

**APPENDIX E**  
**WILDLIFE RESOURCES**



## **E. WILDLIFE RESOURCES**

This appendix provides supporting information on wildlife resources in the proposed Port MacKenzie Rail Extension project area and Alaska Department of Fish and Game (ADF&G) Game Management Subunits 14A and 14B, which the rail line would cross (Figure E-1). The descriptions of wildlife occurrence, abundance, distribution, harvest, and life histories provided in this appendix and used in analyses were compiled by SEA from various sources including ADF&G Subunit 14A and 14B management reports and data (ADF&G, 2008a; 2008b); the ADF&G Wildlife Notebook Series; Alaska Natural Heritage Program (UAA, 2008); Arctos v3 database UAM Mammals (UAF, 2008); U.S. Fish and Wildlife Service data (Conant *et al.*, 2007; Platte *et al.*, 2008); and breeding bird survey data (Shook and Ritchie, 2008; Sauer *et al.*, 2008; Benson, 2001).

### **E.1 Affected Environment**

Table E-1 lists mammals in the study area, which include 3 big game mammals, 14 furbearers, 10 other mammals, and 3 marine mammals. Migratory and resident birds in the study area include 20 waterfowl and waterbirds, 7 raptors and owls, 5 shorebirds, 2 seabirds, and 42 landbirds.

#### **E.1.1 Bears**

Both black and brown bears can become a problem when they have learned to associate humans with food. Bears become conditioned to human food when they access improperly stored garbage, or human or animal foods. Bears have a keen sense of smell and habitually seek the same foods in the same places year after year. Because cubs learn from their mothers where and on what to forage, cubs conditioned to human foods condition their cubs to human foods. Once exposed to human foods and garbage, conditioned bears can become such a problem that they ultimately must be eradicated.

#### **E.1.2 Moose**

Moose are distributed throughout Alaska and are the primary large mammal harvested in the Matanuska-Susitna River Valley. Primary predators of moose calves in the study area are wolves, black bears, and grizzly bears. The moose population in Subunit 14A has remained relatively stable at approximately 5,500 to 6,500 animals (Figure E-2); the moose population in Subunit 14B has remained relatively stable at approximately 1,500 moose (Figure E-3).

Based on early winter densities listed in Table E-1, there would be an estimated 2,873 moose within 5 miles of the proposed rail line alternatives. Seasonal migrants could increase the density of moose in the Matanuska-Susitna Valley. Assuming an estimated 30 percent of the moose in the project area are seasonal migrants from the foothills of Subunit 14A, 862 moose would be expected to move into and out of the project area, potentially crossing the proposed rail twice a year, once during spring and once during fall. Figure E-4 illustrates generalized seasonal moose movement patterns based on information in Masteller (undated) and Modafferi (1988) and moose calving, rutting and winter habitats (ADF&G, 1985).

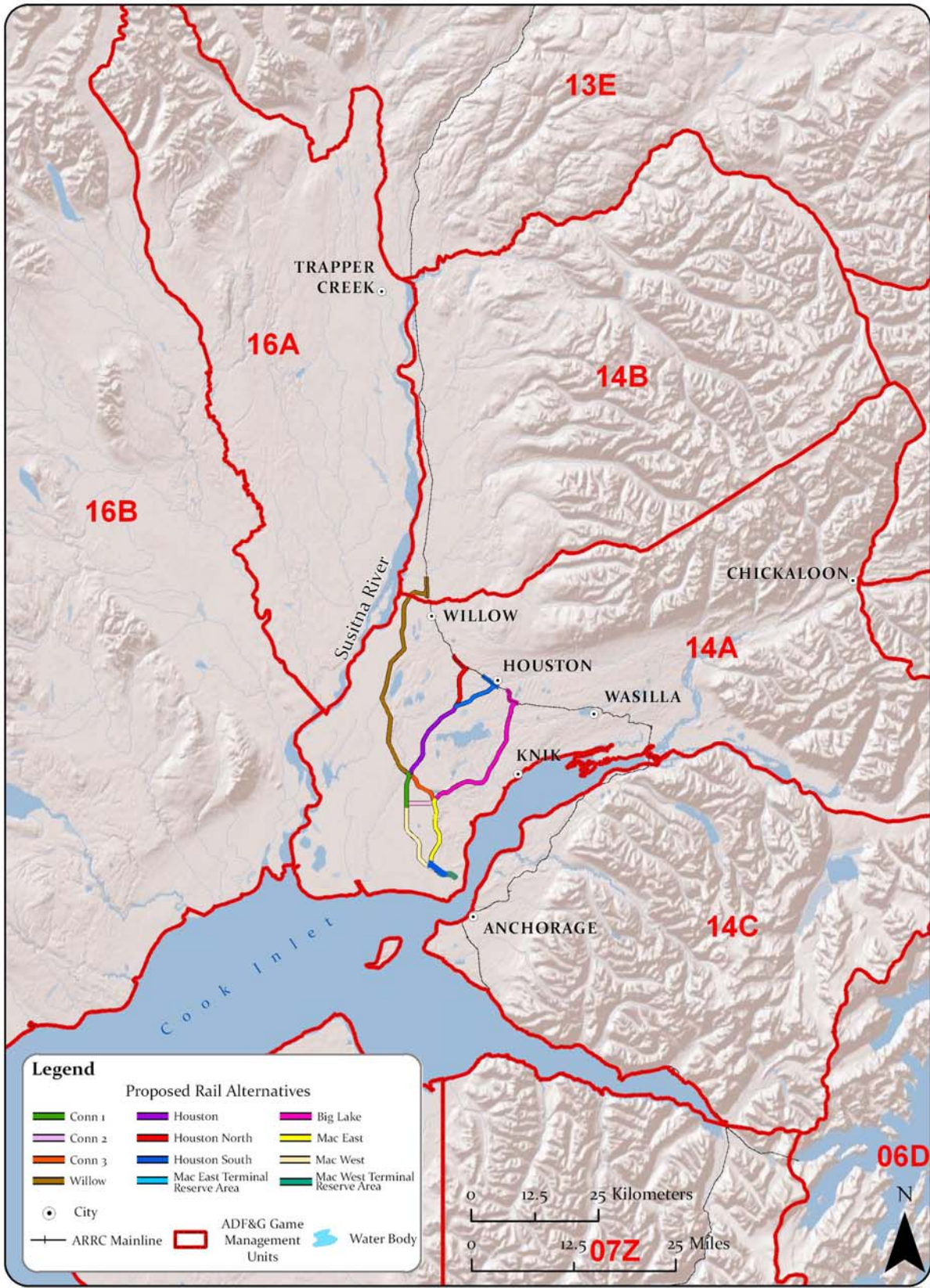


Figure E-1. Alaska Department of Fish and Game Management Units

**Table E-1  
Mammals in the Port MacKenzie Rail Extension Project Area<sup>a</sup> (page 1 of 6)**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Generalized Hunting Season</b>	<b>Mean Annual Harvest 2002-2007 (Game Management Unit 14)<sup>b</sup></b>	<b>Population Estimate (Game Management Unit 14)</b>	<b>Project Area Density</b>
<b>Big Game Mammals</b>					
Black Bear	<i>Ursus americanus</i>	No closed season	153.2 (20 percent)	500 to 1,000	8 to 15 per 100 square miles
Brown Bear	<i>Ursus arctos</i>	September to June	10.2 (5 percent)	185 to 239	3 to 4 per 100 square miles
Moose	<i>Alces alces</i>	August and October	622.7 (6 percent)	10,213	Approximately 3.6 per square mile
Moose	<i>Alces alces</i>	August and October	467.8 (7 percent)	14A, 6,600	3.6 per square mile
Moose	<i>Alces alces</i>	August and October	61.7 (4 percent)	14B, 1,413	0.7 per square mile
Wolf	<i>Canis lupus</i>	August to May	23.6 (21 percent)	115	18 to 21 packs 2 wolves per 100 square miles
<b>Furbearers</b>					
Beaver	<i>Castor canadensis</i>	0.6 mile stream channel; 43.5 acres, solitary; 19.0 acres, families	Streams, ponds, backwaters; forages on shrubs and aquatic vegetation	Breed January or February, young born late April to June; bank den or lodge near dammed streams or on ponds, 2 feet by 3 feet by 3 feet, used year-round	
Coyote	<i>Canis latrans</i>	2,471 to 24,710 acres	Forests, grasslands, scrub/shrub, agricultural; forage primarily on hares, rodents, carrion	Breed February and March; den in hills, floodplain terrace, aboveground or hollow logs, used only during whelping; dens might be occupied during March to July; might use more than one den; dens used repeatedly	

**Table E-1  
Mammals Occurring Within the Port MacKenzie Rail Extension Project Area<sup>a</sup> (page 2 of 6)**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Home Range Size</b>	<b>General Habitats</b>	<b>Breeding and Den Habitat</b>
<b>Furbearers</b>				
Short-tailed Weasel (Ermine)	<i>Mustela erminea</i>	24.7 to 49.4 acres	Forests, riparian woodlands and scrub/shrub; forages primarily on small rodents and lemmings but will eat birds, eggs, frogs, fish, insects	Breed mid to late summer, young born early May through June; den in rodent burrows, stumps, rock outcrops; can remain June to August
Least Weasel	<i>Mustela nivalis</i>	17.3 acres females, 64.2 acres males	Woodlands, riparian, grassy fields and meadows; forages on small mammals, especially voles, lemmings, and other mice; might consume other small vertebrates, insects, or worms when rodents are scarce	Uses burrows made by voles
Lynx	<i>Lynx canadensis</i>	5 to 100 square miles (3,200 to 64,000 acres), depending on food abundance	Spruce and hardwood forest habitats, especially mosaic habitats caused by fire; forage primarily on hares, grouse, ptarmigan, squirrels, rodents	Breed March and early April, kittens born May to June; den in natural shelters such as windblown trees, hollow logs, log jams, rock crevices
Marten	<i>Martes americana</i>	1 to 15 square miles (640 to 9,600 acres), depending on food abundance	Black spruce forests and bogs; forage primarily on rodents, but also eat berries, small birds, eggs, vegetation, and carrion	Breed July and August, young born in April or early May; den in natural shelters such as hollow logs, windblown trees, standing snags/hollow trees
Mink	<i>Mustela vison</i>	20 to 50 acres female, 1,900 acres male	Riparian forests, marshes and scrub/shrub wetlands; forage on fish, birds, eggs, rodents	Breed March to April, most young born in June; den in burrow or hollow log near a pond or stream; young remain in den through July
Muskrat	<i>Ondatra zibethicus</i>	2.5 to 4.9 acres, marshes; 0.25 mile, streams	Marshes, riparian areas, floodplains of large rivers, ponds; forage on aquatic plants, lilies, sedges, grasses, mussels, small fish	Breed during late April to mid-May, two litters per year, first mid-June, second mid-July; den in vegetation piles 2 to 3 feet above water and 5 to 6 feet in diameter, also might tunnel into banks used year-round
Red Fox	<i>Vulpes vulpes</i>	Summer, 150 to 1,300 acres; winter, 3,104 to 49,658 acres	Mosaic habitats, lowland marshes; forages on rodents, small mammals, birds, eggs, insects, vegetation, carrion	Breed February to March, young born April to May; dens 15 to 20 feet long, usually on the side of a hill with several entrances; might use abandoned wolf dens

**Table E-1  
Mammals Occurring Within the Port MacKenzie Rail Extension Project Area<sup>a</sup> (page 3 of 6)**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Home Range Size</b>	<b>General Habitats</b>	<b>Breeding and Den Habitat</b>
<b>Furbearers</b>				
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	0.5 to 1 acre	Spruce forests; forages on seeds, berries, buds, fungi, and occasionally insects and bird eggs	Breed February and March, young born April to May; nest in holes in tree trunks or constructed mass of twigs, leaves, mosses and lichens; several nests maintained per territory; ground burrows or middens used primarily for food storage
River Otter	<i>Lontra canadensis</i>	1.2 to 48.5 miles, waterway	Riparian habitats, rivers, lakes, marshes; forage on fish, mussels, snails, birds, mammals, vegetation	Breed in May, young born in late January to June; burrows in soil or uses fallen/hollow logs, overturned tree root wads, might use year-round
Snowshoe Hare	<i>Lepus americanus</i>	Average 7 to 15 acres, up to 39.5 acres	Forests, woody wetlands, bogs; forages on succulent vegetation, in winter eats twigs, buds, bark of small trees	Breed February to mid-August, young born May to August; nest in ground depression or hollow log
Wolf	<i>Canis lupus</i>	600 square miles (384,000 acres) per pack	Variable; forages on moose, caribou, hares, rodents, birds	Breed February and March, young born in May or early June; den in well-drained soil up to 10 feet deep, young moved from den during mid to late summer
Wolverine	<i>Gulo gulo</i>	Female, 50 to 100 square miles (32,000 to 64,000 acres); male, 240 square miles (153,600 acres)	Variable, coniferous forests, riparian areas could be important winter habitat; forages on moose and caribou carcasses, rodents, squirrels, hares, birds	Breed May through August, young born January through April; den made in snow; occupies dens in caves, under fallen trees, or thickets when inactive

**Table E-1  
Mammals Occurring Within the Port MacKenzie Rail Extension Project Area<sup>a</sup> (page 4 of 6)**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Home Range Size</b>	<b>General Habitats</b>	<b>Breeding and Den Habitat</b>
<b>Other Mammals</b>				
Little Brown Bat	<i>Myotis lucifugus</i>	Migratory; winters in caves, occur in area during spring through fall, summer home range poorly understood	Forest, woody wetlands, riparian; forages in woodlands near water; eats flying insects	Breed September to October, young born in late spring to early summer; use standing snags/hollow trees; availability of suitable maternity sites might limit abundance and distribution
Northern Bog Lemming	<i>Synaptomys borealis</i>	Less than 1 acre; sociable, may form small colonies	Bog, muskeg, mixed and coniferous forests; forages on grasses, sedges, other vegetation	Breed May to August, several litters per year; active year-round; nest in burrows in soil or uses logs/debris
Porcupine	<i>Erethizon dorsatum</i>	Summer range 125 to 250 acres; winter range smaller; densities 25 to 58 per square mile in good habitat	Coniferous and mixed forests and woodlands; forages on inner bark of trees, evergreen needles in winter, buds in spring, roots, leaves, fruits in summer, fruits in fall	Breed September to November or December, young born in spring to winter; den in rock outcrops, live hollow trees, hollow logs; shelter in dense conifers in winter
Northern Flying Squirrel	<i>Glaucomys sabrinus</i>	Up to 86.5 acres; summer, 7 to 12 acres	Coniferous and mixed forests, riparian woods; forages on fungi, lichens, insects, nuts, buds, seeds, fruit	Breed February to May; in lower latitudes might have two litters; nest in tree cavities, leaf nests, underground burrows; use large number of alternative den sites in Alaska
Dusky Shrew	<i>Sorex monticolus</i>	0.3 to 1 acre	Forest and wetland habitats, sphagnum bogs; forages on insects and other small invertebrates such as worms, sowbugs, mollusks	Breed April to August; nest in burrows or fallen logs/debris

**Table E-1  
Mammals Occurring Within the Port MacKenzie Rail Extension Project Area<sup>a</sup> (page 5 of 6)**

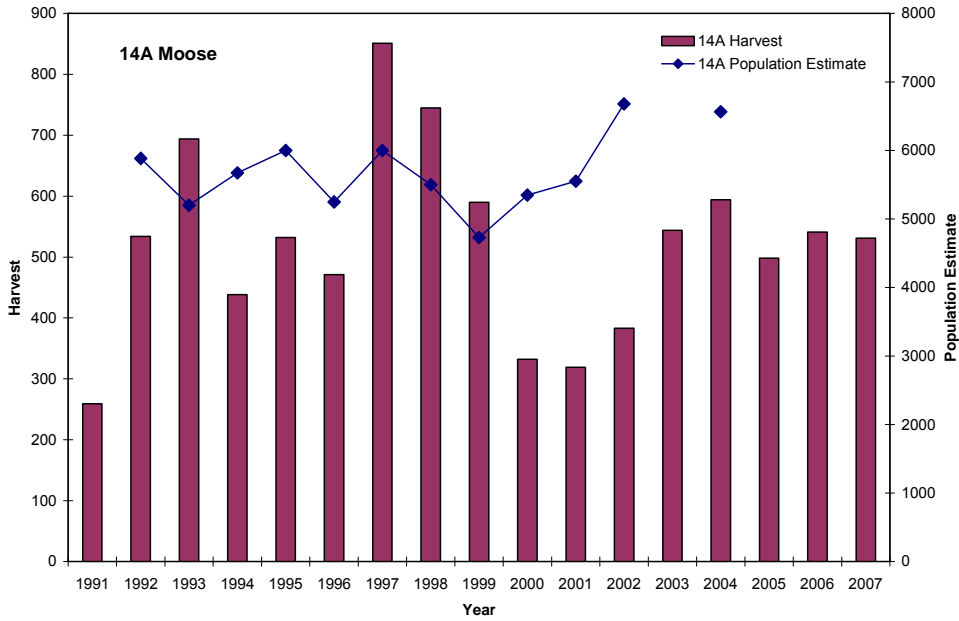
<b>Common Name</b>	<b>Scientific Name</b>	<b>Home Range Size</b>	<b>General Habitats</b>	<b>Breeding and Den Habitat</b>
<b>Other Mammals</b>				
Masked Shrew	<i>Sorex cinereus</i>	0.1 acre	Forest and wetland habitats; forages on insects, invertebrates, carrion, small vertebrates, occasionally seeds	Breed March to September, usually 2 litters; nest in shallow burrows or above ground in logs and stumps
Tundra Shrew	<i>Sorex tundrensis</i>	Less than 1 acre	Dwarf shrub habitats, tundra vegetation; forages on insects, invertebrates	Nest in soil or logs/debris
Meadow Vole	<i>Microtus pennsylvanicus</i>	0.25 acre; dispersal probably more than 0.6 mile	Grasslands, woody wetlands, bogs, riparian; forages on vegetation, grasses, roots and seeds; burrows and uses fallen logs/debris	Breed throughout year with sufficient snow cover; peak activity April to October
Northern Red-backed Vole	<i>Myodes rutilus</i>	Less than 1 acre	Coniferous forests; forages on fungi, berries, lichens, moss, insects, grass	Young born May to September; nest in burrows or fallen log/debris
Tundra Vole	<i>Microtus oeconomus</i>	Male, 0.9 acre; female, 0.3 acre	Muskeg, grasslands, coniferous and mixed woodlands; nests in shallow burrows in soil or uses logs/debris; forages on green grasses and sedges in summer, stores rhizomes and grass seeds for winter	Probably breed throughout the year; population densities can fluctuate

**Table E-1  
Mammals Occurring Within the Port MacKenzie Rail Extension Project Area<sup>a</sup> (page 6 of 6)**

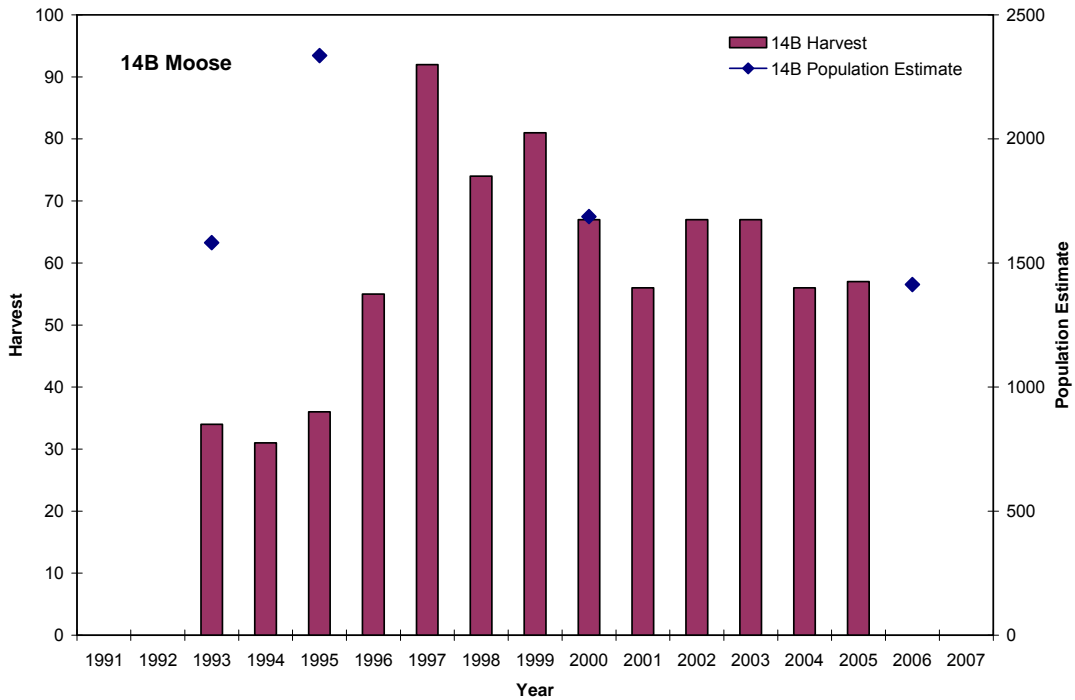
Common Name	Scientific Name	Home Range Size	General Habitats	Breeding and Den Habitat
<b>Marine Mammals</b>				
Beluga Whale	<i>Delphinapterous leucas</i> Cook Inlet stock	Commonly occur in Knik Arm of Cook Inlet	Near shore, river mouth/tidal rivers; forage on fish (eulacoon and salmon, can follow prey up river); squid, crabs, clams; social	Concentrate near river mouths along the northern reaches of Cook Inlet in spring and early summer; calving areas near mouth of Susitna River, Turnagain Arm
Harbor Porpoise	<i>Phocoena phocoena</i>	Seasonal; inshore movements in summer, offshore in winter; movements follow prey species	Near shore, pelagic, river mouth/tidal rivers; forage on fish, squid and crustaceans; Shy, not often observed, but can be heard; solitary or social	Breed in summer, calf born May to early August; mothers and calves move to sheltered coves soon after parturition
Harbor Seal	<i>Phoca vitulina</i>	Can make seasonal migrations of hundreds of miles	Near shore, pelagic, river mouth/tidal rivers, can occur miles up river; forage on fish, squid, crustaceans; solitary	Young May to June in Gulf of Alaska; haulout on intertidal sandbars, rocky shores, ice

<sup>a</sup> Sources: Kavalok, 2005; Kavalok, 2007; McDonough, 2002a; McDonough, 2002b; Pettier, 2006a; Pettier, 2006b; ADF&G Alaska Wildlife Notebook; NatureServe, Animal Diversity Web.

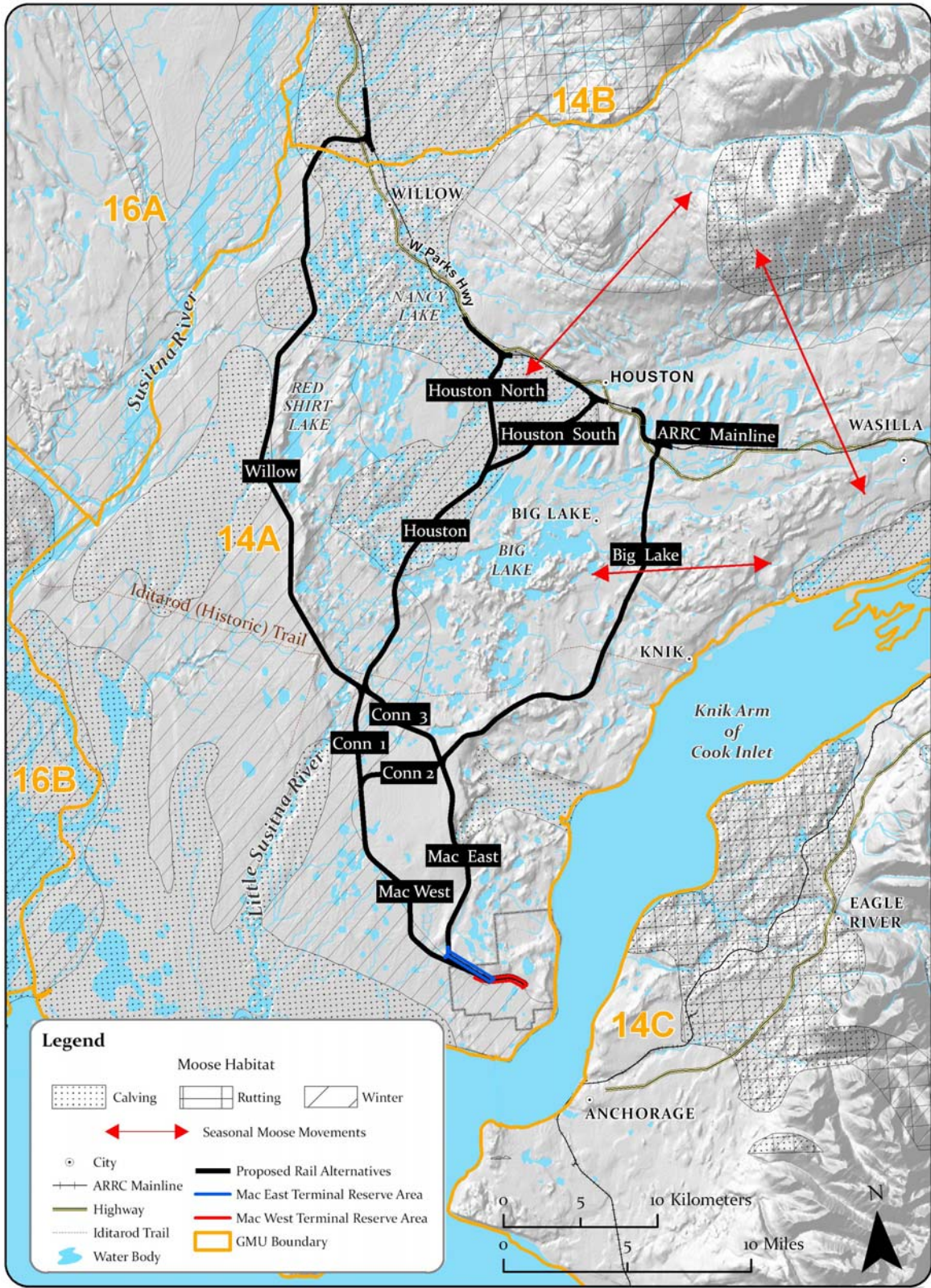
<sup>b</sup> Harvest percentage of estimated population appears in parentheses. Mean annual harvest of moose for Subunits 14A and 14B are listed on separate table lines. All harvested wolves are required to be sealed (registered and recorded). Wolf harvest records are reported from sealing files. No same day airborne hunting of wolves was in affect for Game Management Unit 14 during the reporting period. The National Research Council estimated sustainable harvest rates for wolves from 30 percent up to 40 percent of early winter populations (NRC, 1997).



**Figure E-2. Population and Harvest Trends for Subunit 14A Moose 1991 to 2007 (Peltier, 2006a)**

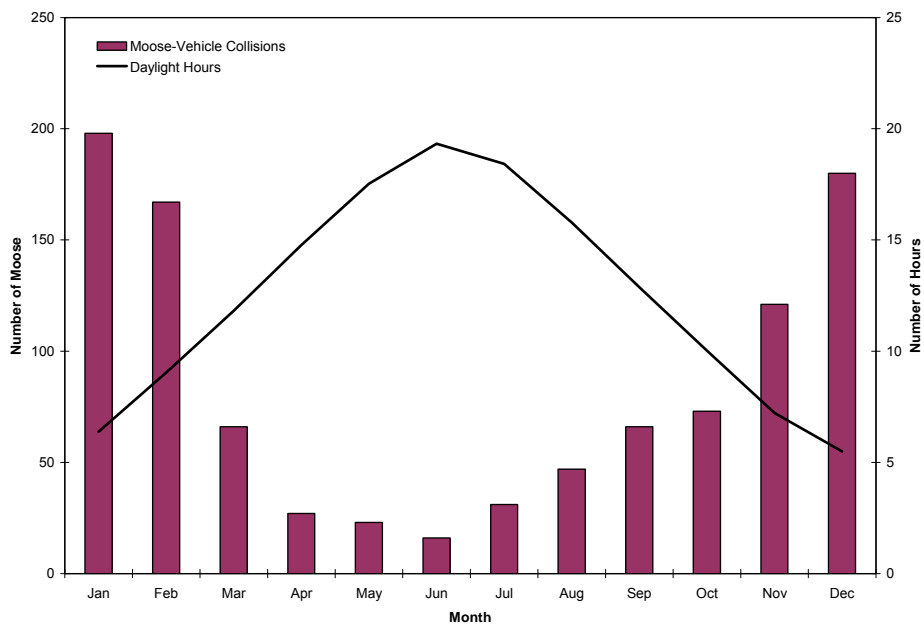


**Figure E-3. Population and Harvest Trends for Subunit 14B Moose 1993 to 2005 (Peltier, 2006b)**



**Figure E-4. Moose Habitats and Generalized Movement Patterns (ADF&G, 1985; Masteller, undated; Modafferi, 1988)**

Increased development in the Matanuska-Susitna Valley has contributed to increased vehicle traffic killing more moose. Accidental death by collisions with vehicles and trains accounts for an average of 25 percent of combined accidental and harvest mortality for moose (McDonough, 2002b; Del Frate, 2004; Peltier, 2006a). Moose-train collision mortality accounted for an average of 9 percent of all accidental moose mortality during 1990 to 2007 (McDonough, 2002b; Del Frate, 2004; Peltier, 2006a; see additional discussion under *Moose-Train Collision Mortality*). A little more than half of the moose-vehicle collision mortalities occurred on four roadways during 2000 to 2008 (ADF&G, 2008b) – Parks Highway (26 percent), Glenn Highway (11 percent), Knik-Goose Bay Road (11 percent), and Point MacKenzie Road (4 percent). Moose-vehicle collisions increase in frequency during the dark winter months (Figure E-5). An average of 176 moose-vehicle collision mortalities occurred annually in Subunit 14A from 1990 to 2007 (McDonough, 2002b; Del Frate, 2004; Peltier, 2006a).



**Figure E-5. Monthly Moose-Vehicle Collision Mortalities from 2000 to 2008 for Subunits 14A and 14B with Daylight Hours by Month (ADF&G, 2008b)**

### E.1.3 Wolves

Wolves are carnivorous and in Game Management Unit 14 their primary foods are moose and caribou. During winter a pack might kill a moose every few days. Wolf and prey populations can be affected by a number of factors, including weather and food availability. Severe winters coupled with active wolf and bear predation can contribute to local big game scarcities. Wolf populations increased during the 1990s, in part due to high prey densities and excess winter moose mortality caused by deep snows during the winters of 1989-1990 and 1994-1995, and because of high wolf densities in surrounding Game Management Units (Peltier, 2006c). Figure E-6 shows current population and harvest trends for wolves in Game Management Unit 14. Wolves in Subunit 14B have been infested with dog-biting louse (*Trichodectes canis*), which reduces the value of an animal’s pelt. This is a concern because it could lead to reduced harvest, which could exacerbate the spread of the dog-biting louse throughout other regions of the state as

wolves disperse from high population density areas (Peltier, 2006c). ADF&G attempted to capture and treat all members of the infested pack, and deployed medicated baits to treat coyotes, feral dogs, and wolves, although infested wolves were caught the following winter (Peltier, 2006c).

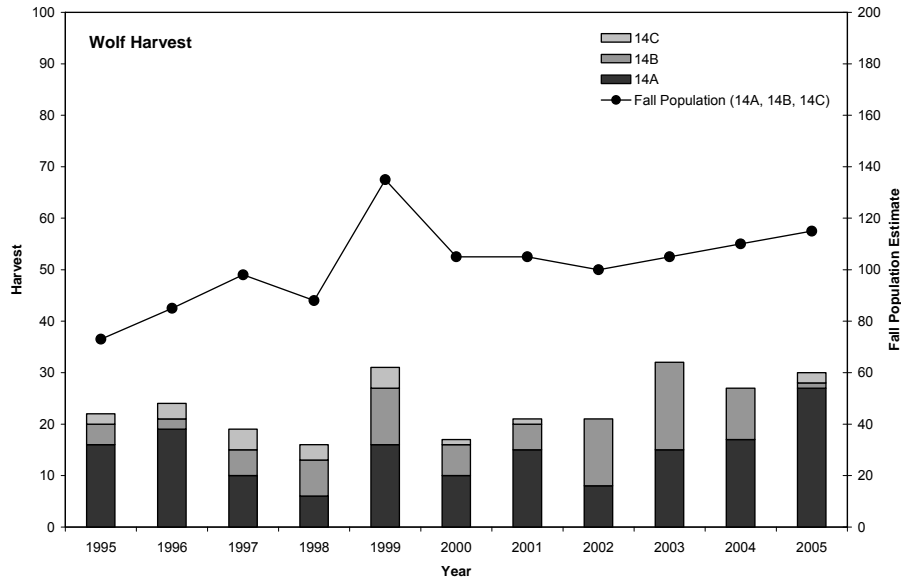


Figure E-6. Harvest and Population Trends for Wolves 1995 to 2005 in Game Management Unit 14 (Peltier, 2006c)

### E.1.4 Furbearers and Other Mammals

There are no completed population surveys for furbearers or other nongame mammals. Wildlife managers request that trappers qualitatively evaluate furbearer abundance to indicate if populations appear to be increasing or decreasing; Table E-2 lists these qualitative trends (Blejwas, 2006).

**Table E-2**  
**Estimated Abundance, Population Trends, and Harvest of Furbearers for Subunits 14A and 14B in the Port MacKenzie Rail Extension Study Area<sup>a</sup> (page 1 of 2)**

Common Name	Species	Relative Abundance	Trend	14A Harvest Estimate <sup>b</sup>	14B Harvest Estimate <sup>b</sup>	Totals
Beaver	<i>Castor canadensis</i>	Common	None	6	6	12
Coyote	<i>Canis latrans</i>	Common	None	15	15	30
Short-tailed Weasel (Ermine)	<i>Mustela erminea</i>	Common	None	21	0	21
Lynx	<i>Lynx canadensis</i>	Scarce	None	0	0	0
Marten	<i>Martes americana</i>	Common	None	27	0	27
Mink	<i>Neovison vison</i>	Common	None	88	27	115
Muskrat	<i>Ondatra zibethicus</i>	Common	None	272	39	311
Red Fox	<i>Vulpes vulpes</i>	Common	None	124	52	176

**Table E-2**  
**Estimated Abundance, Population Trends, and Harvest of Furbearer for Subunits 14A and 14B in the Port MacKenzie Rail Extension Study Area<sup>a</sup> (page 2 of 2)**

Common Name	Species	Relative Abundance	Trend	14A Harvest Estimate <sup>b</sup>	14B Harvest Estimate <sup>b</sup>	Totals
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	Abundant	None	15	15	30
River Otter	<i>Lontra canadensis</i>	Common	None	10	0	10
Wolf	<i>Canis lupus</i>	Common	None	4	4	8
Wolverine	<i>Gulo gulo</i>	Scarce	None	0	0	0
<b>All Furbearers</b>				<b>582</b>	<b>158</b>	<b>740</b>
<b>Prey Species</b>						
Hare	<i>Lepus americanus</i>	Common	Increasing	(Abundance, high levels still increasing; ADF&G 2008c)		
Grouse	<i>cf Falcipennis canadensis</i> or translocated <i>Bonasa umbellus</i>	Common	Decreasing	(Moderate levels; ADF&G 2008c)		
Ptarmigan	<i>Lagopus spp.</i>	Common	None	(Moderate numbers; ADF&G 2008c)		
Mice/Rodents		Abundant	Increasing			

<sup>a</sup> Source: Blejwas, 2006.

<sup>b</sup> Harvest estimates are for the 2004-2005 season based on the ADF&G Trapper Questionnaire. Questionnaire totals were adjusted by percent of sealed furs using either the reported percentages or the average percentage for Region 2 – Southcentral Alaska.

## E.1.5 Birds

Resident (designated R in tables) birds in the study area include owls, magpies, ravens and jays, woodpeckers, chickadees, and finches. Many other birds in the project area are migratory, arriving or passing through in spring beginning with raptors and waterfowl in April and continuing with the arrivals of songbirds through May and passing through or leaving in late summer and fall (during July through October). Migratory birds fall into two classes, (1) long distance (designated L in tables) or Neotropical migrants (those that winter south of the Tropic of Cancer), and (2) short distance (designated S in tables) or Nearctic migrants (those that winter north of the Tropic of Cancer). Birds documented in the project area include 20 waterfowl and waterbirds, 5 shorebirds, 2 seabirds, and 42 landbirds.

## E.1.6 Raptors and Owls

Bald eagles in Cook Inlet can be either summer residents, arriving in late April and departing by freeze-up in mid-to-late September, or residents. Bald-eagle nests in the project area during 2008 were primarily associated with habitats along the Little Susitna River and Willow Creek, occurring primarily in deciduous trees (92 percent), balsam poplar (54 percent), birch (23 percent), and aspen (15 percent) (Shook and Ritchie, 2008). Waterfowl are important in the diet of nesting bald eagles, especially in spring. Salmon are more important prey in late summer and fall.

### E.1.7 Landbirds

Landbirds belong to many diverse groups and include both migrant and resident birds. Resident birds remain active during the winter. Resident woodpeckers, chickadees, crossbills, and redpolls rely primarily on fruit and seed crops. Resident ravens and gray jays scavenge on winter or predator-killed carrion. However, many landbirds feed primarily on insects, which are not available during winter, and these birds remain in Southcentral Alaska only during the summer breeding season when insects are abundant.

### E.1.8 Birds of Conservation Concern

Various reviews and listings of birds in need of conservation have been developed. Table E-3 lists birds featured in the ADF&G Comprehensive Wildlife Conservation Plan (ADF&G, 2006) that have been documented to occur in the project area during the breeding season. Footnotes in Table E-3 also indicate other conservation designations by the U.S. Fish and Wildlife Service, International Wader Study Group, and Boreal Partners in Flight (a working group made up of government representatives and individuals). There are no Federal- or state-listed threatened or endangered bird species in the project area. The U.S. Fish and Wildlife Service defines Birds of Conservation Concern as species, subspecies, and populations that are not already federally listed as threatened or endangered but that without additional conservation actions, are likely to become candidates for Federal listing (USFWS, 2008).

**Table E-3  
Birds of Conservation Concern Documented During the Breeding Season Within the Study Area<sup>a</sup>  
(page 1 of 3)**

<b>Species (Migration)<sup>b</sup></b>	<b>Status<sup>c</sup></b>	<b>Global Rank<sup>d</sup></b>	<b>Alaska Rank<sup>d</sup></b>	<b>Alaska Abundance</b>	<b>Alaska Trend<sup>e</sup></b>	<b>Rationale</b>
American Three-toed Woodpecker (R)	ADF&G	G5	S4	200,000	+6.5%	Sensitive to forest management – cavity nester
Arctic Tern (L)	BCC,ADF &G	G5	S4B	~10,000	–	Long-term decline, sensitive to disturbance
Bald Eagle (S)	BCC, PIF, ADF&G	G4	S4B/S4 N	20,000	+	Contaminant-affected, sensitive to changes in forests
Bank Swallow (L)	ADF&G	G5	S5B	3,000,000	+4.1%	Long-term declines
Belted Kingfisher (S)	ADF&G	G5	S5	140,000	-2.5%	Widespread long-term population declines
<b>Blackpoll Warbler (L)</b>	PIF, ADF&G	G5	S4B	4,000,000	-3.8%	Long-term declines, sensitive to changes in riparian habitats
Boreal Chickadee (R)	ADF&G	G5	S5	1,100,000	-0.5%	Sensitive to forest management – cavity nester
Brown Creeper (R)	ADF&G	G5	S4	50,000	-22.3%	Sensitive to forest management – cavity nester
Cliff Swallow (L)	ADF&G	G5	S4B	1,700,000	-6.0%	Long-term Alaska declines
Common Loon (S)	ADF&G	G5	S4/S5B, S4N	9,000	±	Sensitive to disturbance, contaminants
Dark-eyed Junco (S)	ADF&G	G5	S3N/S5 B	40,000,000	-1.1%	Widespread long-term population declines

**Table E-3**  
**Birds of Conservation Concern Documented During the Breeding Season Within the Study Area<sup>a</sup>**  
 (page 2 of 3)

<b>Species (Migration)<sup>b</sup></b>	<b>Status<sup>c</sup></b>	<b>Global Rank<sup>d</sup></b>	<b>Alaska Rank<sup>d</sup></b>	<b>Alaska Abundance</b>	<b>Alaska Trend<sup>e</sup></b>	<b>Rationale</b>
Golden-crowned Kinglet (R)	ADF&G	G5	S5	170,000	-0.5%	Sensitive to forest management – canopy nester
Great Gray Owl (S)	PIF, ADF&G	G5	S3	10,000	UNK	Sensitive to forest management – canopy nester
Great Horned Owl (S)	ADF&G	G5	S5	140,000	UNK	Sensitive to forest management – canopy nester
Hairy Woodpecker (R)	ADF&G	G5	S4	120,000	+6.8%	Sensitive to forest management – cavity nester
Hermit Thrush (S)	ADF&G	G5	S4B	1,300,000	-1.8%	Long-term declines
Horned Grebe (S)	BCC, ADF&G	G5	S5	UNK	UNK	Long-term range contraction
Lesser Yellowlegs (L)	BCC, ADF&G	G5	S5B	150,000	-4%	Boreal forest habitat loss, alteration
Long-tailed Duck (S)	ADF&G	G5	S5B, S4N	220,000	-5.5%	Significant long-term declines
Murrelet species (S)	BCC, ADF&G	G3/G4	S2/S3	850,000	–	Significant long-term declines, marbled murrelet sensitive to forest management
Merlin (S)	ADF&G	G5	S3/S4B, S3N	40,000	±	Sensitive to contaminants
Northern Flicker (S)	ADF&G	G5	S5B	180,000	+0.2%	Sensitive to forest management – cavity nester
Northern Harrier (L)	ADF&G	G5	S4B, S3N	7,000	UNK	Sensitive to disturbance, contaminants
<b>Olive-sided Flycatcher (L)</b>	BCC, PIF & ADF&G	G4	S3/S4B	200,000	-3.3%	Long-term decline, sensitive to forest management – canopy nester
Osprey (L)	ADF&G	G5	S2B	1,900	±	Sensitive to disturbance, contaminants
Pacific Loon (S)	ADF&G	G5	S5B, S4/S5N	69,000	±	Sensitive to disturbance, contaminants
Pine Siskin (S)	ADF&G	G5	S5	500,000	+5.5%	Long-term declines, sensitive to forest management – canopy nester
Red-breasted Nuthatch (R)	ADF&G	G5	S4	110,000	-0.6%	Sensitive to forest management – cavity nester
Red-necked Grebe (S)	ADF&G	G5	S4/S5B, S4N	12,000	–	Long-term declines, sensitive to disturbance
Red-tailed Hawk (L)	ADF&G	G5	S5B	20,000	UNK	Sensitive to disturbance, habitat loss
Red-throated Loon (L)	ADF&G	G5	S3B, S2/S3N	10,000	±	Sensitive to disturbance, contaminants
Rusty Blackbird (S)	BCC, PIF, ADF&G	G4	S4B	400,000	-5.8%	Long-term declines, sensitive to climate and riparian habitat changes

**Table E-3  
Birds of Conservation Concern Documented During the Breeding Season Within the Study Area<sup>a</sup>  
(page 3 of 3)**

Species (Migration) <sup>b</sup>	Status <sup>c</sup>	Global Rank <sup>d</sup>	Alaska Rank <sup>d</sup>	Alaska Abundance	Alaska Trend <sup>e</sup>	Rationale
Sharp-shinned Hawk (L)	ADF&G	G5	S4B, S3N	15,000	UNK	Migrant raptor, sensitive to habitat loss or alteration
Solitary Sandpiper (L)	BCC, ADF&G	G5	S2B	4,000	-4.1%	Long-term declines, sensitive to changes in boreal wetlands
Surf Scoter (S)	ADF&G	G5	S4B, S4N	275,000	-2%	Significant long-term declines
<b><i>Townsend's Warbler (L)</i></b>	PIF, ADF&G	G5	S5B	1,500,000	+0.2%	Sensitive to forest management – canopy nester
Varied Thrush (S)	PIF, ADF&G	G5	S5	6,000,000	-0.1%	Sensitive to forest management – canopy nester
Violet-green Swallow (L)	ADF&G	G5	S4B	800,000	-5.1%	Long-term Alaska declines
White-crowned Sparrow (L)	ADF&G	G5	S5B	13,000,000	-1.9%	Long-term Alaska declines
White-winged Crossbill (R)	PIF, ADF&G	G5	S5	2,000,000	+4.3%	Sensitive to forest management – canopy nester
White-winged Scoter (S)	ADF&G	G5	S4B, S4N	100,000	-2%	Significant long-term declines
Wilson's Warbler (L)	PIF & ADF&G	G5	S3B	7,000,000	+1%	Sensitive to changes in riparian habitats

<sup>a</sup> Sources: Rosenberg, 2004; ADF&G, 2006; Shook and Ritchie, 2008; Sauer *et al.*, 2008; Platte *et al.*, 2008; URS, 2006.

<sup>b</sup> (R) = Resident; (S) = Short-distance migrant; (L) = Long-distance migrant.

<sup>c</sup> Status: BCC – USFWS, 2008; PIF – Rosenberg, 2004; ADF&G – ADF&G, 2006. Bold italic type indicates ADF&G Species of Special Concern (ADF&G, 1998).

<sup>d</sup> Rankings: G5 = Globally secure; G4 = Globally apparently secure; S5 = State secure; S4 = State apparently secure; S3 = State vulnerable; SNR = State not ranked; N = Non-breeding; B = Breeding.

<sup>e</sup> Average annual long-term population trend in Alaska portion of the Boreal Partners in Flight Bird Conservation Region 4 (the Bird Conservation Region within which the project would lie and for which population estimates have been generated) (Rosenberg, 2004; ADF&G, 2006). UNK represents unknown condition, – represents declining trend of unknown magnitude; + represents increasing trend of unknown magnitude, ± represents stable population trend.

## E.2 Environmental Consequences

### E.2.1 Wildlife Habitat Loss and Alteration

Construction of the proposed Port MacKenzie Rail Extension would result in habitat loss and alteration along the rail line alternatives. This section describes the expected level of wildlife use and habitat loss within the 200-foot ROW. Habitat loss for all habitat types at the level of habitat mapping used for analysis (Homer *et al.*, 2004) would represent less than 1 percent of available habitats for wildlife within 5 miles of the project alternatives.

#### E.2.1.1 Furbearers

Furbearers are a diverse group. Table E-4 lists and describes habitat use, breeding season, den type and use, home range size estimates, and estimated habitat impact area for common furbearers in the project area. The table includes estimates of average impacts to furbearer and other mammal habitat from the eight proposed alternatives.

**Table E-4  
SEA's Estimated Average Habitat Loss Impacts for Mammals Within the 200-foot Right-of-Way<sup>a</sup> (page 1 of 2)**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Home Range Size</b>	<b>General Habitats</b>	<b>Estimated Impacts<sup>b</sup></b>
<b>Furbearers</b>				
Beaver	<i>Castor canadensis</i>	0.6 mile stream channel; 43.5 acres, solitary; 19.0 acres, families	Streams, ponds, backwaters; forages on shrubs and aquatic vegetation	Wetlands Average is 317 acres or 7 to 17 beavers
Short-tailed Weasel (Ermine)	<i>Mustela erminea</i>	24.7 to 49.4 acres	Forests, riparian woodlands and scrub/shrub; forages primarily on small rodents and lemmings, but will eat birds, eggs, frogs, fish, insects	Forested and wetland habitats Average is 1,036 acres or 21 to 42 ermine
Least Weasel	<i>Mustela nivalis</i>	17.3 acres, females; 64.2 acres, males	Woodlands, riparian, grassy fields and meadows; forages on small mammals, especially voles, lemmings and other mice; might consume other small vertebrates, insects, or worms when rodents are scarce	Forested and wetland habitats Average is 1,036 acres or 16 to 60 least weasels
Mink	<i>Mustela vison</i>	20 to 50 acres, female; 1,900 acres, male	Riparian forests, marshes and scrub/shrub wetlands; forages on fish, birds, eggs, rodents	Wetlands Average is 317 acres or 6 to 16 female mink
Muskrat	<i>Ondatra zibethicus</i>	2.5 to 4.9 acres marshes; 0.25 mile streams	Marshes, riparian areas, floodplains of large rivers, ponds; forages on aquatic plants, lilies, sedges, grasses, mussels, small fish	Emergent and shrub/scrub wetlands Average is 146 acres or 30 to 58 muskrats
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	0.5 to 1 acre	Spruce forests; forages on seeds, berries, buds, fungi, and occasionally insects and bird eggs	Evergreen and mixed closed forests Average is 463 acres or 463 to 926 red squirrels
Snowshoe Hare	<i>Lepus americanus</i>	Average 7 to 15 acres, up to 39.5 acres	Forests, woody wetlands, bogs; forages on succulent vegetation, in winter eats twigs, buds bark of small trees	Forested and wetland habitats Average is 1,036 acres or 26 to 69 hares

**Table E-4  
Estimated Average Habitat Loss Impacts for Mammals Within the 200-foot Right-of-Way<sup>a</sup> (page 2 of 2)**

Common Name	Scientific Name	Home Range Size	General Habitats	Estimated Impacts <sup>b</sup>
<b>Other Mammals</b>				
Northern Bog Lemming	<i>Synaptomys borealis</i>	Less than 1 acre; sociable, can form small colonies	Bog, muskeg, mixed and coniferous forests; forages on grasses, sedges, other vegetation	Evergreen and mixed forests and wetland habitats Average is 802 acres or 802 lemmings
Northern Flying Squirrel	<i>Glaucomys sabrinus</i>	Up to 86.5 acres, summer 7 to 12 acres	Coniferous and mixed forests, riparian woods; forages on fungi, lichens, insects, nuts, buds, seeds, fruit	Evergreen and mixed closed forests Average is 463 acres or 5 to 39 flying squirrels
Porcupine	<i>Erethizon dorsatum</i>	Summer range 125 to 250 acres, winter range smaller; densities 25 to 58 per square mile in good habitat	Coniferous and mixed forests and woodlands; forages on inner bark of trees, evergreen needles in winter, buds in spring, roots, leaves, fruits in summer and fall	Evergreen and mixed forests Average is 485 acres or 19 to 44 porcupine
Shrews	<i>Sorex</i> spp.	0.3 to 1 acre	Forest and wetland habitats, sphagnum bogs; forages on insects and other small invertebrates such as worms, sowbugs, mollusks	Forest and wetlands Average is 1,036 acres or 1,036 to 3,453 shrews
Voles	<i>Microtus</i> spp. and <i>Myodes rutilus</i>	0.25 acre, less than 1 acre	Grasslands, woody wetlands, bogs, riparian; forages on vegetation, grasses, roots and seeds, burrows and uses fallen log/debris. Coniferous forests; forages on fungi, berries, lichens, moss, insects, grass	Forest and wetlands Average is 1,036 acres or 1,036 to 4,144 voles

<sup>a</sup> Source: Compiled from various sources including the ADF&G Alaska Wildlife Notebook; NatureServe, Animal Diversity Web; habitat from Homer *et al.*, 2004.

<sup>b</sup> Average impact within the 200-foot right-of-way, terminal reserve, stream relocation, and road relocation areas by habitat type for eight proposed alternatives. Does not represent an alternative.

### **E.2.1.2 Birds**

Tables E-5, E-6, and E-7 list bird species present in the study area based on ground-based surveys (Sauer *et al.*, 2008; URS, 2006; Benson, 2001); SEA estimated numbers within 5 miles of the proposed alternatives (798-square-mile area) are based on regional aerial waterfowl surveys (Conant *et al.*, 2007; Mallek and Groves, 2008; Platte *et al.*, 2008). Raptor surveys were completed for the proposed alignments by the Applicant (Shook and Ritchie, 2008). Some waterfowl and waterbirds nest in habitats the proposed rail line would cross and many more waterfowl and waterbirds migrate through the Cook Inlet region on their way to and from nesting grounds in Western and Arctic Alaska. Spring and fall waterbird migration and summer occurrence data for the Port MacKenzie area were collected during 2005 by the Knik Arm Bridge and Toll Authority (URS, 2006). Most waterfowl and waterbirds nest on the ground near waterbodies. Tables E-8, E-9, and E-10 list habitat loss or disturbance (as the number of affected birds) due to construction of the alternatives based on project area nest season densities or nest occurrence within 0.5 mile of the alternatives. SEA estimated impacts to birds of conservation concern due to habitat loss (Table E-8).

## **E.2.2 Wildlife Habitat Fragmentation**

This section provides detailed results for habitat fragmentation analyses completed by SEA for the proposed rail line segments and alternatives summarized in Chapter 5. Across the project area, habitat patch (habitat areas of a single type) sizes averaged larger for open water, agriculture, and developed habitat types, with a mean shape index of 1.4 hectares (about 3.5 acres) (Table E-9). The small mean patch size, generally less than 1.4 hectares, and low perimeter values, generally less than 600 meters (about 1,970 feet), indicate that most habitat patches were defined by 16, 30 meter by 30 meter (about 98 by 98 feet) pixels (Table E-9). Core areas, interior areas of habitat patches greater than 40 hectares (about 99 acres) in size, averaged larger for open water and agriculture habitat types (Table E-9). Core areas of wildlife habitats the proposed rail line segment combinations would cross averaged 6 to 49 times larger than core areas of habitat patches greater than 40 hectares distributed throughout the project area (Table E-9).

Table E-10 lists habitat core areas the proposed rail line alternatives would cross and fragment. The Mac East-Big Lake Alternative would potentially fragment the smallest number and area of core forested and wetland habitats; the Mac East-Connector 3-Willow Alternative would potentially fragment the greatest number of core forest and wetland habitats; and the Mac West-Connector 1-Houston-Houston South and Mac East-Connector 3-Houston-Houston South alternatives would potentially fragment the largest area of core forested and wetland habitat (Table E-10). The Mac West-Connector 1-Houston-Houston North and Mac West-Connector 1-Houston-Houston South alternatives would potentially fragment the smallest area of core forest habitat, while the Mac West-Connector 1-Willow and Mac East-Connector 3-Willow alternatives would potentially fragment the largest area of core forest habitat (Table E-10). The Mac East-Connector 3-Willow and Mac East-Big Lake alternatives would potentially fragment the smallest area of core wetland habitat, while the Mac West-Connector 1-Houston-Houston South Alternative would potentially fragment the largest area of core wetland habitat (Table E-10).

**Table E-5  
Shorebirds, Seabirds, and Landbirds Occurring During the Breeding Season and SEA's Estimated Habitat Loss Impacts Due to Construction of the Alternatives<sup>a</sup> (page 1 of 4)**

Common Name	Species	Primary Habitats	Study Area Density (birds per mile)	Alaska BCR 4 <sup>b</sup> Population Size (annual trend, Data Quality) <sup>c</sup>	Estimated Study Area Population <sup>d</sup>	Estimated Average Impact (number of birds) <sup>e,f</sup>	Estimated Minimum Impact (number of birds) <sup>g,f</sup>	Estimated Maximum Impact (number of birds) <sup>h,f</sup>
<b>Shorebirds</b>								
Greater Yellowlegs	<i>Tringa melanoleuca</i>	Forests, near water	0.12	j	Unknown	5	4	6
Lesser Yellowlegs	<i>Tringa flavipes</i>	Forests, near water	0.25	j	Unknown	9	8	11
Solitary Sandpiper	<i>Tringa solitaria</i>	Near water	0.03	j	Unknown	1	1	1
Spotted Sandpiper	<i>Actitis macularia</i>	Near water	j	j	Unknown	j	j	j
Common Snipe	<i>Gallinago gallinago</i>	Forests, near water	0.53	j	Unknown	20	17	25
<b>Total Shorebirds</b>					<b>Unknown</b>	<b>35</b>	<b>30</b>	<b>43</b>
<b>Seabirds</b>								
Herring Gull	<i>Larus argentatus</i>	Near water	0.07	j	Unknown	2	2	3
Glaucous-winged Gull	<i>Larus glaucescens</i>	Near water	0.03	j	Unknown	1	1	1
<b>Total Seabirds</b>					<b>Unknown</b>	<b>3</b>	<b>3</b>	<b>4</b>
<b>Landbirds</b>								
Belted Kingfisher (S)	<i>Ceryle alcyon</i>	Riparian shrub and forest	0.01	140,000 (-2.4%, 2 Y)	400	0	0	0
Downy Woodpecker (R)	<i>Picoides pubescens</i>	Forested	0.06	150,000	428	2	2	3
Hairy Woodpecker (R)	<i>Picoides villosus</i>	Needleleaf forest	0.06	120,000 (4.2%, 2 Y)	343	2	2	3
Three-toed Woodpecker (R)	<i>Picoides dorsalis</i>	Needleleaf forest	0.12	200,000 (1.2%, 3 O)	571	4	4	5
Northern Flicker (S)	<i>Colaptes auratus</i>	Needleleaf forest	0.01	180,000 (-0.7%, 2 Y)	514	0	0	0
Olive-sided Flycatcher (L)	<i>Contopus cooperi</i>	Needleleaf forest - black spruce	0.40	200,000 (-1.5%, 2 Y)	571	15	13	18
Western Wood-Peevee (L)	<i>Contopus sordidulus</i>	Riparian shrub - black spruce bogs/successional	0.14	200,000 (-4.0%, 2 Y)	571	5	4	7
Alder Flycatcher (L)	<i>Empidonax alnorum</i>	Shrub/successional	4.46	11,000,000 (-0.4%, 2 Y)	31,411	166	140	205

**Table E-5  
Shorebirds, Seabirds, and Landbirds Occurring During the Breeding Season and Estimated Habitat Loss Impacts Due to Construction of the Alternatives<sup>a</sup> (page 2 of 4)**

Common Name	Species	Primary Habitats	Study Area Density (birds per mile)	Alaska BCR 4 <sup>b</sup> Population Size (annual trend, Data Quality) <sup>c</sup>	Estimated Study Area Population <sup>d</sup>	Estimated Average Impact (number of birds) <sup>e,f</sup>	Estimated Minimum Impact (number of birds) <sup>g,f</sup>	Estimated Maximum Impact (number of birds) <sup>h,f</sup>
<i>Landbirds (continued)</i>								
Say's Phoebe (L)	<i>Sayornis saya</i>	Tundra and shrub habitats	0.00	40,000	114	0	0	0
Gray Jay (R)	<i>Perisoreus canadensis</i>	Needleleaf and mixed forest	0.26	3,000,000 (2.2%, 2 Y)	8,567	10	8	12
Black-billed Magpie (R)	<i>Pica pica</i>	Forested	0.06	50,000	143	2	2	3
Common Raven (R)	<i>Corvus corax</i>	Needleleaf forest	0.18	60,000 (2.5%, 2 Y)	171	7	6	8
Tree Swallow (L)	<i>Tachycineta bicolor</i>	Broadleaf and needleleaf forest	0.48	700,000 (3.8%, 2 Y)	1,999	18	15	22
Violet-green Swallow (L)	<i>Tachycineta thalassina</i>	Forested, near water	0.27	800,000	2,284	10	8	12
Bank Swallow (L)	<i>Riparia riparia</i>	Bluffs, near water	0.03	3,000,000	8,567	1	1	1
Cliff Swallow (L)	<i>Petrochelidon pyrrhonota</i>	Bluffs, near water	0.04	1,700,000	4,854	2	1	2
Black-capped Chickadee (R)	<i>Poecile atricapillus</i>	Riparian broadleaf, and needleleaf forest	0.31	1,400,000 (1.9%, 2 Y)	3,998	11	10	14
Boreal Chickadee (R)	<i>Poecile hudsonia</i>	Needleleaf forest	0.07	1,100,000 (0.7%, 2 Y)	3,141	3	2	3
Red-breasted Nuthatch (R)	<i>Sitta canadensis</i>	Forested	0.01	110,000	314	0	0	0
Brown Creeper (R)	<i>Certhia americana</i>	Forested	0.00	50,000	143	0	0	0
Golden-crowned Kinglet (S)	<i>Regulus satrapa</i>	Forested	0.01	170,000	485	0	0	1
Ruby-crowned Kinglet (S)	<i>Regulus calendula</i>	Open needleleaf and mixed forests	0.97	6,000,000	17,133	36	30	45
Swainson's Thrush (L)	<i>Catharus ustulatus</i>	Riparian needleleaf and mixed forest	3.17	18,000,000	51,399	118	99	146

**Table E-5  
Shorebirds, Seabirds, and Landbirds Occurring During the Breeding Season and Estimated Habitat Loss Impacts Due to Construction of the Alternatives<sup>a</sup> (page 3 of 4)**

Common Name	Species	Primary Habitats	Study Area Density (birds per mile)	Alaska BCR 4 <sup>b</sup> Population Size (annual trend, Data Quality) <sup>c</sup>	Estimated Study Area Population <sup>d</sup>	Estimated Average Impact (number of birds) <sup>e,f</sup>	Estimated Minimum Impact (number of birds) <sup>g,f</sup>	Estimated Maximum Impact (number of birds) <sup>h,f</sup>
<i>Landbirds (continued)</i>								
Hermit Thrush (S)	<i>Catharus guttatus</i>	Riparian needleleaf forest and tall shrubs	0.07	1,300,000 (-1.1%, 2 Y)	3,712	3	2	3
American Robin (S)	<i>Turdus migratorius</i>	Forest and shrub	2.44	14,000,000 (1.6%, 2 Y)	39,977	91	77	112
Varied Thrush (S)	<i>Ixoreus naevius</i>	Forest and shrub	0.33	6,000,000	17,133	12	10	15
Orange-crowned Warbler (L)	<i>Vermivora celata</i>	Low and tall shrub	1.60	13,000,000 (-0.3%, 2 Y)	37,122	60	50	74
Yellow Warbler (L)	<i>Dendroica petechia</i>	Needleleaf forest and shrub	0.06	1,600,000 (-0.7%, 2 Y)	4,569	2	2	3
Yellow-rumped Warbler (L)	<i>Dendroica coronata</i>	Needleleaf forest	2.82	16,000,000 (0.9%, 2 Y)	45,688	105	89	130
Townsend's Warbler (L)	<i>Dendroica townsendi</i>	Mature needleleaf forest	0.00	1,500,000 (0.9%, 3 O)	4,283	0	0	0
Blackpoll Warbler (L)	<i>Dendroica striata</i>	Riparian forest and shrub	0.94	4,000,000 (-2.7%, 2 Y)	11,422	35	30	43
Northern Waterthrush (L)	<i>Seiurus noveboracensis</i>	Black spruce forest	0.45	3,000,000 (7.8%, 2 Y)	8,567	17	14	21
Wilson's Warbler (L)	<i>Wilsonia pusilla</i>	Mixed forest and shrub	0.15	7,000,000 (1.1%, 2 Y)	19,989	6	5	7
Savannah Sparrow (L)	<i>Passerculus sandwichensis</i>	Low shrub and graminoid	0.19	2,000,000 (-0.2%, 2 Y)	5,711	7	6	9
Fox Sparrow (S)	<i>Passerella iliaca</i>	Low and tall shrub	0.34	2,000,000 (2.4%, 2 Y)	5,711	13	11	16
Song Sparrow (S)	<i>Melospiza melodia</i>	Riparian and shrub	0.00	30,000	86	0	0	0
Lincoln's Sparrow (L)	<i>Melospiza lincolni</i>	Low shrub and black spruce bog	0.88	2,000,000 (7.8%, 2 Y)	5,711	33	28	40
White-crowned Sparrow (L)	<i>Zonotrichia leucophrys</i>	Low shrub	0.69	13,000,000 (-1.3%, 2 Y)	37,122	26	22	32

**Table E-5  
Shorebirds, Seabirds, and Landbirds Occurring During the Breeding Season and Estimated Habitat Loss Impacts Due to Construction of the Alternatives<sup>a</sup> (page 4 of 4)**

Common Name	Species	Primary Habitats	Study Area Density (birds per mile)	Alaska BCR 4 <sup>b</sup> Population Size (annual trend, Data Quality) <sup>c</sup>	Estimated Study Area Population <sup>d</sup>	Estimated Average Impact (number of birds) <sup>e,f</sup>	Estimated Minimum Impact (number of birds) <sup>g,f</sup>	Estimated Maximum Impact (number of birds) <sup>h,f</sup>
<i>Landbirds (continued)</i>								
Dark-eyed Junco (S)	<i>Junco hyemalis</i>	Mix and needleleaf forest and tall shrub	2.42	40,000,000 (-0.3%, 2 Y)	114,220	90	76	111
Rusty Blackbird (L)	<i>Euphagus carolinus</i>	Needleleaf and mixed forest with wet graminoid	0.04	400,000 (6.3%, 2 Y)	1,142	2	1	2
White-winged Crossbill (R)	<i>Loxia leucoptera</i>	Mature needleleaf forest	0.27	2,000,000 (31.0%, 2 Y)	5,711	10	9	13
Pine Siskin (R)	<i>Carduelis pinus</i>	Needleleaf forest	0.46	500,000 (3.5%, 3 O)	1,428	17	14	21
<b>Total Landbirds<sup>a,k</sup></b>					<b>507,422</b>	<b>940</b>	<b>794</b>	<b>1,162</b>
<b>Total Resident<sup>k</sup> Landbirds</b>					<b>24,957</b>	<b>69</b>	<b>59</b>	<b>86</b>
<b>Total Long-Distance Migrant Landbirds<sup>k</sup></b>					<b>283,094</b>	<b>625</b>	<b>528</b>	<b>772</b>
<b>Total Short-Distance Migrant Landbirds<sup>k</sup></b>					<b>199,371</b>	<b>246</b>	<b>208</b>	<b>304</b>

<sup>a</sup> Sources: Sauer et al., 2008; Mallek and Groves, 2008; Platte et al., 2008; Benson, 2001; Shook and Ritchie, 2008; Blancher et al., 2007.

<sup>b</sup> Boreal Partners in Flight Bird Conservation Region 4 (the Bird Conservation Region within which the project would lie and for which population estimates have been generated).

<sup>c</sup> Blancher et al., 2007; ADF&G, 2006: Estimate Accuracy 2 = Poor, 3 = Fair; Breeding Bird Survey Data Quality Y=yellow-10% or more of the range covered, O = orange-<10% of range covered.

<sup>d</sup> SEA estimates based on project region density and area within 5 miles of all proposed segments (990 square miles) were generated only for species with an abundance estimate within the region.

<sup>e</sup> Average of eight proposed alternatives. Does not represent an alternative.

<sup>f</sup> Number of nesting birds impacted is based on the estimated project area linear nesting density multiplied by the route length for each of eight proposed alternatives.

<sup>g</sup> Minimum value for eight proposed alternatives.

<sup>h</sup> Maximum value for eight proposed alternatives.

<sup>i</sup> Resident, Long-Distance Migrants, and Short-Distance Migrants are categories of Landbirds.

<sup>j</sup> No available data; the species have been reported to occur in the area.

<sup>k</sup> Totals might not equal sums of values due to rounding.

**Table E-6  
Waterbird Nesting Season Densities, Estimated Study Area Populations, and SEA Estimated Habitat Loss<sup>a</sup> by Alternative<sup>b</sup>**

Common Name	Species	Kenai-Susitna Density (birds per square mile) <sup>d</sup>	Kenai-Susitna Population <sup>d</sup>	Estimated Study Area Population	Alternative <sup>c</sup>							
					Mac West-Connector 1-Willow	Mac West-Connector 1-Houston North	Mac West-Connector 1-Houston South	Mac West-Connector 2-Big Lake	Mac East-Connector 3-Willow	Mac East-Connector 3-Houston North	Mac East-Connector 3-Houston South	Mac East-Big Lake
<b>Waterbirds</b>												
Common Loon	<i>Gavia immer</i>	0.82	1,810	657	2	1	1	1	2	1	1	1
Pacific Loon	<i>Gavia pacifica</i>	0.18	390	141	0	0	0	0	0	0	0	0
Red-throated Loon	<i>Gavia stellata</i>	0.01	30	11	0	0	0	0	0	0	0	0
Sandhill Crane	<i>Grus Canadensis</i>	0.12	263	95	0	0	0	0	0	0	0	0
Merganser	<i>Mergus spp.</i>	0.86	1,883	683	2	1	1	1	2	1	1	1
<b>Geese and Swans</b>												
Canada Goose	<i>Branta</i>											
	<i>Canadensis</i>	0.40	878	319	1	1	1	1	1	1	1	1
Trumpeter Swan	<i>Cygnus buccinator</i>	0.28	618	224	1	0	0	0	1	0	0	0
<b>Ducks</b>												
American Green-winged Teal	<i>Anas crecca</i>	5.39	11,847	4,298	11	9	9	9	11	9	9	8
American Wigeon	<i>Anas americana</i>	2.96	6,522	2,366	6	5	5	5	6	5	5	5
Bufflehead	<i>Bucephala albeola</i>	0.54	1,189	431	1	1	1	1	1	1	1	1
Goldeneye	<i>Bucephala spp.</i>	1.99	4,371	1,586	4	3	3	3	4	3	3	3
Long-tailed Duck	<i>Clangula hyemalis</i>	0.15	329	119	0	0	0	0	0	0	0	0
Mallard	<i>Anas platyrhynchos</i>	5.57	12,244	4,442	11	9	9	10	11	9	9	9
Northern Pintail	<i>Anas acuta</i>	1.53	3,372	1,223	3	2	3	3	3	2	2	2
Northern Shoveler	<i>Anas chrypeata</i>	1.00	2,201	798	2	2	2	2	2	2	2	2
Redhead	<i>Aythya americana</i>	0.08	171	62	0	0	0	0	0	0	0	0
	<i>Aythya collaris</i>	0.87	1,911	693	2	1	1	1	2	1	1	1
Ring-necked Duck	<i>Aythya vallisneria</i>	0.44	962	349	1	1	1	1	1	1	1	1
Canvasback	<i>Aythya spp.</i>	4.47	9,832	3,567	9	7	7	8	9	7	7	7
Scaup	<i>Melanitta spp.</i>	1.47	3,239	1,175	3	2	2	3	3	2	2	2
Scoter												

<sup>a</sup> Number of nesting birds impacted is based on the estimated project area nesting density multiplied by the area of footprint impact for the alternatives.

<sup>b</sup> Sources: Conant *et al.*, 1999, 2000; Conant and Groves, 2001, 2002, 2003, 2004, 2005; Conant and Mallek, 2006; Mallek and Groves, 2007, 2008.

<sup>c</sup> Mac West-Connector 1-Willow (1.75 square miles); Mac West-Connector 1-Houston-Houston North (1.34 square miles); Mac West-Connector 1-Houston-Houston South (1.36 square miles); Mac West-Connector 2-Big Lake (1.40 square miles); Mac East-Connector 3-Willow (1.76 square miles); Mac East-Connector 3-Houston-Houston North (1.34 square miles); Mac East-Connector 3-Houston-Houston South (1.36 square miles); and Mac East-Big Lake (1.25 miles).

<sup>d</sup> Ten-year average 1999 to 2008, Stratum 1 Kenai-Susitna (2,200 square miles); population based on 10-year average.

**Table E-7  
Raptors and Owls Potentially Impacted by Habitat Loss or Disturbance Due to Construction of the Alternatives<sup>a</sup>**

Common Name (Migration & Annual Alaska Trend 1966-2005)	Species	SEA Estimated Nests or Density in Study Area <sup>b</sup>	Alternatives						
			Mac West- Connector 1- Houston North	Mac West- Connector 1- Houston South	Mac West- Connector 2-Big Lake	Mac East- Connector 3-Willow	Mac East- Connector 3-Houston North	Mac East- Connector 3-Houston South	Mac East- Big Lake
Bald Eagle (S) (5.8%)	<i>Haliaeetus leucocephalus</i>	30	2 nests	2 nests	1 nest	5 nests	1 nest	1 nest	1 nest
Osprey	<i>Pandion haliaetus</i>	7	1 nest	1 nest	1 nest	1 nest	1 nest	1 nest	1 nest
Red-tailed Hawk (L) (-4.7%)	<i>Buteo jamaicensis</i>	44	6 nests	5 nests	0 nest	0 nest	6 nests	5 nests	0 nest
Great Horned Owl (R) (9.4%)	<i>Bubo virginianus</i>	7	1 nest	0 nest	0 nest	1 nest	2 nests	1 nest	0 nest
Great Gray Owl <sup>c</sup> (R)	<i>Strix nebulosa</i>	7	1 nest	1 nest	0 nest	0 nest	1 nest	1 nest	0 nest
Northern Saw- whet Owl	<i>Aegolius acadicus</i>	1.51 per square mile	2	2	3	3	2	2	2
Boreal Owl <sup>c</sup> (R)	<i>Aegolius funereus</i>	1.96 per square mile	3	3	3	4	3	3	3

<sup>a</sup> Sources: Shook and Ritchie, 2008; Benson, 2001.

<sup>b</sup> Estimate based on stick nest survey data and regional densities for the northern saw-whet owl and the boreal owl multiplied by the area of the 200-foot right-of-way, terminal reserve, stream relocation and road relocation areas (Benson, 2001).

<sup>c</sup> Number of nests impacted by disturbance is based on nests identified within 0.5 mile of alternatives.

**Table E-8**  
**Birds of Conservation Concern Estimated Nesting Habitat Loss Impacts from Alternatives<sup>a,b</sup>**  
 (page 1 of 4)

Species (Migration) <sup>c</sup>	Rationale	SEA Estimated Study Area Population <sup>d</sup>	Habitat Impact Description	Estimated Average Project Impact (No. Birds) <sup>e</sup>	Estimated Minimum Project Impact (No. Birds) <sup>f</sup>	Estimated Maximum Project Impact (No. Birds) <sup>g</sup>
American Three-toed Woodpecker (R)	Sensitive to forest management - cavity nester	571	155 to 608 acres evergreen and mixed forest	4	4	5
Arctic Tern (L)	Long-term declines, sensitive to disturbance	Unknown	43 to 178 acres emergent wetlands	✓	✓	✓
Bald Eagle (S)	Sensitive to disturbance, contaminants	30	Disturbance to 1 to 6 nest trees	4	2	12
Bank Swallow (L)	Long-term declines	8,567	Bluff nesting habitat loss/disturbance, 44 to 272 acres agricultural and emergent wetlands	1	1	1
Belted Kingfisher (S)	Long-term declines	400	Riparian habitat loss, 11 to 53 acres shrub/scrub habitat	✓	✓	✓
<b>Blackpoll Warbler (L)</b>	Population declines, sensitive to changes in riparian habitats	11,422	Riparian habitat loss, 62 to 253 acres shrub/scrub and woody wetlands	35	30	43
Boreal Chickadee (R)	Sensitive to forest management - cavity nester	3,141	221 to 608 acres evergreen and mixed forests	3	2	3
Brown Creeper (R)	Sensitive to forest management - cavity nester	143	272 to 899 acres evergreen and mixed forests, woody wetlands	✓	✓	✓
Cliff Swallow (L)	Long-term Alaska declines	4,854	Bluff nesting habitat loss/disturbance, 44 to 272 acres agricultural and emergent wetlands	2	1	2
Common Loon (S)	Sensitive to disturbance, contaminants	657	Disturbance to nesting lakes, aquatic habitat degradation	1	1	2
Dark-eyed Junco (S)	Widespread long-term population declines	114,220	232 to 661 acres evergreen and mixed forest and shrub/scrub wetlands	90	76	111

**Table E-8  
Birds of Conservation Concern Estimated Nesting Habitat Loss Impacts from Alternatives<sup>a,b</sup>  
(page 2 of 4)**

<b>Species (Migration)<sup>c</sup></b>	<b>Rationale</b>	<b>Estimated Study Area Population<sup>d</sup></b>	<b>Habitat Impact Description</b>	<b>Estimated Average Project Impact (No. Birds)<sup>e</sup></b>	<b>Estimated Minimum Project Impact (No. Birds)<sup>f</sup></b>	<b>Estimated Maximum Project Impact (No. Birds)<sup>g</sup></b>
Golden-crowned Kinglet (S)	Sensitive to forest management - canopy nester	485	67 to 154 acres evergreen forest	0	0	1
Great Gray Owl (S)	Sensitive to forest management - canopy nester	7	496 to 1,364 acres forests and wetlands	2	0	4
Great Horned Owl (S)	Sensitive to forest management - canopy nester	7	434 to 1,168 acres forest and woody wetlands	2	0	4
Hairy Woodpecker (R)	Sensitive to forest management - cavity nester	343	67 to 154 acres evergreen forest	2	2	3
Hermit Thrush (S)	Long-term declines	3,712	78 to 207 acres evergreen forest and shrub/scrub wetlands	3	2	3
Horned Grebe (S)	Long-term range contraction	Unknown	Disturbance to nesting lakes, 43 to 178 acres emergent wetlands	✓	✓	✓
Lesser Yellowlegs (L)	Boreal forest habitat loss, alteration	Unknown	180 to 550 evergreen forest and wetlands	9	8	11
Long-tailed Duck (S)	Significant long-term declines	119	Disturbance to nesting lakes, 113 to 396 acres wetlands	✓	✓	✓
Murrelet species (S)	Significant long-term declines, marbled murrelet sensitive to forest management	Unknown	67 to 154 acres evergreen forest	✓	✓	✓
Merlin (L)	Sensitive to contaminants, habitat loss	Unknown	496 to 1,364 acres of forest and wetlands	✓	✓	✓
Northern Flicker (S)	Sensitive to forest management - cavity nester	514	221 to 608 acres evergreen and mixed forest	✓	✓	✓
Northern Harrier (L)	Wetland and grassland habitat loss, in decline	Unknown	114 to 490 acres agricultural and wetlands	✓	✓	✓

**Table E-8  
Birds of Conservation Concern Estimated Nesting Habitat Loss Impacts from Alternatives<sup>a,b</sup>  
(page 3 of 4)**

<b>Species (Migration)<sup>c</sup></b>	<b>Rationale</b>	<b>Estimated Study Area Population<sup>d</sup></b>	<b>Habitat Impact Description</b>	<b>Estimated Average Project Impact (No. Birds)<sup>e</sup></b>	<b>Estimated Minimum Project Impact (No. Birds)<sup>f</sup></b>	<b>Estimated Maximum Project Impact (No. Birds)<sup>g</sup></b>
<i>Olive-sided Flycatcher</i> (L)	Long-term decline, sensitive to forest management - canopy nester	571	221 to 608 acres evergreen and mixed forests	15	13	18
Osprey (L)	Sensitive to disturbance, contaminants	7	Disturbance to 0 to 1 nest tree	2	0	2
Pacific Loon (S)	Sensitive to disturbance, contaminants	390	Disturbance to nesting lakes, aquatic habitat degradation	✓	✓	✓
Pine Siskin (S)	Long-term declines, sensitive to forest management - canopy nester	1,428	221 to 608 acres evergreen and mixed forests	17	14	21
Red-breasted Nuthatch (R)	Sensitive to forest management - cavity nester	314	221 to 608 acres evergreen and mixed forests	✓	✓	✓
Red-necked Grebe (S)	Long-term declines, sensitive to disturbance	Unknown	Disturbance to nesting lakes, 43 to 178 acres emergent wetlands	✓	✓	✓
Red-tailed Hawk (L)	Sensitive to contaminants, habitat loss	44	91 to 417 open forest, woodland, shrub/scrub and woody wetland	6	0	12
Red-throated Loon (L)	Sensitive to disturbance, contaminants	11	Disturbance to nesting lakes, aquatic habitat degradation	✓	✓	✓
Rusty Blackbird (S)	Long-term decline, sensitive to climate and riparian habitat changes	1,142	334 to 1,004 acres evergreen and mixed forest, and wetlands	2	1	2
Sharp-shinned Hawk (L)	Sensitive to contaminants, habitat loss	Unknown	91 to 417 open forest, woodland, shrub/scrub and woody wetland	✓	✓	✓
Solitary Sandpiper (L)	Long-term declines, sensitive to changes in boreal wetlands	Unknown	68 to 520 acres woodlands, wetlands, agricultural	1	1	1
Surf Scoter (S)	Significant long-term declines	1,175 (scoter)	129 to 426 acres woodlands and wetlands	3	2	3

**Table E-8  
Birds of Conservation Concern Estimated Nesting Habitat Loss Impacts from Alternatives<sup>a,b</sup>  
(page 4 of 4)**

Species (Migration) <sup>c</sup>	Rationale	Estimated Study Area Population <sup>d</sup>	Habitat Impact Description	Estimated Average Project Impact (No. Birds) <sup>e</sup>	Estimated Minimum Project Impact (No. Birds) <sup>f</sup>	Estimated Maximum Project Impact (No. Birds) <sup>g</sup>
<i>Townsend's Warbler</i> (L)	Sensitive to forest management - canopy nester	4,283	221 to 608 acres evergreen and mixed forest	✓	✓	✓
Varied Thrush (S)	Sensitive to forest management - canopy nester	17,133	383 to 968 acres forest	12	10	15
Violet-green Swallow (L)	Long-term Alaska declines	2,284	122 to 448 acres open forest and woodlands, emergent and woody wetlands	10	8	12
White-crowned Sparrow (L)	Long-term Alaska declines	37,122	200 acres low shrub and graminoid habitats removed, fragmented	26	22	32
White-winged Crossbill (R)	Sensitive to forest management - canopy nester	5,711	221 to 608 acres evergreen and mixed forests	10	9	13
White-winged Scoter (S)	Significant long-term declines	1,175 (scoter)	129 to 426 acres woodlands and wetlands	3	2	3
Wilson's Warbler (L)	Sensitive to changes in riparian habitats	19,989	165 to 507 acres mixed forest and shrub/scrub wetlands	6	5	7
<b>Total Estimated Birds Impacted</b>				<b>271</b>	<b>216</b>	<b>346</b>

<sup>a</sup> Sources: Rosenberg, 2004; ADF&G, 2006; Shook and Ritchie, 2008; Sauer *et al.*, 2008; Platte *et al.*, 2008; URS, 2006; ADF&G, 1998; USFWS, 2008.

<sup>b</sup> Number of nesting birds impacted is based on the SEA estimated project area nesting density multiplied by either the alternative length for linear densities or by the 200-foot right-of-way, terminal reserve, stream relocation and road relocation areas for the average, minimum and maximum alternatives.

<sup>c</sup> (R) = Resident; (S) = Short-distance migrant; (L) = Long-distance migrant; ✓ indicates the species has been documented in the project area and impacts would occur but data are insufficient to estimate the scale of impact. Bold-italics indicates ADF&G Species of Special Concern (ADF&G, 1998).

<sup>d</sup> SEA estimates generated only for species with an abundance estimate within the project area.

<sup>e</sup> Average of eight proposed alternatives. Does not represent an alternative.

<sup>f</sup> Minimum value for eight proposed alternatives.

<sup>g</sup> Maximum value for eight proposed alternatives.

**Table E-9  
Proposed Port MacKenzie Rail Extension Project Area Habitat Patch and Core Area Statistics<sup>a,b,c</sup>**

	Habitat										All Classes
	Evergreen Forest	Deciduous Forest	Mixed Forest	Emergent Wetlands	Shrub/Scrub	Woody Wetlands	Agriculture	Barren Land	Open Water	Developed	
<b>Project Area Habitat Patches</b>											
Area (hectares)	26,852	37,825	39,394	28,506	5,497	33,427	4,935	1,800	23,294	6,394	207,925
Number	18,016	27,868	41,637	23,654	9,414	24,822	784	1,179	1575	2,946	151,895
Mean Size (hectares)	1.5	1.4	0.9	1.2	0.6	1.3	6.3	1.5	14.8	2.2	1.4
Mean Edge (meters)	560	507	456	457	348	528	805	565	1,293	737	500
Shape Index	1.45	1.39	1.41	1.38	1.36	1.40	1.47	1.45	1.47	1.55	1.40
<b>Core Areas for Habitat Patches Larger than 40 hectares</b>											
Area (hectares)	7,628	11,408	6,575	9,207	464	9,091	3,563	528	18,305	2,223	68,992
Number	6,154	7,582	10,879	5,254	1,332	7,201	258	353	1,054	1,250	41,317
Mean Size (hectares)	1.2	1.5	0.6	1.8	0.3	1.3	13.8	1.5	17.4	1.8	1.7
Mean Edge (meters)	395	457	277	419	218	411	961	465	1,060	309	394
Shape Index	1.71	1.72	1.67	1.70	1.67	1.71	1.74	1.72	1.71	1.68	1.70
<b>Core Habitats Crossed by Proposed Rail Line Segments</b>											
Area (hectares)	579	449	312	957	0	679	3,367	0	0	18	6,361
Number	21	53	49	13	0	32	5	0	0	9	182
Mean Size (hectares)	27.5	8.5	6.4	73.6	0	21.2	673.5	0	0	2.0	35.0
Mean Edge (meters)	3,741	1,784	1,516	8,622	0	3,967	33,340	0	0	670	3,622
Shape Index	2.25	2.03	1.98	2.67	0	2.45	3.53	0	0	1.76	2.19

<sup>a</sup> Source: Homer et al., 2004.

<sup>b</sup> To convert hectares to acres, multiply by 2.471; to convert meters to feet, multiply by 3.2808.

<sup>c</sup> Number = number of core areas crossed; area = total size of core areas.

**Table E-10  
Statistics for Core Area Habitats Larger than 100 Acres the Proposed Port MacKenzie Rail Extension Alternatives would Cross<sup>a</sup>**

Habitat	Alternative <sup>b</sup>																	
	Mac West-Connector 1-Willow		Mac West-Connector 1-Houston-North		Mac West-Connector 1-Houston-South		Mac West-Connector 2-Big Lake		Mac East-Connector 3-Willow		Mac East-Connector 3-Houston-North		Mac East-Connector 3-Houston-South		Mac East-Big Lake			
	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area		
Wildlife Habitats																		
Evergreen Forest	10	290	5	104	5	104	6	139	10	336	5	150	5	150	5	150	5	91
Deciduous Forest	30	201	19	46	19	46	12	203	30	201	19	46	19	46	19	46	12	203
Mixed Forest	37	173	2	0	2	0	11	222	46	258	11	86	11	86	11	86	13	99
Emergent Wetland	0	0	10	353	7	622	0	0	0	0	10	353	7	622	0	0	0	0
Shrub/Scrub Wetland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Woody Wetland	12	489	21	546	20	527	10	501	4	288	13	345	12	326	4	305		
Agriculture	3	2,857	3	2,857	3	2,857	4	3,367	1	1,127	1	1,127	1	1,127	1	1,127	0	0
Forests	77	663	26	150	26	150	29	564	86	795	35	282	35	282	30	282	30	393
Wetland	12	489	31	899	27	1,149	10	501	4	288	23	697	19	947	4	305		
Forest and Wetland	89	1,152	57	1,049	53	1,299	39	1,065	90	1,083	58	979	54	1,229	34	698		

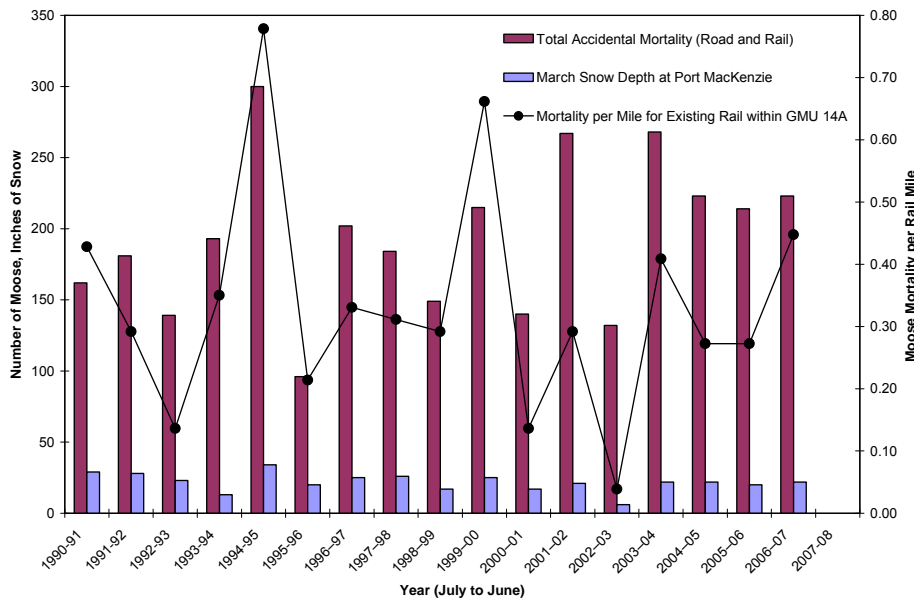
<sup>a</sup> Source: Homer *et al.*, 2004.

<sup>b</sup> No. = number of core areas crossed; area = total size of core areas in hectares. To convert hectares to acres, multiply by 2.471.

### E.2.3 Moose-Train Collision Mortality

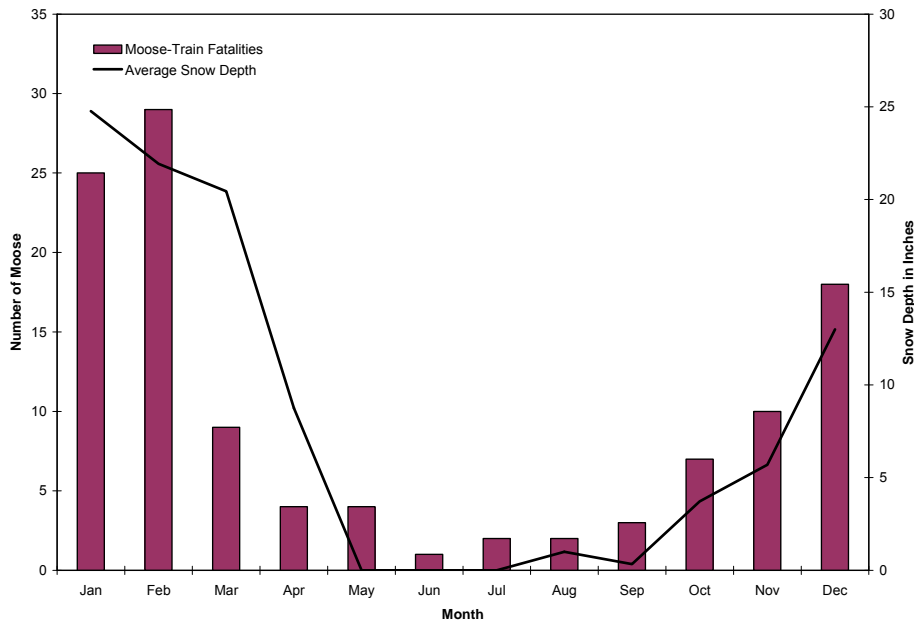
This section provides information used by SEA to calculate and assess moose-train collision mortality summarized in Chapter 5. Rail collision mortality for moose was estimated based on the reported annual mortality for moose from the existing 51.4 miles of rail line running through Subunit 14A (Figure E-7). The existing 51.4 miles of rail line through Subunit 14A averages a reported annual moose-train collision mortality of 0.33 moose per mile, or about 17 moose per year (range 0.14 to 0.78 moose per mile; McDonough, 2002b; Del Frate, 2004; Peltier, 2006a). Moose-train collision mortality accounts for an average of 9 percent of accidental moose mortality, and accidental mortality (road and train collisions) accounts for an average of 25 percent of total accidental and harvest mortality for moose in Subunit 14A (McDonough, 2002b; Del Frate, 2004; Peltier, 2006a).

The frequency of trains along the proposed rail line would be 24 percent lower than the frequency of trains on the existing 51.4-mile rail line in the project area. Estimated moose-train collision mortality from operation of the proposed 33- to 47-mile rail line would average 3 to 4 moose per year, ranging from 1 to 9 collision mortalities per year. The frequency of trains would be increased on the existing rail line because of operation of the proposed rail line extension from an average of 8.5 trains per day to an average of 10.5 trains per day. The number of moose-train collision mortalities would then be expected to increase by 20 percent, or about 3 moose per year on the existing line from 17 moose per year to 20 moose per year (range 0.17 to 0.94 moose per mile, or 2 to 8 moose per year). Combined direct and indirect moose-train collision mortality as a result of the proposed rail line would then average 6 to 7 moose per year, ranging from 3 to 17 moose per year.



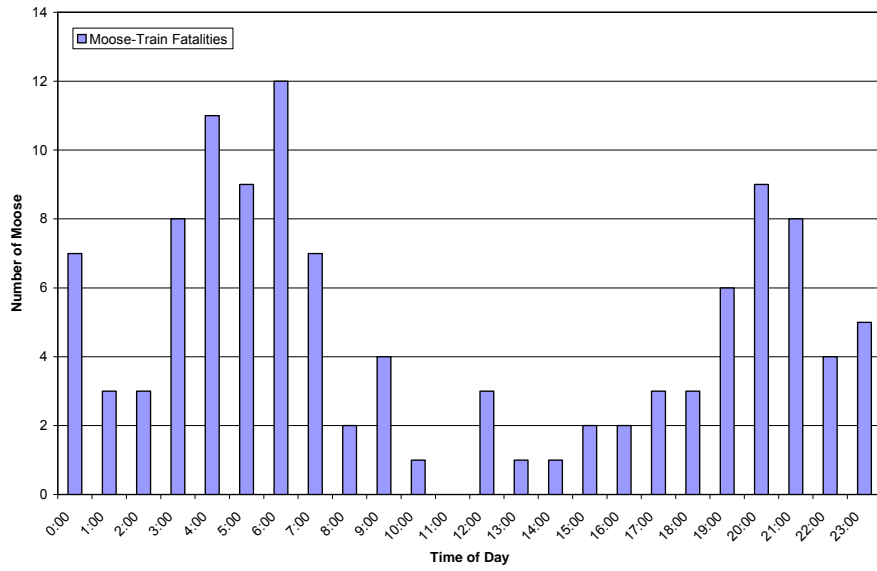
**Figure E-7. Reported Annual Moose-Train Collision Mortality for 51.4 miles of Existing Rail Line in Subunit 14A in the Proposed Port MacKenzie Rail Extension Study Area with February Snow Depth at the Point MacKenzie Station (McDonough, 2002b; Del Frate, 2004; Peltier, 2006a; NRCS, 2008)**

Most train moose kills along the existing rail line in the lower Susitna Valley occur during January, February, and March (Modafferi, 1991). Most (72 percent) moose-train kills along the existing rail line in Subunit 14A occurred during January, February, November, and December (ADF&G, 2008c; Figure E-8), when the frequency of trains averages 5 trains per day compared to the 10 to 12 trains per day during May to October. Collision mortality along the stretch of track in Subunit 14A appears to be influenced by February snow depth at the Point MacKenzie snow course (NRCS, 2008) (Figure E-7). Moose-train collision mortalities resulting from proposed rail line operations could range higher than the estimated values during years with snow depths greater than 34 inches, or if a greater proportion of seasonal moose movements occur across the alternatives than occurs across the existing 51.4-mile rail line in the study area.



**Figure E-8. Moose-Train Collision Mortality by Month for 51.4 miles of Existing Rail Line in Subunit 14A in the Proposed Port MacKenzie Rail Extension Project Area with Average Snow Depth at the Wasilla or Point MacKenzie Stations, 2000 to 2008 (ADF&G, 2008b; NRCS, 2008)**

Moose-train collisions on the existing rail line occurred throughout the day with a bimodal pattern of increased mortality from 3:00 to 7:00 and 19:00 to 0:00 (Figure E-9). Because of the extreme seasonal changes in daylight hours, most collisions occurred during darkness (69 percent), followed by daylight hours (16 percent), and twilight hours at dawn and dusk (15 percent) (ADF&G, 2008b). Meat from about 40 percent of moose-train collision mortalities was salvaged for human consumption (ADF&G, 2008b).



**Figure E-9. Moose-Train Collision Mortality by Hour for 51.4 miles of Existing Rail Line in Subunit 14A in the Proposed Port MacKenzie Rail Extension Study Area, 2000 to 2008 (ADF&G, 2008b)**

## E.3 References

- ADF&G (Alaska Department of Fish and Game). 1985. Alaska Habitat Management Guide. Southcentral Region: Map Atlas. Juneau, AK: Alaska Department of Fish and Game, Division of Habitat.
- ADF&G. 1998. Alaska Species of Special Concern. Juneau, AK: Alaska Department of Fish and Game. Online at: [http://www.adfg.state.ak.us/special/esa/species\\_concern.php](http://www.adfg.state.ak.us/special/esa/species_concern.php) (accessed December 2008).
- ADF&G. 2006. Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife and Fish Resources. Juneau, AK: Alaska Department of Fish and Game.
- ADF&G. 2008a. Alaska Wildlife Harvest Summary 2006-2007. Juneau, AK: Alaska Department of Fish and Game, Division of Wildlife Conservation.
- ADF&G. 2008b. Rail and Road-Kill Data 2000-2008, Moose Density and Movement Graphics; Unpublished Data. Palmer, AK: Alaska Department of Fish and Game, Division of Wildlife Conservation. Provided by Tim Peltier, and Nick Cassara.
- ADF&G. 2008c. Status of Upland Game 2008. Juneau, AK: Alaska Department of Fish and Game, Division of Wildlife Conservation. Online at: <http://www.wildlife.alaska.gov/index.cfm?adfg=game.upland> (accessed November 25, 2008).
- ADF&G. 2009. Region II Briefing Book. Alaska. Alaska Department of Fish and Game, Division of Wildlife Conservation. Online at: <http://www.boards.adfg.state.ak.us/gameinfo/meetinfo/2008-2009/Spring%202009/regionIIoverview.pdf> (accessed February 2009).
- Benson, A. M. 2001. Owl Surveys Conducted in Alaska During 2001: A Summary Report. Alaska Bird Observatory. Prepared for United States Fish and Wildlife Service, Migratory Bird Office, Anchorage, AK.
- Blancher, P. J., K. V. Rosenberg, A. O. Panjabi, B. Altman, J. Bart, C. J. Beardmore, G. S. Butcher, D. Demarest, R. Dettmers, E. H. Dunn, W. Easton, W. C. Hunter, E. E. Inigo-Elias, D. N. Pashley, C. J. Ralph, T. D. Rich, C. M. Rustay, J. M. Ruth, and T. C. Will. 2007. Guide to the Partners in Flight Population Estimates Database. Version: North American Landbird Conservation Plan 2004. Partners in Flight Technical Series No. 5. Online at: <http://www.partnersinflight.org/> (accessed August 2007).
- Blejwas, K. 2006. Trapper Questionnaire. Statewide Annual Report, 1 July 2004 to 30 June 2005. Juneau, AK: Alaska Department of Fish and Game, Division of Wildlife Conservation.
- Conant, B., and D. J. Groves. 2001. Alaska-Yukon Waterfowl Breeding Population Survey May 15 to June 12, 2001. Juneau, AK: U.S. Fish and Wildlife Service.

- Conant, B., and D. J. Groves. 2002. Alaska-Yukon Waterfowl Breeding Population Survey May 17 to June 9, 2002. Juneau, AK: U.S. Fish and Wildlife Service.
- Conant, B., and D. J. Groves. 2003. Alaska-Yukon Waterfowl Breeding Population Survey May 16 to June 9, 2003. Juneau, AK: U.S. Fish and Wildlife Service.
- Conant, B., and D. J. Groves. 2004. Alaska-Yukon Waterfowl Breeding Population Survey May 14 to June 5, 2004. Juneau, AK: U.S. Fish and Wildlife Service.
- Conant, B., and D. J. Groves. 2005. Alaska-Yukon Waterfowl Breeding Population Survey May 15 to June 7, 2005. Juneau, AK: U.S. Fish and Wildlife Service.
- Conant, B., and E. J. Mallek. 2006. Alaska-Yukon Waterfowl Breeding Population Survey May 16 to June 6, 2006. Juneau, Alaska. U.S. Fish and Wildlife Service.
- Conant, B., J. I. Hodges, and D. J. Groves. 1999. Alaska-Yukon Waterfowl Breeding Population Survey May 25 to June 20, 1999. Juneau, AK: U.S. Fish and Wildlife Service.
- Conant, B., J. I. Hodges, and D. J. Groves. 2000. Alaska-Yukon Waterfowl Breeding Population Survey May 15 to June 10, 1999. Juneau, AK: U.S. Fish and Wildlife Service.
- Conant, B., J. I. Hodges, D. J. Groves, and J. G. King. 2007. "Alaska Trumpeter Swan Status Report 2005." *Waterfowl Management*. U.S. Fish and Wildlife Service. April.
- Del Frate, G. G. 2004. Unit 14A Moose Management Report. Pages 161-173 in C. Brown (ed.), Moose Management Report of Survey and Inventory Activities 1 July 2001-30 June 2003. Juneau, AK: Alaska Department of Fish and Game.
- Homer, C., C. Huang, L. Yang, B. Wylie and M. Coan. 2004. "Development of a 2001 National Land Cover Database for the United States." *Photogrammetric Engineering and Remote Sensing* 70(7):829-840. Online at: [http://www.mrlc.gov/pdf/July\\_PERS.pdf](http://www.mrlc.gov/pdf/July_PERS.pdf) (accessed November 2008).
- Kavalok, T. 2005. Unit 14 Black Bear Management Report. Pages 183-194 in C. Brown (ed.), Black Bear Management Report of Survey and Inventory Activities 1 July 2001-30 June 2005 (Project 17.0). Juneau, AK: Alaska Department of Fish and Game.
- Kavalok, T. 2007. Unit 14 Brown Bear Management Report. Pages 155-163 in P. Harper (ed.), Brown Bear Management Report of Survey and Inventory Activities 1 July 2004-30 June 2006. Juneau, AK: Alaska Department of Fish and Game.
- Mallek, E. J., and D. J. Groves. 2007. Alaska-Yukon Waterfowl Breeding Population Survey May 14 to June 5, 2007. Fairbanks and Juneau, AK: U.S. Fish and Wildlife Service.
- Mallek, E. J., and D. J. Groves. 2008. Alaska-Yukon Waterfowl Breeding Population Survey May 15 to June 6, 2008. Fairbanks and Juneau, AK: U.S. Fish and Wildlife Service.

- Masteller, M. A. Undated. Seasonal Ranges and Movements of Cow Moose Wintering on Palmer Hay Flats State Game Refuge. Palmer, AK: Alaska Department of Fish and Game.
- McDonough, T. 2002a. Unit 14 Black Bear Management Report. Pages 180-190 in C. Healy (ed.), Black Bear Management Report of Survey and Inventory Activities 1 July 1998-30 June 2001. Juneau, AK: Alaska Department of Fish and Game.
- McDonough, T. 2002b. Unit 14A Moose Management Report. Pages 154-166 in C. Healy (ed.), Moose Management Report of Survey and Inventory Activities 1 July 1999-30 June 2001. Juneau, AK: Alaska Department of Fish and Game.
- Modafferi, R. D. 1988. Susitna Hydroelectric Project Final Report: Big Game Studies. Volume I: Moose-Downstream. Anchorage, AK: Alaska Department of Fish and Game.
- Modafferi, R. D. 1991. "Train Moose-Kill in Alaska: Characteristics and Relationship with Snowpack Depth and Moose Distribution in Lower Susitna Valley." *Alces* 27:193-207.
- NRC (National Research Council). 1997. Wolves, Bears, and their Prey in Alaska. Biological and Social Challenges in Wildlife Management. Washington, D.C.: National Academy Press.
- NRCS (National Resources Conservation Service). 2008. Data for Willow Airstrip and Point MacKenzie Stations. National Water and Climate Center, U.S. Department of Agriculture, National Resources Conservation Service, Portland, Oregon. Online at: <http://www.wcc.nrcs.usda.gov/cgibin/state-site.pl?state=AK&report=snowcourse> (accessed March 2008).
- Peltier, T. C. 2006a. Unit 14A Moose Management Report. Pages 159-171 in P. Harper (ed.), Moose Management Report of Survey and Inventory Activities 1 July 2003-30 June 2005. Juneau, AK: Alaska Department of Fish and Game.
- Peltier, T. C. 2006b. Unit 14B Moose Management Report. Pages 172-180 in P. Harper (ed.), Moose Management Report of Survey and Inventory Activities 1 July 2003-30 June 2005. Juneau, AK: Alaska Department of Fish and Game.
- Peltier, T. C. 2006c. Unit 14 Wolf Management Report. Pages 100-108 in P. Harper (ed.), Wolf Management Report of Survey and Inventory Activities 1 July 2002-30 June 2005. Juneau, AK: Alaska Department of Fish and Game.
- Platte, R., R. Stehn, T. Mills, and W. Larned. 2008. Southcentral Alaska Loon Observations from Aerial surveys, 2001-2003; Unpublished Report. Anchorage, AK: U.S. Fish and Wildlife Service, Office of Migratory Bird Management.
- Rosenberg, K. V. 2004. Partners in Flight Continental Priorities and Objectives Defined at the State and Bird Conservation Region Levels: Alaska. Ithaca, NY: PIF Northeast Regional Coordinator, Cornell Lab of Ornithology.

- Sauer, J. R., J. E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966 - 2007. (Version 5.15.2008.). Laurel, MD: USGS Patuxent Wildlife Research Center. Online at: <http://www.mbr-pwrc.usgs.gov/bbs/bbs.html> (accessed November 2008).
- Shook, J. E., and R. J. Ritchie. 2008. Raptor Nest Surveys of Potential ARRC Routes Between Houston Area and Port MacKenzie, Alaska, 2008; Unpublished Report prepared for ICF International. Prepared by ABR, Inc.-Environmental Research & Services, Fairbanks, AK.
- URS (URS Corporation). 2006. Knik Arm Crossing Area Shorebird Study; Unpublished report prepared for Knik Arm Bridge and Toll Authority. Prepared by URS Corporation, Anchorage, AK.
- UAA (University of Alaska-Anchorage). 2008. Zoology Tracking Lists and Status Reports. Alaska Natural Heritage Program. Environment and Natural Resources Institute, University of Alaska Anchorage, Anchorage, AK. Online at: [http://aknhp.uaa.alaska.edu/zoology/Zoology\\_Tracking.htm](http://aknhp.uaa.alaska.edu/zoology/Zoology_Tracking.htm) (accessed November 2008).
- UAF (University of Alaska-Fairbanks). 2008. Arctos v3 Virtual Private Database: UAM Mammals. University of Alaska Fairbanks, Fairbanks, AK. Online at: <http://arctos.database.museum/home.cfm> (accessed November 2008).
- USFWS (U.S. Fish and Wildlife Service). 2008. Birds of Conservation Concern 2008. Arlington, VA: U.S. Fish and Wildlife Service, Division of Migratory Bird Management. Online at: <http://www.fws.gov/migratorybirds/> (accessed June 2009).