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OCCURRENCE AND DISTRIBUTION OF SMALL MAMMALS ON THE GOODNEWS RIVER, SOUTHWESTERN ALASKA

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ABSTRACT—A paucity of data exists on the occurrence, distribution, and abundance of small mammal communities in southwestern Alaska. To add to the understanding of these communities we conducted a comprehensive small mammal survey in southwestern Alaska. We trapped small mammals along the Goodnews River in Togiak National Wildlife Refuge from 26 June to 5 September 1996. Objectives of our study were to determine what small mammal species occur in the Goodnews River area, to determine species distribution in 4 representative habitats during 3 time periods, and to determine ideal time periods to trap small mammals in order to maximize the diversity of species encountered and the number of specimens captured. In 3600 trap-nights we captured 468 specimens including masked shrew (*Sorex cinereus*), pygmy shrew (*S. hoyi*), Alaska tiny shrew (*S. yukonicus*), tundra shrew (*S. tundrensis*), tundra vole (*Microtus oeconomus*), red-backed vole (*Clethrionomys rutilus*), Greenland collared lemming (*Dicrostonyx groenlandicus*), and brown lemming (*Lemmus trimucronatus*). The pygmy shrew, Alaska tiny shrew, Greenland collared lemming, and brown lemming are the 1st representatives of these species from the region to be placed in a museum collection. The willow habitat supported the greatest number of specimens captured (n = 170), while the wet tundra habitat yielded the greatest number of species captured (n = 4). The fall trap period (26 August to 5 September) yielded the greatest number of specimens captured (n = 229), while the spring (26 June to 6 July) and summer trap periods (26 July to 5 August) yielded greatest species diversity. Findings of rare and uncommon species illustrate the need to conduct additional surveys in the region.

Key words: small mammals, survey, Goodnews River, Togiak National Wildlife Refuge, southwestern Alaska

Knowledge of small mammal resources in southwestern Alaska is vague (Nolan and Peirce 1996). Very little attention has been given to the occurrence, distribution, and abundance of small mammal communities in southwestern Alaska, although small mammals are an important component of the biotic environment. Small mammals are a significant food source to avian and mammalian predators (Ehrlich and others 1988). They comprise the diet of short-eared owls (*Asio flammeus*), northern harrier (*Circus cyaneus*), rough-legged hawk (*Buteo lagopus*), sandhill cranes (*Grus canadensis*), red fox (*Vulpes vulpes*), wolves (*Canis lupus*), and brown bears (*Ursus arctos*), which all occur in Togiak National Wildlife Refuge (Togiak NWR) (TNWR CCP 1986).

The distribution and abundance of predators may vary with populations of small mammals (Krebs 1985), and the distribution of avian predators and size of their clutches is positively correlated with the abundance of small-mammal populations (Ehrlich and others 1988). Knowledge of small mammals present in an area and the role they play in ecosystem function is necessary for effective management (Brown 1996).

Historical information on past surveys is southwest Alaska is scant. The region is remote and difficult to access. Logistics, weather, and topography make sampling particularly challenging. Hall (1981) cites no records of specimens captured in Togiak NWR. Peterson and Sigman (1977) documented 12 specimens of the

dusky shrew (*Sorex monticolus*) captured in 2000 trap-nights during a survey at Cape Peirce within the Refuge. Another survey (172 trap-nights) of small mammals at Cape Peirce, similar in size to our study area, yielded 16 specimens total of *Sorex* spp., *Microtus* spp., and meadow jumping mice (*Zapus hudsonius*) (Moran 1994). Neither study, however, documented methodologies or species verification techniques.

Objectives of our study were to 1) determine what small mammal species occur in the Goodnews River area, 2) determine species distribution in 4 representative habitats during 3 time periods, and 3) determine ideal time periods to trap small mammals in order to maximize the diversity of species encountered and the number of specimens captured.

STUDY AREA AND METHODS

Togiak National Wildlife Refuge (NWR) is located in southwestern Alaska west of Dillingham and approximately 695 km from Anchorage. The Goodnews River is approximately 55 river mi long and drains Goodnews Lake in the Ahklun Mountain range southwest to Kuskokwim Bay. The first 30 river miles run through Togiak NWR, and the remaining portion runs through private native corporation land. The river is important habitat for all 5 species of Pacific salmon (*Onchorhynchus* spp.).

The 1.7-million ha refuge is typical of a northern maritime climate characterized by cool temperatures, high humidity, and cloudy skies (Klinkhart 1978). Average temperatures range from 16ºC in the summer to −15°C in the winter. Yearly rainfall averages 53 cm and snowfall varies from 94 to 130 cm (ASCC 1998).

Topography includes mountainous terrain with low-lying tundra and elevations ranging from approximately 60 m to 800 m. Alder (*Alnus* spp.), and alpine tundra dominates mountainous elevations. Along the river the vegetative mosaic is characterized by areas of tussock tundra, willows (*Salix* spp.), shrub, and wet tundra. Tussock tundra is well-drained and is equally dominated by crowberry (*Empetrum nigrum*), blueberry (*Vaccinium uliginosum*), cranberry (*Vaccinium vitis-idaea*), and sedges (*Carex* spp.). Willow areas are dominated by willows of varying age structure with a moss understory and moist but well drained soils. Shrub areas consist mainly of dwarf birch (*Betula nana*) and shrub willow (*Salix* spp.) with lichen (*Cladina* spp.) carpet understory. Wet tundra is dominated by sedges and cotton grass (*Eriophorum* spp.) and has standing water.

We trapped small mammals in 4 habitats near river mile 28 on the Goodnews River (59°17′980″N, 161°06′890″W). Habitats were representative of major vegetative cover types in the region. We used Viereck and others (1992) to classify the habitats as 1) closed tall willow shrub (referred to as willow), 2) open low-mixed shrub sedge tussock tundra (shrub tundra), 3) wet graminoid herbaceous (wet tundra), and 4) tussock tundra (tussock tundra).

Trap design followed JA Cook (University of Alaska Museum Fairbanks, Fairbanks, AK, pers. comm.) and Nolan (1996). We set traps every 15 m along 1 straight line transect per habitat for a total of 20 stations per transect. Each station consisted of 2 museum special snap traps and 1 conical pitfall trap set equidistant around a circle with a 1-m diameter. We baited snap traps with peanut butter and did not bait pitfall traps. Pitfall traps were custom made of galvanized aluminum metal and conically shaped with a 15.25-cm diameter top and 22.86-cm depth.

We trapped small mammals during 3 time periods during the summer of 1996. Trapping periods occurred 26 June to 6 July (spring), 26 July to 5 August (summer), and 26 August to 5 September (fall). Spring, summer, and fall vary yearly and are subjective terms used here to describe trap periods. Because of a shortage of traps, we trapped for 5 d per habitat and trapped 2 habitats at a time. We trapped the willow and shrub tundra habitats for the first 5 d of each trap period and set traps in the remaining 2 habitats for the last 5 d. We checked traps once every 24 h and placed specimens in individual plastic freezer bags. Each bag contained a 3 × 5 index card labeled with date, habitat number, location, latitude and longitude, specimen number, species, collector, and condition of specimen when found (dead or alive). We recorded standard measurements, mass, sex, and breeding condition for each specimen. Specimens were killed using thoracic compression if found alive in traps (G Jarrell, University of Alaska Museum Fairbanks, Fairbanks, AK, pers. comm.). We froze specimens within 3 h of collection and shipped them to cu-

TABLE 1. Number of specimens captured in each time period and habitat and during a survey of small mammals along the Goodnews River, Togiak National Wildlife Refuge, Alaska, 26 June to 5 September 1996.

Specimen	Time period[a]	Willow	Shrub tundra	Wet tundra	Tussock tundra	Total
Sorex spp.	Spring	10	20	2	0	32
	Summer	46	54	21	22	143
	Fall	69	48	23	34	174
Red-backed voles	Spring	15	4	0	0	19
	Summer	10	11	9	0	30
	Fall	18	25	9	2	54
Tundra voles	Spring	2	0	0	0	2
	Summer	10	0	0	0	10
	Fall	0	0	1	0	1
Lemmings	Spring	0	0	0	1	1
	Summer	0	1	1	0	2
	Fall	0	0	0	0	0
Total		180	163	66	59	468

[a] Spring (26 June to 6 July), Summer (26 July to 5 August), Fall (26 August to 5 September)

rators of mammals at the University of Alaska Fairbanks for species verification and archiving.

We used the statistical package S-Plus (Department of Statistics, Carnegie Mellon University, Pittsburgh, PA) to determine statistical significance between counts of specimens and species type, habitat type, and time period. Hypotheses tested were 1) there is no correlation between species captured and habitat type, and 2) there is no correlation between species captured and time period. All shrew species were collapsed into one *Sorex* spp. category and lemming species were collapsed into one lemming category. We used generalized linear models (log linear analysis) (McCullagh and Nelder 1989) with the Poisson distribution to generate models and χ^2 values. Significance level for P was set at 0.05.

Results

Species Occurrence

We captured 468 small mammal specimens from 26 June to 5 September. We captured 4 species of insectivores and 4 species of rodents in 3600 trap-nights including 276 masked shrews (*S. cinereus*), 24 tundra shrews (*S. tundrensis*), 5 pygmy shrews (*S. hoyi*), 3 Alaska tiny shrews (*S. yukonicus*), 103 red-backed voles (*Clethrionomys rutilus*), 13 tundra voles (*Microtus oeconomus*), 1 Greenland collared lemming (*Dicrostonyx groenlandicus*), 2 brown lemmings (*Lemmus trimucronatus*) and 41 unidentified shrews. Shrews comprised 75% and rodents 25% of all captures, respectively. Masked shrews comprised 90% of all *Sorex* spp. identified. Pygmy shrews and Alaska tiny shrews were uncommon; combined, they represented 2% of the shrews identified. The majority of rodents captured (87%) were red-backed voles, followed by tundra voles (11%) and lemmings (2%).

Distribution

We captured shrews and red-backed voles in all habitats surveyed (Table 1). We captured tundra voles in 2 of the 4 habitats and lemmings in 3 of the habitats. Shrews dominated all habitats numerically and were most abundant in the willow habitat.

Trapping in the willow and shrub tundra habitats yielded the greatest numbers of shrews, red-backed voles, and tundra voles. A significantly greater number of specimens was captured in these habitats vs the wet and tussock tundra habitats ($\chi^2 = 8.78$, df = 3, $P = 0.03$). Few tundra voles were ($n = 13$) captured, but 92% of these were captured in the willow habitat.

Statistical analysis indicated a relationship between species captured and habitat type (counts of specimens = species type + habitat type, $\chi^2 = 34$, df = 9, $P < 0.001$). *Sorex* spp. dominated all habitats numerically. The majority of tundra voles were captured in the willow habitat. Captures of red-backed voles were most numerous in willow and shrub tundra habitats. Captures of lemmings were rare in all habitats with only 1 specimen captured in each of the shrub tundra, wet tundra and tussock

tundra habitats. Species diversity was greatest in wet tundra habitat ($n = 4$), while the greatest number of individuals ($n = 170$) was found in willow habitat.

Time Associations

A relationship existed between number of specimens captured and species type and time period (counts of specimens = species type + time period, loglinear analysis, $\chi^2 = 21.83$, df = 6, $P < 0.001$). Overall, a greater number of specimens were captured in the fall ($n = 229$) than the spring ($n = 54$) or summer ($n = 185$). However, spring and summer trap periods yielded greater species diversity because no lemmings were captured in the fall. A significantly greater number of shrews and red-backed voles were captured in the fall versus spring and summer ($\chi^2 = 9.09$, df = 2, $P = 0.01$). The majority of tundra voles ($n = 12$) were captured during the summer.

DISCUSSION

Although limited to a single year, this survey provides valuable information on small-mammal occurrence, relative abundance, and habitat utilization. It adds important data to an almost nonexistent literature on these species in southwestern Alaska. The region is remote and difficult to access. Logistics, weather, and topography make sampling particularly challenging. In Alaska, we are still faced with determining what species exist where, even in the 21st century. The need for continued studies and published literature on occurrence, distribution, and habitat associations of small mammals in Alaska is illustrated by findings of a new species of small mammal as recently as 1993 (Dokuchaev 1997) and by this study in which captures of pygmy shrews and Alaska tiny shrews represent range extensions for these species (Peirce and Peirce 2000a).

Our captures of 3 Alaska tiny shrews are important because only 7 other specimens existed worldwide at the time of our study. Currently, <35 specimens exist in collections worldwide. Twenty-nine specimens are housed at the University of Alaska Fairbanks Museum collection. Other specimens reside at the University of Moscow, Russia (1), and at the Burke Museum, University of Washington, Seattle, WA (3) (G. Jarrell, University of Alaska Museum Fairbanks, Fairbanks, AK, pers. comm.). Captures of lemmings are scientifically valuable because although known to exist in the region, representative specimens from the area are rare.

Meadow jumping mice were documented in 1995 in *Calamogrostis* spp. grass microhabitat (Peirce and Peirce 2000b). These trap sites (Peirce and Peirce 2000b) were 50 m from the current trap site located in willow habitat. Reasons for lack of captures in this study remain unknown but may be due to habitat specificity in meadow jumping mice. Shrews dominated numerically and were found in all areas surveyed, which is consistent with other studies (Getz 1961; Long 1972; Hazard 1982; Jones and Birney 1988).

No systematic studies of small mammals have been conducted in southwestern Alaska, and it is possible we captured few tundra voles and lemmings because they were at a low point in their population cycle or few exist here typically. Our pitfall traps may have been too shallow to capture all small mammals successfully as 1 lemming almost escaped by jumping out of the trap. The fall trap period yielded the greatest number of captures during this study, consistent with other findings (Churchfield 1990). Spring and summer trap periods yielded higher numbers of tundra voles and lemmings.

Trapping efforts along the Goodnews River yielded rare and unusual specimens and additional efforts would most likely yield similar results. For general surveys, we recommend trapping in additional areas in this region during late summer and early fall when animal numbers are likely at their highest to maximize number of captures. Alternately, trapping during periods throughout the summer to maximize the likelihood of capturing rare and uncommon species would be more appropriate for an inventory.

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