Mammal Inventory of Alaska's National Parks and Preserves

SOUTHWEST ALASKA NETWORK:

Kenai Fjords National Park, Lake Clark National Park and Preserve, and Katmai National Park and Preserve

Final Report

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Mammals, small mammals, inventory, NPS Southwest Alaska Network, Kenai Fjords National Park, Lake Clark National Park and Preserve, Katmai National Park and Preserve, Aniakchak National Monument and Preserve

Abbreviations

ADFG—Alaska Department of Fish and Game
ALAG—Alagnak Wild River
ANIA—Aniakchak National Monument and Preserve
BCP—Beringian Coevolution Project
CU—Cornell University, Ithaca, NY
ISU—Idaho State University, Pocatello, ID
KATM—Katmai National Park and Preserve
KEFJ—Kenai Fjords National Park
LACL—Lake Clark National Park and Preserve
MSB—Museum of Southwestern Biology
NPS—National Park Service
SWAN—Southwest Alaska Network of the National Park Service
UNM—University of New Mexico, Albuquerque
UAM—University of Alaska Museum of the North, Fairbanks
USNM—United States National Museum, Washington, DC

NPS Accessions

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Abstract

This report summarizes the inventory of mammals of three park units in the Southwest Alaska Network (SWAN) of the National Park Service, Alaska Region, in 2003 and 2004. This study was part of a cooperative effort of the Beringian Coevolution Project at the Museum of Southwestern Biology, University of New Mexico and the SWAN Inventory and Monitoring Program of the National Park Service of Alaska.

We begin the process of documenting the approximately 38 species of mammals that occur in SWAN, with a primary focus on small mammals (i.e., shrews, voles, lemmings, weasels, porcupine, squirrels, and hares). This survey resulted in over 2000 primary specimens comprising 18 small mammal species.

Small mammal captures varied considerably between years and across parks. From all localities sampled in SWAN, two shrews (cinereus shrew, montane shrew) and two voles (northern red-backed vole, tundra vole) were the most frequently captured species (935, 389, 484, and 84 specimens, respectively), comprising over 92% of all specimens collected in two field seasons of effort.

This study confirms the importance of ongoing efforts to fully document the region's small mammal fauna. Such persistence has paid a large dividend in SWAN with the documentation of four new species in Kenai Fjords National Park, seven in Lake Clark National Park and Preserve, and three in Katmai National Park and Preserve. This inventory also extended the known distributions of several other species.

These findings, when combined with specimen information gathered from a review of holdings at UAM and other major collections, bring the total number of documented small mammal species to 4 of 14 probable species, or 29% coverage in KEFJ, 18 of 22 species, or 82% coverage in LACL, and 13 of 21 probable species, or 62% coverage in KATM.

The specific products of this inventory include a large collection of well-prepared, well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts) for taxonomic, zoogeographic, ecological, genetic, parasitological, epidemiological, and other research and management purposes.

Executive Summary

This inventory project was a cooperative effort of the Beringian Coevolution Project at the Museum of Southwestern Biology, University of New Mexico and the Inventory and Monitoring Program of the National Park Service of Alaska. Other participating institutions included the University of Alaska Museum of the North-Fairbanks, Idaho State University-Pocatello, the University of Saskatchewan-Saskatoon, Canada, USDA National Parasite Collection-Beltsville, Maryland, the Institute of Biological Problems of the North-Magadan, Russia, Sikhote-Alin Zapovednik-a Russian sister-park, and the Finnish Forest Research Institute-Vantaa, Finland. Thirteen people assisted in two summers of field work in 2003 and 2004.

This report details the inventory of mammals in three of the five park units that comprise SWAN: Kenai Fjords NP, Lake Clark NP&P, Katmai NP&P. We begin the process of documenting the approximately 38 species of mammals that occur in this network of National Parks and Preserves, with a primary focus on small mammals (i.e., shrews, voles, lemmings, weasels, porcupine, squirrels, and hares).

The specific products of this inventory include a large collection of well-prepared, well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts). This survey (370 person-days and 15,715 trap nights of collecting effort) resulted in over 2000 primary specimens comprising 18 species. All primary voucher specimens of mammals were deposited in the University of Alaska Museum of the North, Fairbanks.

From all localities sampled in SWAN, two shrew (cinereus shrew, montane shrew) and two vole (northern red-backed vole, tundra vole)species were the most frequently captured species, comprising over 92% of all specimens collected in two field seasons of effort.

These findings, when combined with specimen information gathered from a review of holdings at UAM and other major collections, bring the total number of documented small mammal species to 4 of 14 probable species or 29% coverage in KEFJ, 18 of 22 species or 82% coverage in LACL, and 13 of 21 probable species or 62% coverage in KATM.

This inventory provided the first specimen-vouchered records of four new species in Kenai Fjords National Park, seven in Lake Clark National Park and Preserve, and three in Katmai National Park and Preserve. The inventory also extended the known distributions of several other species.

Perspectives on the value of the specimen-based approach to inventory and monitoring are discussed, and recommendations for future efforts are provided.

Introduction

This report summarizes the inventory of the small mammals of three of the five park units comprising the Southwest Alaska Network (SWAN) of Alaska's National Parklands: Kenai Fjords National Park (KEFJ), Lake Clark National Park and Preserve (LACL), and Katmai National Park and Preserve (KATM). Aniakchak National Monument and Preserve (ANIA) and Alagnak Wild River (ALAG) were not sampled in this study (but see Table 3). For this effort (Cook and MacDonald 2004a, 2004b, 2004c) the Beringian Coevolution Project (BCP) at the Museum of Southwestern Biology (MSB), University of New Mexico (UNM) worked collaboratively with the SWAN Inventory and Monitoring Program and the University of Alaska Museum of the North (UAM).

Assessing the biological diversity of life forms has become a priority within the U.S. National Park Service (NPS). In response to this challenge, the BCP inventories of the poorly known small mammal fauna of SWAN had two basic objectives:

1. Conduct an inventory at selected sites throughout SWAN to document the occurrence (with a goal of 90% coverage), relative abundance, and general habitat affinities of its small mammal fauna (shrews, voles, lemmings, weasels, porcupine, squirrels, and hares). The effort did not attempt to provide fine-grained geographic analyses of quantifiable precision because the time frame for this work was much too short given the wide temporal fluctuations in abundance that is amply documented for high latitude mammals.

2. Provide a large series and variety of permanently preserved materials and associated data sets for taxonomic, zoogeographic, ecological, genetic, parasitological, epidemiological, and other research and management purposes. Because the fauna of Alaska is the least studied of the continent, these NPS inventories are an important contribution to our understanding of mammalian diversity.

Methods and Materials

Review of Museum Collections

Documentation of species' occurrence in SWAN was complemented by a review of specimen holdings at the University of Alaska Museum of the North (UAM) and other major collections, primarily the U.S. National Museum (USNM). Scientific and common names of mammals used in this report follow Wilson and Reeder (1993) and Wilson and Cole (2000), respectively. Vegetation classification generally follows Viereck et al. (1992).

Field Studies

Between 2003 and 2004, our field crews established over 116 trapline transects (Table 1) at 25 general localities throughout SWAN (Figures 1-3). Thirteen people from several

institutions were involved in this effort (Table 2), sampling SWAN with a total of nearly 370 person-days and 15,715 trap nights of collecting effort.

Our collecting strategy was designed to maximize the number and diversity of samples by using a variety of methods in available habitats. While particular effort was made to sample rare or undocumented small mammals, the sampling methods used also allowed us to evaluate the occurrence and relative abundance of the more common species.

Diversity of captured specimens was maximized by utilizing a variety of trap types, including snap traps (Museum Specials, rat traps) and live traps (44 oz. plastic drinking cups buried as pitfall traps, Shermans). Squirrels were sampled primarily with shotgun.

Traplines for shrews and voles were set in the range of available habitats and ecotones in each study location. Traplines typically consisted of 20 or more trap stations per line, with stations spaced 8-10 m apart. At each station, two snap traps or one snap trap and one pitfall trap were typically set within 2 m of each station point. The snap traps were baited with a mixture of rolled oats and peanut butter; pitfall traps were buried flush with the ground and left unbaited. Traps were usually set in the late afternoon and checked the following morning. Productive lines were usually kept in operation for two or more nights.

Field Locations

KENAI FJORDS NATIONAL PARK

Upper Nuka River (Seldovia Quad; 59.6167N, 150.6667W [NAD27]; 300-330 m elevations). 8-10 July 2003. Several crew members established a spike camp above treeline in this narrow passageway through the Kenai Mountains that separates the wet Gulf Coast subregion from Cook Inlet and the drier lowlands of western Kenai Peninsula. A total of 63 animals, comprising four species were sampled here during two nights of trapping.

North Arm, Nuka Bay (Seldovia Quad; 59.55N, 150.5167W [NAD27]; low coastal elevations). 7-11 July 2003. Base camp was the NPS cabin on east side North Arm. From here we sampled 74 small mammals, comprising three species in a variety of forest and non-forest habitats.

Shelter Cove, Beauty Bay (Seldovia Quad; 59.5167N, 150.6333W [NAD27]; low coastal elevations). 9-10 July 2003. Traplines were run for one night (215 trapnights of effort) in meadow and forest-edge habitat at the head of Shelter Cove near the mouth of the Nuka River. A total of 43 specimens of three species were collected.

Delight Spit (Seldovia Quad; 67.1N, 154.2667W [NAD27]; low coastal elevations). 11-15 July 2003. We collected a total of 80 small mammals of three species in estuarine meadow and adjacent forest habitats in close vicinity to the cabin located on East Arm

of Nuka Bay. Black bears proved to be a nuisance at the cabin and along some of our lines in the area.

Delight Lake (Seldovia Quad; 59.5333N, 150.3W [NAD27]; 5-10 elevations). 11-15 July 2003. Several traplines established in lowland forest and riparian habitats in the vicinity of Delight Lake resulted in the capture of 77 small mammal specimens of three species.

Paguna Arm (Seldovia Quad; 59.6833N, 150.1333W [NAD27]; 2-130 m elevations). 16-18 July 2003. Working by skiff from the NPS vessel, the Serac, we sampled a diversity of meadow, scrub and forest habitats at the head of the bay and near the mouth of a major stream that flows into the east side of Paguna Bay about 2.5 km farther to the south. A total of 112 specimens comprising four species were documented at these two sites.

Crater Bay (Blying Sound Quad; 59.7167N, 149.7667W [NAD27]; 5-200 m elevations). 18-19 July 2003. We sampled a total of 12 small mammals of three species during our overnight anchorage on the west side of Harris Peninsula. Lines were set in mature spruce forest on the south side of the bay, as well as upslope in alpine tundra habitats to the north.

Northwestern Lagoon (Blying Sound Quad; 59.7667N, 149.9167W [NAD27]; lowland coastal elevations). 19-20 July 2003. A total of 30 specimens comprising three species were sampled during one night of trapping in this flat, lowland area on the north side of Northwestern Lagoon.

Aialik Bay (Blying Sound Quad; 59.8167N, 149.6333W [NAD27]; 2-50 m elevations). 20-22 July 2003. A number of traplines were established at the heads of Tooth Cove and the cove immediately south of Tooth Cove ("South Tooth Cove"). In two nights of trapping these lines produced a total of 123 specimens consisting of three small mammal species.

Resurrection River (Seward Quad; 60.2833N, 149.7W [NAD27]; 150-170 m elevations). 25-28 July 2003. Our crew was helicoptered upvalley from Seward airport along a flooding Resurrection River to an upland meadow area surrounded by spruce forest approximately 2.5 km upriver from the mouth of Placer Creek near the extreme northern end of the Park that transitions into the interior lowlands of the Kenai Peninsula. We sampled a total of 134 small mammals of three species at this locality.

LAKE CLARK NATIONAL PARK AND PRESERVE

Chulitna Bay, Lake Clark (60.167N, 154.567W [NAD27]): 7-11 July 2003. A total of 11 trapline transects, established at three separate collecting sites (**Turner Bay**, **West of Chulitna River mouth**, **South of Chulitna River**) resulted in the capture of 243 animals, comprising nine species. Three of these—tiny shrew, northern bog lemming, little brown bat—were found only at this location.

Head of Lake Clark (60.383N, 153.833W [NAD27]): 11-14 July 2003. We sampled 99 small mammals of six species, including the first of several meadow jumping mice taken during our survey, using a total of 11 traplines set in a variety of herbaceous, scrub, and forest vegetation types.

Silver Salmon Creek vicinity, Cook Inlet (59.983N, 152.667W [NAD27): 15-19 July 2003. A total of 195 small mammals of five species were sampled on 10 trapline transects in two separate general localities: **Johnson River** and **Silver Salmon Lakes**. We captured the highest number of meadow jumping mice (6) in this area of study.

Turquoise Lake (60.783N, 153.85W [NAD27]): 20-24 July 2003. A total of 143 specimens was sampled on 15 trapline transects established in a wide variety of habitats at various elevations. We found small mammal species richness in LACL highest at this locality (12 species), and the only site where we obtained samples of pygmy shrew, singing vole (a first for LACL), and collared pika.

Two Lakes vicinity (61.10N, 153.85W [NAD27]): 25-28 July 2003. The establishment of 15 trapline transects near **Two Lakes** and the **Necons River** resulted in the capture of six species and 156 total specimens.

Port Alsworth, Tanalian Mountain (60.20N, 154.217W [NAD27]): 31 July 2003. A small series of arctic ground squirrels was collected with shotgun one day in the hills near Port Alsworth. No trapline transects were established in this area; however, a tundra shrew (a first for LACL), a number of red squirrels, ermine, and several other fur-bearing species were obtained from some of the town's residents.

KATMAI NATIONAL PARK AND PRESERVE

Idavain Lake (58.7649N, 155.8908W [NAD27]; 230-249 m elevation): 3-5 July 2004. A total of two long trapline transects and 764 trap nights of effort resulted in the capture of 26 animals, comprising seven species. This was only one of two localities where pygmy shrew was captured. The presence of snowshoe hare, brown bear, wolf, moose, and beaver was noted in this area.

Fure's Cabin (58.6701N, 155.4290W [NAD27]; 27-39 m elevation): 5-9 July 2004. We sampled 53 small mammals of nine species from four traplines set in a variety of herbaceous and forest vegetation types between the cabin overlooking Naknek Lake NE to Lake Grosvenor. Also present in the area were snowshoe hare, brown bear, wolf, moose, and beaver.

Amalik Bay (58.1050N, 154.5274 [NAD27; 2-12 m elevation): 9-12 July 2004. A total of 253 small mammals of five species were sampled on five trapline transects established in the vicinity of the NPS Ranger Cabin. Our highest total numbers of montane shrew, cinereus shrew, meadow jumping mouse, and northern red-backed vole were taken at this locality.

Murray Lake (58.7734N, 155.0277 [NAD27]; 505-763 m elevation): 13-18 July 2004. A total of 101 specimens was sampled on five trapline transects established in a variety of alpine habitats at various elevations. We found small mammal species richness for KATM highest at this locality (10 species), and the only site were we obtained a sample of hoary marmot, a first for KATM. Other mammals found present in this area were brown bear, river otter, red fox, wolf, moose, caribou, porcupine, and beaver.

Unnamed lakes west of Contact Creek (58.2207N, 155.9816W [NAD27]; 172-182 m elevation): 19-22July 2004. The establishment of four trapline transects in the vicinity of two small lakes resulted in the capture of five species and only 18 total specimens. Also present in the area was sightings or sign of brown bear, river otter, red fox, moose, caribou, and beaver.

Specimen Processing

Each animal sampled was preserved as a scientific specimen in the form of a skeletal preparation or as a whole-bodied fluid (ETOH) preparation. Some study skins were also prepared. Our crews carried a tank of liquid nitrogen in the field to preserve tissues (heart, liver, kidney, spleen, and lung) and embryos. These frozen specimens were transferred to ultra-low temperature freezers at UAM and MSB and are archived at -70° C. We preserved ectoparasites, and endoparasites from many of the mammals collected. These exceptional data sets will be used to address epidemiological, coevolutionary, taxonomic, and biogeographic questions. Intestinal tracts from shrews were also preserved. Field protocols (Appendix 2) allowed us to rigorously document and preserve specimens.

The primary voucher specimens from this study were accessioned into the mammal collection at UAM and are in process of curation (Appendix 1). The samples of endoparasite are now accessioned at the US National Parasite Collection in Beltsville, MD. Ectoparasites are being identified by a number of qualified experts.

Results and Species Accounts

The specific products of this inventory of SWAN's mammal fauna include a large collection of well-prepared, well-documented, and diverse preparations of specimens and associated materials (tissues, parasites, fecal samples, digestive tracts). This resulted in the collection and preservation of over 2000 primary specimens of 17 species (Table 3; Appendix 1).

Two shrews (cinereus shrew, montane shrew) and two voles (northern red-backed vole, tundra vole) were the most frequently captured species overall in SWAN (935, 389, 484, and 84 specimens, respectively; Table 4), comprising over 92% of all specimens collected in two field seasons of effort.

This study, when combined with previous efforts and from information gathered from specimens at UAM and other major collections, increased the total number of vouchered small mammal species as follows (see Table 3 and Figure 4 for comparison of park units statewide):

- **KEFJ:** 4 of 14 probable species, or 29% coverage.
- **LACL:** 18 of 22 species, or 82% coverage.
- **KATM:** 13 of 21 species, or 62% coverage.

Species Accounts
The following accounts summarize information on each terrestrial species that occurs or probably occurs in SWAN. Data on all specimens are listed in Appendix 1 and are available in greater detail on UAM's mammal collection website (http://arctos.database.museum). Copies of field notes and data sheets are filed at UAM.

Order **INSECTIVORA**—Shrews
Family **Soricidae**

Sorex cinereus**,** cinereus shrew
We captured more cinereus shrews than any other species of small mammal (Table 4). This shrew was abundant in both KEFJ and LACL during field season 2003. Coastal localities accounted for the majority of captures in both LACL and KATM. It occurred in all major vegetation types (Table 5), but was relatively most abundant in dense herbaceous and scrub habitats. Pitfall traps provided most shrew specimens.

The cinereus shrew is the dominant shrew in many communities throughout its extensive range in Alaska. High densities and wide habitat use may be responsible, at least partially, for the lower abundance of other shrew species (Wrigley et al. 1979).

This widely-distributed species has now been documented in all 12 inventoried park units (Table 3).

Sorex hoyi, pygmy shrew
We did not find any pygmy shrews in KEFJ, however, this species has been found elsewhere on the Kenai Peninsula (Allen 1904, AMNH, MSB).

A single pygmy shrew captured near Turquoise Lake in 2003 constitutes the only record of the species in LACL.

In 2004, the captures of a single pygmy shrew at Idavain Lake and another next to an unnamed lake between Naknek Lake's Bay of Islands and Lake Grosvenor (58.6759° N, 155.4203° W) constitute the first and only records of this species in KATM and extend

the known range of this primarily boreal species farther out the Alaska Peninsula from Nondalton (Rausch 1967).

Pygmy shrews are now documented in 9 of 12 inventoried parks (Table 3).

Sorex monticolus, montane shrew
This species was found in all three SWAN units, and for the first time in KEFJ and LACL.

In KEFJ, a relatively low number of montane shrews (57 specimens) was collected at 8 of 10 localities in a variety of scrub, herbaceous, and forest habitats. Montane shrews from the Kenai Peninsula are referable to *S. m. shumaginensis* of southcentral (excluding Prince William Sound populations) and western Alaska (Alexander 1996). Based on skull variation, Alexander (1996) found some shrews from the Kenai Peninsula slightly divergent from those composing the remainder of the mainland population.

In LACL, these shrews were found at all trapline localities and most frequently captured at Turquoise Lake (66 specimens). These samples comprise the first documented records in LACL of this widely-distributed shrew.

Montane shrews were captured at all localities in KATM except Idavain Lake. Most (78%) came from the dense estuarine meadows at Amalik Bay where they were exceptionally numerous. Schiller and Rausch (1956) and Cahalane (1959) also found this species (as *Sorex vagrans*) to be the Park's most abundant shrew.

This shrew is widely distributed across the state, occurring from the Brooks Range south and on many of the islands along Alaska's southern coast,including Unimak Island. It has been documented in all NPS park units outside Southeast Alaska except ANIA and ALAG.

Sorex tundrensis, tundra shrew
An over-wintered tundra shrew found dead and in good condition near a home in Port Alsworth was the only one encountered in 2003, and is the first documented record for LACL.

We captured a small number of tundra shrews (13) at three localities north of the Aleutian Range in KATM. These constitute the first documented records for this park unit.

This shrew is found over much of mainland Alaska, and in 11 of 12 National Park units. Its range extends out the Alaska Peninsula to at least Lower Dog Salmon River in Becharof National Wildlife Refuge (UAM). It is absent from the Kenai Peninsula and KEFJ.

According to most authors (e.g., Junge et al. 1983, van Zyll de Jong 1983; but see Rausch and Rausch 1993), this species is also found across the Bering Strait in eastern Siberia.

Sorex yukonicus, Alaska tiny shrew
Two tiny shrews collected at Turner Bay comprise only the second documented record of this species in LACL. The first, from Turquoise Lake on 28 June 1999, is a single individual recently discovered in the collections at Moscow (Russia) University by Dr. N. Dokuchaev (pers. com.). The Turner Bay tiny shrews were captured on consecutive days in the same pitfall trap set near the shore's edge in willow thickets interspersed with *Iris*, *Elymus* and *Carex*.

We failed to find tiny shrew in KATM, but may eventually be found in areas of boreal forest in the more northern reaches of the park.

This newly-discovered and apparently rare species has now been documented in eight park units across the state.

Order **CHIROPTERA**—Bats
Family **Vespertilionidae**

Myotis lucifugus, little brown bat
No bats were encountered in KEFJ. Specimens referable to this species have been collected elsewhere on the Kenai Peninsula (UAM), and A. Wright (NPS, pers. com. 2003) reported seeing bats on several occasions in the vicinity of Exit Glacier.

Several bats were seen (after 2330 hr) flying around the lodge and camp south of the Chulitna River near Turner Bay in LACL. The two captured in a mist net set near a shed surrounded by closed mixed forest constitute first specimen records for this park.

No bats were detected during our time in KATM. Cahalane (1959) reported seeing single bats near Lake Coville, Brooks River, south shore Naknek Lake, and Savonoski River. Specimens of this species are known from Lake Iliamna and King Salmon (MSB, UAM, Parker et al. 1997). Little brown bats may occur year-round on Kodiak and Afognak islands (Parker et al. 1997).

Order **CARNIVORA**—Carnivores
Family **Canidae**

Canis latrans, coyote
Coyotes were seen and heard in KEFJ at Delight Spit and Delight Lake. Tracks were also noted at Shelter Cove. Sightings of this species elsewhere in the park by NPS

personnel are from the east side of Aialik Peninsula and along the Resurrection River near Exit Glacier. Specimens have been preserved from a number of locations on the Kenai Peninsula (UAM), but none from KEFJ.

In LACL, a lone coyote was seen on Tanalian Mountain near Port Alsworth on 31 July 2003. To our knowledge, no specimens of this species, which first arrived in the region during the 20th century, has been preserved from the park.

Coyotes have been seen in areas north, south, and west of KATM, but so far there is no documented proof of their occurring within the park (L. Butler, ADFG, King Salmon, pers. com. Sept. 2004).

Canis lupus, wolf
This species has been reported from the Resurrection River area along the northeastern boundary of KEFJ (B. Rice, A. Wright-NPS, pers. com. 2003). No specimens have been preserved from the park, and none were encountered during our stay there. Wolves disappeared from the Kenai Peninsula shortly after 1900 (about the time caribou were eliminated). They reappeared in the mid-1960s and by the early 1970s were distributed over most of the peninsula (ADFG 1973, Peterson et al. 1984).

We did not encounter any wolves during their time in LACL, but did note their sign at Two Lakes. No specimens of this widely-distributed canid have been preserved from the park.

Wolf tracks were noted at three localities in KATM. Several specimens from the park are housed at the USNM.

Vulpes vulpes, red fox
We did not encounter nor learn of any red foxes occurring in KEFJ. This species is said to be sparse on the Kenai Peninsula and only occasionally seen in the far upper reaches of Resurrection River (ADFG 1978). There are a small number of fox specimens from the Kenai Peninsula at the USNM, including the type specimen of the endemic form, *V. v. kenaiensis* (Hall 1981).

Individual red foxes were noted in at Chulitna Bay and Turquoise Lake in LACL. The partial carcass of a red fox trapped near Dice Bay was necropsied for parasites and its tissues sampled. The skull and a sample of muscle tissue was also preserved from a red fox trapped near Port Alsworth.

In KATM, lone red foxes were seen at Amalik Bay and Murray Lake. Fox sign was also noted near Contact Creek. A specimen from Naknek Lake is housed at the USNM. This canid is found throughout the Alaska Peninsula and is indigenous to the eastern Aleutians at least as far west as Umnak Island (Murie 1959, Bailey 1993).

Family **Felidae**

Lynx canadensis, Canada lynx
Lynxes are occasionally seen in the Resurrection River area of KEFJ (A. Wright-NPS, pers. com.). Several specimens from other localities on the Kenai Peninsula have been preserved (UAM, USNM).

In LACL, a lynx was seen near the shore of Lake Clark near Tommy's Creek. The skull and a sample of muscle tissue was preserved from a lynx captured near Lake Clark.

Lynxes have been reported as fairly common to periodically abundant in KATM (Schiller and Rausch 1956, Cahalane 1959). ADFG (1973) considered them present in generally low numbers along the Alaska Peninsula to about Port Hyden. No lynx or their sign was noted during field season 2004, nor have any specimens been preserved from the park.

This Nearctic species is a denizen of northern forests with dense understory, roaming into tundra and coastal rainforest areas during periods of prey scarcity (Banfield 1974).

Family **Mustelidae**

Gulo gulo, wolverine
We encountered wolverine tracks in KEFJ at Paguna Arm and Northwestern Lagoon. Past sightings of this wide-ranging species by NPS personnel are from Taroka Arm, Exit Glacier, and far out on the ice field above Exit Glacier. No specimens of this species have been preserved from KEFJ.

No wolverines or their sign were seen during the course of our inventory of LACL and KATM, nor have any specimens been preserved for study from either park.

Wolverines are considered rather common along the Alaska Peninsula as far west as Unimak Island (Osgood 1904, Murie 1959), occurring in a wide range of habitats from sea level to well above treeline in the mountains (Cahalane 1959).

In a recent molecular study that included wolverine specimens from NPS staff in northwestern Alaska, Tomasik and Cook (2005) found relatively low evolutionary divergence between Eurasian and North American haplotypes that did not support the hypothesis that the Bering Strait divided two distinct species of wolverine. Within North America, only the southeastern Alaska, Nunavut in northern Canada, and to a more limited extent, Kenai Peninsula populations were distinctive. The subspecies *G. g. katschemakensis* is confined to the Kenai Peninsula (Hall 1981). In the view of Tomasik and Cook (2005), wolverines from the Kenai Peninsula are not distinctive enough to support subspecies status.

Lontra canadensis, northern river otter
River otters were present at Delight Spit, Paguna Arm, and Northwestern Lagoon in KEFJ, and at Amalik Bay, Murray Lake, and near Contact Creek in KATM. None were observed in LACL.

This species is known to occur throughout the region and along the Alaska Peninsula to Unimak Island (USNM; Murie 1959, ADFG 1978). Osgood (1904) noted otters on Lake Clark when he visited the area for the U. S. Biological Survey in 1902 and Schiller and Rausch (1956) and Cahalane (1959) noted otters in a variety of areas in KATM in the 1950s.

No specimens have been preserved in museum collections from any park unit in SWAN.

Martes americana, American marten
Marten are apparently rare on the Kenai Peninsula (ADFG 1978). Reports from NPS personnel of marten in KEFJ were limited to areas along the Resurrection River (B. Rice, A. Wright, L. Fairchild-NPS, pers. com. 2003). No specimens have been preserved from this park.

No martens were encountered in LACL during this study; however, voucher material from three individuals trapped near Port Alsworth in November 2002 were preserved.

The status of marten in KATM is unclear. No martens or their sign were encountered during this study nor have any specimens documenting their occurrence in the park been preserved. Marten are considered present in the mature spruce forests north of Lake Iliamna and occasional southward to Coville and Naknek lakes (ADFG 1978). In recent years a marten was reportedly trapped on King Salmon Creek and another on Pauls Creek just to the west of the park (R. Russell *fide* L. Butler, ADFG, King Salmon, pers. com. October 2004).

Mustela erminea, ermine
Ermines were not encountered in KEFJ, but we received a report of their occurrence in the vicinity of Exit Glacier in past years (A. Wright, NPS, pers. com. 2003). UAM houses a single specimen from Day Harbor near Seward. No specimens are known from the park.

An ermine was seen at Turner Bay in LACL and one was found dead of unknown causes at Turquoise Lake. Two winter-caught ermine from Port Alsworth and one from Silver Salmon Creek were prepared as vouchers.

No ermine or their sign was encountered during our inventory of KATM, nor are there any specimens preserved from within the park. Ermines are known to occur throughout the region and on Unimak Island (Murie 1959).

Mustela nivalis, least weasel
Least weasels were not observed or reported present in either LACL or KATM. The closest verifiable records to LACL of this diminutive weasel are Tyonek on Cook Inlet (USNM: Osgood 1904), Red Devil on the Kuskokwim River (UAM), and at the far end of the Alaska Peninsula near Cold Bay (UAM). A specimen of this weasel was recently preserved from Aniakchak National Preserve (1993, UAM), but there is none yet from within KATM.

The species appears to be sparsely distributed throughout much of its holarctic range, which includes the Alaska Peninsula and Unimak Island (UAM, USNM; Murie 1959). It is not known to occur on the Kenai Peninsula.

Mustela vison, American mink
Sightings or the sign of minks were noted in KEFJ at North Arm, Delight Lake, and Northwestern Lagoon. The type locality of the southcentral and southwestern Alaska subspecies, *M. v. melampeplus* is “Kenai Peninsula.” (Hall 1981). No museum specimen is known from the park.

No sightings or sign of this semi-aquatic species was noted during our study in either LACL or KATM. Schiller and Rausch (1956) reported their common occurrence in the region and preserved a specimen from KATM (Kukak Bay, USNM). Mink are found throughout the Alaska Peninsula and on Unimak Island (Murie 1959).

Mink populations in Alaska reach their highest densities along the rich coastal areas of southeastern and southcentral Alaska. Lower densities and greater fluctuations characterize Interior populations (ADFG 1978).

Family **Ursidae**

Ursus americanus, American black bear
Black bears were present, sometimes numerous, at most localities visited in KEFJ. The type locality of Kenai Peninsula’s endemic subspecies, *U. a. perniger*, is the mountains south of Chugachik Bay, opposite Homer (Hall 1981). UAM houses a number of black bear specimens from the Kenai Peninsula but none from the park.

ADFG (1973) considered black bear rare below the sparse spruce forests near Lake Iliamna. There is an unsubstantiated report of a black bear seen at Kulik Lake near the northern border of KATM (R. Russell *fide* L. Butler, ADFG, King Salmon, pers. com. October 2004). The closest documented records are two specimens taken east of Lake Iliamna at Iniskin Bay (USNM).

Two highly divergent lineages (coastal and continental) of Alaska black bear have been identified. The coastal lineage extends along the Pacific Coast from Kuiu and Kupreanof Islands in southeastern Alaska to northern California, whereas the continental lineage is

more widespread, occurring from central Alaska (and northern southeastern) to the East Coast (Byun et al 1997, Wooding and Ward 1997, Stone and Cook 2000).

Ursus arctos, brown bear
A lone brown bear was seen from the air in KEFJ just north of our spike camp in the upper Nuka River valley. Brown bears are occasionally seen near the mouth of Nuka River and in the Resurrection River area, including at Exit Glacier (B. Rice, I. Martin, A. Wright-NPS, pers. com. 2003). The upper Resurrection River was identified as a concentration feeding area for brown bears by ADFG (1973).

The tracks of a brown bear were noted near the head of Lake Clark , and a number of animals were seen in the tidal flats near Silver Salmon.

In KATM, we encountered brown bears or their sign at all localities visited. Bears were particularly numerous along the coast at Amalik Bay.

Scientific specimens of brown bear have been preserved from several localities in LACL and KATM (UAM, USNM).

Order **ARTIODACTYLA**—Ungulates
Family **Cervidae**

Alces alces, moose
A lone moose was seen from the air in KEFJ along the Upper Nuka River Valley, and old sign was observed at Shelter Cove just south of this river's mouth in Beauty Bay. This area was also identified as an area of incursion by moose to the outer coast of KEFJ by ADFG (1973). No sign of moose was encountered again until the Resurrection River, where several moose were seen from the air during our flight upriver and their sign noted near Exit Glacier and in the vicinity of our camp north of Placer Creek. The Resurrection River Valley was identified by ADFG (1973) as a concentration area for moose during fall and winter.

Our field crew in LACL observed a female moose on the east side of Turner Bay.

We observed individual moose or their sign at all localities visited in KATM. Lem Butler, ADFG wildlife biologist, King Salmon, informed us that moose have been expanding their population westward to the end of the Alaska Peninsula with an occasional animal showing up on Unimak Island.

No specimens of this species have been preserved from any SWAN park unit.

Rangifer tarandus, caribou
Caribou are limited in distribution to more northern areas of the Kenai Peninsula (ADFG 1973), where they were reintroduced beginning in 1965 from Nelchina stocks following their extirpation from the Peninsula around the turn of the last century (Spencer and Hakala 1964, Burris and McKnight 1973). It is unlikely that any would find their way as far south as KEFJ except as a rare visitor.

Caribou and their signs were seen in LACL only at Turquoise Lake.

The only evidence of caribou encountered during our time in KATM was shed antlers near Murray Lake and Contact Creek. Lem Butler, ADFG wildlife biologist, King Salmon, has found the caribou populations throughout the region in decline, with poor range conditions, in his opinion, being the primary cause.

No specimens of caribou have been preserved from any park unit of SWAN.

Family **Bovidae**

Oreamnos americanus, mountain goat
Mountain goats range along the coastal mountains of southern Alaska as far west as Cook Inlet and on the Kenai Peninsula. KEFJ provides prime habitat for mountain goats. They occur in the Kenai Mountains along both sides of the Harding Icefield (ADFG 1973). During this study we noted goats in the mountains north of Delight Lake and in the vicinity of Crater Bay on Harris Peninsula. Bud Rice (NPS, pers. com. 2003) provided previous goat sightings along the length of Aialik Peninsula with concentrations of animals near the base of the peninsula, as well as sightings near Callisto Head at the mouth of Resurrection Bay. No specimens of mountain goat have been preserved from KEFJ.

Ovis dalli, Dall's sheep
Dall's sheep are found in the Kenai Mountains west and north of the Harding Icefield from the head of Kachemak Bay to Turnagain Arm (ADFG 1973). It is not known whether sheep from the southernmost herd near Bradley Lake ever venture as far south as the upper Nuka River and KEFJ.

A group of eight Dall's sheep was seen in LACL on Tanalian Mountain, north of Port Alsworth, which is at the southernmost edge of this species' range (ADFG 1973). The only preserved specimens of this species from anywhere in the region are two in the USNM from the Chigmit Mountains (exact location unknown).

Order **RODENTIA**—Rodents
Family **Sciuridae**

Marmota caligata, hoary marmot
Hoary marmots occur throughout the mountains of the Kenai Peninsula, including KEFJ. We noted this species at the head of Paguna Arm, above Crater Bay and Coleman Bay, and near tidewater at Tooth and "South Tooth" Coves in Aialik Bay. Marmots were also reported from the Exit Glacier area (A. Wright-NPS, pers. com. 2003). No specimens for future study have been preserved from the Park, but given the tremendous geographic variation and high levels of endemism reported for this species (Hall 1981), such an effort should be high priority.

A marmot was seen but not collected in the mountains east of Turquoise Lake, LACL. Osgood (1904) mentioned sightings of marmots in the hills near Keejik (*sic*) on Lake Clark. No specimens have been preserved from this park.

In KATM, several marmots were sighted and an adult female collected in the mountains near Murray Lake. The Murray Lake specimen is the first documented record of this species in KATM.

This species has been found along the length of the Alaska Peninsula (Allen 1904, Osgood 1904, Murie 1959). It has been documented in at least seven of Alaska's National Parks.

Spermophilus parryii, arctic ground squirrel
Arctic ground squirrels are absent from the Kenai Peninsula and KEFJ, but present in at least 11 other park units across the state.

In LACL, arctic ground squirrels were collected at Turquoise Lake and Port Alsworth. Osgood (1904) noted several pairs of ground squirrels occupying a short stretch of beach on Lake Clark and collected several (USNM) on the mountains about the head of the lake.

This species was present and samples taken at all localities visited in KATM except the forested habitats at Fure's Cabins. Cahalane (1959) found this squirrel abundant throughout KATM, including near sea level along the coast east of the Aleutian Range.

A recent molecular study by Eddingsaas et al. (2004) suggest that arctic ground squirrels have a long evolutionary history in Alaska, a history that is intricately linked to multiple glacial cycles. Specimens collected from NPS park units will prove invaluable in future efforts to clarify the relationships among Alaska populations.

Tamiasciurus hudsonicus, red squirrel
Red squirrels occur in forested habitats in KEFJ, LACL, and KATM, and in at least eight other park units in the state (Table 3).

Kenai Peninsula squirrels are considered a separate subspecies, *T. h. kenaiensis* (Hall 1981); however, there has not been a significant taxonomic revision of this species since Allen (1898). A study of geographic variation throughout its entire range is needed (Nagorsen 1990), but no specimens have been preserved from KEFJ.

Red squirrels were sampled in LACL near the Chulitna River, Turquoise Lake, and Two Lakes, and in KATM at Naknek Lake near the southern limit of the species' range (Schiller and Rausch 1956). At KATM in the vicinity of Fure's Cabin, we found a large proportion of the spruce, this squirrel's primary source of food and shelter, either dead or dying, presumably from spruce beetle infestation.

Family **Castoridae**

Castor canadensis, American beaver
In KEFJ, we noted the presence of beavers only along the Resurrection River.

Beavers were observed in LACL at the head of Lake Clark and Turquoise Lake.

Beavers or their activities were noted at all localities visited in KATM except Amalik Bay. This species is abundant at the base of the Alaska Peninsula and may occur in limited numbers as far out the Peninsula as Port Moller (ADFG 1978).

No specimen of this species has been preserved from SWAN parks.

Family **Dipodidae**

Zapus hudsonius**,** meadow jumping mouse
Jumping mice have not been documented on the Kenai Peninsula.

In LACL, meadow jumping mice were collected at the head of Lake Clark, Johnson River, Silver Salmon, and Turquoise Lake. Osgood (1904) collected several jumping mice for the USNM from near Keejik (*sic*) on Lake Clark.

Meadow jumping mice were widespread in KATM, with samples being secured at all localities visited except Contact Creek.

There are considerable gaps in our knowledge of the distribution of this species in Alaska. Specimens indicate that it occurs from the Yukon River southward to the end of the Alaska Peninsula (and possibly on Unimak Island) and into southeast Alaska. Meadow jumping mice can be widespread in a variety of herbaceous meadow and

shrub habitats, but are usually most abundant in the thick mosaic of vegetation along ponds, streams, marshes, and estuaries. During the winter months, they hibernate underground in well-drained soils.

Family **Muridae**

Clethrionomys rutilus, northern red-backed vole
Northern red-backed voles were the second most frequently captured small mammal in KEFJ, but at no locality did we find them very numerous, suggesting they, like tundra voles, were at a relatively low population level in 2003. In outward appearance, the red-backed voles of KEFJ are distinctive, being relatively thin-tailed and dark in overall coloration with a varying proportion of our coastal samples possessing white chins, throat patches, and belly stripes of varied size and configuration.

This species was the second most frequently captured small mammal in LACL, accounting for 27 per cent of all trapline captures. It was found at all localities sampled.

In KATM in 2004, red-backed voles were sampled at all localities but no area were they found numerous.

This holarctic vole occurs extensively throughout most of the state and in a wide variety of habitat types.

Dicrostonyx groenlandicus, collared lemming
The collared lemming is an inhabitant of the treeless tundra zones of northern, western, and southwestern Alaska, where it extends into the eastern Aleutian Islands and on St. Lawrence Island in the Bering Sea (Hall 1981).

No collared lemmings were found in LACL in 2003; however, the recent discovery by UAM of a mummified collared lemming in rocky alpine tundra habitat approximately 6.5 km west of The Cone (59°53’25”N, 153°55’41” W) and only about 50 km south of LACL, along with the capture of several collared lemmings near Kirschner Lake (59°26’58”N, 153°56’37.3” W), suggest the potential occurrence of this species farther north in the Chigmit Mountains and the park.

No collared lemming was secured in KATM in 2004 . Nearby records from King Salmon (UAM), Kirschner Lake (UAM), Becharof Lake (Schiller and Rausch 1956), and Aniakchak National Preserve (UAM) indicate the probable occurrence and eventual discovery of this species in KATM.

Lemmus trimucronatus, brown lemming
Brown lemmings inhabit most of mainland Alaska (but not the Kenai Peninsula), as well as two Bering Sea islands and across the Bering Strait into far eastern Siberia. The species is documented in 11 of Alaska's park units.

We failed to collect any brown lemmings in LACL in 2003 or in KATM in 2004, and there are no specimens from either park to verify occurrence. We suspect this widely-distributed lemming will eventually be documented in both parks as it has been found in the upper reaches of the Chulitna River (Osgood 1904), along the Iliamna River near Old Iliamna (USNM), and at Surprise Lake, Aniakchak National Preserve (UAM).

Microtus miurus, singing vole
Singing voles occur above timberline on the western slopes of the Kenai Mountains (Allen 1902, 1903; Osgood 1901; Fuller 1981), but have yet to be documented in KEFJ. Concentrated but time-limited trapping efforts for this vole in the upper Nuka River area were unsuccessful in 2003. The many old *Microtus* runways seen in this area suggested there being a population crash of either singing or tundra voles within the past year.

The capture of eight singing voles at Turquoise Lake constitutes the first record of this species in LACL. These, together with several specimens collected by UAM in 2002 from east of the park (Max Lake, McCarthy River), extends the known distribution of this species southwest along the Alaska Range from Denali National Park (Manville and Young 1965, Cook and MacDonald 2002).

Microtus oeconomus, tundra vole
The tundra vole has an exceptionally broad distribution across Alaska and its National Parks. This vole, whose range also extends into northwestern Canada and widely across northern Eurasia (Musser and Carleton 1993), is a relatively recent colonizer of North America (Galbreath and Cook 2004).

Tundra voles were captured at only four localities in KEFJ in 2003. In years of abundance, we expect this vole is usually more prevalent and widespread throughout the meadow and tundra habitats of the park.

A total of 42 tundra voles were collected at six trapping localities in LACL. At no locality were they particularly numerous.

A total of only 12 tundra voles collected at two trapping localities in KATM (Murray Lake and Contact Creek) indicated a low population level in 2004 for this often abundant species.

Microtus pennsylvanicus, meadow vole
The meadow vole is found across the boreal zone of central and southern Alaska, and in six of Alaska's park units. As its name implies, this species is most often found, and periodically in abundance, in open herbaceous habitats such as meadows, marshes, and grassy riparian areas.

We sampled meadow voles at only four localities in LACL and three in KATM.

This vole was first recorded in the SW region of Alaska by Osgood (1904). Schiller and Rausch (1956) documented this species on the Alaska Peninsula as far southwest as Naknek Lake.

Ondatra zibethicus, common muskrat
ADFG (1978) considered muskrats uncommon on the Kenai Peninsula and of only occasional occurrence along the Resurrection River at the northeastern boundary of the Park. No sightings or specimens from the park have been reported.

No muskrats were observed during the course of our inventory of LACL. Osgood (1904) found them abundant in suitable aquatic habitats throughout the region and provided specimens from the mouth of the Chulitna River and the head of Lake Clark.

Cahalane (1959) considered this species rare in KATM. No muskrats were observed in 2004, nor have any specimens been preserved from within the park.

Muskrats are found throughout most of the Alaska mainland south of the Brooks Range (Hall 1981) and on the Alaska Peninsula as far west as Ugashik (Murie 1959, ADFG 1978). They are present is at least 11 of Alaska's National Park units.

Synaptomys borealis, northern bog lemming
Northern bog lemmings have been documented on the Kenai Peninsula west of the Kenai Mountains (Osgood 1901, Allen 1904, UAM, MSB) but not as yet in KEFJ. This species is often uncommon to rare and generally restricted to open habitats with a preference for damp meadows, marshes, bogs, and fens. Continued inventory efforts, particularly in the vicinity of the Resurrection River, may eventually document the occurrence of this lemming within the park.

A single northern bog lemming was collected in LACL near the mouth of the Chulitna River, close to where Osgood (1904) first recorded the species in the region.

We collected a total of five northern bog lemmings from three localities in KATM in 2004. The only other records of this species from the park is a single animal at Cape Ugyak and another at Brooks River (Schiller and Rausch 1956).

This species is usually uncommon to rare throughout forested Alaska, but can become numerous some years. Only six of Alaska's National Park units have documented records of this New World lemming.

Family **Erethizontidae**

Erethizon dorsatum, North American porcupine
Porcupines are probably rare but widespread in KEFJ. No porcupines were encountered during this study but fresh tracks were noted at Paguna Arm, and an old den site with numerous droppings was discovered under the shelter of a large boulder in mature forest at Crater Bay. Additional sightings of porcupines from NPS personnel were from Holgate Arm and Exit Glacier.

A porcupine was seen crossing the runway at Chulitna Bay in LACL and another was noted at Turquoise Lake. Osgood (1904) found them sparingly throughout the region and was told by residents of Lake Clark that this species is quite common in that vicinity.

Old fecal droppings in the vicinity of Murray Lake were our only evidence of this animal's presence in KATM. Cahalane (1959) considered porcupines very scarce and probably local in distribution. This species has been reported the length of the Alaska Peninsula (Murie 1959, USNM).

Order **LAGOMORPHA**—Pikas and Hares
Family **Ochotonidae**

Ochotona collaris, collared pika
Three pikas were collected in LACL at Turquoise Lake in 2003. Two pikas collected by McKay in 1882 (USNM; True 1886) in the Chigmit Mountains (exact locality unknown) have long been the only documented record of this species from anywhere in the region (Rausch 1962, MacDonald and Jones 1987). Osgood (1904) mentioned pika sightings by local residents on the mountain near Keejik (*sic*) on Lake Clark. This species has not been reported farther south in the Aleutian Range, nor is it present on the Kenai Peninsula.

Family **Leporidae**

Lepus americanus, snowshoe hare
We did not encounter snowshoe hares or their sign in KEFJ; however, A. Wright (NPS, pers. com. 2003) reported hares present in the valley of the Resurrection River near Exit Glacier but that this population has been at a low for the past few years. ADFG (1978) considered snowshoe hares generally uncommon on the Kenai Peninsula.

In LACL, snowshoe hares were sampled at Turquoise Lake (N = 1) and along the Necons River near Two Lakes (N = 2). Osgood (1904) found hares especially abundant in 1902 about Lake Clark (where a series of specimens was preserved) and along the Chulitna River.

Sign of snowshoe hares in KATM was seen only at Idavain Lake and Fure's Cabin, suggesting that the hare population was relatively low at that time. Schiller and Rausch (1956) obtained a single young hare from the west end of Naknek Lake, the only specimen record of this species from the park. In 1953-54, Cahalane (1959) found snowshoe hares at peak numbers and widespread in KATM, including near the beaches on Shelikof Strait.

This hare occurs throughout the boreal forests of Alaska and does not range far beyond the limits of trees on the Alaska Peninsula (Murie 1959, ADFG 1978). Two snowshoe hare specimens from Becharof Lake (UAM) represent the westernmost record of this species on the Alaska Peninsula.

Lepus othus, Alaskan hare

The Alaskan hare is restricted to coastal tundra areas in western Alaska, and has been documented with a small scattering of specimens from the tip of the Alaska Peninsula north to Kotzebue Sound (Klein 1995). This Alaska endemic is closely related to *Lepus arcticus* of the high Canadian Arctic and *Lepus timidus* of Asia (Waltari et al 2004).

We found no evidence of Alaskan hares in KATM in 2004, and specimen records are lacking. According to King Salmon resident Richard Russell (*fide* L. Butler, ADFG, pers. com. October 2004), Alaskan hares were not uncommon in the King Salmon area in the early 1970s, and Schiller and Rausch (1956) reported them as numerous farther west along the Peninsula in the early 1950s. The only evidence of this species' occurrence in KATM is droppings reported north of Idavain Lake by Cahalane (1959).

Habitat Affinities

Habitats of small mammals are often defined by their association with particular plants (Hoffmeister 1986). Under the influences of the topography, soils, climate conditions, and other ecological factors, plants may be placed into distinct groups referred to as vegetative communities, associations, or types. Mammals can often be associated with particular plant communities (some at the macro-scale, most others and especially the smallest ones to micro-habitat scales). Some species are restricted to few communities, others are found in many. The degree of a species' dominance in a particular vegetative community and its range across various communities often is related to varying population levels.

Populations of small mammals of high latitudes often fluctuate dramatically from year to year and season to season. These shifts in abundance, along with dynamic interspecific

interaction (particularly among congeneric species), suggest that long-term studies of small mammal communities will be required to carefully assess the particular affinities of each species.

In addition to vegetation, other features and factors may influence a species' distribution, including topography, soil types, snow cover, availability of food or pathogens, and/or the presence of other important features such as water bodies, rocks, and ground litter. The unique biogeographic and evolutionary history of each species also influences its current distribution. Because Alaska's habitats have changed markedly since the last glaciation, the current distribution of nearly all species must be viewed within the dynamic geologic and climatic histories of these high latitudes.

Our preliminary work indicates that small mammals were unevenly distributed over the range of vegetation types sampled (Table 5). Patterns of habitat occupancy indicated that northern red-backed voles, overall the most common small rodent in SWAN during this study, were sampled in all major vegetation types, but were most abundant in forested habitats. The local distribution of this common species may be closely tied to the presence of overhead cover, especially woody plant cover. Tall tussocks may serve as overhead protection in non-forested habitats.

The general habitat requirements of shrews are probably most related to invertebrate abundance and physical conditions such as temperature and moisture (Nagorsen 1996). All shrews seem to require sites with adequate ground cover. Cinereus shrews were numerous during the time of our study and relatively evenly distributed across the range of major vegetation types sampled. Montane shrews were also relatively numerous and broadly distributed but more so in herbaceous and to a lesser extent, scrub vegetation. This shrew was the most frequently captured species in KATM in 2004. They were particularly numerous in the dense estuarine meadows at Amalik Bay. Cinereus shrews were also relatively numerous there, along with meadow jumping mice. Tundra shrews, despite their common name, tended to frequent forest and scrub habitats, as did the few pygmy shrews sampled. The two tiny shrews captured in LACL were found in lakeside scrub.

The three species of *Microtus* voles, while nowhere abundant during this study, displayed differing patterns of habitat occupancy. Meadow voles were found concentrated in the wetter non-forested habitats, while singing voles (found in LACL only) were restricted primarily to mesic-to-dry scrub and herbaceous habitats. Tundra voles, in contrast, usually occupy grassy situations across a relatively broad range of vegetation types and elevations. Bog lemmings usually inhabit wetter non-forested habitats and their edges.

Arctic ground squirrels were numerous throughout the higher elevations of LACL and KATM, occurring in tundra, meadow, streambank, talus, and lakeshore habitats with loose, friable soils and adequate supplies of low, early successional vegetation. We also discovered a small colony of ground squirrels living in dense herbaceous and scrub

vegetation next to a beach at Amalik Bay in KATM. This species does not occur on the Kenai Peninsula.

Red squirrels in all three parks were found only in the spruce and mixed forests, whereas the few marmots seen in KATM were in steep rocky situations well above treeline. Marmots were more numerous in KEFJ, occurring in open rocky slopes down to tidewater.

Discussion and Significance

This study confirms the importance of ongoing, multi-year efforts to fully document the small mammal fauna. Such persistence has paid a large dividend in SWAN with the addition of four newly vouchered species in KEFJ, ten in LACL, and three in KATM (Table 3).

Discovery of the Alaska tiny shrew, perhaps the rarest and poorest known mammal in North America, in LACL was an anticipated surprise. These records significantly expand the known range of the species and together with samples collected elsewhere in Alaska there are a total 37 specimens now known to science.

This inventory also confirms the importance of SWAN for a rich assemblage of interior and coastal mammals. Of SWAN's approximately 38 species of land mammals (Table 3 and including ANIA), most have holarctic distributions or close affinities with Old World species (e.g., Rausch 1963, Hoffmann and Peterson 1967, Hoffmann et al. 1979). As shown in Table 3, 92% of the small mammals (and 74% of all land mammals) believed to occur in SWAN in its entirety are now documented with at least a few specimens. Specimen coverage of small mammals within SWAN's individual park units, however, varied from 29% (KEFJ) to 82% (LACL).

Five species—two insectivores (cinereus shrew, montane shrew), a generalized fruit-seed-leaf feeder (northern red-backed vole), and a graminoid grazer (tundra vole)—dominated the small mammal communities of SWAN in 2003-2004, accounting for over 92% of all trapline captures. It is important to emphasize that wide density shifts are the norm at high latitudes, so these years provide a single snapshot of relative densities across species.

The most significant and valuable product of this inventory is the large collection of well-documented and diverse preparations of scientific specimens.

Why specimens? As elucidated by Reynolds et al. (1996), voucher specimens and corresponding data assembled during field surveys of mammals are critical for accurate identification of the animals studied and for verification of the data gathered and reported as resulting from the investigation. Voucher specimens are particularly valuable for studies of the smaller species that are poorly known and difficult to identify (e.g., shrews, *Microtus* voles).

Long after the original inventory is completed, voucher specimens and their associated materials will be used for a wide array of studies such as taxonomic revisions, biogeographic and conservation studies (e.g., Cook and MacDonald 2001), evolutionary studies (Cook et al. 2001), parasitology (e.g., Hoberg et al. 2004), and epidemiology (Yates et al. 2002).

Voucher specimens also provide a critical historical baseline for assessment of change caused by natural or human perturbations. Because they represent historical populations, the value of large series of specimens increases through time, particularly as the diversity of many localities is degraded. Extensive inventories of federal lands has become increasingly important because these lands often are now used to establish baseline conditions for investigations aimed at documenting anthropogenic influences and other impacts responsible for environmental change. Lessons learned from the Exxon Valdez disaster in Prince William Sound suggest that baseline data are critical to interpretation of impacts. NPS has an opportunity to incorporate regular (annual) sampling (and archiving) of select small mammals into their monitoring initiative. Such collections would prove invaluable for efforts to monitor temporal change in a major component of the biotic diversity of the Alaska's parklands. If these samples are not regularly archived, NPS will miss a tremendous opportunity to establish significant baseline datasets for future analyses of environmental change.

With PCR (polymerase chain reaction) and other innovations in the study of DNA, we now can examine and monitor genetic variation in populations of animals that were collected during different time periods, thus providing a more rigorous view of temporal genetic variation and population structure. For example, known contact zones between taxa can now be reanalyzed for temporal stability (but only if specimens from the contact zone were collected at regular intervals). Because of the dynamic geologic history of Alaska and the role that glaciers played in the distribution of organisms, these kinds of studies are essential to documenting and managing biodiversity. Recent concern with persistent organic pollutants (POPS) combined with rapid technological innovation with regard to our ability to track POPS, further enhances the utility of these specimens in such crucial areas of study such as monitoring environmental quality.

Without the preservation of specimens, inventories such as this one would have extremely limited value (either short-term or long-term). Federal tax dollars used for biodiversity assessments are most efficiently spent if agencies recognize the critical need for vouchers and provide support in both field and museum budgets for their preservation and maintenance (Reynolds et al. 1996).

Although the importance of museum specimens should be generally recognized and their preparation considered essential to good science, for many the question remains: Why collect so many specimens?

Some perspectives on Alaska and the need for cooperative efforts:

- Alaska mammalogy is still in the early exploration phase and several new species have been discovered in the state in the last 15 years (Dokuchaev 1997, MacDonald and Cook 1996). For most species of Alaska mammals, many areas, including SWAN, are poorly known and inadequately represented in systematic collections. This point is acutely apparent when recent phylogeographic studies are reviewed (e.g., Fleming and Cook 2002, Stone et al. 2002, Fedorov et al. 2004). These studies have shown that many high latitude species have significant geographic structure (Cook et al. 2001). In some cases, cryptic species have been identified (Small et al. 2003).

- Small numbers of specimens will not adequately represent the inherent morphologic, genetic, and parasitic variation that exists within and among populations. Rigorous and statistically defensible scientific studies require large samples of well-preserved (and diverse) materials to account for age, sex, geographic, and/or individual variation. Taxonomic studies based on skull morphology may require undamaged material from 20 or more adult individuals of each sex per locality (i.e., a minimum of 40 adult individuals per population).

- Many of the shrews and small rodents are difficult or impossible to identify except through the careful study of specimens. Close examination of tooth pattern and comparison of body measurements and other characters are necessary to distinguish most of Alaska's shrews. Voles of the genus *Microtus* can also be especially difficult to differentiate.

- Considerable sampling effort is needed to document the rare and uncommon species. In this survey, thousands of trap-nights were required to secure two tiny shrews and 6 bog lemmings.

- The number of animals removed from a population only has biological significance if it is related to the total number of animals in the population and their rate of replacement (Reynolds et al. 1996). Because Alaska's small mammals are short-lived and prolific, their reproductive potential is more than sufficient to accommodate low levels of removal through the sampling methods used in these inventory projects.

- Because federal resource agencies are mandated to efficiently and effectively manage and monitor the lands and wildlife entrusted to them, there must be solid documentation and a clear understanding of the distribution and status of biodiversity. One of the most efficient means to achieve this goal is to build a solid archive of material that represents temporal and spatial slices of these environments (Cook et al. 2004). Natural history collections are such a resource. These collections can be enhanced in a variety of ways. For example, large numbers of furbearers and game mammals are harvested each year in or near parklands in Alaska. With very little cost, the carcasses or tissue samples could be

archived annually from a significant number of individuals. Such a resource would provide an invaluable means of assessing and monitoring the health of these populations (and their environments) through time. NPS should set up a collaborative program with ADF&G and a natural history museum to build this resource.

Recommendations for Future Inventory and Monitoring Efforts

1. Inventory studies must be viewed as an ongoing process and NPS must remain committed to continue the efforts begun in these initial inventories. Future monitoring efforts should include a sampling regime that regularly vouchers diverse preparations (specimens) of representative species. These initial inventories have set the stage for additional collaborative efforts to fully document the mammal fauna of SWAN.

2. The discovery by 2003 of only three tiny shrews, *Sorex yukonicus*, in LACL demonstrates how much we have yet to learn about Alaska's small mammal fauna. Additional pitfall trapping in LACL, KATM, and elsewhere in the state is needed to help determine the full geographic extent of this rare species' distribution, its ecological requirements, and to provide an adequate database of specimens to more precisely assess its taxonomic relationship with other Beringian shrews. Discovery of the tiny shrew in North America and its description as a new species within the last decade (Dokuchaev 1997) further illustrates the value of a specimen-based approach to inventory studies. Indeed, the initial detection of this new species to science was made possible only because large series of shrew specimens sampled in surveys from the 1980s were preserved and thus available for later study by specialists.

3. Only two pygmy shrews, *Sorex hoyi*, were documented in KATM, and only one in LACL. Additional pitfall trapping in SWAN and elsewhere in the state is needed to help determine the full extent of this species' distribution, geographic variation, parasites, and ecological requirements.

4. We believe that continued inventory efforts in LACL, KATM, and elsewhere in the region will result in the discovery of the collared lemming, *Dicrostonyx groenlandicus*, beyond its currently known range. The distribution and taxonomic status of this reclusive lemming in general is poorly understood. In this account, we follow the conservative application of a single species name (and the resulting modification of subspecies listed by Hall, 1981) for Alaska collared lemmings used by Jarrell and Fredga (1993) and supported by Fedorov et al. (1999) and Fedorov and Goropashnaya (1999), while recognizing that this is not the last word on this subject. As noted by Engstrom (1999), the number of taxa from Alaska, in particular, is still in doubt, and further studies are needed to document the diversity of collared

lemmings and illuminate the evolutionary history that may date as far back as the earliest radiation of arvicoline rodents (Musser and Carleton 1993).

5. As indicated in Table 3, vouchers are still lacking for a number of small mammal species that probably occur in various SWAN units, including pygmy shrew (KEFJ), little brown bat (KEFJ, KATM), ermine (KEFJ, KATM), least weasel (LACL, KATM), haory marmot (KEFJ, LACL), red squirrel (KEFJ), collared lemming (KATM, possibly LACL), brown lemming (LACL, KATM), singing vole (KEFJ, possibly KATM), muskrat (KEFJ, KATM), porcupine (KEFJ, LACL, KATM), and snowshoe hare (KEFJ).

6. In addition to an expansion of cooperative efforts to fully document the small mammal fauna of KEFJ (areas of greatest promise are along the Resurrection River and at the headwaters of the Nuka River), the entire Kenai Peninsula is in need of thorough inventory and specimen collection. Even among the now documented species, nearly all still lack adequate numbers of samples for conducting studies and making sound management decisions. What is the status of northern flying squirrels, meadow jumping mice, and a number of other species on the Peninsula? The unique fauna of the Kenai Peninsula offers unprecedented opportunities for an array of studies that relate the dynamic glacial history of the region (and the possibility of persistent refugia; Elias 1995) to the evolution and geography of its biota. The systematic relationships among endemic taxa have been particularly problematic and are in need of further research efforts. Such investigations must be based on adequate series of diverse and well-preserved specimens.

7. The exceptional faunas of LACL and KATM are composed of a mix of Interior and coastal species. The systematic relationships among Beringian shrews and arctic ground squirrels have been particularly problematic and are in need of further research efforts. Such investigations must be based on adequate series of diverse and well-preserved specimens. Considerable interest in the effects of climate change on biotic diversity suggests that studies of the fauna and flora of the parklands of SWAN could be key to understanding these impacts.

8. Ongoing efforts could expand our knowledge of the distributions and habitat preferences of western arctic, boreal, and coastal species that come in contact in SWAN, and provide important baseline information for monitoring distribution shifts in relation to changes in climate. However, efforts to provide fine-grained geographic analyses of quantifiable precision will largely be a waste of time and energy unless sufficient commitment to a long term (multi-decade) investigation is supported. We feel such an effort is unwarranted given other more pressing issues related to wildlife.

9. Long-term monitoring on biotic change is best accomplished by preserving materials from populations sampled periodically over time. Such efforts could be enhanced significantly if a number of trapline transects were sampled in each of Alaska's far flung National Parks (and Wildlife Refuges) for a three or four day period each

summer using several trap types, particularly pitfall traps. Such an effort, perhaps done opportunistically by Park personnel, would not only provide a cost-effective and time-sensitive series of valuable specimens from a larger number of species, but would also help elucidate variation in abundance at broader geographic scales. Specimen-based monitoring of northern small mammal populations has been ongoing in Scandinavia for many decades. We encourage NPS to develop a similar monitoring program throughout Alaska's National Park system.

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Table 1a. Trapline transects for sampling small mammals in Kenai Fjords National Park, Alaska, July 2003.

GENERAL LOCALITY Kenai Fjords NP	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
Upper Nuka River	1	59°37'37"	150°40'24"	300	200	8-10 July 2003	200	21 Cinereus Shrew, 4 Montane Shrew, 3 N. Red-backed Vole, 2 Tundra Vole	Dry Forb Herbaceous: forbs plus some grass, tall willow, rock and low alder edge
	2	59°37'35"	150°40'05"	330	800	8-10 July 2003	196	22 Cinereus Shrew, 2 Montane Shrew, 2 N. Red-backed Vole, 2 Tundra Vole	Open Low Scrub: talus edge, primarily forbs, 2-3 ft. willow, low alder edge
	3	59°37'40"	150°40'13"	300	200	8-10 July 2003	82	5 Cinereus Shrew	Open Low Scrub: low forbs with grasses, buttercups, lupine and 2-3 ft. willow
North Arm, Nuka Bay	1	59°33'45"	150°31'20"	3	250	7-9 July 2003	300	43 Cinereus Shrew, 7 N. Red-backed Vole, 3 Tundra Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow along spruce forest edge
	2	59°33'45"	150°31'20"	5	100	10-11 July 2003	50	18 Cinereus Shrew, 3 N. Red-backed Vole	Closed Needleleaf Forest
Shelter Cove, Beauty Bay	1	59°31'12"	150°38'25"	12	200	9-10 July 2003	215	23 Cinereus Shrew, 6 Montane Shrew, 14 N. Red-backed Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow along spruce forest edge
Delight Spit	1	59°32'43"	150°20'08"	10	300	11-15 July 2003	500	60 Cinereus Shrew, 13 Montane Shrew, 7 N. Red-backed Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow partially along spruce forest edge
Delight Lake	1	59°32'35"	150°18'43"	10	200	11-13 July 2003	200	16 Cinereus Shrew, 3 Montane Shrew, 1 N. Red-backed Vole	Open Needleleaf Forest: edge of lake in sitka spruce, devil's club, moss, forbs, with alder, will shrubs
	2	59°32'42"	150°19'36"	5	200	12-14 July 2003	200	20 Cinereus Shrew, 4 N. Red-backed Vole	Open Needleleaf Forest: cliff edge with sitka spruce, devil's club, *Viburnum*, mosses, forbs, 5-8 ft. alder
	3	59°32'51"	150°19'45"	2	350	12-15 July 2003	350	27 Cinereus Shrew, 4 Montane Shrew, 2 N. Red-backed Vole	Mixed Woodland: forest/ sedge meadow edge with devil's club, 5-8 ft. alder, sitka spruce, moss, fireweed

Table 1a. Trapline transects for sampling small mammals in Kenai Fjords National Park, Alaska, July 2003.

GENERAL LOCALITY Kenai Fjords NP	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
Paguna Arm	1	59°41'38"	150°08'02"	2	500	16-17 July 2003	60	22 Cinereus Shrew, 3 Montane Shrew, 9 N. Red-backed Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow partially along spruce forest edge
	2	59°41'38"	150°08'02"	2	500	16-17 July 2003	120	22 Cinereus Shrew, 1 Montane Shrew, 6 N. Red-backed Vole	Closed Needleleaf Forest: with dense thickets of alder
	3	59°40'38"	150°05'49"	3	500	16-17 July 2003	164	10 Cinereus Shrew, 4 N. Red-backed Vole, 7 Tundra Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow with *Festuca*, alder shrub
	4	59°40'38"	150°05'49"	3	500	16-18July 2003	204	12 Cinereus Shrew, 8 N. Red-backed Vole, 2 Tundra Vole	Open Needleleaf Forest: mature spruce
	5	59°41'40"	150°08'52"	130	200	17-18 July 2003	75	1 Cinereus Shrew, 4 N. Red-backed Vole, 1 Tundra Vole	Open Tall Scrub: alpine meadow/talus slope edge with alder, grasses, *Veratrum*
Crater Bay	1	59°43'	149°46'30"	200	500	18-19 July 2003	50	3 Cinereus Shrew, 3 N. Red-backed Vole	Alpine tundra
	2	59°41'30"	149°47'00"	5-15	500	18-19 July 2003	125	1 Cinereus Shrew, 2 Montane Shrew, 3 N. Red-backed Vole	Close mature spruce Forest
Northwestern Lagoon	1	59°46'25"	149°55'28"	5	200	19-20 July 2003	70	6 Cinereus Shrew, 1 Montane Shrew, 1 N. Red-backed Vole	Open Low Scrub: willow wetland area
	2	59°46'12"	149°55'34"	5	200	19-20 July 2003	144	2 Cinereus Shrew, 7 Montane Shrew	Dry Graminoid Herbaceous: *Elymus* estuarine meadow with *Festuca*, alder and willow
	3	59°46'19"	149°55'22"	5	200	19-20 July 2003	50	1 Cinereus Shrew, 3 Montane Shrew, 1 N. Red-backed Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow/alder edge
	4	59°46'25"	149°55'11"	230	10	19-20 July 2003	70	2 Cinereus Shrew, 2 Montane Shrew, 2 N. Red-backed Vole	Closed Needleleaf Forest: spruce
Aialik Bay, Tooth Cove	1	59°49'03"	149°38'24"	10	300	20-22 July 2003	80	12 Cinereus Shrew, 10 N. Red-backed Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow/alder edge
	2	59°49'03"	149°38'24"	10-20	500	20-22 July 2003	80	1 Cinereus Shrew, 12 N. Red-backed Vole, 1 Tundra Vole	Mesic Graminoid Herbaceous: hillside meadow near alder thickets

Table 1a. Trapline transects for sampling small mammals in Kenai Fjords National Park, Alaska, July 2003.

GENERAL LOCALITY Kenai Fjords NP	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
	3	59°49’03”	149°38’24”	10	500	20-22 July 2003	160	10 Cinereus Shrew, 10 N. Red-backed Vole, 8 Tundra Vole	Dry-Wet Graminoid Herbaceous: hillside meadow with occasional alders
Aialik Bay, “South Tooth Cove”	1	59°48’23”	149°38’38”	10	500	20-22 July 2003	80	5 Cinereus Shrew, 11 N. Red-backed Vole, 3 Tundra Vole	Dry Graminoid Herbaceous: *Elymus* estuarine meadow near alder edge
	2	59°48’23”	149°38’38”	10	500	20-22 July 2003	80	4 Cinereus Shrew, 14 N. Red-backed Vole	Dry Graminoid Herbaceous/Low Scrub slope
	3	59°48’23”	149°38’38”	10	500	20-22 July 2003	156	5 Cinereus Shrew, 11 N. Red-backed Vole, 3 Tundra Vole	Dry Graminoid Herbaceous/Tall-Low Scrub
Resurrection River	1	60°17’02”	149°42’50”	160	200	25-27 July 2003	120	25 Cinereus Shrew, 2 Montane Shrew, 3 N. Red-backed Vole	Mesic Graminoid Herbaceous: upland bog meadow near edge of spruce forest
	2	60°17’03”	149°42’37”	160	200	25-26 July 2003	120	9 Cinereus Shrew, 16 N. Red-backed Vole	Close Needleleaf Forest: spruce
	3	60°17’10”	149°42’39”	150	200	25-26 July 2003	50	8 Cinereus Shrew, 2 Montane Shrew, 8 N. Red-backed Vole	Close Broadleaf Forest: some spruce with thick alders
	4	60°17’10”	149°42’39”	150	200	25-26 July 2003	50	6 Cinereus Shrew, 1 Montane Shrew, 10 N. Red-backed Vole	Closed Needleleaf Forest: spruce
	5	60°16’54”	149°42’34”	170	200	25-27 July 2003	160	19 Cinereus Shrew, 2 N. Red-backed Vole	Open Low Scrub: dwarf birch, *Ledum*, *Vaccinium*, sedges
	6	60°16’59”	149°42’40”	170	200	25-26 July 2003	80	7 Cinereus Shrew, 7 N. Red-backed Vole	Close Needleleaf Forest: spruce, hemlock, alder, moss
	7	60°17’02”	149°42’45”	160	200	26-27 July 2003	30	6 Cinereus Shrew, 1 Montane Shrew, 2 N. Red-backed Vole	Close Needleleaf Forest: spruce, hemlock, moss along stream

* Cinereus Shrew (*Sorex cinereus*), Montane Shrew (*Sorex monticolus*), Northern Red-backed Vole (*Clethrionomys rutilus*), Tundra Vole (*Microtus oeconomus*).

TABLE 1b. Trapline transects at ten general localities in Lake Clark National Park and Preserve, Alaska, July 2003.

GENERAL LOCALITY Lark Clark NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
Turner Bay	1	60°10.815”	154°33.937	91.5	150	7-9 July 2003	100	29 Cinereus Shrew, 3 Montane Shrew, 27 N. Red-backed Vole	Closed Mixed Forest
	2	60°10.841’	154°33.930	91.5	300	7-9 July 2003	84	37 Cinereus Shrew, 3 Montane Shrew, 2 Tiny Shrew, 15 N. Red-backed Vole	Open Tall Scrub: willow thickets along shoreline with blue-flag, beach grass, sedges next to water
West Chulitna River	1	60°10.539’	154°34.791’	91.5	200	7-10 July 2003	225	34 Cinereus Shrew, 1 Montane Shrew, 9 N. Red-backed Vole, 4 Meadow Vole, 2 Tundra Vole	Bryoid moss: moss, lichen, dwarf birch, grass, small spruce at edge of marsh
	2	60°10.659’	154°34.842’	91.5	75	7-11 July 2003	308	15 Cinereus Shrew, 4 Meadow Vole, 3 Tundra Vole, 1 N. Bog Lemming	Wet Graminoid Herbaceous: open marsh with moss and grass bordered by open spruce
	3	60°10.566’	154°34.495’	91.5	300	7-9 July 2003	100	7 Cinereus Shrew, 1 Montane Shrew, 9 N. Red-backed Vole, 2 Meadow Vole, 2 Tundra Vole	Needleleaf Woodland: black spruce, bog lowlands. Some bog birch, grasses, with bog cranberry, sphagnum
	4	60°10.740’	154°34.760’	91.5	100	8-10 July 2003	46	2 N. Red-backed Vole	Open Mixed Forest: spruce and birch trees with ground cover of moss, cranberry, blueberry
South Chulitna River	1	60°10.652’	154°34.020’	91.5	100	7-10 July 2003	60	1 Red Squirrel	Closed Needleleaf Forest: spruce by lodge yard
	2	60°10.792’	154°33.980’	91.5	100	7-10 July 2003	60	0 captures	Closed Needleleaf Forest: spruce
	3	60°10.650’	154°34.024’	91.5	100	7-10 July 2003	105	8 Cinereus Shrew, 2 Montane Shrew, 6 N. Red-backed Vole, 2 Meadow Vole, 8 Tundra Vole	Open Tall Scrub: some willow and grass in the middle of a yard
	4	60°10.692’	154°34.078’	91.5	25	9 July 2003	mist net	2 Little Brown Bat	Shed surrounded by Closed mixed /spruce Forest
	5	60°10.650’	154°34.024’	91.5	200	10-11 July 2003	22	2 Tundra Vole	Graminoid Herbaceous: grassy area between bare earth (airstrip) and birch/alder thickets
Head of Lake Clark	1	60°23.826	153°50.832’	91.5	120	11-14 July 2003	183	5 Cinereus Shrew, 2 Montane Shrew, 8 N. Red-backed Vole, 2 Meadow Vole	Dense willow/sedge community adjacent to slough; black spruce, moss, labrador tea in upland areas

TABLE 1b. Trapline transects at ten general localities in Lake Clark National Park and Preserve, Alaska, July 2003.

GENERAL LOCALITY Lark Clark NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
	2	60°23.588’	153°50.274’	198.25	600	11-13 July 2003	48	1 Montane Shrew, 4 N. Red-backed Vole	Black spruce, bog cranberry, currant, crowberry, devil’s club forest mixed with rocky cliffs and open meadows
	3	60°23.888’	153°51.035’	91.5	150	11-13 July 2003	50	3 N. Red-backed Vole	Closed Needleleaf Forest: spruce
	4	60°23.947’	153°51.282’	90	150	12-13July 2003	70	5 Cinereus Shrew, 2 N. Red-backed Vole, 2 Meadow Vole	Wet Graminoid Herbaceous
	5	60°23.789’	153°49.808’		3.9	12-14 July 2003	225	7 Cinereus Shrew, 2 N. Red-backed Vole, 12 Tundra Vole, 1 *Microtus* sp.	Dry grass dominated meadow with scattered willow over old bog
	6	60°23’44.1”	153°50’33.8”	90	250	12-14 July 2003	150	10 Cinereus Shrew, 8 N. Red-backed Vole, 5 Meadow Vole	Graminoid Herbaceous: grass with some lupine and horsetail; along bank of slough with open spruce forest inland
	7	60°23.955’	153°51.291	90	100	12-14 July 2003	60	4 Cinereus Shrew, 2 N. Red-backed Vole, 1 Meadow Jumping Mouse	Wet Graminoid Herbaceous
	8	60°23.639’	153°49.941	102	4.6	12-14 July 2003	56	1 N. Red-backed Vole	Large black spruce forest
	9	60°23.706’	153°50.320’	91.5	100	13-14 July 2003	24	3 Cinereus Shrew, 1 N. Red-backed Vole, 2 Meadow Vole	Wet Graminoid Herbaceous-Tall willow with grass, rush, lupine understory bordering inland slough
	10	60°23.749’	153°50.652’	90	80	13-14 July 2003	24	3 Cinereus Shrew, 1 Meadow Vole	Wet Graminoid Herbaceous: slough edge with grass, willow, rose
	11	60°23.823’	153°50.300’	92		13-14 July 2003	20	1 Cinereus Shrew, 2 N. Red-backed Vole	Graminoid herbaceous between slough and black spruce forest
Johnson River	1	59°59.499’	152°40.094’	10	50	15-19 July 2003	170	27 Cinereus Shrew, 14 Montane Shrew, 23 N. Red-backed Vole, 2 Meadow Jumping Mouse	Bryoid Herbaceous: mat of moss with cotton grass and sedges, a few willows in marsh surrounded by alder bordering a lake
	2	60°00.929’	152°36.988’	10	103.4	15-16 July 2003	40	4 Cinereus Shrew	Wet Graminoid Herbaceous: near tidal flats of river

TABLE 1b. Trapline transects at ten general localities in Lake Clark National Park and Preserve, Alaska, July 2003.

GENERAL LOCALITY Lark Clark NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
	3	60°00.566’	152°36.827’	10	79.7	15-16 July 2003	42	5 Cinereus Shrew	Mesic Graminoid Herbaceous: patches of alder surrounded by grassy open areas on hill west of ocean
	4	59°59’23.0”	152°39’24.9”	10	37	15-19 July 2003	16	1 N. Red-backed Vole	Open spruce forest
	5	59°59.363’	152°39.690’	10	66.4	16-18 July 2003	90	17 Cinereus Shrew, 2 Montane Shrew, 11 N. Red-backed Vole	Open sitka spruce with ferns and alder
	6	59°59’23.0”	152°39’24.9”	10	37	17-19 July 2003	10	0 captures	Open spruce forest
Silver Salmon	1	59°58.892’	152°40.100’	10	300	15-17 July 2003	210	21 Cinereus Shrew, 8 Montane Shrew, 14 N. Red-backed Vole, 1 Meadow Jumping Mouse	
	2	59°58.878’	152°39.865’	10	112.3	16-19 July 2003	54	2 Cinereus Shrew, 6 N. Red-backed Vole	Graminoid herbacous with scattered sitka spruce trees
	3	59°59.533’	152°40.429’	10-20	103.4	16-19 July 2003	144	26 Cinereus Shrew, 3 Montane Shrew, 4 N. Red-backed Vole, 1 Meadow Vole, 3 Meadow Jumping Mouse	Herbaceous meadow with scattered alder and willow near edge of alder-ferns
	4	59°58.239’	152°39.798’	10	150	18-19 July 2003	30	2 Cinereus Shrew, 1 N. Red-backed Vole	Grassy-beach pea bank along river and trail
Turquoise Lake	1	60°47.298’	153°51.811’	735	56	20-23 July 2003	160	3 Cinereus Shrew, 21 Montane Shrew, 1 N. Red-backed Vole, 1 Microtus miurus, 2 Tundra Vole, 1 Arctic Ground Squirrel	Forb herbaceous along stream with willow, fern, fireweed, parsnip, some moss
	2	60°47.436’	153°51.912’	894	137.4	20-22 July 2003	74	1 Montane Shrew, 3 N. Red-backed Vole, 1 Singing Vole	Boulders-willow-dwarf willow
	3	60°47.186’	153°51.516’		64	20-23 July 2003	54	3 Cinereus Shrew, 6 Montane Shrew, 1 N. Red-backed Vole, 1 Red Squirrel	Open Broadleaf Forest: *Populus* canopy with understory of alder and willow and herbaceous ground cover
	4	60°47.143’	153°51.497’	850	7.3	20-23 July 2003	3	0 captures	Graminoid herbaceous
	5	60°47.180’	153°51.679’		12.3	20-23 July 2003	40	1 Cinereus Shrew, 3 Montane Shrew, 1 N. Red-backed Vole	Graminoid herbaceous: labrador tea, crowberry, cranberry, rushes
	6	60°47.135’	153°51.370’	1250	6	20-23 July 2003	15	3 Montane Shrew	Graminoid herbaceous surrounding large boulder near avalanche chute

TABLE 1b. Trapline transects at ten general localities in Lake Clark National Park and Preserve, Alaska, July 2003.

GENERAL LOCALITY Lark Clark NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
	7	60°47.216’	153°51.371’	1300-1600	49	20-22 July 2003	6	0 captures	Mesic graminoid herbaceous
	8	60°46.712’	153°50.817’		54.5	20-24 July 2003	130	3 Cinereus Shrew, 1 Pygmy Shrew, 11 Montane Shrew, 5 N. Red-backed Vole, 6 Singing Vole, 1 Tundra Vole, 1 Meadow Jumping Mouse, 1 Arctic Ground Squirrel	Dwarf willow-tussock grass-boulder slope
	9	60°47’31.0”	153°51’32.1”	1050	27	20-23 July 2003	5	0 captures	Dry forb herbaceous
	10	60°47’41.2”	153°51’36.2”	1050	42	20-23 July 2003	60	1 N. Red-backed Vole	Dry forb herbaceous
	11	60°47’39.2”	153°51’37.5”	1050	42	20-23 July 2003	102	1 Cinereus Shrew, 1 N. Red-backed Vole, 1 Collard Pika	Bryoid herbaceous (lichen) of rubble slope
	12	60°47.071’	153°51.586’		6.7	20-23 July 2003	12	0 captures	Stream bank with bare soil and dwarf willow; *Spermophilus* present
	13	60°46.759’	153°50.969’		14	20-24 July 2003	25	4 Montane Shrew, 1 Arctic Ground Squirrel	Stream bank with bare soil and dwarf willow
	14	60°47.234’	153°51.890’	735	64.7	21-24 July 2003	162	19 Cinereus Shrew, 2 Montane Shrew, 3 Tundra Vole	Willow dwarf scrub with understory of grasses, fireweed, some sedges
	15	60°47.362’	153°51.958’		200	22-24 July 2003	56	3 Cinereus Shrew, 15 Montane Shrew, 4 N. Red-backed Vole	*Vaccinium*-willow-bog birch-poplar
Two Lakes	1	61°06.473’	153°51.178’		103.8	25-27 July 2003	10	26 Cinereus Shrew	Shoreline
	2	61°06.720’	153°51.354’		1604	25-28 July 2003	208	8 Cinereus Shrew, 17 N. Red-backed Vole, 3 Tundra Vole	Long ridgeline
	3	61°06.741’	153°51.472’		15.7	26-28 July 2003	16	0 captures	Rock outcrop
	4	61°06.574’	153°51.301’		44.6	25-27 July 2003	20	1 N. Red-backed Vole	Small aspen stand
	5	61°06.398’	153°51.262’	342	5.4	26-28 July 2003	54	9 Cinereus Shrew, 1 Montane Shrew, 7 N. Red-backed Vole	Lakeshore edge of graminoids, bog birch, willow with alder and scattered black spruce
	6	61°06.416’	153°51.555’		15.6	26-28 July 2003	10	0 captures	Open dwarf tree scrub
	7	61°06.194’	153°51.412’	365	99	26-28 July 2003	48	2 Cinereus Shrew, 1 N. Red-backed Vole	Open Mixed Forest: spruce, birch, aspen, willow
Necons Rver	1	61°06.425’	153°51.427’		90.5	25-28 July 2003	164	4 Cinereus Shrew, 2 N. Red-backed Vole, 2 Tundra Vole	Mesic Graminoid Herbaceous: dry bog

TABLE 1b. Trapline transects at ten general localities in Lake Clark National Park and Preserve, Alaska, July 2003.

GENERAL LOCALITY Lark Clark NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
	2	61°06.398’	153°51.262’	342	5.4	25-26 July 2003	41	2 Cinereus Shrew, 2 Montane Shrew, 8 N. Red-backed Vole, 1 Snowshoe Hare	Alder shoreline with spruce and birch
	3	61°06.362’	153°51.152’	351	3.8	25-28 July 2003	90	13 Cinereus Shrew, 12 N. Red-backed Vole	Overgrown *Vaccinium*-bog birch meadow with scattered spruce
	4	61°06.362’	153°51.195’	317		26-28 July 2003	36	2 Cinereus Shrew, 1 Montane Shrew, 2 N. Red-backed Vole	Birch forest
	5	61°06.370’	153°51.202’	345		26-28 July 2003	18	0 captures	Black spruce forest
	6	61°06’18.3”	153°51’31.9”		42	26-28 July 2003	20	1 N. Red-backed Vole, 1 Snowshoe Hare	Open spruce/poplar mixed forest on southfacing slope
	7	61°06’13.4”	153°51’51.3”		23	26-28 July 2003	20	1 N. Red-backed Vole	Low Scrub: alder and willow
	8	61°06.253’	153°51.796’	348		26-28 July 2003	78	15 Cinereus Shrew, 1 Montane Shrew, 8 N. Red-backed Vole, 2 Tundra Vole	Pond edge with grass-bog birch border and alder-black spruce

* Arctic Ground Squirrel (*Spermophilus parryii*), Cinereus Shrew (*Sorex cinereus*), Collared Pika (*Ochotona collaris*), Little Brown Bat (*Myotis lucifugus*), Meadow Jumping Mouse (*Zapus hudsonius*), Meadow Vole (*Microtus pennsylvanicus*), Montane Shrew (*Sorex monticolus*), Northern Bog Lemming (*Synaptomys borealis*), Northern Red-backed Vole (*Clethrionomys rutilus*), Pygmy Shrew (*Sorex hoyi*), Red Squirrel (*Tamiasciurus hudsonicus*), Singing Vole (*Microtus miurus*), Snowshoe Hare (*Lepus americanus*), Tiny Shrew (*Sorex yukonicus*), Tundra Vole (*Microtus oeconomus*).

TABLE 1c. Trapline transects at five general localities in Katmai National Park and Preserve, Alaska, July 2004.

GENERAL LOCALITY Katmai NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
Idavain Lake	1	58.7649°	155.8908°	233	400	3-5 July 2004	498	5 Cinereus Shrew, 1 Pygmy Shrew, 1 N. Red-backed Vole, 8 Meadow Vole, 2 Meadow Jumping Mouse, 1 N. Bog Lemming	Wet meadow/tall willow along edge of lake
	2	58.7692°	155.8809°	249	300	3-5 July 2004	266	2 N. Red-backed Vole, 2 Meadow Vole, 1 Meadow Jumping Mouse, 1 N. Bog Lemming, 2 Arctic Ground Squirrel	Spruce woodland interspersed with shrub thickets and open wet meadow
Fure's Cabin (NE Naknek Lake, Portage Lake, Lake Grosvenor)	1	58.6701°	155.4290°	27	200	5-9 July 2004	404	14 Cinereus Shrew, 3 Montane Shrew, 3 Tundra Shrew, 2 N. Red-backed Vole, 2 Meadow Vole, 2 N. Bog Lemming, 1 Meadow Jumping Mouse, 1 Red Squirrel	Tall grass/forb meadow around cabin site and at edge of closed mixed spruce/birch/cottonwood forest
	2	58.6708°	155.4296°	39	300	5-9 July 2004	500	2 Cinereus Shrew, 1 Montane Shrew, 6 N. Red-backed Vole	Mixed spruce/birch forest
	3	58.6759°	155.4203°	32	200	6-9 July 2004	188	2 Cinereus Shrew, 1 Montane Shrew, 1 Pygmy Shrew, 1 N. Red-backed Vole, 2 Meadow Vole, 1 Red Squirrel	Mixed forest along edge of "Portage" Lake
	4	58.6823°	155.4076°	32	100	6-9 July 2004	198	1 Cinereus Shrew, 3 Tundra Shrew, 4 N. Red-backed Vole	Mixed forest along edge of Lake Grosvenor
Amalik Bay	1	58.1050°	154.5274°	10	100	9-12 July 2004	262	12 Cinereus Shrew, 59 Montane Shrew, 1 N. Red-backed Vole, 5 Meadow Jumping Mouse	Estuarine meadow with scattered alder and willow thickets
	2	58.1055°	154.5284°	10	100	9-12 July 2004	300	22 Cinereus Shrew, 45 Montane Shrew, 7 N. Red-backed Vole, 2 Meadow Jumping Mouse	Estuarine meadow along edge of tall alder thickets
	3	58.1050°	154.5272°	12	100	9-12 July 2004	186	6 Cinereus Shrew, 27 Montane Shrew, 1 N. Red-backed Vole, 5 Meadow Jumping Mouse	Estuarine meadow along edge of tall alder thickets
	4	58.1022°	154.5291°	2	200	9-12 July 2004	332	6 Cinereus Shrew, 34 Montane Shrew, 4 N. Red-backed Vole, 5 Meadow Jumping Mouse, 1 Arctic Ground Squirrel	Along coastline with cow parsnip meadows and scattered thickets of tall shrubs

TABLE 1c. Trapline transects at five general localities in Katmai National Park and Preserve, Alaska, July 2004.

GENERAL LOCALITY Katmai NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES*	VEGETATION TYPE
	5	58.1053°	154.4283°	10	75	10-11 July 2004	40	1 Cinereus Shrew, 8 Montane Shrew, 1 N. Red-backed Vole, 1 Meadow Jumping Mouse	Estuarine meadow
Murray Lake	1	58.7734°	155.0277°	517	200	13-16 July 2004	168	5 Cinereus Shrew, 3 Montane Shrew, 1 Tundra Shrew, 1 N. Red-backed Vole, 1 Meadow Jumping Mouse, 6 Arctic Ground Squirrel	Grassy tundra with medium to tall willow thickets along south-facing hillside
	2	58.7722°	155.0267°	505	200	14-18 July 2004	236	1 Cinereus Shrew, 8 Montane Shrew, 1 Tundra Shrew, 3 N. Red-backed Vole, 3 Tundra Vole, 5 Meadow Jumping Mouse, 1 Arctic Ground Squirrel	Tall grass-forb meadow with tall willow thickets along inlet stream
	3	58.7721°	155.0224°	517	300	13-18 July 2004	960	2 Cinereus Shrew, 9 Montane Shrew, 2 Tundra Shrew, 1 N. Red-backed Vole, 1 Meadow Jumping Mouse, 1 N. Bog Lemming	Grass-forb meadow and tall scrub thickets
	4	58.7712°	155.0282°	515	200	13-18 July 2004	316	1 Cinereus Shrew, 3 Montane Shrew, 1 Tundra Shrew, 5 N. Red-backed Vole, 1 Meadow Vole	Grass-forb meadow and tall scrub thickets along inlet stream
	5	58.7561°	155.0313°	763	400	13-18 July 2004	650	21 Sorex monticolus, 1 Tundra Shrew, 2 N. Red-backed Vole, 6 Tundra Vole, 3 Meadow Jumping Mouse, 1 Arctic Ground Squirrel	North-facing hillside meadows and scrub thickets with scattered talus fields
Unnamed lakes west of Contact Creek	1	58.2207°	155.9816°	182	300	19-22 July 2004	314	1 Cinereus Shrew, 1 Tundra Vole	Stream/marsh edge with scattered willow tickets
	2	58.2231°	155.9868°	177	100	21-22 July 2004	44	1 Tundra Vole	Wet meadow/scattered shrubs along shoreline of upper lake
	3	58.2205°	155.9813°	173	200	19-22 July 2004	357	3 Cinereus Shrew, 1 Montane Shrew, 1 Tundra Shrew	Herbaceous/shrub lake shore to herbaceous/shrub thicket edges along northeast-facing hillside
	4	58.2200°	155.9927°	172	400	19-22 July 2004	360	8 Cinereus Shrew, 1 N. Red-backed Vole, 1 Tundra Vole	Herbaceous/shrub lake shore to herbaceous/shrub thicket edges along northeast-facing hillside

* Arctic Ground Squirrel (*Spermophilus parryii*), Cinereus Shrew (*Sorex cinereus*), Meadow Jumping Mouse (*Zapus hudsonius*), Meadow Vole (*Microtus pennsylvanicus*), Montane Shrew (*Sorex monticolus*), Northern Bog Lemming (*Synaptomys borealis*), Northern Red-backed Vole (*Clethrionomys rutilus*), Pygmy Shrew (*Sorex hoyi*), Red Squirrel (*Tamiasciurus hudsonicus*), Tundra Vole (*Microtus oeconomus*).

Table 2. Field personnel involved in mammal inventories of the Southwest Alaska Network of Alaska National Parks in 2003 and 2004.

DATE	PARK UNIT	FIELD PERSONNEL (Institution)
7-28 July 2003	KEFJ	Stephen MacDonald (MSB) Eric Waltari (ISU) Anson Koehler (ISU) Carlee Hengel (ISU) Joseph A. Cook (ISU-MSB) Lucretia Fairchild (NPS)
7-31 July 2003	LACL	Kurt Galbreath (CU) Natalie Dawson (ISU) Dolly Crawford (ISU) Kayce Bell (ISU) Joseph A. Cook (ISU-MSB) Bill Leacock (NPS)
3-23 July 2004	KATM	Stephen MacDonald (MSB) Natalie Dawson (MSB) Anson Koehler (MSB) Tim Dyasuk (UAF) Joseph A. Cook (MSB) Tahzay Jones (NPS)

Table 3. Checklists of the land mammals of 12 Alaska National Park units inventoried between 2000 and 2004. Current status: ● = present and substantiated with a voucher specimen, ✪ = species of probable, but unverified occurrence, ✪ = newly discovered and vouchered in these inventories. Species highlighted in gray and dark green are considered "small mammals" in this study.

SPECIES	CENTRAL NETWORK			ARCTIC NETWORK					SOUTHWEST NETWORK				Number of Park Units
	YUCH	DENA	WRST	GAAR	KOVA	NOAT	CAKR	BELA	KEFJ	LACL	KATM	ANIA	
SHREWS													
Cinereus Shrew (*Sorex cinereus*)	●	●	●	●	●	●	●	●	✪	●	●	✪	12
Pygmy Shrew (*Sorex hoyi*)	●	●	●	●	✪		✪		✪	✪	✪		9
Montane Shrew (*Sorex monticolus*)	●	●	●	●	●	●	✪	●	✪	✪	●	✪	12
American Water Shrew (*S. palustris*)	✪	●	✪										3
Tundra Shrew (*Sorex tundrensis*)	●	●	✪	✪	●	●	●	●		✪	✪	✪	11
Barren Ground Shrew (*Sorex ugyunak*)				✪	✪	●	●	✪					5
Alaska Tiny Shrew (*Sorex yukonicus*)	✪	✪	✪	✪	✪		✪	✪		●			8
BATS													
Little Brown Bat (*Myotis lucifugus*)		✪	●						✪	✪	✪		5
CARNIVORES													
Arctic Fox (*Alopex lagopus*)				●			✪	✪					3
Coyote (*Canis latrans*)	✪	●	●	●					✪	✪	✪		7
Wolf (*Canis lupus*)	●	●	●	●	●	●	●	✪	✪	✪	●	✪	12
Red Fox (*Vulpes vulpes*)	✪	●	✪	●	✪	✪	✪	●	✪	✪	●	✪	12
Canada Lynx (*Lynx canadensis*)	✪	●	●	●	✪	✪		✪	✪	✪	✪		10
Wolverine (*Gulo gulo*)	●	●	●	●	●	●	●	●	✪	✪	✪	✪	12
Northern River Otter (*Lontra canadensis*)	✪	●	●	✪		✪		✪	✪	✪	✪	✪	10
American Marten (*Martes americana*)	●	●	●	●	✪	✪			✪	✪	✪		9
Ermine (*Mustela erminea*)	●	●	✪	●	✪	●	✪	✪	✪	✪	✪	✪	12
Least Weasel (*Mustela nivalis*)	✪	●	✪	●	✪	●	✪	●		✪	✪	●	11

Table 3. Checklists of the land mammals of 12 Alaska National Park units inventoried between 2000 and 2004. Current status: ● = present and substantiated with a voucher specimen, ⭘ = species of probable, but unverified occurrence, ✪ = newly discovered and vouchered in these inventories. Species highlighted in gray and dark green are considered "small mammals" in this study.

SPECIES	CENTRAL NETWORK			ARCTIC NETWORK					SOUTHWEST NETWORK				Number of Park Units
	YUCH	DENA	WRST	GAAR	KOVA	NOAT	CAKR	BELA	KEFJ	LACL	KATM	ANIA	
American Mink (*Mustela vison*)	⭘	●	⭘	●	●	●	⭘	●	⭘	⭘	●	⭘	12
Black Bear (*Ursus americanus*)	●	●	●	●	⭘				⭘	⭘			7
Brown Bear (*Ursus arctos*)	⭘	●	●	●	⭘	●	⭘	●	⭘	●	●	⭘	12
UNGULATES													
Moose (*Alces alces*)	⭘	●	●	⭘	●	⭘	⭘	⭘	⭘	⭘	⭘	⭘	12
Caribou (*Rangifer tarandus*)	●	●	●	●	●	●	●	⭘		⭘	⭘	⭘	11
Bison (*Bison bison*)			⭘										1
Mountain Goat (*Oreamnos americanus*)			●						⭘				2
Muskox (*Ovibos moschatus*)							⭘	⭘					2
Dall's Sheep (*Ovis dalli*)	●	●	●	●	⭘	●				●			7
RODENTS													
Northern Flying Squirrel (*Glaucomys sabrinus*)	⭘	●	⭘										3
Alaska Marmot (*Marmota broweri*)				●		⭘							2
Hoary Marmot (*Marmota caligata*)	●	●	●						⭘	⭘	✪	⭘	7
Arctic Ground Squirrel (*Spermophilus parryii*)	●	●	●	●	●	●	●	●		●	●	⭘	11
Red Squirrel (*Tamiasciurus hudsonicus*)	●	●	●	●	●				⭘	●	●		8
American Beaver (*Castor canadensis*)	⭘	●	⭘	●	⭘				⭘	⭘	⭘	⭘	9
Meadow Jumping Mouse (*Zapus hudsonius*)		✪	⭘							●	●	⭘	5
Northern Red-backed Vole (*Clethrionomys rutilus*)	●	●	●	●	●	●	●	●	✪	●	●	⭘	2
Collared Lemming (*Dicrostonyx groenlandicus*)				✪	✪	●	●	●			⭘	●	7

Table 3. Checklists of the land mammals of 12 Alaska National Park units inventoried between 2000 and 2004. Current status: ● = present and substantiated with a voucher specimen, ✪ = species of probable, but unverified occurrence, ✪ = newly discovered and vouchered in these inventories. Species highlighted in gray and dark green are considered "small mammals" in this study.

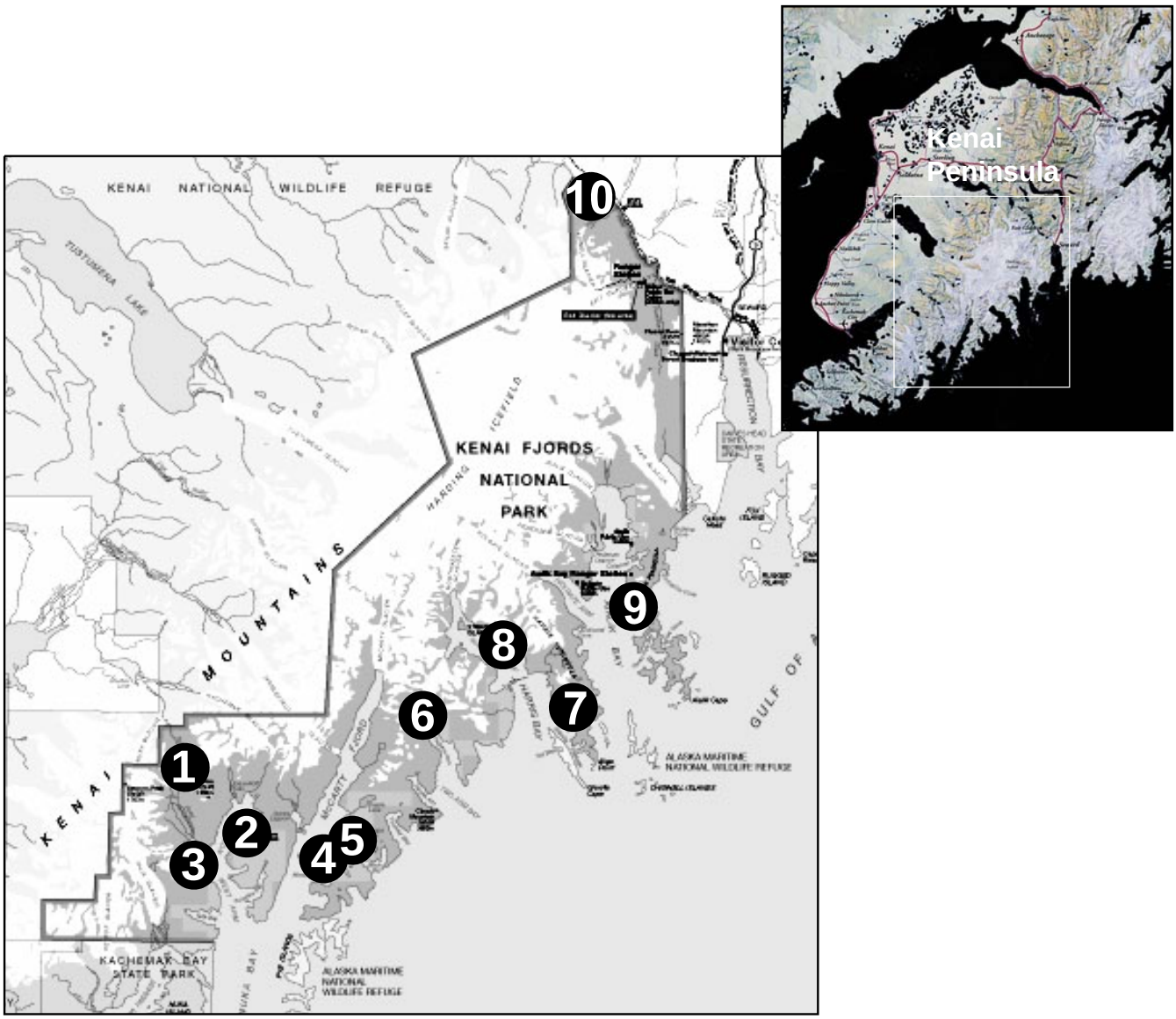
SPECIES	CENTRAL NETWORK			ARCTIC NETWORK					SOUTHWEST NETWORK				Number of Park Units
	YUCH	DENA	WRST	GAAR	KOVA	NOAT	CAKR	BELA	KEFJ	LACL	KATM	ANIA	
Brown Lemming (*Lemmus trimucronatus*)	●	●	●	●	●	●	●	●		✪	✪	●	11
Long-tailed Vole (*Microtus longicaudus*)	●		●										2
Singing Vole (*Microtus miurus*)		●	✪	●	✪	●	●	●	✪	✪			9
Tundra Vole (*Microtus oeconomus*)	●	●	●	●	●	●	●	●	✪	●	●	✪	12
Meadow Vole (*Microtus pennsylvanicus*)	●	●	●	✪						●	●		6
Taiga Vole (*M. xanthognathus*)	●	●	✪	●	●								5
Common Muskrat (*Ondatra zibethicus*)	●	●	✪	●	✪	●	●	●	✪	●	✪		11
Northern Bog Lemming (*Synaptomys borealis*)	●	●	●	●					✪	●	●		7
North American Porcupine (*Erethizon dorsatum*)	✪	●	●	●	●	●	✪	✪	✪	✪	✪	✪	12
LAGOMORPHS													
Collared Pika (*Ochotona collaris*)	●	●	●							✪			4
Snowshoe Hare (*Lepus americanus*)	●	●	●	●	✪	●			✪	●	●		9
Alaskan Hare (*Lepus othus*)								●			✪	✪	3
Number of Species	37	39	42	37	31	27	25	27	27	36	33	23	
% Vouchered	70%	97%	76%	95%	64%	78%	64%	67%	15%	64%	51%	13%	
Number of "Small Mammal" Species	23	25	26	22	19	16	16	16	14	22	21	14	
% Vouchered	87%	96%	77%	100%	79%	94%	81%	87%	29%	82%	62%	21%	
Inventory Additions	2	2	4	5	5	0	3	2	4	10	3	--	

Table 4. Number of small mammals sampled in the Southwest Alaska Network, NPS Alaska, 2003 - 2004.

SPECIES	SW PARK UNIT			
	KEFJ	LACL	KATM	*TOTALS*
SHREWS				
Cinereus Shrew (*Sorex cinereus*)	458	385	92	*935*
Pygmy Shrew (*Sorex hoyi*)	--	1	2	*3*
Montane Shrew (*Sorex monticolus*)	57	109	223	*389*
Tundra Shrew (*Sorex tundrensis*)	--	1	13	*14*
Alaska Tiny Shrew (*Sorex yukonicus*)	--	2	--	*2*
BATS				
Little Brown Bat (*Myotis lucifugus*)	--	2	--	*2*
CARNIVORES				
Ermine (*Mustela erminea*)	--	4	--	*4*
RODENTS				
Hoary Marmot (*Marmota caligata*)	--	--	1	*1*
Arctic Ground Squirrel (*Spermophilus parryii*)	--	10	11	*21*
Red Squirrel (*Tamiasciurus hudsonicus*)	--	14	2	*16*
Meadow Jumping Mouse (*Zapus hudsonicus*)	--	8	32	*40*
Northern Red-backed Vole (*Clethrionomys rutilus*)	203	238	43	*484*
Singing Vole (*Microtus miurus*)	--	8	--	*8*
Tundra Vole (*Microtus oeconomus*)	30	42	12	*84*
Meadow Vole (*Microtus pennsylvanicus*)	--	25	15	*40*
Northern Bog Lemming (*Synaptomys borealis*)	--	1	5	*6*
LAGOMORPHS				
Collared Pika (*Ochotona collaris*)	--	3	--	*3*
Snowshoe Hare (*Lepus americanus*)	--	3	--	*3*
TOTAL # SPECIMENS	*748*	*856*	*451*	***2055***
TOTAL TRAPNIGHTS	*4573*	*4563*	*6579*	***15,715***

Table 5. Relative abundance (captures/100 trap nights) and proportion (percent) of small mammals in three major vegetation types, Southwest Alaska Network, field seasons 2003-2004 (*species captured only in LACL and KATM; **only KATM; ***only LACL).

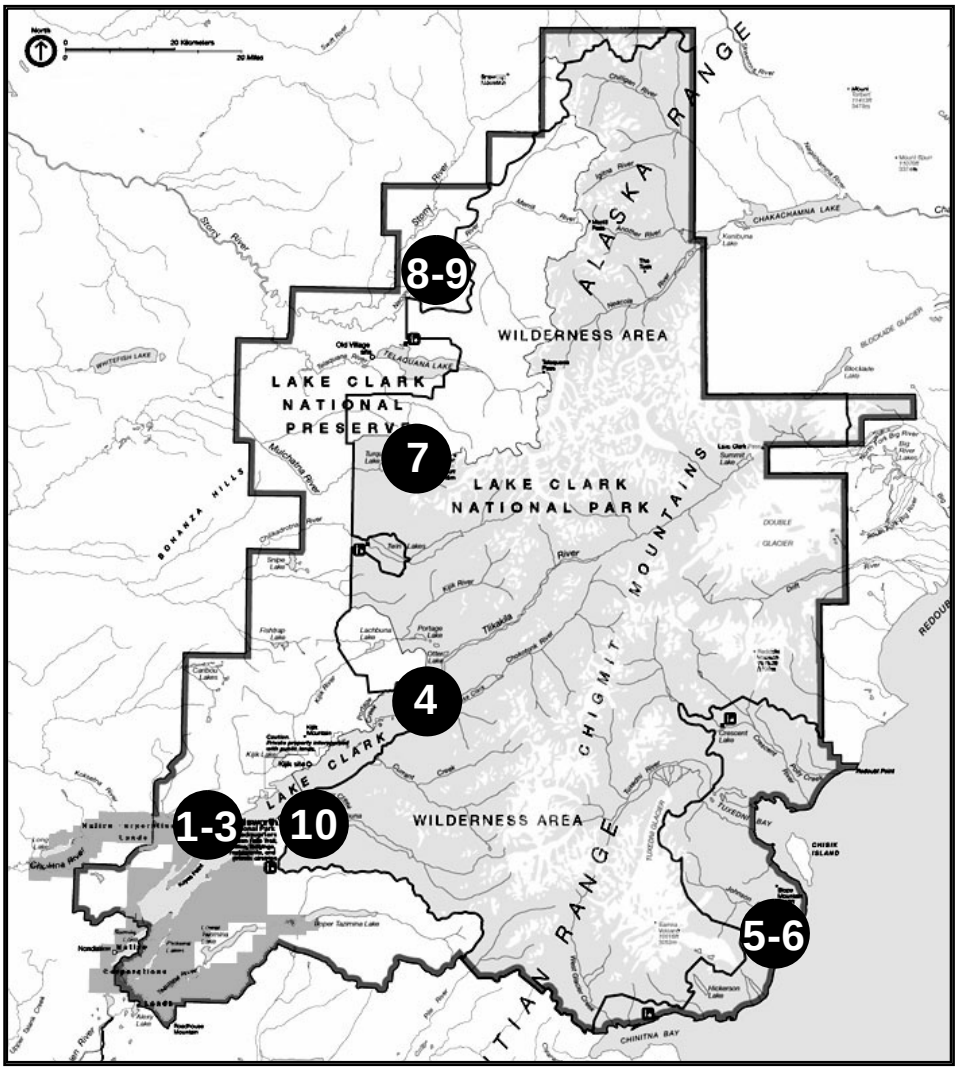
SPECIES	FOREST	SCRUB	HERBACEOUS
Shrews			
Cinereus Shrew (*Sorex cinereus*)	5.94 **(33%)**	5.65 **(31%)**	6.54 **(36%)**
Pygmy Shrew (*Sorex hoyi*)*	0.05 **(43%)**	0.05 **(43%)**	0.015 **(14%)**
Montane Shrew (*Sorex monticolus*	1.01 **(16%)**	2.04 **(32%)**	2.99 **(47%)**
Tundra Shrew (*Sorex tundrensis*)**	0.26 **(41%)**	0.22 **(34%)**	0.17 **(25%)**
Alaska Tiny Shrew (*Sorex yukonicus*)***	--	0.09 **(100%)**	--
Small Rodents			
Northern Red-backed Vole (*Clethrionomys rutilus*)	4.70 **(45%)**	2.90 **(27%)**	2.93 **(28%)**
Tundra Vole (*Microtus oeconomus*)	0.13 **(8%)**	0.74 **(45%)**	0.76 **(47%)**
Singing Vole (*Microtus miurus*)***	--	0.67 **(94%)**	0.04 **(6%)**
Meadow Vole (*Microtus pennsylvanicus*)*	0.31 **(28%)**	0.22 **(20%)**	0.57 **(52%)**
Northern Bog Lemming (*Synaptomys borealis*)*	0.05 **(38%)**	--	0.08 **(62%)**
Meadow Jumping Mouse (*Zapus hudsonius*)*	0.05 **(7%)**	0.16 **(22%)**	0.51 **(71%)**
All Species	12.5 (31%)	13.18 (33%)	14.61 (36%)
Trap Nights	3545	3482	8218



SAMPLING LOCALITIES

1. Upper Nuka River (59.6167N, 150.6667W [NAD27]): 8-10 July 2003
2. North Arm, Nuka Bay (59.55N, 150.5167W [NAD27]): 7-11 July 2003
3. Shelter Cove, Beauty Bay (59.5167N, 150.6333W [NAD27]): 9-10 July 2003
4. Delight Spit (67.1N, 154.2667W [NAD27]): 11-15 July 2003
5. Delight Lake (59.5333N, 150.3W [NAD27]): 11-15 July 2003
6. Paguna Arm (59.6833N, 150.1333W [NAD27]): 16-18 July 2003
7. Crater Bay (59.7167N, 149.7667W [NAD27]): 18-19 July 2003
8. Northwestern Lagoon (59.7667N, 149.9167W [NAD27]): 19-20 July 2003
9. Aialik Bay (59.8167N, 149.6333W [NAD27]): 20-22 July 2003
10. Resurrection River (60.2833N, 149.7W [NAD27]): 25-28 July 2003

Figure 1. General localities in Kenai Fjords National Park, Kenai Peninsula, Alaska, sampled for small mammals in 2003.



SAMPLING LOCALITIES

Chulitna Bay vicinity, Lake Clark (60° 10'N, 154° 34'W): 7-11 July 2003
1. Turner Bay
2. West of Chulitna River mouth
3. South of Chulitna River mouth

4. Head of Lake Clark (60° 23'N, 153° 50'W): 11-14 July 2003

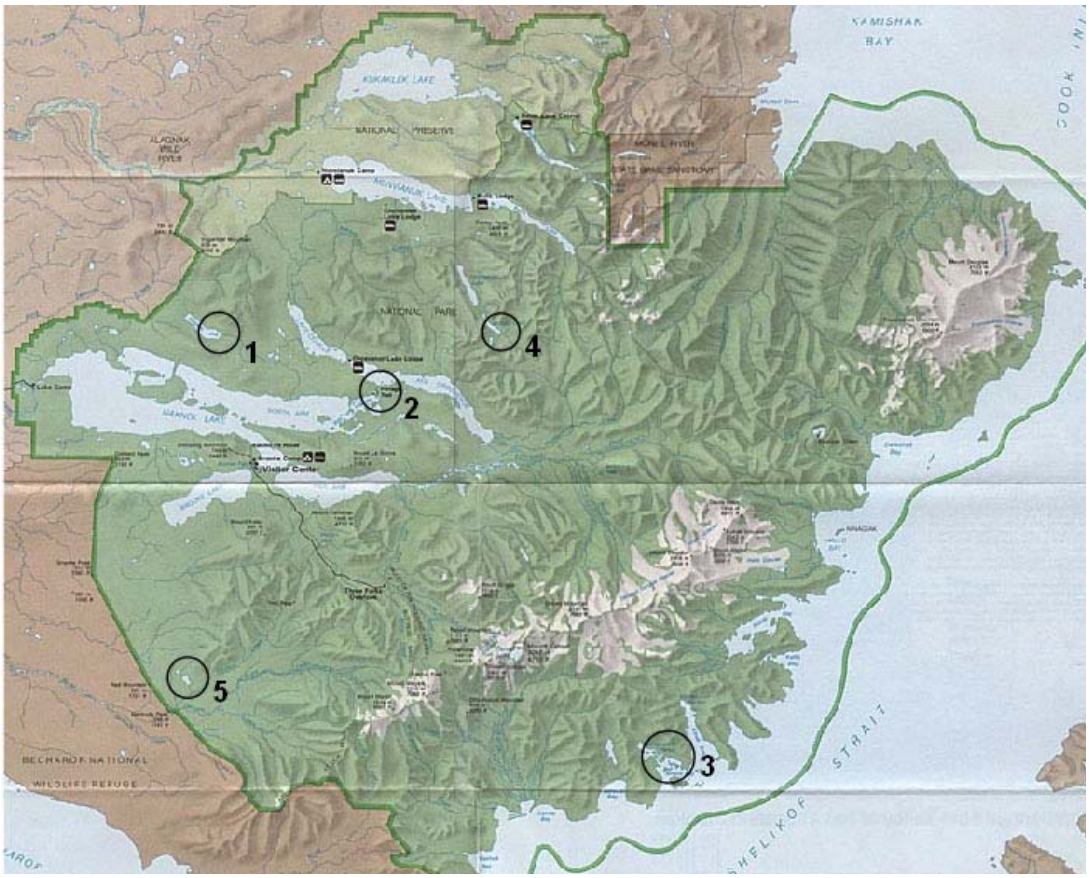
Silver Salmon vicinity, Cook Inlet (59° 59'N, 152° 40'W): 15-19 July 2003
5. Johnson River
6. Silver Salmon Lakes

7. Turquoise Lake (60° 47'N, 153° 51'W): 20-24 July 2003

Two Lakes vicinity (61° 06'N, 153° 51'W): 25-28 July 2003
8. Two Lakes
9. Recons River

10. Port Alsworth, Tanalian Mountain (60° 12'N, 154° 13'W): 31 July 2003

Figure 2. General localities in Lake Clark National Park and Preserve, Alaska, sampled for small mammals in 2003.



SAMPLING LOCALITIES

1. Idavain Lake (base camp: 58.7649° N, 155.8908° W [NAD27]); 3-5 July 2004

2. NE Naknek Lake, Fure's Cabin (58.6701° N, 155.4290° W [NAD27]); 5-9 July 2004

3. Amalik Bay, NPS Ranger cabin (58.1050° N, 154.5274° W [NAD27]); 9-13 July 2004

4. Murray Lake (58.7734° N, 155.0277° W [NAD27]); 13-19 July 2004

5. Unnamed lakes west of Contact Creek (58.2207° N, 155.9816° W [NAD27]); 19-23 July 2004

Figure 3. General localities in Katmai National Park and Preserve, Alaska, sampled for small mammals in 2004.

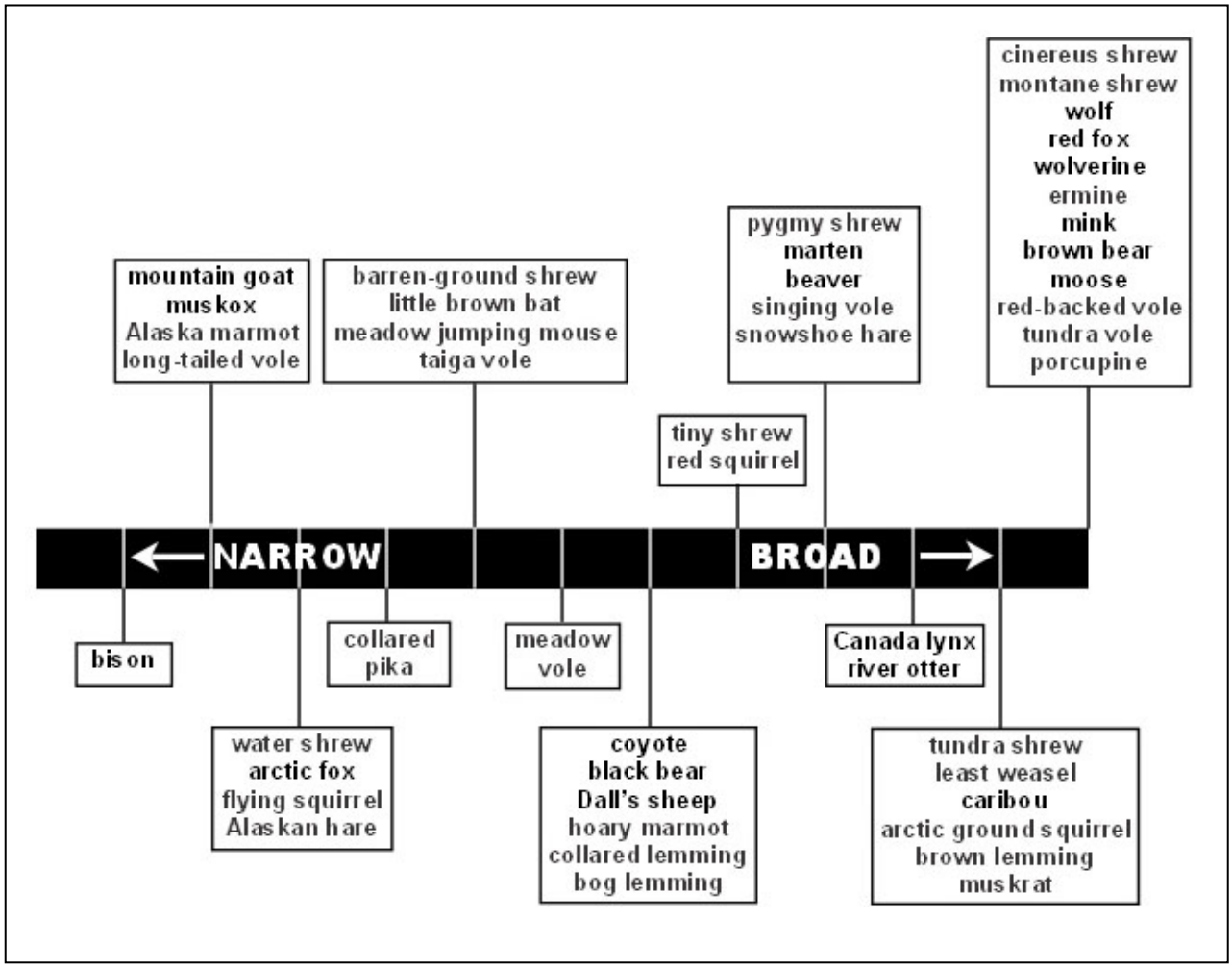


Figure 4. Range of occurrence of mammal species across 12 of Alaska's National Park Units (Southeast network excluded). For example, cinereus shrew and red-backed vole are broadly distributed, occurring in all park units, while long-tailed vole has a relatively narrow distribution, occurring in only 2 of 12 park units.