarily due to its scarcity in historical range in the contiguous 48 states, where it was listed (50 CFR 17) as of March, 2000 as a threatened species under the Endangered Species Act. However, there is no indication that the population is threatened in Alaska or northern Canada. Currently, snowshoe hares are relatively abundant in Interior Alaska, and lynx numbers have grown in the mid- to late 1990s, based on the increasing proportion of young animals taken by trappers (Taylor, 1993a, 1994b, 1995, 1996; James, 1996). Home-range size varies between the sexes (males tend to have larger ranges), as well as seasonally and with changes in prey abundance (Berrie, 1973; Stephenson, 1986; Perham, 1995). In favorable habitat in eastern Interior Alaska, home ranges of male lynx average 139 km^2 (range = 13 to 242 km^2; n = 6), overlapping the ranges of several females, whose home ranges average 56 km^2 (n = 3) (Perham, 1995). Lynx are known to disperse widely when hare populations decline (Mowat et al., 1999).

3.2.6 Marine Mammals

By J. Burns, C.B. Johnson, and S.R. Johnson

3.2.6.1 North Slope/Beaufort Sea

Most of the marine mammals that occur regularly in the Beaufort Sea have a holarctic distribution that includes multiple geographic stocks (Table 3.2-19). Those with stocks present in the Beaufort include the polar bear, ringed and bearded seals, and bowhead and belukha whales. Gray whales were also in this category, but the two Atlantic stocks are now extinct and the western Pacific one is nearly so. The eastern Pacific stock is no longer listed as threatened or endangered. In Alaskan waters, several marine mammals reach the northern limit of their summer distribution in the northeastern Chukchi Sea, occurring irregularly and in low numbers in the Beaufort Sea. Usually, such species are noted in the extreme western part near Point Barrow. Their occasional presence farther east is more on the order of infrequent extra-limital occurrences. These species include the harbor porpoise, killer whale, and gray whale. Others such as the walrus and spotted seal occur regularly in the western Beaufort and decrease markedly farther east, the former mainly as individual stragglers east of Pitt Point and the latter as stragglers east of Oliktok Point. Ringed

Table 3.2-19. *Marine mammal species (in taxonomic order) of the Beaufort Sea and Prince William Sound, including their status under the Marine Mammal Protection Act (MMPA), and the Endangered Species Act (ESA).*

Order	Common Name	Scientific Name	Abundance (a)	Seasonal Residency	Status under MMPA (b)	Status under ESA
BEAUFORT SEA						
Cetaceans	Bowhead whale	*Balaena mysticetus*	Abundant	Seasonal	Depleted	Endangered
	Gray whale	*Eschrichtius robustus*	Occasional	Seasonal	Protected	Delisted
	Fin whale	*Balenoptera physalus*	Occasional	Seasonal	Depleted	Endangered
	Killer whale	*Orcinus orca*	Occasional	Seasonal	Protected	—
	Belukha whale	*Delphinapterus leucas*	Abundant	Seasonal	Protected	—
Pinnipeds	Walrus	*Odobenus rosmarus divergens*	Occasional	Seasonal	Protected	—
	Spotted seal	*Phoca largha*	Common	Seasonal	Protected	—
	Ringed seal	*Phoca hispida*	Abundant	Year round	Protected	—
	Ribbon seal	*Phoca fasciata*	Occasional	Seasonal	Protected	—
	Bearded seal	*Erignathus barbatus*	Abundant	Year round	Protected	—
Carnivores	Polar bear	*Ursus maritimus*	Abundant	Year round	Protected	—
PRINCE WILLIAM SOUND						
Cetaceans	Northern right whale	*Eubalaena glacialis*	Unknown	—	Depleted	Endangered
	Gray whale	*Eschrichtius robustus*	Occasional	Seasonal	Protected	Delisted
	Blue whale	*Balenoptera musculus*	Occasional	Seasonal	Depleted	Endangered
	Fin whale	*Balenoptera physalus*	Common	Seasonal	Depleted	Endangered
	Sei whale	*Balenoptera borealis*	Occasional	Seasonal	Protected	—
	Minke whale	*Balenoptera acutorostrata*	Common	Year round (c)	Protected	—
	Humpback whale	*Megaptera novaeangliae*	Common	Seasonal	Depleted	Endangered
	Sperm whale	*Physeter macrocephalus*	Unknown	—	Depleted	Endangered
	Belukha whale	*Delphinapterus leucas*	Occasional	Seasonal	Depleted	—
	Short finned pilot whale	*Globicephala macrorhynchus*	Rare	—	Protected	—
	Rissos dolphin	*Grampus griseus*	Rare	—	Protected	—
	Baird’s beaked whale	*Bararclius bairdii*	Unknown	—	Protected	—
	Cuvier’s beaked whale	*Ziphius cavirostris*	Unknown	—	Protected	—
	Stejneger’s beaked whale	*Mesoplodon stefnegari*	Unknown	—	Protected	—
	Killer whale	*Orcinus orca*	Abundant	Year round (c)	Protected	—
	Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Occasional	Seasonal	Protected	—
	Harbor porpoise	*Phocoena phocoeno*	Abundant	Year round (c)	Protected	—
	Dall’s porpoise	*Phocoenoides dalli*	Abundant	Year round (c)	Protected	—
Pinnipeds	Steller’s sea lion	*Eumetopial jubatus*	Common	Year round (c)	Depleted	Endangered (d)
	Northern fur seal	*Callorhinus ursinus*	Occasional	Seasonal	Depleted	—
	Harbor seal	*Phoca vitulina richardsi*	Abundant	Year round	Protected	—
Carnivores	Sea otter	*Enhydra lutris*	Abundant	Year round	Protected	—

a. Modified from Morris et al. (1983) and Calkins (1986).
b. Marine Mammal Protection Act. Endangered species are classified automatically as depleted; all stocks of depleted species are strategic stocks.
c. Reduced numbers in winter.
d. Population segment west of 144° west longitude (Cape Suckling); segment east of there is listed as threatened.

seals, bearded seals, and polar bears, all of which move extensively, are present year-round. Bowhead and belukha whales are normally present from late April to mid-October. Bowhead whales, bearded seals, ringed seals, and polar bears are important subsistence species for hunters from Barrow, Nuiqsut, and Kaktovik. Belukha whales are taken sporadically when available.

Pacific Walrus

Walruses are obligate benthic feeders that periodically haul out on sea-ice or land to rest. Their distribution is restricted to continental-shelf waters, where they feed at depths of 110 m or less (Fay and Burns, 1988). Essentially the entire population, estimated to number at least 201,000 in 1990 (Gilbert et al., 1992), winters in the Bering Sea. Some animals, mainly males, remain there during summer and use land haulouts on the Russian and Alaskan coasts. The largest segment of the population migrates north in spring and early summer, and reaches the northern Chukchi Sea usually in mid-July to early August, depending on the severity of ice conditions. One component summers in the eastern Chukchi Sea. The eastern distribution of these animals is normally considered to be in the vicinity of Point Barrow (Brooks, 1954), though it is now known that small numbers move beyond there into the Beaufort Sea (Burns, pers. obs.). In occasional years when sea-ice remains close to shore, small herds occur as far east as Cape Simpson. Beyond that, they occur as individual stragglers and as beach-cast remains as far east as Canada's Yukon Territory (Bee and Hall, 1956; Harington, 1966; Youngman, 1975). A single animal that had apparently overwintered near Banks Island was reported by Stirling (1974).

In most years relatively few walruses enter the Beaufort Sea, and their residence time is short because the pack ice recedes north, well beyond the narrow continental shelf on which they forage. In the central Beaufort, they are beyond the margin of their normal range and are present only occasionally and usually as singletons.

Spotted Seal

The primary sources of information about spotted seals in the Beaufort Sea are J. Burns (pers. obs.); T. Bendock (1985, pers. comm.); H. Brower, Sr. (numerous pers. comms.); J. Helmericks (1990, 1999, pers. comm.); local knowledge; Porsild (1945); Bee and Hall (1956); Youngman (1975); BLM and MMS (1998); and USACE (1999). Spotted seals occur in the coastal zone of the Beaufort Sea every summer. They are a component of a much larger population that is abundant but for which the population size is unknown (Small and DeMaster, 1995). Spotted seals winter in the Bering Sea, and many migrate north in the summer. These seals appear in the northern Chukchi in July, and a small number, now estimated at about 1,000 (BLM and MMS, 1998), move east past Point Barrow. The basis for that estimate is not clear. Most of the spotted seals occur in the western and west-central Beaufort.

The Harrison Bay/Colville River region is probably the eastern boundary of their normal summer range, though a few are encountered as far east as Herschel Island, Canada. In the 1960s and early 1970s, about 200 to 300 spotted seals hauled out at several locations in the eastern Colville Delta. Currently, the numbers there are on the order of 25 to 30. The reduction has been attributed to increased access and harvests by local subsistence hunters (J. Helmericks, 1999, pers. comm.; H. Helmericks, 2000, pers. comm.). It is more likely, however, that dynamics of the spotted-seal population have been negatively affected by the significant decline in primary productivity of the Bering Sea, found by Schell (1998) to have been on the order of 30 to 40 percent since 1965.

Spotted seals arrive in the Beaufort after ice has cleared from the bays, and they depart with the onset of freezeup in early October. These far-ranging seals feed at sea, in coastal bays and lagoons, and in rivers during periods of high fish concentrations. They haul out on islands and sandbars. Only a few haulouts are known to be used regularly, and these include Oarlock Island in Dease Inlet, where the highest numbers are encountered; in Smith Bay near the mouth of the Ikpikpuk River; and in the Colville River delta. A few regularly ascend the Colville River as far upstream as the confluence of the Itkillik River, and there are occasional reports of seals to Ocean Point and beyond. When spotted seals are hauled out, even minor disturbances cause them to flee into the water. The few seals that use haulouts on the Colville River delta are probably those most frequently subjected to anthropogenic disturbances.

Ringed Seal

Ringed seals are abundant and present year-round in the Beaufort Sea. They are most evident when floating sea ice is present. Floating ice includes both landfast and pack-ice habitats. Ringed seals make and maintain holes through the ice by abrading it with the strong claws of their fore-flippers. During autumn to early summer, highest densities of these seals occur in the fast ice habitat. As snow accumulates, they enlarge breathing holes to haul out and make lairs in snowdrifts and pressure ridges. In winter the lairs are for resting, while more complex pupping lairs are made starting in about mid-March. The white-coated pups are born in these complex lairs from late March to May, and are nursed for 4 to 6 weeks (Smith and Stirling, 1975; Smith and Hammill, 1981; Kelly, 1988). Starting in late April, seals of all ages begin to haul out on top of the ice and snow to bask during the annual molt. Basking seals are most numerous in late May-June.

The first areawide aerial survey of molting ringed seals on the fast ice between Point Barrow and Barter Island was done in June 1970. Intermittent surveys have continued to the present. Compared to other areas in Alaska, the density of seals on fast ice of the Beaufort is low and annually variable. In 1970, the observed densities were: 0.88/km^2 between Point Barrow and Lonely, 0.41 between Lonely and Oliktok, 0.53 between Oliktok and Flaxman Island, and 0.94 in the area between Flaxman and Barter islands (Burns and Harbo, 1972). In comparison, surveys in 1996-98 found 0.57 to 0.83 basking seals/km^2 between Oliktok and Flaxman Island, and 0.67 to 1.17/km^2 between Flaxman and Barter islands. These values were within the range of those from surveys in the mid-1980s (Frost and Lowry, 1999). More limited surveys in the central Beaufort in

1997-99 near proposed development projects produced estimates of 0.39 to 0.65 seals/km^2 on fast ice overlying water depths of 3 m or more (Moulton and Elliott, 1999). The “countable” seals represent an as-yet unknown proportion of the overwintering population.

In Alaska, ringed seals rarely haul out on shore. During the ice-free season, relatively few are seen at sea because of low sightability in all but calm or nearly calm winds. They are, however, present in the coastal zone, in open water, and in pack-ice habitats. Treacy (1988-98) reported incidental sightings in all years of his bowhead whale surveys and noted that they are broadly distributed throughout the open-water habitat. He commented (Treacy, 1999, pers. comm.) that it was not uncommon to encounter active feeding aggregations of 10 to 25 seals.

Though ringed seals are an important subsistence resource in the Beaufort Sea region, current hunting effort, especially in winter, is much reduced compared to former times. Winter hunting success is traditionally greatest during late autumn-early winter and steadily declines during February to mid-April, as the seals become more sedentary. It increases again in late spring-early summer when they begin to haul out during the molt, migrate, and become more easily accessible to hunters using small boats in the deteriorating ice.

Bearded Seal

Bearded seals are present year-round in the Beaufort Sea. Though quantitative estimates are lacking, they are considered common though not abundant during late spring-early autumn, and common but few during the months of heavy, comparatively stable ice cover. These seals are strongly associated with the more labile ice of subarctic and arctic regions, where it overlies waters less than about 500 to 650 ft deep (150 to 200 m). In Alaska they occur very infrequently in the winter fast-ice zone. Bearded seals are benthic feeders, and their diet includes many items also consumed by walruses — such as bivalve molluscs. The population in Alaskan waters is largely migratory, with the center of winter abundance in the Bering Sea. Farther north, they are restricted to areas within the pack ice where environmental conditions produce persistent openings (leads, polynyas, flaw zones, etc.). Such conditions become progressively more limited north of Bering Strait, and especially in the Beaufort Sea (Burns, 1967; Burns and Frost, 1983; Kelly, 1988).

Bearded seals are the largest of the phocid seals, with adults weighing up to 800 pounds (lb) [360 kilograms (kg)]. The high yield of meat, utility of their large durable hides, and good availability during spring breakup make them the preferred seal taken by subsistence hunters. Relatively few are taken in the Beaufort Sea, except near Point Barrow.

Bearded seals are rarely found or seen on fast ice of the Beaufort Sea before spring breakup (Burns and Harbo, 1972; Frost et al., 1989; Frost and Lowry, 1999). Reported sightings of 13 bearded seals on the fast ice between Long and Stockton islands during surveys on 4-8 June 1999 (Moulton and Elliott, 1999) are unusual, perhaps questionable, and at variance with their absence during replicate surveys of the same transects on subsequent days.

During the open-water season, these seals are broadly distributed from shore seaward in open water and into the pack ice. They do not normally haul out on land unless debilitated. In early autumn, juveniles occasionally occur in river mouths and lagoons where low-salinity water freezes before the more salty waters of other nearshore areas.

Polar Bear

State of Alaska

Photo 3.2-21. *Polar bear.*

In the Beaufort Sea, polar bears are present year-round, though with major seasonal shifts in distribution. These animals form a separate stock that occurs in the area from Point Hope (east-central Chukchi Sea) to Cape Bathurst (western Amundsen Gulf). This stock has increased at an estimated annual rate of 2 percent or more during the past three decades. It now numbers perhaps 2,000+ animals and is thought to be at or near carrying capacity (Amstrup, 1995; FWS, 1995b). The average density in the region from Point Barrow to Cape Bathurst was estimated to be 1 per 141 to 269 km^2 in 1986 (Amstrup et al., 1986).

During late autumn to spring, polar bears are widely distributed, occurring on land, on the fast ice, and on the pack ice. However, they are most abundant in the active flaw zone, where their principal prey, ringed seals, are most available. During open water, they are mainly associated with the distant pack-ice, though they are occasionally seen on land or swimming in open water at a considerable distance from the ice. In autumn, as the ice comes closer to the coast, some commonly swim ashore and scavenge beachcast carcasses or the remains of bowhead whales taken by subsistence hunters — a relatively common occurrence at Kaktovik. Polar bears can be a safety hazard as they enter settlements and occasionally destroy property and kill people.

Unlike other bears, polar bears do not aestivate, but are active all winter. The exceptions are pregnant females, which make maternal dens in deep snowdrifts during late October-November. Of 90 dens in the Beaufort Sea region reported by Amstrup (1995), 48 were on drifting pack-ice, 38 were on land, and 4 were on landfast ice. The distribution of dens is illustrated in Amstrup (1995, p. 259).

Cubs, usually two, are born in December to January. The mothers and cubs emerge from maternal dens in late March-early April, and those that were on land go to sea. There has been continuing concern about the effects of anthropogenic disturbances on bears in maternity dens. Amstrup (1995) noted that disturbances resulting from opening dens, capture, examination, marking, and radio-tracking of maternal bears did not affect litter sizes or the growth and condition of cubs. Also, 10 of 12 bears in dens tolerated exceptional levels of human activity. He believed that because of the high tolerance threshold, the imposition of short-term spatial and temporal restrictions on human activities near dens could prevent undue disturbance of bears in dens (Amstrup, 1995, p. 262).

Gray Whale

Gray whales feed primarily on benthos. Their summer distribution is mainly limited to shallow waters of the continental shelf. Gray whales are abundant in the northeastern Chukchi and occur irregularly in the Beaufort. During annual whale surveys in autumn from 1987 to 1997, Treacy (1988-98) saw these whales in only two years. In 1988, a beachcast carcass was seen east of Deadhorse, and three animals were entrapped in newly formed shore ice at Point Barrow. On October 2, 1997, three groups totaling nine whales were seen near Point Barrow. On occasion they occur farther east. One was taken by Eskimo hunters near Cross Island in 1933; 30 were seen near Cooper Island 33 km east of Point Barrow on October 5, 1972; one was seen near Barter Island in September 1975; and three were reported off Tuktoyaktuk, Canada, in August 1980 (Maher, 1960; Marquette and Braham, 1982). Interestingly, they were not mentioned by Porsild (1945) or Youngman (1975) as occurring in waters of the Mackenzie Delta or the Yukon Territory. Presumably the more recent sightings reflect the increase and recovery of this once-depleted species, now estimated to number 23,000 (Small and DeMaster, 1995).

In the central Beaufort, gray whales occur infrequently. It is not known if more of these whales may go into the Beaufort Sea if annual summer ice conditions continue to ameliorate. They are not an important subsistence species, though they may be taken occasionally.

Belukha Whale

Belukha whales occur in the Beaufort from mid- to late April through late October-early November. Rarely, some may overwinter. Like bowhead whales, they migrate north from wintering areas, mainly in the Bering Sea, starting in early spring. Usually some are seen at Point Barrow by mid-April, often travelling with or in proximity to bowheads. Also like bowheads, most travel through offshore leads to the eastern Beaufort Sea and Amundsen Gulf, where they summer. During early summer they are common in the warm waters of Mackenzie (primarily), Kugmallit, and Liverpool bays. Others occur in open water and in the distant summer pack-ice (largest component) (Harwood et al., 1996), probably moving among the three habitats. Young are born mainly during mid-June to mid-July and nurse for 12 to 18 months (Burns and Seaman, 1985).

The Beaufort Sea stock, recognized on the basis of where they spend the summer, is estimated to number more than 41,000. Belukhas of the eastern Chukchi stock, estimated at perhaps 3,700 animals (Small and DeMaster, 1995), now summer mainly in and near the 170-km-long Kasegaluk Lagoon system near the settlement of Point Lay (Frost et al., 1993). At least some, and perhaps all of them, move north into the Beaufort during late July-early August (Burns and Seaman, 1985; R. Suydam, 1999, pers. comm.), at about the same time animals of the Beaufort Sea stock begin migrating west. Though most belukhas in the Beaufort during summer are in the east, some are present in low numbers across the entire region. The late summer/autumn return migration from Canadian waters is protracted. Most belukhas travel in and near the front zone of the pack ice, but also through open water from the offshore ice margin to the coast (Burns and Seaman, 1985; Treacy, 1988-98).

The responses of belukhas to noise and disturbance are highly variable and range from habituation to flight at long distances from approaching large vessels. Responses are probably related to a number of factors including experiences of the whales, time and nature of habitat use, activities of the whales, type of disturbance, and with respect to vessels, their characteristics and maneuvers. In Cook Inlet, before the serious population reduction [thought to be due primarily due to overharvest (NMFS, 2000)], they frequented the area of the City of Anchorage port facilities and several rivers in which small boat traffic was heavy. They still use the remaining primary estuary in which they have been intensively hunted for many years. In Bristol Bay they feed among the salmon fishing boats. In other areas they continue to return to favored bays and river mouths in spite of extensive hunting pressure. Conversely, in deep ice-covered waters of the Canadian High Arctic, during spring, they swam away from large ships and icebreakers as far away as 35 to 50 km. In general, belukhas are more tolerant of disturbance in open water than when their movements are constrained by sea ice (Burns, pers. obs.; Burns and Seaman, 1985; Cosens and Dueck, 1993; Richardson, Greene et al., 1995).

Bowhead Whale

The Bering Sea (western arctic) stock is the largest of the five that occur in the holarctic range of this species. Size of the Bering Sea stock was estimated at 10,400 to 23,000 before decimation by the commercial whaling industry in the last half of the nineteenth century, and perhaps 3,000 when whaling ended in 1914 (Woodby and Botkin, 1993). This stock has slowly increased since then and in 1993 was estimated at 8,000, with a 95 percent confidence interval from 6,900 to 9,200 (Zeh et al., 1994). The estimated rate of increase from 1978 to 1993 was 3.2 percent (Zeh et al., 1996) and occurred in the face of harvesting, other sources of mortality, and industrial activity in the Beaufort Sea. In spite of its current population size and trend, the Bering Sea stock is still classified as endangered (ESA designation) and depleted (MMPA designation).

Bowheads winter in the Bering Sea, migrate north in spring, and summer in a broad area from Amundsen Gulf and the eastern Beaufort Sea to the eastern part of the East Siberian Sea. The spring migration begins in late March-early April, depending on ice conditions. From April to June, most are distributed along a migration corridor that extends from the Bering Sea wintering grounds to feeding grounds in the eastern Beaufort (Moore and Reeves, 1993). Usually the first migrants are seen at Barrow in mid-April, though in the extreme heavy ice year of 1980, they did not appear until late May (Krogman et al., 1989). After rounding Point Barrow, bowheads (and belukhas) travel through offshore leads in the continuous pack-ice to the eastern Beaufort Sea, where they spend the summer feeding on abundant zooplankton. An unknown but variable part of the population migrates along the Russian coast to feeding grounds in the western Chukchi Sea (Bogoslovskaya et al., 1982). Whales that summered in the eastern Beaufort begin the first part of the fall migration in late August/September and are usually out of the Beaufort by late October (Treacy, 1988-98; Moore and Reeves, 1993). If food is abundant, they feed en route, sometimes close to shore.

Other than during the spring and autumn migrations, the number of bowheads in the Alaskan sector of the Beaufort is low. Successful harvesting of this very important subsistence resource occurs during both the spring and autumn near Point Barrow, but is restricted to the autumn near Kaktovik and Nuiqsut. Near Barrow, the spring migration through leads next to the landfast ice provides hunters with access to the whales, as does their westward passage in open water past Point Barrow in autumn. The autumn migration provides the only opportunity for whalers near Kaktovik and Nuiqsut. From 1990 to 1999, Barrow hunters landed 207 whales, of which 110 were taken during autumn. During that same period, 26 were landed by whalers from Kaktovik (range 1 to 4/yr) and 20 by hunters from Nuiqsut (range 0 to 4/yr) (George, 1999, pers. comm.; Alaska Eskimo Whaling Commission harvest records). Several variables contribute to whaling effort and success in autumn — notably weather, proximity of migrating whales, sea-ice conditions, and at Barrow, success of the spring whaling season. Miller et al. (1996) and Treacy (1988-98) reported that proximity of the pack ice during autumn influences the migration, with a tendency for bowheads to migrate farther offshore during years of extensive ice cover.

There has been ongoing concern about the effects of disturbance on bowhead migration and feeding during autumn, particularly from low-flying aircraft, marine shipping, vessel-based seismic exploration, and stationary exploration and production facilities. Richardson, Greene et al. (1995) reported available information about these issues. In summary, whale responses to low-level aircraft were highly variable depending on activities of the whales and the habitat in which they were encountered. When responses were elicited, they included diving, turning away from the aircraft, or dispersal away from the area being circled. The effects were transitory. Responses to ships and boats were also highly variable, mainly depending on what the vessels were doing. Bowheads greater than 500 m to the side or behind a small ship seemed unaffected. Whales approached within 100 to 500 m when a ship was stationary or not maneuvering toward them. In other instances whales attempted to avoid approaching vessels at distances of 4 km or more. Bowheads can be displaced by as much as a few kilometers while fleeing, but stop doing so when a vessel is a few kilometers past.

Little is known about disturbance by icebreakers actively involved in ice-breaking, which produces the highest noise levels. In one instance, migrating whales apparently avoided such activity at a distance of 25+ km, though they responded similarly to a drillship and nearby support vessels operating in open water. In other instances of stationary offshore activities, bowheads showed no overt responses unless the broadband received sound levels were about 20 decibels (dB) or more above ambient levels.

Reactions of bowheads to airgun arrays and single airguns were studied in Beaufort Sea during the 1980s, and again in 1996-98. The earlier work, based on small sample sizes, showed that bowheads often avoided strongly when an operating airgun array approached within ~7.5 km (~160 dB re 1 µPa rms) (Richardson et al., 1986; Ljungblad et al., 1988). However, subtle behavioral effects extended to greater distances (Richardson et al., 1986). Also, Eskimo hunters reported that migrating bowheads avoided seismic boats at much greater distances (MMS, 1997a). During 1996-98, aerial surveys near Prudhoe Bay showed that most migrating bowheads avoided the area within 20 km of an active airgun array (Richardson et al., 1999). Some avoided the 20- to 30-km area as well. The seismic operation was close to shore, and westbound bowheads deflected offshore to avoid it. Broadband received levels of pulses 20 km from the array were typically 120 to 130 dB re 1 µPa (rms) — notably lower than previously demonstrated to cause avoidance of airgun arrays by baleen whales. The avoidance distances were large even though the airgun array was rather small: 560 to 1,500 cubic inches (in^3) and 6 to 16 guns, with only one array operating at any one time. Bowheads re-occupied the 20-km avoidance zone within 12 to 24 hours after airgun operations ended. The recent work shows that studies in the 1980s underestimated the distances where bowheads begin to avoid an approaching airgun array, and overestimated the received sound levels necessary to elicit avoidance.

To date, no indications exist that industry-related anthropogenic disturbance has adversely affected the population of whales or the success of subsistence whaling in the Beaufort Sea. Whaling has been and is the single activity that has had the greatest impact on this stock of bowheads.

3.2.6.2 Prince William Sound Tanker Routes

Nine species of marine mammals are abundant or common in Prince William Sound; other species are uncommon, rare, or unknown in occurrence (Table 3.2-19) and will not be discussed here. All marine mammals are protected by the Marine Mammal Protection Act (1972), some are protected by the Endangered Species Act (1973), and great whales are further regulated by the International Whaling Commission. The status, abundance, and residency of each species are listed in Table 3.2-19.

In Prince William Sound, six species of cetaceans, two species of pinnipeds, and one species of carnivore are common to abundant. Killer whales are found worldwide in all major oceans but favor the colder waters of both the North and South Hemispheres (Matkin et al., 1997). Of four species of whales common to Prince William Sound, the killer whale is the only toothed whale and primarily feeds on marine mammals and fish (Calkins, 1986). Killer whales are abundant and present year-round, but the migratory pattern in and out of the Sound probably varies among pods (Dahlheim and Matkin, 1994). Of more than 14 pods identified in Prince William Sound, eight are regularly found there (Matkin et al., 1994).

Four baleen whales occur seasonally in Prince William Sound. Fin, humpback, and gray whales are the largest species to visit the Sound and are migratory; minke whales are small migratory whales that might occur there year-round (Calkins, 1986). Fin and humpback whales are endangered species, whereas the gray whale has been delisted. Numbers of large baleen whales using Prince William Sound are not readily available, but humpback whales probably are most abundant, with 60 to 100 individuals feeding there during summer (von Ziegesar et al., 1994). Humpbacks feed on euphausiids and fish (Kawamura, 1980). Fin whales occur in Prince William Sound during April-June, when they are migrating to the Bering Sea (Hall, 1979). Gray whales also are migrating to and from the Bering and Chukchi seas when they occur in the Sound in late spring and early fall (Calkins, 1986). Gray whales feed primarily on benthic amphipods but also take other benthic and pelagic invertebrates (Rice and Wolman, 1971; Nerini, 1984). Minke whales summer in the Gulf of Alaska and mostly are seen between the 200-m depth contour and shore (Consiglieri and Braham, 1982). Minke whales generally feed on euphausiids and fish (Tamura et al., 1998).

Dall’s and harbor porpoises both are abundant and widespread in Prince William Sound, with Dall’s being the more common (Calkins, 1986; Harvey and Dahlheim, 1994). Both species feed on fish and crustaceans, but generally on different species (Calkins, 1986). Dall’s porpoises occur on the continental shelf and slope and prefer straits, passes between islands, and areas of merging currents (Scheffer, 1949; Cowan, 1944), while harbor porpoises frequent bays, harbors, and river mouths (Tomilin, 1957 cited in Calkins, 1986). Both species are more abundant in Prince William Sound in summer than winter (Hall, 1979).

Of three species of pinnipeds that can occur in Prince William Sound, Steller sea lions and harbor seals are year-round residents, and northern fur seals are occasional visitors (Calkins, 1986). Steller sea lions use terrestrial haulouts as resting areas, but gather at traditional rookeries during May-July to pup and breed; the nearest rookery to Prince William Sound is at Seal Rocks, on the eastern side of Montague Island (Calkins et al., 1994). Sea lions feed on fish (primarily pollock), cephalapods (squid and octopus), and crustaceans (Hoover, 1988a). Sea lions from the central Gulf of Alaska (including Prince William Sound) have declined in number since the late 1980s (Loughlin et al., 1992) and were listed as an endangered species in 1990. Harbor seals are one of the two most abundant marine mammals breeding in the Sound and are year-round residents there; however, they also have undergone substantial population declines since the 1980s (Frost, Lowry et al., 1994). Nearshore areas within 20 km of the coast are the primary habitat of harbor seals (Hoover, 1988a), which prey on fish, crustaceans, and cephalopods (Calkins, 1986; Hoover, 1988b). Harbor seals use terrestrial haulouts throughout the year, but more so in early and late summer to pup and molt, respectively (Frost, Lowry et al., 1994).

Steller Sea Lion

Steller sea lions, which are endangered in the area of concern, occur in Prince William Sound year-round, though their numbers are low compared to other areas in the Gulf of Alaska. According to Calkins et al. (1994), there are no rookeries in the Sound, but there are five haulouts, two of which are used year-round and three seasonally. There is some ambiguity with respect to categorization of haulouts within the Sound and those at and near the southern entrances. Those in the Sound include Glacier Island, Perry Island, Point Eleanor, The Needle, and nominally, Point Elrington. Those at the southern entrances include the Wooded Islands (a rookery and haulout), Seal Rocks (rookery and haulout) in Hinchinbrook Entrance, Danger Island, and Procession Rocks. There have been no surveys of all of these sites in a single year.

Based on fragmentary data from these sites in different years, there are now perhaps 3,500 to 4,000 sea lions in and near the Sound. In June-July 1990, there were 1,232 on the Wooded Islands, 1,471 on Seal Rocks, 926 on The Needle, and 382 at Pt. Elrington (Merrick et al., 1991). Seal Rocks is the only rookery/haulout in close proximity to the tanker traffic area. In August 1994, there were 116 sea lions on The Needle, 151 on Procession Rocks, and 17 on Danger Island (Burns, unpubl. data). A correction factor of 1.31 is used to expand counts of non-pups obtained in June-July. On rookeries censused in June-July, the counts are divided by 2.63 to estimate the number of pups (Small and DeMaster, 1995).

Sea lions have undergone a major population decline in parts of their range: on the order of 63 percent from 1986 to 1989 in the area from the central Gulf of Alaska, including Prince William Sound, to the central Aleutian Islands (NMFS, 1992). At Sugarloaf Island, one of the Barren Islands group (near the Sound), the decline from 1956-57 to

Photo 3.2-22. *Steller sea lions with pups.*

1990 was from 11,963 to between 1,319 and 1,513 animals, or 87 to 89 percent (Merrick et al., 1991).

According to Pitcher and Calkins (1981), sexual maturity in females — defined as the age of first pregnancy — occurs at ages 3 to 8 years (average 4.8). Some males become sexually mature as early as age 3, but usually between 5 and 7. Normally, males do not successfully breed (defend territories) until 9 to 13 years. A single pup is born during mid-May to mid-July, with the peak in mid-June. A high incidence of reproductive failures has been noted (Calkins and Pitcher, 1982; Calkins and Goodwin, 1988). Breeding occurs, on average, 12 days after parturition. There is a period of delayed embryonic implantation which lasts until mid-October. The maternal bond is maintained for slightly less than a year, though 1- to 3-year-old animals have been observed to nurse along with a newborn pup. Mothers periodically leave their pups on the rookery and go to sea on feeding forays. Pups first enter the water when about 2 weeks old. They travel at sea with their mothers starting between ages 24 to 32 days and are proficient swimmers by 36 to 41 days. As summarized by Hoover (1988a), sea lions consume a wide range of food items including many different kinds of fish, cephalopods, decapods, gastropods, and occasionally the pups of other marine mammals.

According to Calkins et al. (1994), there was little evidence of a population-level effect of the *Exxon Valdez* oil spill on sea lions within or beyond Prince William Sound, in part because the rookeries and haulouts are on high, steep-sided islands subjected to strong surf activity, and because crude oil did not persist on their pelage. They found that in 1989 the predicted numbers of pups and total sea lions on rookeries and haulouts were not significantly different from the actual counts. Sea lions were, however, exposed to oil. Hydrocarbon compounds were incorporated into tissue and were being metabolized, as shown by several biochemical indicators.

Harbor Seal

Harbor seals are ubiquitous and abundant in Prince William Sound and are present year-round. There is considerable movement into and out of the Sound and among haulouts within it. For these seals, most rookeries also serve as haulouts, and the latter term will be used in this discussion. Haulout sites are close to the water's edge — usually within the tide zone — and occur on the mainland, in river deltas, on ice calved from tidewater glaciers, and on myriad reefs, ledges, rocks, islets, and islands. Man-made structures such as docks or rafted logs are also used. The substrates of terrestrial haulouts vary from mud and sand to solid rock. Seals use haulouts throughout the year, with the highest numbers occurring on them during pupping (mainly May-June) and molting (mainly August-September). Aerial surveys of harbor seals are done during these two seasons of maximal haulout activity, but primarily during the molt. At some important haulouts, ground-based observations over weeks or months have been made. The largest concentrations of seals occur at haulouts around the perimeter of the Sound, including the Copper River Delta and the mainland glacial fjords of the northern and western parts.

In the Gulf of Alaska region, including Prince William Sound, there has been a significant and prolonged population decline. One of the longest and most intensively studied haulouts is on Tugidak Island near Kodiak, where seals declined by about 85 percent between 1976 and 1988 (most rapidly during the late 1970s) (Pitcher, 1990). Trend count surveys in Prince William Sound were initiated in 1983. The first survey route (Route A) flown during the molting season included 25 land sites in the central and southeastern parts of the Sound. This route did not include any of the major haulouts around the perimeter. From 1984 to 1988, the decline at those 25 sites was about 42 percent (Pitcher, 1989). When the decline in the Sound actually began is not known. However, in view of the Tugidak Island studies and the emerging information about a major North Pacific regime shift that occurred in about 1976 (Ebbesmeyer et al., 1991), it seems likely that it was already occurring during the late 1970s. Based on a longer time series of Route A surveys, Frost et al. (1999) found that the decline was approximately 63 percent from 1984 to 1997, with at an annual rate of 4.6 percent from 1990 to 1997.

In actuality the picture is not so clear-cut. Starting in 1991, a second survey route (Route B), which includes 26 index sites in the northern, western, and southwestern Sound, was established (Hoover-Miller et al., 2001). Six of those sites are in glacial fjords where seals are abundant. The combined data from both survey routes indicate that while the decline continued at most sites on Route A, numbers in the glacial fjords steadily increased. Considered together, data from both routes indicate that the "population" of seals in the Sound has been stable or increasing since about 1992-93. The ongoing trend of a warming climate has resulted in major retreat and shrinking of the glaciers, perhaps producing more favorable ice (haulout) and feeding conditions in the fjords. Regional shifts in the distribution of seals in different parts of the Sound are evident.

With respect to actual numbers, the summary data presented by Small and DeMaster (1995) indicate that the average of counts at all 51 sites was 2,394, based on surveys during the molting seasons in 1991-92. An additional 3,491 seals were on haulouts in the Copper River Delta. The accepted correction factor for unseen seals is 1.61. Therefore, the minimum number of seals in this region was about 9,500, though the actual population size remains unknown.

Pitcher and Calkins (1979) conducted the most detailed biological studies of harbor seals in the Gulf of Alaska/Prince William Sound region, and the following information is from that report, unless otherwise noted. The sex ratio in this population was found to be 1:1 in age groups 0 to 21, but strongly skewed in favor of females after that. The oldest seal they examined was 31. The age at sexual maturity has apparently changed over time, probably in response to changed environmental conditions. Bishop (1967) reported that in his samples obtained from Tugidak Island in 1963-64, females reached sexual maturity at ages 3 to 4 before the decline. In the late 1970s, females became sexually mature at about age 5, and males at 5 or 6.

Pups are born in May through early July, with a marked peak in early to mid June. A single pup is born and nursed for 3 to 4 weeks. The pups can swim from birth and usually do so within an hour (often the birth site is inundated by the next rising tide). During the nursing period, pups travel with their dams. Breeding occurs again at about the time that pups are weaned and is followed by a period of delayed embryonic implantation that lasts until about mid-October. Pregnancy rates in 6, 7 and ≥8 year-olds were, respectively, 88 percent, 89 percent and 92 percent. Natural mortality is high: 74 percent for females and 79 percent for males in age groups 0 to 4 years. It was much lower in older seals: 11 percent for females ages 4 to 19 and 13 percent in males ages 4 to 17. In both sexes, mortality increased again after age 18.

There is considerable variation in the prey items eaten by harbor seals in the Gulf of Alaska/Prince William Sound region, probably due to the variety of vastly different habitats in which the seals occur. Fishes (a minimum of 27 species) comprised 73 percent, cephalopods (mainly octopus) 22 percent, and decapods (shrimps and crabs) 4.1 percent of stomach contents. In descending order, the top four food items were pollock, cephalopods, capelin, and flatfish.

In 1989, an estimated 302 seals were "missing" from haulouts in the Sound that were oiled by the *Exxon Valdez* oil spill. That estimate was based primarily on statistical analyses of counts from surveys of Route A done during August-September 1988-92. The missing seals were presumed to have died from the spill (Frost, Lowry et al., 1994).

Indeed, many seals were exposed to the oil (Lowry et al., 1994) and to the massive influx of people and equipment that ensued. Haulouts were oiled, treated, inspected, and studied. Seals were coated with oil, incorporated volatile hydrocarbon compounds into their tissues, and metabolized them, as shown by biochemical indicators (Frost, Manen et al., 1994). The problem of evaluating mortality, however, involves the contentious issue of distinguishing between sublethal exposure to oil and spill-caused deaths.

Fourteen dead seals were recovered in the Sound, 11 of which were premature or newborn pups (Williams et al., 1994). There was also an ongoing population decline, natural morality of young animals is high, the seals are highly mobile, and they are often displaced by disturbance. The survey-based impact study reported by Frost, Lowry et al. (1994a) was based on assumptions that molting seals have 100 percent fidelity to sampled haulouts, that cleanup and other human activities did not displace seals, and that a state of dynamic equilibrium prevails among Route A sites. A review of that study by Hoover-Miller et al. (2001) indicates that the single-year reduction in seals at oiled haulouts cannot be used as an estimator of spill-caused mortality. Indeed, it was found that:

- The surveys in 1989 were inadequate and not done at the proper time;
- Statistical tests applied to data from "treatment" and "control" sites were not appropriate;
- Seals showed considerably less than 100 percent site fidelity;
- A condition of dynamic equilibrium among haulouts does not exist; and
- Both short and long-term shifts occur in the distribution of seals in the Sound, even absent disturbance.

The strength of evidence does not support the claim that 302 seals died from the *Exxon Valdez* oil spill.

Sea Otter

More than 90 percent of the world's sea otters inhabit Alaska (Rotterman and Simon-Jackson, 1988). Alaska's marine waters contain an estimated 100,000 to 150,000 sea otters (Calkins and Schneider, 1985), of which 14,352 (1994 estimate, USFWS, unpubl. data) reside year-round and breed in Prince William Sound. Although the southern sea otter is listed as endangered, the Alaska stock has no special protection beyond that accorded other marine mammals by the Marine Mammal Protection Act. The Alaska sea-otter population generally has grown and expanded since harvesting stopped in 1911, but that growth in Prince William Sound was disrupted by an earthquake in 1964 and the *Exxon Valdez* oil spill in 1989 (Estes, 1991; Johnson and Garshelis, 1995; Garshelis and Johnson, in press). Sea otters occupy shallow areas (<54 m deep; Kenyon, 1969) along coastlines where they can find protection from wind and storm-driven waves. In Prince William Sound, they feed on a variety of bivalves, crustaceans, and other invertebrates in the nearshore area (Calkins, 1978; Garshelis, 1983; Doroff and Bodkin, 1994; Johnson and Garshelis, 1995)

The *Exxon Valdez* oil spill in western Prince William Sound resulted in the death of hundreds of sea otters. The otter mortality was not over the entire western Prince William Sound, but concentrated in heavily oiled areas. The overall population in western Prince William Sound has increased over the 1990s (Monson et al., 2000), and various indicators suggest the sea otter population in spill-affected areas was recovering a few years after the spill (Johnson and Garshelis, 1995). There are continuing concerns over demographic effects from the initial oil exposure to the spill and over the toxicological effects of residual oil several years after the spill (Monson et al., 2000; Dean et al., 2000) in areas that were heavily oiled. However, as cautioned by Johnson and Garshelis (1995), other environmental factors may affect the sea otter population in western Prince William Sound. For example, the sea otter population in the Aleutian Islands has declined by about 90 percent during the 1990s without any oil spill impacts. Predation by killer whales is implicated in this decline and may also affect the sea otters in Prince William Sound. Harvest by humans may also impact populations in the sound. Subsistence harvest records show hundreds of sea otters killed each year from locations in the sound, including 424 otters in 1998, 195 otters in 1999, and 330 otters in 2000 (U.S. Fish and Wildlife Service, unpublished data). The harvest numbers are underestimates because it is not known how many otters are harvested but unreported. Conclusions about the spill's impact on the sea otter population are confounded by the failure to relate killer-whale predation, human harvest, and other mortality sources (e.g., winter die-offs), combined with poor understanding of major changes in population dynamics (e.g., pre-1911 fur harvest and the 1964 earthquake), which still affect the distribution of sea otters and their prey.

Additional species of marine mammals inhabit marine waters outside Prince William Sound along the tanker routes. These include blue whale, right whale, sei whale, sperm whale, and fur seal (USACE, 1999). Most of these additional species of whales and the southern sea otter are considered threatened or endangered.

3.2.7 Threatened and Endangered Species

By R. Ritchie, D. Troy, and J. Kidd

Three species of animals listed as threatened or endangered in Alaska under the Endangered Species Act (ESA) may occur along the TAPS ROW: Spectacled and Steller's eiders, both listed as threatened, and the Eskimo Curlew, listed as endangered. Also occurring along TAPS, the Arctic subspecies (*tundrius*) and American subspecies (*anatum*) of Peregrine Falcon were delisted from the ESA in 1994 and 1999, respectively. The Short-tailed Albatross, also considered endangered, occurs in the shipping lanes adjacent to Prince William Sound. Seventeen species of terrestrial and freshwater aquatic vertebrates were formerly Category 2 candidate species in Alaska (FWS, 1996a).

Although no federally listed threatened or endangered plant species occur along the TAPS ROW, at least one species, formerly considered a candidate species — the Yukon aster, *Aster yukonensis* — may occur along TAPS (Table 3.2-20; FWS 1996a). Habitat for this species includes gravelly slopes, road cuts, and lakeshores (Welsh, 1974), and it has been found in the Koyukuk River basin (Murray and Lipkin, 1987). In addition, the Alaska Natural Heritage Program maintains a list of rare vascular plants found in the state (Alaska Natural Heritage Program, 2000). At least one of these species — Muir's fleabane, *Erigeron muirri* — occurs along TAPS (specimens collected from Toolik Lake and Sagwon uplands; Lipkin and Murray, 1997). These plant species are not formally protected by federal statutes and are not discussed further below.

The following describes only those species currently protected by provisions of the ESA or recently delisted as protected ESA species. In addition to the federal ESA list, the State of Alaska maintains a list of species of special concern (ADF&G, 1998). Table 3.2-20 contains a complete list of endangered and threatened species and species of concern recognized or formerly recognized by federal and state statutes.

3.2.7.1 Birds

Short-tailed Albatross

The Short-tailed Albatross is listed as endangered in the U.S. (65 FR 46643). The Short-tailed Albatross formerly ranged throughout much of the northern North Pacific Ocean as far south as Mexico and bred on numerous islands off Japan and Taiwan. Presently, it breeds only on Torishima Island and on Minami-kojima off southwestern Japan. This restricted breeding distribution makes the species vulnerable to extinction. The most recent data suggest a total world population of about 1,000 birds (Michaelson et al., 1999). Research suggests that the species concentrates near the shelf-break of the outer continental shelf in Alaska in the North Pacific Ocean (Sherburne, 1993).

Spectacled Eider

The Spectacled Eider is a seaduck that nests in arctic Russia and western and northern Alaska and winters in the Bering Sea. This species is listed under the ESA as threatened throughout its range (58 FR 27474) and FWS recently proposed to designate most of the Alaska North Slope and the nearshore Beaufort Sea as critical habitat for this species (65 FR 6114). When the original TAPS environmental impact statement (BLM, 1972) was written, the North Slope of Alaska was thought to harbor only a small proportion of the world's population of Spectacled Eiders, and most of those birds were thought to occur west of the Colville River, especially in the vicinity of Teshekpuk Lake (Dau and Kistchinski, 1977). Since then, the primary Alaska breeding population (Yukon-Kuskokwim Delta) has declined markedly (Stehn et al., 1993). Subsequent research has revealed a larger population and more widespread distribution of Spectacled Eiders on the North Slope than formerly acknowledged (Larned et al., 1999). The North Slope is now the most important breeding area in Alaska for Spectacled Eiders. This is the ESA-listed species most likely to be encountered along the TAPS ROW, albeit only along the northernmost segment on the Arctic Coastal Plain.

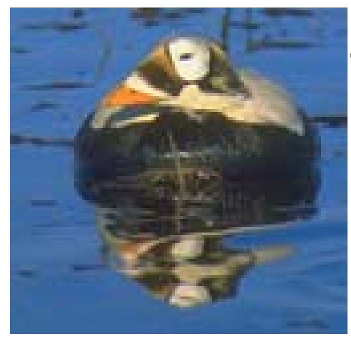

BP Exploration

Photo 3.2-23. *Spectacled Eider.*

Abundance of Spectacled Eiders decreases from west to

Table 3.2-20. *Status and distribution of threatened and endangered species in Alaska. The list of species excludes marine mammals (see Table 3.2-19) and was modified from FWS (1999a) and ADF&G (1998). [E = endangered, T = threatened, D = delisted (*proposed for delisting), SOSC = state species of special concern; NL = no listing].*

Common Name / Group	Species	Federal	State	Range in Alaska	TAPS & Marine Transportation System
Aleutian Canada Goose	*Branta canadensis leucopareia*	T, D*	SOSC	Aleutian Islands, Semidi Island	No
Spectacled Eider	*Somateria fischeri*	T	SOSC	Western, Northern (coastal)	Yes
Steller’s Eider	*Polysticta stelleri*	T	SOSC	Southwestern, Northern, Western (coastal)	Yes
Eskimo Curlew	*Numenius borealis*	E	NL	Probably extirpated	Yes
Short-tailed Albatross	*Phoebastria albatrus*	E	E	North Pacific, Bering Sea	Yes
American Peregrine Falcon	*Falco peregrinus anatum*	D	SOSC	Interior	Yes
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	D	SOSC	Northern, Western	Yes
Northern (Queen Charlotte) Goshawk	*Accipiter gentilis laingi*	NL	SOSC	Southeast	No
Olive-sided Flycatcher	*Contopus borealis*	NL	SOSC	Central, Southern, Southeast	Yes
Gray-cheeked Thrush	*Catharus minimus*	NL	SOSC	Interior, Southern, Southeast	Yes
Townshend’s Warbler	*Dendroica townshendi*	NL	SOSC	Interior, Southern, Southeast	Yes
Blackpoll Warbler	*Dendroica striata*	NL	SOSC	Interior, Southern	Yes
Aleutian shield fern	*Polystichum aleuticum*	E	NL	Adak Island	No
Yukon aster	*Aster yukonensis*	NL	SOSC	Disjunct through the Brooks Range	Possible
Green sea turtle	*Chelonia mydas* (incl. *agassizi)*	T	NL	Pacific Ocean	Possible
Leatherback sea turtle	*Dermochelys coriacea*	E	NL	Pacific Ocean	Possible
Loggerhead sea turtle	*Caretta caretta*	T	NL	Pacific Ocean	Possible
Olive (Pacific) Ridley sea turtle	*Lepidochelys olivacea*	T	NL	Pacific Ocean	Possible
Snake River sockeye salmon	*Oncorhynchus nerka*	E	NL	Pacific Ocean	Possible
Snake River spring/summer chinook salmon	*Oncorhynchus tshawytscha*	T	NL	Pacific Ocean	
Snake River fall chinook salmon	*Oncorhynchus tshawytscha*	T	NL	Pacific Ocean	Possible
Puget Sound chinook salmon	*Oncorhynchus tshawytscha*	T	NL	Pacific Ocean	Possible
Lower Columbia River chinook salmon	*Oncorhynchus tshawytscha*	T	NL	Pacific Ocean	
Upper Willamette River chinook salmon	*Oncorhynchus tshawytscha*	T	NL	Pacific Ocean	Possible
Upper Columbia R. spring chinook salmon	*Oncorhynchus tshawytscha*	E	NL	Pacific Ocean	Possible
Upper Columbia River steelhead	*Oncorhynchus mykiss*	E	NL	Pacific Ocean	Possible
Snake River Basin steelhead	*Oncorhynchus mykiss*	T	NL	Pacific Ocean	Possible
Lower Columbia River steelhead	*Oncorhynchus mykiss*	T	NL	Pacific Ocean	Possible
Upper Willamette River steelhead	*Oncorhynchus mykiss*	T	NL	Pacific Ocean	Possible
Middle Columbia River steelhead	*Oncorhynchus mykiss*	T	NL	Pacific Ocean	Possible

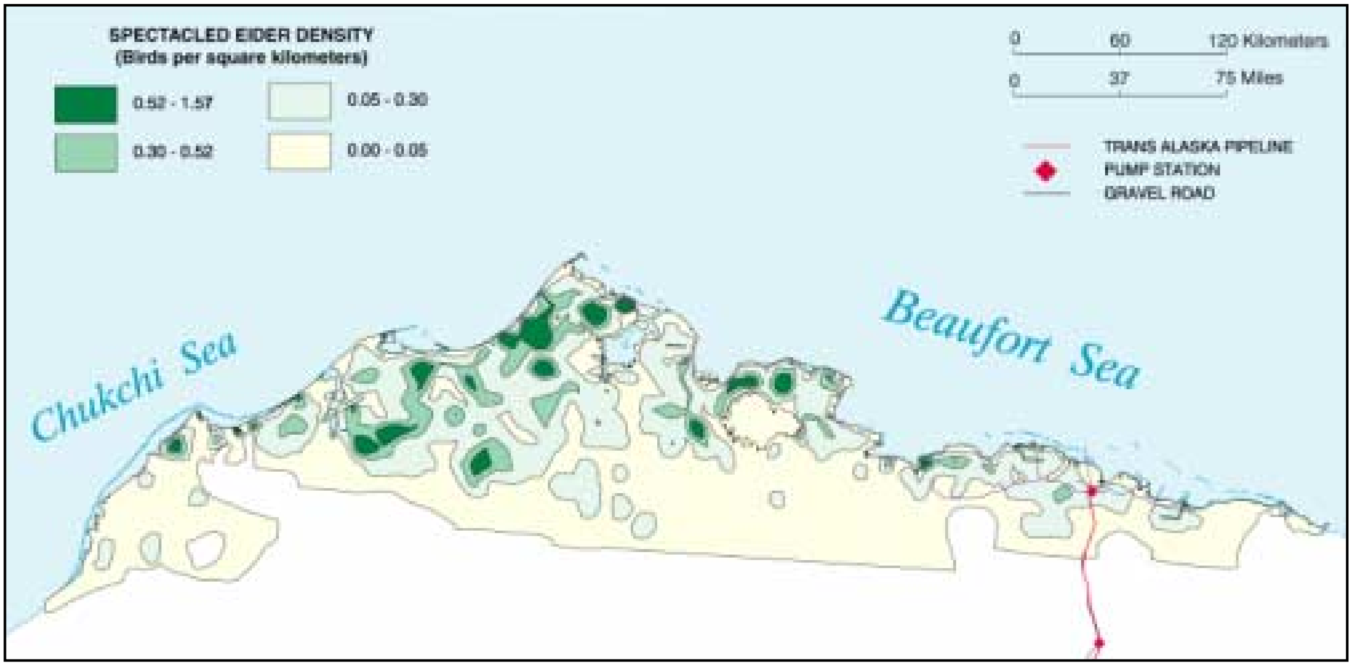


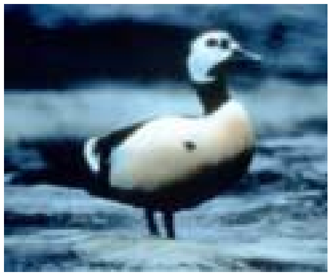
Figure 3.2-22. *Abundance patterns of Spectacled Eiders across the North Slope (modified from Larned et al., 1999).*

east across the Arctic Coastal Plain. Most high-density areas are west of Harrison Bay, and relatively few pairs are found east of the Shaviovik River (Larned et al., 1999) (Figure 3.2-22). About 100 pairs of Spectacled Eiders occur in the Prudhoe Bay area (TERA, 1997). Larned et al. (1999) summarized four classes of Spectacled Eider abundance across the Arctic Coastal Plain (Figure 3.2-22). Approximately 40 miles of the TAPS ROW is in the region surveyed, and Spectacled Eider abundance in the ROW is entirely within the lowest two categories: below average to no birds (Larned et al., 1999). This classification indicates that the best habitats for Spectacled Eiders along TAPS are at the northernmost end, near Pump Station 1. More intensive surveys of most of this region south to approximately TAPS MP 7 from 1991 to 1997 (TERA, 1996b, 1997) found a few Spectacled Eiders near TAPS but none within 1 km of the ROW. Spectacled Eiders may occur farther south than the areas covered by current surveys, although densities probably are low. Along TAPS, the southernmost report of Spectacled Eider is from MP 12 (Hohenberger et al., 1981).

Spectacled Eiders may occur along the northern end of TAPS from late May through mid-September. Spectacled Eiders return from wintering grounds in the Bering Sea to the Arctic Coastal Plain in late May or early June. Male Spectacled Eiders depart during mid- to late June at the onset of nesting, while females leave from late June through mid-September, depending on their breeding success (failed breeders depart earliest). After leaving the coastal plain, Spectacled Eiders molt in a few locations in arctic and eastern Russia or Ledyard Bay in northwestern Alaska before continuing on to staging areas near St. Lawrence Island and wintering areas in the central Bering Sea (Petersen et al., 1999; TERA, 1999). Additional information on breeding biology and status of the Spectacled Eider is summarized in FWS (1996b).

Critical habitat has been proposed for Spectacled Eiders on the North Slope by FWS (65 FR 6114). Under the proposal for critical habitat, the northern section of the TAPS ROW and Pump Station 1 are included within the area designated as critical habitat for the North Slope Nesting Unit. Within that area, specific “primary constituent elements” of critical habitat have been defined as “...those physical and biological features that are essential to the conservation of the species (primary constituent elements) and that may require special management considerations or protection...” (65 FR 6117). For the North Slope Nesting Unit, five primary constituent elements have been described: all deep waterbodies; all waterbodies that are part of basin wetland complexes; all permanently flooded wetlands and waterbodies containing either *Carex aquatilis, Arctophila fulva,* or both; all habitat immediately adjacent to these habitat types; and all marine water out to 25 miles from shore, its associated aquatic flora and fauna in the water column, and the underlying benthic community. These habitats occur along the ROW and around Pump Station 1.

Steller's Eider



R. Lanctot

Photo 3.2-24. *Steller's Eider.*

The Alaska breeding population of Steller's Eider was listed as threatened (59 FR 35896) in 1997 because of a substantial population decline in recent years (Kertell, 1991; Quakenbush and Cochrane, 1993). During summer, Steller's Eiders are likely to occur only at the northernmost end of TAPS, but in winter, small groups regularly occur in Cook Inlet, near Kodiak Island, and occasionally in the Gulf of Alaska and Prince William Sound (FWS, 1998a). Most Steller's Eiders wintering in Alaska are from the larger (nonlisted) Russian breeding population. Winter distribution of the Alaska breeding birds is poorly documented.

Steller's Eiders historically nested in a discontinuous distribution on the Aleutian Islands, the Alaska Peninsula, the Yukon-Kuskokwim Delta, and the Seward Peninsula; from the vicinity of Point Lay to Barrow in northwestern Alaska; across most or all of the Arctic Coastal Plain of northern Alaska; and across most of arctic Russia from the Kheta River (west of the Lena River) eastward nearly to the tip of the Chukchi Peninsula (Kertell, 1991; Quakenbush and Cochrane, 1993). Currently, Steller's Eiders nest in Alaska only on the Yukon-Kuskokwim Delta and on the Arctic Coastal Plain, and in Russia on the arctic coast (Quakenbush and Cochrane, 1993).

On the Yukon-Kuskokwim Delta, this species has almost disappeared as a breeding bird, with only a few pairs nesting there since 1994 (Flint and Herzog, 1999). On the Arctic Coastal Plain of Alaska, Steller's Eiders nest primarily near Barrow, but the total breeding range probably extends from Point Lay to near the Colville River Delta (Day et al., 1995; Quakenbush et al., 1995). Non-breeding and post-breeding birds use nearshore waters of the northeastern Chukchi Sea and large lakes around Barrow for molting and summering, and they also rarely occur in summer as single birds along the coast as far east as the border with the Yukon. The Steller's Eider has been recorded periodically in the Prudhoe Bay area, and at least one pair apparently nested there in 1993 (FWS, 1998a).

Information on habitat use by breeding Steller's Eiders is sparse. On the Yukon-Kuskokwim Delta, they formerly nested in what is described as the "vegetated intertidal zone" (i.e., salt marshes) of the central delta, where the coastal habitat is irregularly flooded (King and Dau, 1981). In arctic Alaska, they nest and raise broods in areas dominated by low-centered polygons and shallow ponds with emergent grasses and sedges, flooded tundra (i.e., wet meadows), lakes, and drained lake basins. The presence of emergent plants seems to be important to brood-rearing Steller's Eiders (Quakenbush and Cochrane, 1993). A recent study in the Barrow area found that waterbodies with *Arctophila fulva* (pendant grass) had considerable use (greater than their availability) during the pre-nesting, nesting, and brood-rearing periods (Quakenbush et al., 1995). Suitable habitats for Steller's Eiders occur near Pump Station 1 and along the north end of TAPS, but no Steller's Eiders have been reported there.

Critical habitat has been proposed for Steller's Eiders on the North Slope by FWS (65 FR 13262). The eastern channel of the Colville River forms the eastern boundary of the area designated as critical habitat for the North Slope breeding population of Steller's Eiders. Thus, the ROW and facilities are not in critical habitat proposed for this species.

Eskimo Curlew

The Eskimo Curlew is perhaps the only endangered species whose range overlaps the TAPS ROW. Once numerous, this species is now on the verge of extinction, if not already extinct (Page and Gill, 1994). This arctic-nesting shorebird declined to low numbers before its distribution or much of its breeding biology was described (Gollop et al., 1986). This species has been recorded numerous times in northern Alaska, but nesting was never documented (Gabrielson and Lincoln, 1959). Potential breeding habitat occurs in a narrow band along the northern foothills of the Brooks Range (Gill et al., 1998). The cause of the Eskimo Curlew's decline is unknown, but over-hunting, habitat change through conversion of wintering and staging areas to agriculture, changes in prey availability, and climate change have been suggested as factors (Faanes and Senner, 1991). The only factor that may have operated on the breeding grounds was climate change, including colder conditions (perhaps resulting in poor reproduction) during the period of decline.

Arctic Peregrine Falcon

The Arctic Peregrine Falcon, formerly listed as endangered and then reclassified as threatened, was delisted from the ESA on 5 October 1994 (59 FR 50796). Under the provisions of the ESA, FWS monitored this species for 5 years following delisting and during the Section 7 consultation process, treated it as a Category 2 candidate species. With this 5-year monitoring period completed, protection of Arctic Peregrine Falcons is no longer mandated by the ESA. Instead, FWS will offer consultation to reduce development impacts on this species (Swem, 1999, pers. comm.).

Arctic Peregrine Falcons nest in northern and northwestern Alaska from the U.S.-Canada border to Norton Sound on the Bering Sea. Regionally, they occur along the TAPS ROW on the Sagavanirktok River and its tributaries between late April and mid-September. Incubation begins by late May, hatching occurs by early July, and young fledge by late August (Cade, 1960; Ritchie, 1987). Arctic Peregrine Falcons winter mainly in South America (Hickey and Anderson, 1969). Peregrines are primarily cliff-nesters and regularly use river bluffs and cliffs in the northern foothills of the Brooks Range (Cade, 1960). They prey mainly on birds. As Peregrine Falcons have recovered from substantial declines between the 1950s and 1970s (Ambrose et al., 1988), they occasionally have used habitats of lesser quality, including low coastal bluffs (Mauer, 1999, pers. comm.) and mud banks of lakes and rivers on the Arctic Coastal Plain (Ritchie, unpubl. data).


Skip Ambrose

Photo 3.2-25. *Arctic Peregrine Falcon.*

Nesting Peregrine Falcons have been recorded on the Sagavanirktok River within 1 mile of the TAPS ROW. The Colville River and its tributaries and the Sagavanirktok River are the core breeding areas for peregrines in northern Alaska. Traditional concentration areas for nesting peregrines in this area include Franklin and Sagwon bluffs, but nesting has been documented as far south as Slope Mountain (Wright and Bente, 1999; APSC, 1993). During the 1970s, peregrines in northern Alaska were reduced to about 35 percent of the breeding population known in the 1950s due to poor productivity linked to pesticides (Ambrose et al., 1988). The Sagavanirktok River corridor was no exception; fewer than five pairs occupied its cliffs in the mid-1970s (Roseneau et al., 1976). By 1988, at least 10 pairs occupied the area, and in 1998 more than 25 pairs occupied bluffs along the river (Wright and Bente, 1999).

American Peregrine Falcon

The American Peregrine Falcon, formerly listed as endangered and reclassified as threatened, was delisted from the ESA on 25 August 1999 (64 FR 46542). As with the Arctic subspecies, the FWS will treat it as a Category 2 candidate and monitor it for a 5-year period after delisting.

American Peregrine Falcons occur in Interior Alaska, possibly reaching the coast in western and Southcentral Alaska (Ambrose et al., 1988). Regionally, they occur along the TAPS ROW south of the Brooks Range divide and nest in the drainages of the Yukon River, including the Koyukuk, Tanana, and main Yukon, and their tributaries. Nests have not been located south of the Alaska Range along TAPS in the Copper River drainage (Swem, 1999, pers. comm.), although suitable habitat appears to be present (Cade, 1960). They feed primarily on birds and winter in the southern U.S. and in Mexico, and some birds migrate to Central and South America. As the population continues to recover, peregrines may use many of these unoccupied regions. In Interior Alaska, peregrines are present from late April to late September; they begin incubation as early as mid-May, and young hatch by late June and fledge in August. Peregrines nest on riparian cliffs and dirt bluffs, occasionally using more remote rock outcroppings in uplands adjacent to major rivers (Ritchie and Rose, 1999). Nesting has been recorded within 1 mile of TAPS at the Tanana River pipeline crossing and within 5 miles on the Salcha River and other locations along the Tanana River. Traditional nesting areas for peregrines along TAPS include the middle Yukon River, the Tanana River between Fairbanks and Delta Junction, and some tributaries in the Tanana-Yukon Uplands (White et al., 1977). Nesting habitat for peregrines and other raptors is also found at Grapefruit Rocks near the pipeline at MP 417-418 between Livengood and Fairbanks.

Between the late 1960s and 1985, the American Peregrine population in Interior Alaska declined to at least 55 percent of historical numbers (Ambrose et al., 1988). The lowest levels occurred in the 1970s, and numbers began to increase by the late 1970s paralleling increases of the Arctic subspecies in northern Alaska. The population has continued to increase and presently exceeds historical baselines established in the 1960s. For instance, 16 to 19 nest sites were known for the Tanana River from pre-1963 records (Haugh, 1976), but by 1998, pairs of falcons occupied 38 sites along the same section of river, including quarries along the Richardson Highway (Ritchie et al., 1998).

3.2.7.2 Plants

Currently no plants listed as threatened or endangered in Alaska occur along the TAPS and adjacent areas.

3.2.7.3 Mammals

No terrestrial mammals are listed as threatened or endangered in Alaska. Threatened or endangered marine mammals, including the bowhead whale, are discussed in Section 3.2.6.