

# **Mammal Inventory of Alaska's National Parks and Preserves**

## ***Katmai National Park and Preserve***

### **Annual Report 2004**



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## Abstract

This report details the inventory of mammals at five general localities in Katmai National Park and Preserve (KATM) between 3 and 23 July 2004 as part of a cooperative effort of the Beringian Coevolution Project (BCP) at the Museum of Southwestern Biology (MSB), University of New Mexico and the Inventory and Monitoring Program of the National Park Service of Alaska.

We begin the process of documenting the approximately 33 species of mammals that occur in the Park, with a primary focus on small mammals (i.e., shrews, voles, lemmings, weasels, porcupine, squirrels, and hares). This survey resulted in 451 primary specimens comprising 12 species.

Small mammal populations were at low levels during the time of this study. Across all localities sampled, two shrews (montane shrew, cinereus shrew) were the most frequently captured species (223 and 92 specimens, respectively), comprising about 70% of all mammals sampled.

This inventory provided the first specimen-vouchered records of pygmy shrew, tundra shrew, and hoary marmot. The discovery of pygmy shrew in KATM constitutes a southwestward range extension of this poorly known species. Potentially occurring small mammal species still needing specimen documentation include ermine, least weasel, collared lemming, brown lemming, muskrat, porcupine, Alaskan hare, and little brown bat.

The findings from this study, 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 in KATM to 13 of 21 probable species, or 62% coverage.

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 (BCP) at the Museum of Southwestern Biology (MSB), University of New Mexico (UNM) and the Inventory and Monitoring Program of the National Park Service (NPS-I&M) of Alaska. Other participating institutions included the University of Alaska Museum (UAM), USDA National Parasite Collection, and The Finnish Forest Research Institute (Vantaa Research Centre). BCP personnel involved in this field effort included Stephen MacDonald (Research Associate UAM, MSB), Natalie Dawson (PhD. candidate, UNM), Anson Koehler (Master's candidate, UNM), Tim Dyasuk (Dillingham-University of Alaska Fairbanks student), and Joseph Cook (PI and Curator of Mammals, MSB). Tahzay Jones (NPS-King Salmon) was also an active participant in this effort.*

*This report details the inventory of mammals at five general localities in Katmai National Park and Preserve (KATM) between 3 and 23 July 2004. We begin the process of documenting the approximately 33 species of mammals that occur in the Park, 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 (132 person-days and 6579 trap nights of collecting effort) resulted in 451 primary specimens (excluding embryos) comprising 12 species. All primary voucher specimens of mammals were deposited in the University of Alaska Museum, Fairbanks.*

*Small mammal populations were at low levels during the time of this study. Across all localities sampled, two shrews (montane shrew, cinereus shrew) were the most frequently captured species (223 and 92 specimens, respectively), comprising about 70% of all mammals sampled.*

*The findings from this study, 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 in KATM to 13 of 21 probable species, or 62% coverage.*

*This inventory provided the first specimen-vouchered records of pygmy shrew, tundra shrew, and hoary marmot. The discovery of pygmy shrew in KATM constitutes a southwestward range extension of this poorly known species. Potentially occurring small mammal species still needing specimen documentation include ermine, least weasel, collared lemming, brown lemming, muskrat, porcupine, Alaskan hare, and little brown bat.*

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

## **Introduction**

This report details an inventory of the small mammals of Katmai National Park and Preserve (KATM) between 3 and 23 July 2004. The Beringian Coevolution Project (BCP) at the Museum of Southwestern Biology (MSB), University of New Mexico (UNM), worked collaboratively with the Inventory and Monitoring Program of the National Park Service, Alaska, and the University of Alaska Museum (UAM) to conduct an inventory at selected sites throughout KATM to document the occurrence, relative abundance, and general habitat affinities of its small mammal fauna (Table 1).

This effort is beginning to 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 KATM was complemented by a review of specimen holdings at the University of Alaska Museum (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**

The BCP field crew conducted surveys for small mammals at five general localities in 2004 (Figure 1). Crew members included Stephen MacDonald (Research Associate-UAM, MSB), Natalie Dawson (PhD. Candidate-UNM), Anson Koehler (Masters candidate-UNM), Tim Dyasuk (Dillingham, University of Alaska Fairbanks undergraduate student), and Joseph Cook (PI and Curator of Mammals, MSB). Tahzay Jones (NPS-King Salmon) was also an active participant in this 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, Sherman live traps). Several arctic ground squirrels and a marmot were sampled with shotgun.

Traplins for shrews and voles were set in the range of available habitats and ecotones in each study location. Traplins 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.

Our field crew sampled the five general areas in KATM with a total of 132 person-days and 6579 trap nights of collecting effort on 20 trapline transects. These transects were located in a variety of habitats and elevations (Table 3).

## **Field Locations**

**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 highest at this locality (10 species), and the only site where 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): 19-22 July 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. Several study skins were also prepared. Our crew 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 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. The samples of endoparasite are now at the US National Parasite Collection in Beltsville, MD and the Vantaa Research Centre in Vantaa, Finland. The samples of ectoparasites are being disbursed to qualified experts from MSB.

## Results and Species Accounts

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). A total of 451 small mammal specimens (excluding embryos) comprising 12 species was archived from KATM during the 2004 field season (Table 2).

Small mammal populations were at low levels during the time of this study. Two shrews (montane shrew, cinereus shrew) were the most frequently captured species (223 and 92 specimens, respectively), comprising 70% of all specimens collected, with our one coastal site, Amalik Bay, accounted for over 77% of all montane shrew captures and 50% of all cinereus shrew captures.

This study, when combined with previous efforts and from specimen information gathered from holdings at UAM and other major collections, increased the total number of vouchered small mammal species in KATM to 13 of 21 probable species (Table 1), or 62% coverage (see Table 5 for comparison with other park units).

### Species Accounts

The following accounts summarize information on each terrestrial species known or suspected to occur in KATM. Not included in these accounts are harbor porpoise (*Phocoena phocoena*) and harbor seal (*Phoca vitulina*), two marine mammals seen at Amalik Bay. Detailed data on all specimens will be available in the UAM database and accessible on its website (<http://arctos.database.museum>).

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

*Sorex cinereus*, cinereus shrew

Cinereus shrews were widespread but nowhere abundant in 2004, resulting in the total capture of 92 individuals, over half of which came from our one coastal locality at Amalik Bay. This species is widely distributed in Alaska and generally common throughout its range.

*Sorex hoyi*, pygmy shrew

The captures of a single pygmy shrew at Idavain Lake and another NE of Fure's Cabin next to Portage Lake constitute the first and only records of this species in KATM. These specimens extend the known range of the species farther out the Alaska Peninsula from Nondalton (Rausch 1967).

*Sorex monticolus*, montane shrew

Montane shrews were captured at all localities 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 most abundant shrew in KATM.

*Sorex tundrensis*, tundra shrew

We captured a small number (13) of tundra shrews at three localities north of the Aleutian Range. These are the first documented records of this species for KATM. Tundra shrews are found throughout most of Alaska, including the length of the Alaska Peninsula (Murie 1959, Hall 1981). According to most authors (e.g., Junge et al. 1983, van Zyll de Jong 1983; but see Rausch and Rausch 1993), this species also occurs in eastern Siberia.

? *Sorex yukonicus*, Alaska tiny shrew

We failed to find tiny shrew in KATM. This newly-described (and elusive) species (Dokuchaev 1997) is now known to occur at the base of the Alaska Peninsula as far south as Turner Bay, Lake Clark NP&P (Cook and MacDonald 2004), suggesting some possibility of it eventually being found in KATM, particularly in boreal forest ecosystems in the more northern reaches of the park.

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

*Myotis lucifugus*, little brown bat

No bats were seen during our time in the Park. 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 (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 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

The BCP crew did not encounter any wolves but did note their sign at Idavain Lake, Fure's Cabin, and Murray Lake. Specimens of this widely-distributed canid have been preserved from the park (USNM).

*Vulpes vulpes*, red fox

Individual red foxes were seen at Amalik Bay and Murray Lake, where an adult female was observed hunting ground squirrels (successfully). Fox sign was also noted near Contact Creek. The red fox is found throughout the Alaska Peninsula and are indigenous to the eastern Aleutians at least as far west as Umnak Island (Murie 1959).

Family **Felidae**

*Lynx canadensis*, Canada lynx

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. No specimens have been preserved from the Park.

Family **Mustelidae**

*Gulo gulo*, wolverine

No wolverines or their sign was seen during the course of this study, nor have any specimens of this wide-ranging mustelid been preserved from the 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).

*Lontra canadensis*, northern river otter

River otters were seen at Amalik Bay and their sign (tracks, trails, toilets) was observed at Amalik Bay, Murray Lake, and near Contact Creek. This species is known to occur throughout the region and along the Alaska Peninsula to Unimak Island (USNM; Murie 1959, ADFG 1978). 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.

*Martes americana*, American marten

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 *vide* L. Butler, ADFG, King Salmon, pers. com. October 2004).

*Mustela erminea*, ermine

No ermine or their sign was encountered during this study, nor are there any specimens preserved from within the park. Ermine are known to occur throughout the region as far west as Unimak Island (Murie 1959).

*Mustela nivalis*, least weasel

Least weasels were not observed or reported. The species appears to be sparsely distributed throughout much of its range, which includes the Alaska Peninsula and Unimak Island (UAM, USNM; Murie 1959). A specimen of this holarctic weasel was recently preserved from Aniakchak National Preserve (1993, UAM), but there is none yet from within KATM.

*Mustela vison*, American mink

No sightings or sign of this semi-aquatic species was noted during our study. Schiller and Rausch (1956) reported their common occurrence in the region and preserved a specimen from within the park (Kukak Bay, USNM 301350). Mink are found throughout the length of the Alaska Peninsula and on Unimak Island (Murie 1959).

### Family **Ursidae**

? *Ursus americanus*, American black bear

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 *vide* 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).

*Ursus arctos*, brown bear

We encountered brown bears or their sign at all localities visited. Bears were particularly numerous along the coast at Amalik Bay. Scientific specimens have been preserved from several localities in the park (UAM, USNM).

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

*Alces alces*, moose

We observed individual moose or their sign at all localities visited. Lem Butler, ADFG wildlife biologist, King Salmon, informed us that moose have been expanding their

population southwestward 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 the park.

*Rangifer tarandus*, caribou

The only evidence of caribou encountered 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 the park.

Order **RODENTIA**—Rodents

Family **Sciuridae**

*Marmota caligata*, hoary marmot

Several marmots were noted and an adult female collected in the mountains near Murray Lake. This species has been found along the length of the Alaska Peninsula (Allen 1904, Osgood 1904, Murie 1959). The Murray Lake specimen is the first documented record of this species in KATM.

*Spermophilus parryii*, arctic ground squirrel

Arctic ground squirrels were present and samples taken at all localities visited 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.

*Tamiasciurus hudsonicus*, red squirrel

This squirrel occurs to the limit of spruce in the vicinity of Naknek Lake (Schiller and Rausch 1956). We encountered and sampled red squirrels only at Fure's Cabin, where a large proportion of the spruce, this squirrel's primary source of food and shelter, were either dead or dying, presumably from spruce beetle infestation.

Family **Castoridae**

*Castor canadensis*, American beaver

Beavers or their activities were noted at all localities visited except Amalik Bay. This species is abundant at the base of the Alaska Peninsula and may occur in limited numbers as far south as Port Moller (ADFG 1978). No specimen of this species has been preserved from the park.

Family **Dipodidae**

*Zapus hudsonius*, meadow jumping mouse

Meadow jumping mice were sampled at all localities except Contact Creek. This mouse is commonly found throughout the length of the Alaska Peninsula to (possibly) Unimak Island (Murie 1959).

## Family **Muridae**

### *Clethrionomys rutilus*, northern red-backed vole

Red-backed voles were sampled at all localities but no area were they found numerous in 2004. This holarctic vole occurs extensively and periodically in abundance throughout most of the state and in a wide variety of habitat types.

### *Dicrostonyx groenlandicus*, collared lemming

No collared lemmings were captured; however, nearby records from King Salmon (UAM), Kirschner Lake (UAM), Becharof Lake (Schiller and Rausch 1956), and Aniakchak National Preserve (UAM) suggest the probable occurrence and eventual discovery of this species within the park.

### *Lemmus trimucronatus*, brown lemming

No brown lemmings were sampled in this study nor are there any specimens verifying their occurrence. We suspect this widely-distributed lemming will eventually be documented in the park 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 oeconomus*, tundra vole

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

### *Microtus pennsylvanicus*, meadow vole

Meadow voles were sampled at three localities north of Naknek Lake. Schiller and Rausch (1956) extended the range of this central Alaska species to the south shore of this lake.

### *Ondatra zibethicus*, muskrat

Cahalane (1959) considered this species rare in KATM. No muskrats were observed during the course of this study nor have any specimens been preserved from within the park. Muskrats have been reported on the Alaska Peninsula as far west as Ugashik (Murie 1959, ADFG 1978).

### *Synaptomys borealis*, northern bog lemming

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

## Family **Erethizontidae**

### *Erethizon dorsatum*, North American porcupine

Old fecal droppings in the vicinity of Murray Lake were our only evidence of this animal's presence in the park. Cahalane (1959) considered porcupines very scarce and

probably local in distribution within KATM. This species has been reported the length of the Alaska Peninsula (Murie 1959; USNM).

## Order **LAGOMORPHA**—Pikas and Hares

### Family **Leporidae**

#### *Lepus americanus*, snowshoe hare

Sign of snowshoe hares was seen only at Idavain Lake and Fure's Cabin, suggesting that the hare population of KATM was relatively low in 2004. In 1953-54, Cahalane (1959) found snowshoe hares at peak numbers and widespread in KATM, including near the beaches on Shelikof Strait. This species does not range far beyond the limits of trees on the Alaska Peninsula (Murie 1959, ADFG 1978). Two hare specimens from Becharof Lake (UAM) represent the westernmost record of this species on the Peninsula. Schiller and Rausch (1956) obtained a single young hare from the west end of Naknek Lake, the only specimen record of this species in KATM.

#### *Lepus othus*, Alaskan hare

We did not find any evidence of Alaskan hares in the park 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 found 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 4; Figures 2a, 2b ). Montane shrews, the most frequently captured species in 2004, were most numerous in herbaceous vegetation types, particularly the dense estuarine meadows at Amalik Bay. Cinereus shrews were also relatively numerous here, along with meadow jumping mice. Elsewhere, tundra shrews and pygmy shrews tended to frequent forested habitats while *Microtus* voles and the bog lemming inhabited non-forested habitats and their edges.

The red-backed vole is usually a numerically dominant species, but was not abundant in 2004. This species occurred in a broad range of vegetation types and most frequently in forest associations. The local distribution of this 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.

Arctic ground squirrels were numerous throughout the higher elevations of the park, 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.

Red squirrels were encountered only in the spruce and mixed forests near Fure's Cabin, while the few marmots seen were in steep rocky situations well above treeline near Murray Lake.

Overall in 2004, small mammals were more diverse and abundant in herbaceous habitats (Figure 3).

## **Discussion and Significance**

This inventory confirms the importance of the Katmai National Park and Preserve for its rich convergence of tundra and taiga mammals. Of the Park's approximately 33 species of mammals, many have holarctic distributions or close affinities with Old World species (e.g., Rausch 1963, Hoffmann and Peterson 1967, Hoffmann et al. 1979).

Among small mammals, 13 of 21 species believed to occur in KATM are now documented with specimens. Small mammal species yet to be documented are little brown bat, ermine, least weasel, collared lemming, brown lemming, muskrat, porcupine, and Alaskan hare. One other species, the newly discovered and little known Alaska tiny shrew, may also occur in the Park and continued efforts should be made to document it along with the other nine species.

Small mammal populations were generally low during the time of this study. Across all localities sampled, two shrews, montane shrew and cinereus shrew, were the most frequently captured species (223 and 92 specimens, respectively), accounting for 70% of all trapline captures, with nearly half of these coming from just one locality, the estuarine meadows at Amalik Bay. It is important to emphasize that wide density shifts are the norm at high latitudes, so this year provides a single snapshot of relative densities across all these species.

This inventory provided the first documented records from KATM of pygmy shrew, tundra shrew, and hoary marmot. The discovery of pygmy shrew at Idavain Lake and Fure's Cabin constitutes a new species for the Park and extends the known range of this boreal species farther out the Alaska Peninsula from Nondalton just south of Lake Clark.

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 difficult to identify (e.g., shrews, *Microtus* voles) and these are often poorly known (most Alaska small mammals).

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. As they represent historical populations, the value of large series of specimens increases through time, particularly as the diversity of many localities is degraded. Solid inventories of federal lands has become increasingly important as 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 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).

While 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 KATM, 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, several thousand trap-nights were required to secure 2 pygmy shrews.
- 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 and rigorously preserves diverse preparations (specimens) of representative species. This initial inventory has set the stage for additional collaborative efforts to fully document the small mammal fauna of the KATM.
  - The documentation of only two pygmy shrews, *Sorex hoyi*, in KATM demonstrates how much we have yet to learn about Alaska's small mammal fauna. Additional pitfall trapping in KATM and elsewhere in the state is needed to help determine the full extent of this species' distribution, geographic variation, parasites, and ecological requirements.

- We believe that continued inventory efforts in KATM and elsewhere in the region will result in the discovery of the Alaska tiny shrew, *Sorex yukonicus*, beyond its currently known range. 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.
2. KATM's exceptional fauna is composed of a mix of coastal and interior species that offer unprecedented opportunities for an array of studies that relate the dynamic glacial history of the region to the evolution, ecology, and geography of its biota. 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 KATM could be key to understanding these impacts.
  3. Ongoing efforts could expand our knowledge of the distributions and habitat preferences of tundra and boreal species that come in contact in KATM, and provide important baseline information for monitoring distribution shifts in relation to changes in climate. Long-term monitoring of biotic change is best accomplished by preserving materials from populations sampled periodically over time.

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**Table 1.** Checklist of the land mammals of *Katmai National Park and Preserve*, Alaska. Current status: ● = present and substantiated with vouchered specimen, ○ = present or probably present but not substantiated with a vouchered specimen, ? = status unknown but occurs close enough to the park to be looked for. Species highlighted in gray are considered “small mammals” as used in this report.

<b>INSECTIVORA - Shrews</b>
Family <b>Soricidae</b>
● <i>Sorex cinereus</i> , cinereus shrew
● <i>S. hoyi</i> , pygmy shrew
● <i>S. monticolus</i> , montane shrew
● <i>S. tundrensis</i> , tundra shrew
? <i>S. yukonicus</i> , tiny shrew
<b>CHIROPTERA - Bats</b>
Family <b>Vespertilionidae</b>
○ <i>Myotis lucifugus</i> , little brown bat
<b>CARNIVORA – Carnivores</b>
Family <b>Canidae</b>
○ <i>Canis latrans</i> , coyote
● <i>C. lupus</i> , wolf
● <i>Vulpes vulpes</i> , red fox
Family <b>Felidae</b>
○ <i>Lynx canadensis</i> , Canada lynx
Family <b>Mustelidae</b>
○ <i>Gulo gulo</i> , wolverine
○ <i>Lontra canadensis</i> , northern river otter
○ <i>Martes americana</i> , American marten
○ <i>M. erminea</i> , ermine
○ <i>M. nivalis</i> , least weasel
● <i>M. vison</i> , American mink
Family <b>Ursidae</b>
? <i>U. americanus</i> , American black bear
● <i>U. arctos</i> , brown bear

<b>ARTIODACTYLA - Ungulates</b>
Family <b>Cervidae</b>
○ <i>Alces alces</i> , moose
○ <i>Rangifer tarandus</i> , caribou
<b>RODENTIA – Rodents</b>
Family <b>Sciuridae</b>
● <i>Marmota caligata</i> , hoary marmot
● <i>Spermophilus parryii</i> , arctic ground squirrel
● <i>Tamiasciurus hudsonicus</i> , red squirrel
Family <b>Castoridae</b>
○ <i>Castor canadensis</i> , American beaver
Family <b>Dipodidae</b>
● <i>Zapus hudsonius</i> , meadow jumping mouse
Family <b>Muridae</b>
● <i>Clethrionomys rutilus</i> , N. red-backed vole
○ <i>Dicrostonyx groenlandicus</i> , collared lemming
○ <i>Lemmus trimucronatus</i> , brown lemming
● <i>M. oeconomus</i> , tundra vole
● <i>M. pennsylvanicus</i> , meadow vole
○ <i>Ondatra zibethicus</i> , muskrat
● <i>Synaptomys borealis</i> , N. bog lemming
Family <b>Erethizontidae</b>
○ <i>Erethizon dorsatum</i> , N.A. porcupine
<b>LAGOMORPHA – Pikas &amp; Hares</b>
Family <b>Leporidae</b>
● <i>Lepus americanus</i> , snowshoe hare
○ <i>Lepus othus</i> , Alaskan hare

**TABLE 2.** Number of small mammals sampled at five general localities in *Katmai National Park and Preserve*, Alaska, between 3-23 July 2004. Scientific names of species are listed in Table 1.

SPECIES	GENERAL LOCALITY					<i>TOTALS</i>
	Idavain Lake	Fure's Cabin	Amalik Bay	Murray Lake	Contact Creek	
<b>SHREWS</b>						
Cinereus shrew	5	19	47	9	12	<i>92</i>
Pygmy shrew	1	1				<i>2</i>
Montane shrew		5	173	44	1	<i>223</i>
Tundra shrew		6		6	1	<i>13</i>
<b>RODENTS</b>						
Hoary marmot				1		<i>1</i>
Arctic ground squirrel	2		1	8		<i>11</i>
Red squirrel		2				<i>2</i>
Meadow jumping mouse	3	1	18	10		<i>32</i>
Northern red-backed vole	3	13	14	12	1	<i>43</i>
Tundra vole				9	3	<i>12</i>
Meadow vole	10	4		1		<i>15</i>
Northern bog lemming	2	2		1		<i>5</i>
<b>TOTAL # SPECIMENS</b>						
	<i>26</i>	<i>53</i>	<i>253</i>	<i>101</i>	<i>18</i>	<i>451</i>
<b>TOTAL # SPECIES</b>						
	7	9	5	10	5	<b>12</b>
<b>TOTAL TRAPNIGHTS</b>						
	764	1290	1120	2330	1075	<b>6579</b>

**TABLE 3.** Trapline transects at 5 general localities in *Katmai National Park and Preserve*, Alaska, July 2004. Scientific names of species are listed in Table 1.

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 Red-backed vole, 8 Meadow vole, 2 Meadow jumping mouse, 1 Bog lemming	Wet meadow/tall willow along edge of lake
	2	58.7692°	155.8809°	249	300	3-5 July 2004	266	2 Red-backed vole, 2 Meadow vole, 1 Meadow jumping mouse, 1 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 Red-backed vole, 2 Meadow vole, 2 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 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 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 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 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 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 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 Red-backed vole, 5 Meadow jumping mouse, 1 Arctic ground squirrel	Along coastline with cow parsnip meadows and scattered thickets of tall shrubs
	5	58.1053°	154.4283°	10	75	10-11 July 2004	40	1 Cinereus shrew, 8 Montane shrew, 1 Red-backed vole, 1 Meadow jumping mouse	Estuarine meadow

**TABLE 3.** Trapline transects at 5 general localities in *Katmai National Park and Preserve*, Alaska, July 2004. Scientific names of species are listed in Table 1.

GENERAL LOCALITY Katmai NP& P	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES	VEGETATION TYPE
Murray Lake	1	58.7734°	155.0277°	517	200	13-16 July 2004	168	5 Cinereus shrew, 3 Montane shrew, 1 Tundra shrew, 1 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 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 Red-backed vole, 1 Meadow jumping mouse, 1 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 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 Montane shrew, 1 Tundra shrew, 2 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 Red-backed vole, 1 Tundra vole	Herbaceous/shrub lake shore to herbaceous/shrub thicket edges along northeast-facing hillside

**Table 4.** Relative abundance (captures/100 trap nights) of small mammals in three major vegetation types, *Katmai National Park and Preserve*, Alaska, field season 2004. Scientific names of species are listed in Table 1.

<b>Species</b>	<b>FOREST</b>	<b>SCRUB</b>	<b>HERBACEOUS</b>
<b>Shrews</b>			
Cinereus shrew	0.43	0.92	1.96
Pygmy shrew	0.09	--	0.03
Montane shrew	0.17	1.51	5.40
Tundra shrew	0.26	0.22	0.17
<b>Small Rodents</b>			
Red-backed vole	1.13	0.49	0.59
Tundra vole	--	0.38	0.14
Meadow vole	0.35	0.05	0.28
Bog lemming	0.09	--	0.11
Jumping mouse	0.09	0.22	0.75
<b>All Species</b>	2.60	3.78	9.42
<b>Trap Nights</b>	1152	1851	3576

**Table 5.** 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 are considered “small mammals.”

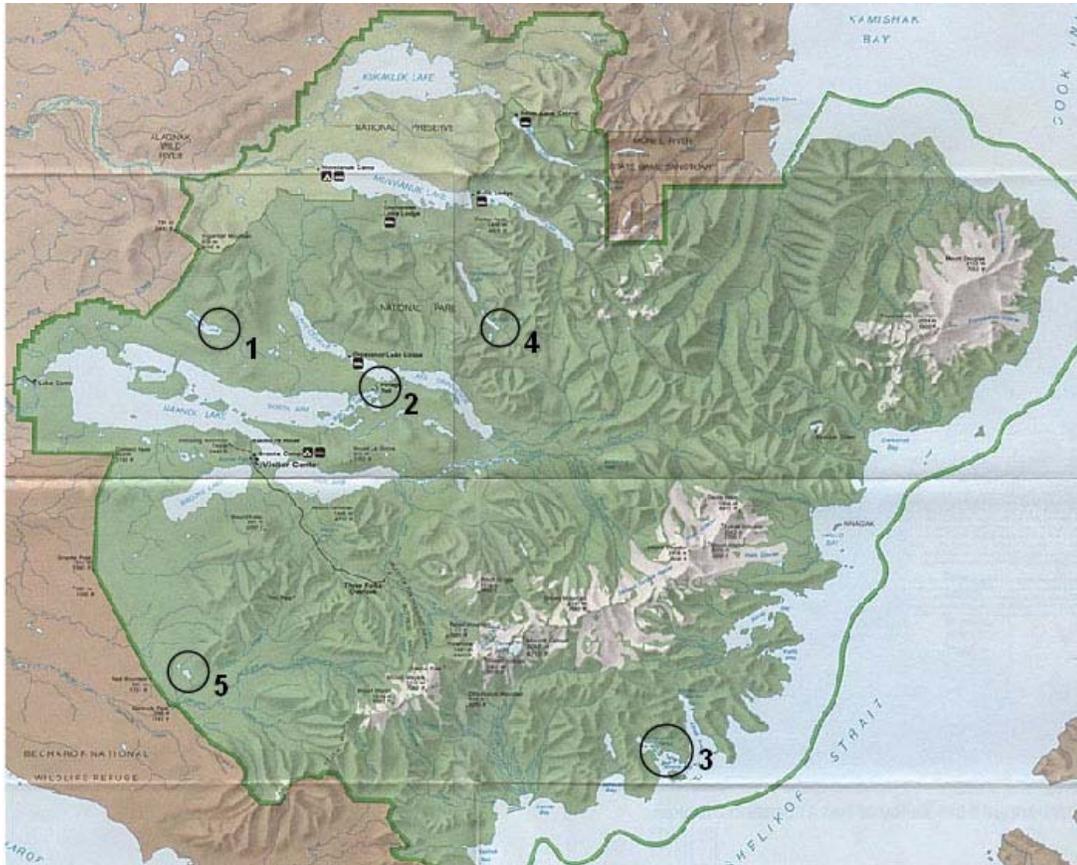
SPECIES	CENTRAL NETWORK			ARCTIC NETWORK					SOUTHWEST NETWORK				Number of Park Units
	YUCH	DENA	WRST	GAAR	KOVA	NOAT	CAKR	BELA	KEFJ	LACL	KATM	ANIA	
<b>SHREWS</b>													
Cinereus shrew <i>Sorex cinereus</i>	●	●	●	●	●	●	●	●	☆	●	●	○	12
Pygmy shrew <i>S. hoyi</i>	●	●	●	●	☆		☆		○	☆	☆		9
Montane shrew <i>S. monticolus</i>	●	●	●	●	●	●	☆	●	☆	☆	●	○	12
Water shrew <i>S. palustris</i>	○	●	☆										3
Tundra shrew <i>S. tundrensis</i>	●	●	☆	☆	●	●	●	●		☆	☆	○	11
Barren ground shrew <i>S. ugyunak</i>				☆	☆	●	●	☆					5
Tiny shrew <i>S. yukonicus</i>	☆	☆	☆	☆	☆		☆	☆		●			8
<b>BATS</b>													
Little brown bat <i>Myotis lucifugus</i>		○	●						○	☆	○		5
<b>CARNIVORES</b>													
Arctic fox <i>Alopex lagopus</i>				●				○	○				3
Coyote <i>Canis latrans</i>	○	●	●	●					○	○	○		7
Wolf <i>C. lupus</i>	●	●	●	●	●	●	●	○	○	○	●	○	12
Red fox <i>Vulpes vulpes</i>	○	●	○	●	○	○	○	●	○	☆	●	○	12
Canada lynx <i>Lynx canadensis</i>	○	●	●	●	○	○	○	○	○	☆	○		10
Wolverine <i>Gulo gulo</i>	●	●	●	●	●	●	●	●	○	○	○	○	12
N. river otter <i>Lontra canadensis</i>	○	●	●	○		○		○	○	○	○	○	10
Am. marten <i>Martes americana</i>	●	●	●	●	○	○			○	☆	○		9
Ermine <i>Mustela erminea</i>	●	●	○	●	○	●	○	○	○	☆	○	○	12
Least weasel <i>M. nivalis</i>	○	●	○	●	○	●	○	●		○	○	●	11
American mink <i>M. vison</i>	○	●	○	●	●	●	○	●	○	○	●	○	12
Am. black bear <i>Ursus americanus</i>	●	●	●	●	○				○	○			7
Brown bear <i>U. arctos</i>	○	●	●	●	○	●	○	●	○	●	●	○	12
<b>UNGULATES</b>													
Moose <i>Alces alces</i>	○	●	●	○	●	○	○	○	○	○	○	○	12
Caribou <i>Rangifer tarandus</i>	●	●	●	●	●	●	●	○		○	○	○	11
American bison <i>Bison bison</i>			○										1
Mtn. goat <i>Oreamnos americanus</i>			●						○				2
Muskox <i>Ovibos moschatus</i>							○	○					2
Dall's sheep <i>Ovis dalli</i>	●	●	●	●	○	●				●			7

**Table 5.** 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 are considered “small mammals.”

SPECIES	CENTRAL NETWORK			ARCTIC NETWORK					SOUTHWEST NETWORK				Number of Park Units
	YUCH	DENA	WRST	GAAR	KOVA	NOAT	CAKR	BELA	KEFJ	LACL	KATM	ANIA	
<b>RODENTS</b>													
N. flying squirrel <i>Glaucomys sabrinus</i>	○	●	○										3
Alaska marmot <i>Marmota broweri</i>				●		○							2
Hoary marmot <i>M. caligata</i>	●	●	●						○	○	☆	○	7
Arctic ground squirrel <i>Spermophilus parryii</i>	●	●	●	●	●	●	●	●		●	●	○	11
Red squirrel <i>Tamiasciurus hudsonicus</i>	●	●	●	●	●				○	●	●		8
Am. beaver <i>Castor canadensis</i>	○	●	○	●	○				○	○	○	○	9
Meadow jumping mouse <i>Zapus hudsonius</i>		☆	○							●	●	○	5
N. red-backed vole <i>Clethrionomys rutilus</i>	●	●	●	●	●	●	●	●	☆	●	●	○	12
Collared lemming <i>Dicrostonyx groenlandicus</i>				☆	☆	●	●	●			○	●	7
Brown lemming <i>Lemmus trimucronatus</i>	●	●	●	●	●	●	●	●		○	○	●	11
Long-tailed vole <i>Microtus longicaudus</i>	●		●										2
Singing vole <i>M. miurus</i>		●	☆	●	☆	●	●	●	○	☆			9
Tundra vole <i>M. oeconomus</i>	●	●	●	●	●	●	●	●	☆	●	●	○	12
Meadow vole <i>M. pennsylvanicus</i>	●	●	●	☆						●	●		6
Yellow-cheeked vole <i>M. xanthognathus</i>	●	●	○	●	●								5
Muskrat <i>Ondatra zibethicus</i>	●	●	○	●	○	●	●	●	○	●	○		11
N. bog lemming <i>Synaptomys borealis</i>	●	●	●	●					○	●	●		7
N. Am. porcupine <i>Erethizon dorsatum</i>	☆	●	●	●	●	●	○	○	○	○	○	○	12
<b>LAGOMORPHS</b>													
Collared pika <i>Ochotona collaris</i>	●	●	●							☆			4
Snowshoe hare <i>Lepus americanus</i>	●	●	●	●	○	●			○	●	●		9
Alaskan hare <i>L. othus</i>								●			○	○	3

**Table 5.** 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 are considered “small mammals.”

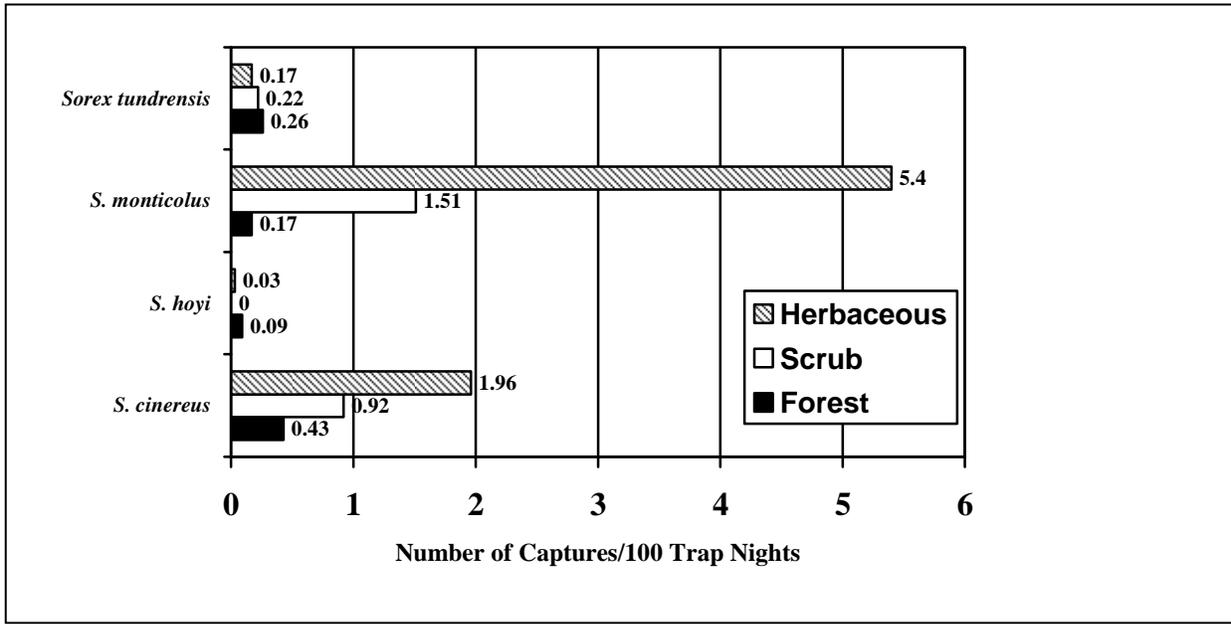
SPECIES	CENTRAL NETWORK			ARCTIC NETWORK					SOUTHWEST NETWORK				Number of Park Units
	YUCH	DENA	WRST	GAAR	KOVA	NOAT	CAKR	BELA	KEFJ	LACL	KATM	ANIA	
Number of Species	37	39	42	37	31	27	25	27	27	36	33	23	
% Vouchered	70%	97%	76%	95%	64%	78%	64%	67%	15%	64%	51%	13%	
Number of “Small Mammal” Species	23	25	26	22	19	16	16	16	13	22	21	14	
% Vouchered	87%	96%	77%	100%	79%	94%	81%	87%	31%	82%	62%	21%	
Inventory Additions	2	2	4	5	5	0	3	2	4	10	3	--	



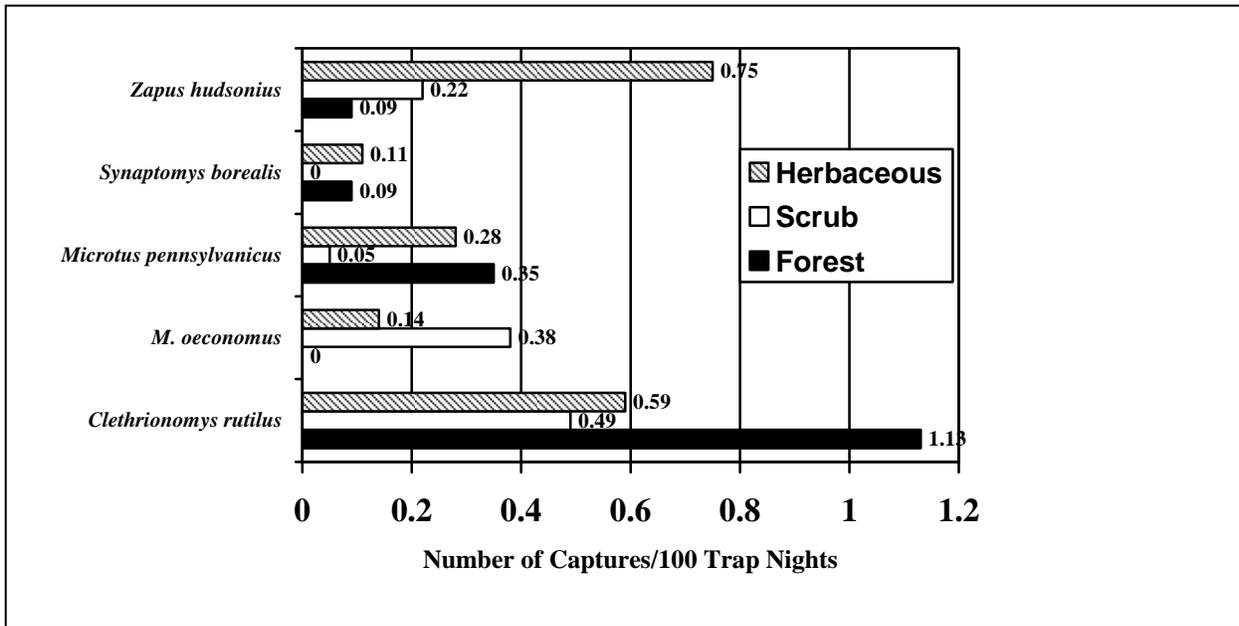
### SAMPLING LOCALITIES

1. 3-5 July 2004: Idavain Lake (base camp: 58.7649° N, 155.8908° W)
2. 5-9 July 2004: NE Naknek Lake, Fure's Cabin (58.6701° N, 155.4290° W).
3. 9-13 July 2004: Amalik Bay, NPS Ranger cabin (58.1050° N, 154.5274° W).
4. 13-19 July 2004: Murray Lake (58.7734° N, 155.0277° W)
5. 19-23 July 2004: Unnamed lakes west of Contact Creek (58.2207° N, 155.9816° W)

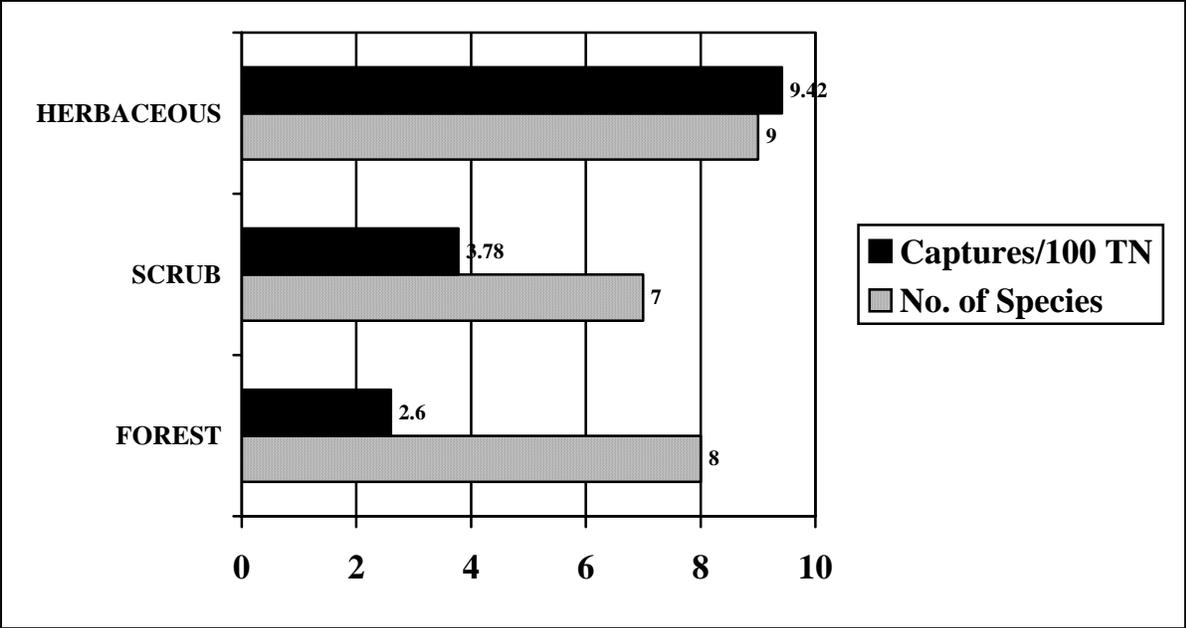
**Figure 1.** General localities in *Katmai National Park and Preserve*, Alaska, sampled for small mammals in 2004.



**Figure 2a.** Relative abundance (captures/100 trap nights) of tundra (*Sorex tundrensis*), montane (*S. monticolus*), pygmy (*S. hoyi*), and cinereus (*S. cinereus*) shrews in three major vegetation types, *Katmai National Park and Preserve*, July 2004.



**Figure 2b.** Relative abundance (captures/100 trap nights) of meadow jumping mouse (*Zapus hudsonius*), northern bog lemming (*Synaptomys borealis*), meadow vole (*Microtus pennsylvanicus*), tundra vole (*M. oeconomus*) and northern red-backed vole (*Clethrionomys rutilus*) in three major vegetation types, *Katmai National Park and Preserve*, July 2004.



**Figure 3.** Relative abundance and species richness of shrews and small rodents in three major vegetation types, *Katmai National Park and Preserve*, Alaska, field season 2004.