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Authors: Rickart, Eric A., Robson, Shannen L., and Heaney, Lawrence R.

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MAMMALS OF GREAT BASIN NATIONAL PARK, NEVADA: COMPARATIVE FIELD SURVEYS AND ASSESSMENT OF FAUNAL CHANGE

Eric A. Rickart[1], Shannen L. Robson[1,2], and Lawrence R. Heaney[3]

ABSTRACT.—Great Basin National Park in east central Nevada encompasses most of the southern Snake Range including Wheeler Peak, which at 3980 m is the highest peak in the interior Great Basin. The original detailed surveys of the mammals of this region were made between 1929 and 1939 by field crews from the Museum of Vertebrate Zoology, University of California, Berkeley. Between 2000 and 2003, we conducted additional field surveys of mammals in the park region in conjunction with the National Park Service Inventory and Monitoring Program. Here, we provide a comprehensive report on the mammal fauna of the park and its immediate surroundings based on a review of historical records and recent field surveys. We document 48 native species of mammals in the region. In addition, there are 7 species that potentially occur within the park, 4 species of questionable occurrence, 6 species formerly present but now extirpated, and 4 nonnative species. We provide a short account for each species that summarizes ecology and local distribution and lists both historical and recent records of occurrence. Through comparative analysis of historical and recent data, we examine faunal changes in the park region during the past 70 years. Based on our results, we make some general recommendations for future resource management.

Key words: mammals, Great Basin National Park, Nevada, Mammalia, faunal survey, faunal change.

The Great Basin is a vast interior drainage system of more than 500,000 km^2 bounded by the Sierra Nevada and southern Cascade Mountains to the west, the Wasatch Range to the east, and by the Columbia and Colorado river drainages on the north and south, respectively (Grayson 1993). The complex geography of the Great Basin has resulted in great biological diversity, which has fostered investigations into the natural history, ecology, and conservation of the region's biota (Hall 1946, Brown 1971, 1978, Grayson 1993, Chambers and Miller 2004). During the past century, ecological communities in the Great Basin have undergone dramatic change due, in large measure, to direct human activities. The region is now recognized as one of the most threatened ecosystems in North America (Noss et al. 1995).

Established in 1987, Great Basin National Park is the only national park located entirely within the physiographic Great Basin. Located in White Pine County in east central Nevada, the park includes much of the southern portion of the Snake Range (Fig. 1). It encompasses one of the most dramatic elevational gradients within the interior Great Basin, from about 1770 m on the eastern boundary to the summit of Wheeler Peak, which at 3980 m is the 2nd-highest peak in Nevada and the highest point in the central Great Basin. Most of the park's 31,195 ha encompasses mid- and high-elevation habitat, including more than 2800 ha above 3000 m elevation (National Park Service 2001).

The earliest historical reference to mammals of the park region is from the Simpson military expedition of 1859, which passed through the area while mapping an overland route from Utah to California (Simpson 1876). The 1st comprehensive zoological surveys were conducted between 1929 and 1939 by field crews from the University of California, Berkeley, Museum of Vertebrate Zoology (MVZ) and involved extensive collections from the Snake Range and adjacent Spring and Snake valleys (Hall 1946). In subsequent years, other zoologists made minor collections or produced brief reports on regional mammals.

During the summers of 2000, 2002, and 2003, we surveyed nonvolant mammals at sites in the southern Snake Range, including areas throughout much of Great Basin National Park and adjacent areas in the Snake Valley. The 2000 survey was conducted in the same general

[1]Vertebrate Collections, Utah Museum of Natural History, University of Utah, Salt Lake City, UT 84112. E-mail: rickart@unmh.utah.edu
[2]Department of Anthropology, University of Utah, Salt Lake City, UT 84112. E-mail: robson@umnh.utah.edu
[3]Department of Zoology, Field Museum of Natural History, Chicago, IL 60605. E-mail: heaney@fieldmuseum.org

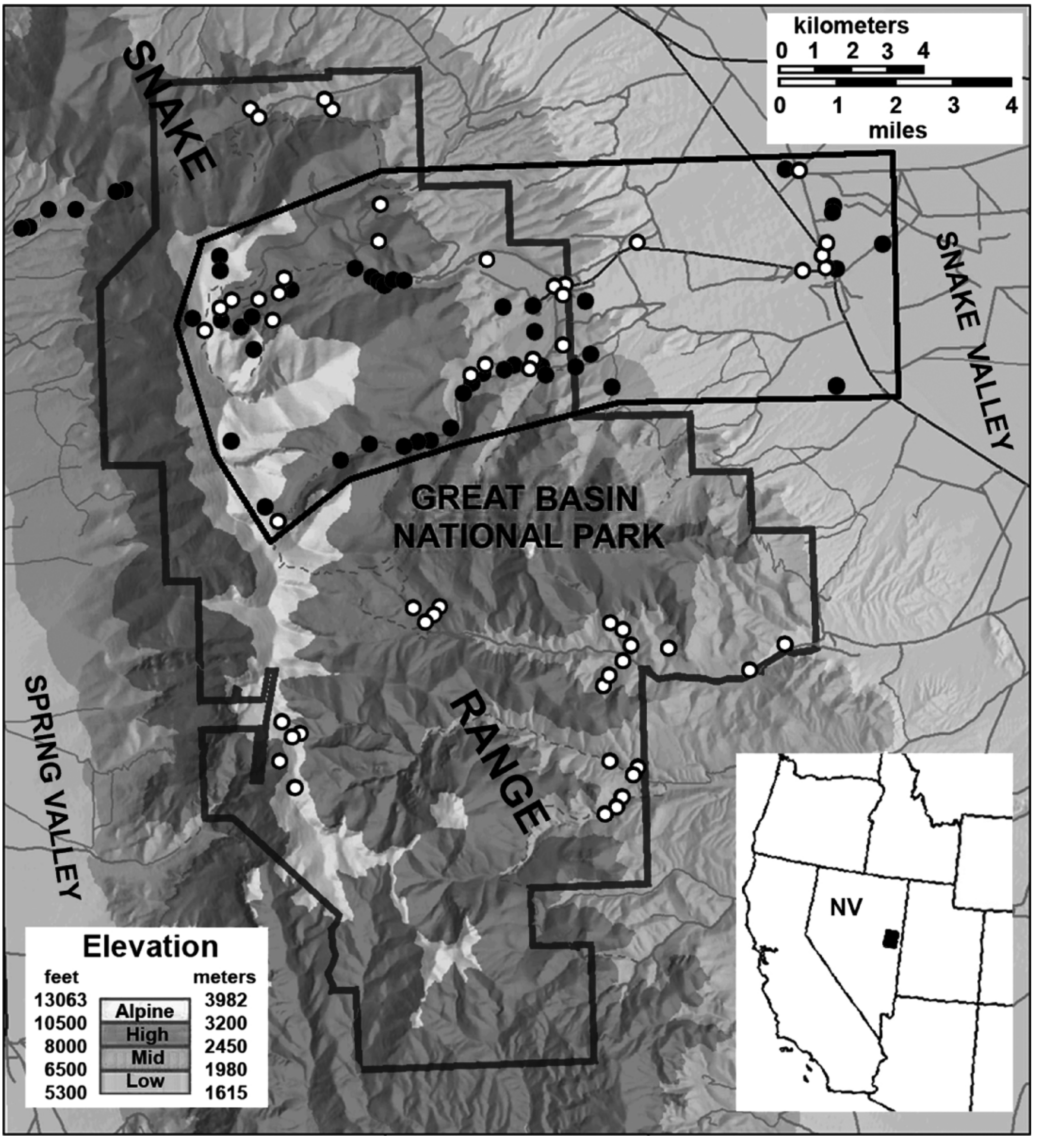

Fig. 1. Map of Great Basin National Park, Nevada, and immediate surrounding areas, with localities for historical (filled circles) and recent (open circles) faunal surveys. Polygon encloses localities included in the landscape-level analysis of faunal change.

area surveyed in the 1920s and 1930s by field crews from the Museum of Vertebrate Zoology (Hall 1946) to obtain a more complete assessment of patterns of species richness and relative abundance along the entire elevational habitat gradient (Rickart 2001). Surveys in the following years were conducted as part of the National Park Service Inventory and Monitoring Program (National Park Service 1999, 2001) to develop a comprehensive list of the mammals occurring in the park, to gather basic information on their conservation status, and to establish a basis for future management efforts (Rickart and Robson 2005).

Herein we provide a comprehensive summary of available information on the mammals of Great Basin National Park based on a review of published records, historical museum specimens, and our recent field surveys. We discuss the present-day fauna in the context of historical biogeography and the Quaternary fossil record of the region. We also conduct a comparative analysis of records from the early MVZ surveys with results from our surveys to investigate historical changes in local mammal communities during the past 70 years. Finally, we discuss factors relating to long-term management of biodiversity in the park.

STUDY AREA

Great Basin National Park is located entirely within the southern portion of the Snake Range, in White Pine County along the eastern border of Nevada (Fig. 1). As with most mountain ranges of the Great Basin, the Snake Range is oriented along a north–south axis. It is divided into northern and southern segments by Sacramento Pass (elevation 2180 m). Because the drainage divide is nearer the western flank, the transverse profile of the range is asymmetric: the western flank is steep and lacks foothills, whereas the eastern slope is less abrupt and has extensive foothills. The range exhibits a nearly complete stratigraphic series of early Cambrian to Pennsylvanian rocks (principally shale, limestone, dolomite, and quartzite). Orogeny involved initial thrust-faulting during the late Mesozoic or early Tertiary, followed by granitic intrusion and subsequent faulting in the middle and late Tertiary. During the Pleistocene, glaciers developed at higher elevations along with a pluvial lake in adjacent Spring Valley. Quaternary deposits of sand and gravel have formed alluvial fans in association with stream channels on the eastern and western flanks of the range (Drewes 1958).

The local elevational gradient of nearly 2300 m from the floor of Spring Valley to the summit of Wheeler Peak is the most extensive in the interior Great Basin (Grayson 1993). The extreme variation in temperature and moisture across this gradient, coupled with geological and edaphic complexity, has resulted in a diverse range of habitats within the park region. Major plant associations (Eddleman and Jaindl 1994) are divisible into 4 general elevation zones:

(1) low-elevation desert shrub below 1950 m, consisting of xeric shrub communities dominated by greasewood (*Sarcobatus vermiculatis*), shadscale (*Atriplex confertifolia*), saltbush (*Atriplex canescens*), blackbrush (*Coleogyne ramosissima*), and big sagebrush (*Artemisia tridentata*); and riparian habitat dominated by willows (*Salix* spp.);

(2) mid-elevation woodland and shrub, 1951–2450 m, consisting of communities dominated by piñon pine (*Pinus monophylla*), juniper (*Juniperus osteosperma* and *J. scopulorum*), curlleaf mountain-mahogany (*Cercocarpus ledifolius*), quaking aspen (*Populus tremuloides*), and sagebrush (*Artemisia tridentata*); and riparian areas dominated by willows (*Salix* spp.), narrowleaf cottonwood (*Populus angustifolia*), and water birch (*Betula occidentalis*);

(3) high-elevation forest, 2451–3200 m, consisting of subalpine forests of Engelmann spruce (*Picea engelmannii*), white fir (*Abies concolor*), and Douglas-fir (*Pseudotsuga menziesii*); and montane meadows dominated by perennial grasses, sedges, and forbs;

(4) alpine forest and tundra, above 3200 m, consisting of forest, krumholtz, and tundra communities near treeline and above, with limber pine (*Pinus flexilis*), bristlecone pine (*Pinus longaeva*), dwarf juniper (*Juniperus communis*), currants (*Ribes* spp.), and herbaceous perennials.

During the Pleistocene, cycles of climate change in the Great Basin caused elevational shifts in vegetation (Grayson 1993). Presumably, this produced cycles of relative connectivity and isolation between highland areas, with resultant episodes of colonization and localized extirpation in the mountain systems of this region. Throughout the Holocene, these mountains remained habitat islands, sustaining plant and animal populations largely isolated from each other by intervening arid lowlands. As a result, mountain ranges in relatively close proximity may support very distinctive biotas. This is certainly true for the nonvolant mammal faunas, in which many taxa have very uneven distributions across neighboring mountain systems (Lawlor 1998, Rickart 2001).

Although it is located in one of the more remote and unpopulated sections of the lower United States, the park region nevertheless has experienced significant human impacts since the late 19th century (Unrau 1990). The effects of disturbance on the local ecology by humans and domesticated animals over the past century are both significant and long lasting.

METHODS

Faunal Records

We gathered information on the distribution and relative abundance of mammals from museum collection records, published literature, unpublished park documents and reports, and recent field surveys conducted by the authors and colleagues. In addition to records regarding mammals from within the park itself, we gathered information from the broader region to identify species that potentially could occur within the park. We defined the park region to encompass additional areas within the Snake Range (including the northern portion north of Sacramento Pass) and adjacent Snake and Spring valleys east and west of the Snake Range (Fig. 1). Records from outside the park boundaries are marked with an asterisk.

Most information on occurrence patterns of mammals comes from museum specimen records. These were accessed through the Mammal Networked Information System (MaNIS), a web-based network of North American mammal collections (Wieczorek 2006). MaNIS affiliate collections that house historical specimens from the park region include (in order of decreasing number of records) the Museum of Vertebrate Zoology, University of California, Berkeley (MVZ); Utah Museum of Natural History, University of Utah (UMNH); Burke Museum, University of Washington (UWBM); Museum of Southwestern Biology, University of New Mexico (MSB); San Diego Natural History Museum (SDNHM); Bell Museum of Natural History, University of Minnesota (MMNH); Michigan State University Museum (MSU); Museum and Biodiversity Center, University of Kansas (KU); Museum of Zoology, University of Michigan (UMMZ); and Royal Ontario Museum (ROM). Historical records listed for species accounts include numbers of specimens along with institutional acronyms.

Additional records of mammals were taken from the literature, primarily from Hall (1946), who assembled an exhaustive and comprehensive faunal report on the mammals of Nevada, including detailed accounting of known specimen and sight records within the park region before 1945. Recent records for bats are from Ports and Bradley (1996) and Krejca and Taylor (2003). We included sightings and sign records by park staff and visitors (Allan 2004; park staff, personal communication). For records not supported by voucher specimens, we gave the most credence to reports from trained professionals and to instances involving repeated observation of species that can be identified unambiguously.

Regional prehistoric (Quaternary) records of extant mammals were summarized from published reports on excavated cave deposits from sites within the park region including Lehman Caves (Ziegler 1964), Snake Creek Cave (Barker and Best 1976), Smith Creek Cave (Miller 1979, Thompson and Mead 1982, Mead et al. 1992) in the Snake Range, and Crystal Ball Cave (Heaton 1990) in the Snake Valley. We did not verify identifications presented in these reports; however, most of the prehistoric records were extensively reviewed by Grayson (1987, 1993). We did not include records for extinct species.

Field Methods

Our recent field surveys in the park region involved directed sampling in a broad range of microhabitats at local sites to gather basic information on local diversity and relative abundance of species (Wilson et al. 1996). This is the same general approach used in early regional surveys (Hall 1946, 1981). We used a mixture of snap traps (Museum Special and Victor rat traps), Sherman live traps, and Macabee gopher traps to capture small mammals. Small shrews were principally captured in pitfall traps constructed from aluminum beverage cans (Rickart and Heaney 2001). Separate trap lines of 5–50 traps were placed in areas of relatively uniform habitat and were operated for 3–5 consecutive nights. Traps were placed in runways, beside fallen logs, by burrow openings, or in other locations with signs of small mammal activity, and were baited with a mixture of oatmeal and peanut butter (snap traps) or mixed bird seed (live traps). Pitfall traps were not baited, but over time, captured insects probably increased the traps' effectiveness for capturing shrews. All traps were examined each morning and late afternoon. Relative trapping effort was measured as cumulative trap-nights (1 trap-night equaling 1 trap set for 24 hours). Live-trapped animals were marked and released at the point of capture after positive species identification. Animals captured in snap traps were prepared as voucher specimens and are housed at UMNH and at the Field Museum, Chicago, Illinois (FMNH). Identifications of specimens at FMNH and UMNH were verified by the authors. Taxonomic nomenclature follows Wilson and Reeder (2005). Within the text, elevations are reported in meters. Historical records originally expressed in feet have been converted to meters with the original English measurements reported in parentheses.

Faunal Change

To investigate recent historical changes in the small mammal fauna, we compared records from early MVZ surveys (1929–1939) to our recent (2000–2003) surveys undertaken within the same general region: a section of the eastern slope of the southern Snake Range extending from the floor of the Snake Valley to the crest of the range near Wheeler Peak (Fig. 1). Because most historical localities could not be located with great precision, our recent fieldwork seldom involved resurveys of precise collection localities. Accordingly, historical-recent comparisons were made at a broader "landscape" scale by pooling data from localities falling within 4 elevation zones: (1) low-elevation sites below 1950 m encompassing sites in the valley floor, foothills, and riparian areas along the lower portions of Lehman and Baker creek drainages; (2) mid-elevation sites between 1951 and 2450 m in the Baker and Lehman creek drainages; (3) high-elevation localities between 2451 and 3200 m in the Lehman and Baker creek drainages; and (4) localities in the alpine zone above 3200 m surrounding the headwaters of these drainages. Comparisons were limited to small taxa (<500 g) inventoried both historically and recently with standard mammal traps (i.e., modern records of shrews from pitfall sampling were excluded because this technique was unknown to early collectors).

For each elevation zone, we assessed temporal changes in the mammal fauna by comparing relative abundance of species within pooled samples from historical localities (specimen counts) and recent surveys (number of captures). Based on standard field protocols, the use of historical specimen counts as a proxy for actual capture frequencies is justified. In general, uncommon species were saved whenever they were collected, and although some specimens of abundant species were discarded, they were still represented by larger numbers (Hall 1946, 1981). Therefore, it is reasonable to assume that specimen counts provide good general estimates of relative abundance. This is especially true for samples representing pooled localities.

Temporal changes in relative abundance were evaluated with chi-square tests and graphically through either rarefaction (Solow and Roberts 2006) or bootstrap procedures (Efron and Tibshirani 1986). Species absent in a single time interval were included in the chi-square analysis under the assumption that sampling was sufficient to demonstrate true absence or extreme rarity. This assumption enabled all species across time intervals to be included in the analysis. Rarefaction accounts for different sample sizes (total number of individuals), permitting the direct comparison of abundance over time (Legendre and Legendre 1998). For recent samples, expected chi-square frequencies are based on those from historical samples and assumed the same total abundance. Species absent in the historical time interval were not included in the rarefaction, but were included in the resulting graphs to indicate changes in presence and absence over time. For both bootstrap and rarefaction methods, 1000 iterations generated 95% confidence intervals around mean abundance values of each species. Further assessments were made by comparing the rank abundance of species.

NATIVE MAMMALS OF CONTEMPORARY OCCURRENCE

We located 893 historical (pre-1990) specimen records representing 48 species of mammals collected from the greater park region. Of these, 848 records (95%) are from a single source, the Museum of Vertebrate Zoology, University of California (MVZ). A total of 390 specimens representing 31 species were collected from localities now within the park boundaries. Most of these represent specimens collected between 1929 and 1939 from sites in the Baker and Lehman creek drainages. The 2000–2003 surveys we conducted covered a broad elevational range in the park region and included the entire spectrum of local habitats. Collectively, they involved 4379 trap-nights and yielded 642 captures representing

26 species, from which 520 voucher specimens were saved. From all sources of information, 64 species of native mammals have been recorded from the greater park region (49 from within the park itself). Information on each is summarized in the following accounts.

Order Lagomorpha

Brachylagus idahoensis
(Merriam 1891)

Pygmy Rabbit

This species, which is endemic to the Great Basin, is restricted to areas dominated by big sagebrush at lower elevations on valley floors and bajadas (Green and Flinders 1980). The only specimen record from the park region is from Spring Valley southwest of Osceola; additionally, Hall (1946) reported a sighting from Baker Creek. During our recent surveys, small rabbits observed in sagebrush habitat on the eastern margin of the park might have included pygmy rabbits, but may well have been young *Sylvilagus nuttalli* that were documented in this area. We consider records based on sightings or sign records to be equivocal. Nevertheless, it is possible that this species occurs in areas dominated by big sagebrush at low to mid-elevations within and surrounding the park. There is considerable unevenness in the local distribution and abundance of pygmy rabbits, and they are threatened by habitat modification and fragmentation (Flinders 1999). Late Quaternary records indicate that pygmy rabbits declined with the spread of piñon-juniper woodland (Grayson 2006), mirroring a historic trend of increasing piñon-juniper that may, in part, explain the recent decline of this species. Pygmy rabbits and other species associated with sagebrush habitat might benefit from management plans to reverse the spread of piñon-juniper habitat in the park (Great Basin National Park 2003)

HISTORICAL RECORDS.—Spring Valley, 11.3 km SW Osceola, 1860 m (6100 ft), 1 MVZ, collected 1929*; Baker Creek, 1981 m (6500 ft), sighting reported in Hall 1946.

RECENT RECORDS.—none.

Lepus californicus Gray 1837

Black-tailed Jackrabbit

Black-tailed jackrabbits are abundant throughout the Great Basin (Zeveloff 1988) and occupy a variety of open, low-elevation habitats (Best 1996). This species is commonly observed in open desert and woodland habitats at low to mid-elevations in the park region. During our surveys black-tailed jackrabbits were often sighted from 1860 m (in desert shrub habitat) to above 2440 m (in mixed juniper and mountain-mahogany woodland). At least occasionally, jackrabbits occur at much higher elevations; in June 2003 an individual was observed crossing a snowfield near tree line at 3230 m (10,600 ft).

HISTORICAL RECORDS.—3.2 km E Smith Creek Cave, Mt. Moriah, 1707 m (5600 ft), 1 MVZ, collected 1937*.

RECENT RECORDS.—1.6 km S, 3.0 km E Lehman Caves Visitors Center, 1875 m (6150 ft), sighting reported 2000; 0.5 km N, 1 km E Lehman Caves Visitors Center, 2005 m (6575 ft), sighting reported 2000; 2.8 km N, 3.8 km W Lehman Caves Visitors Center, 2590 m (8500 ft), sighting reported 2000; near north fork of Baker Creek, 3230 m (10,600 ft), sighting reported 2003.

Sylvilagus audubonii (Baird 1858)

Desert Cottontail

Desert cottontails range throughout the southern portion of the Great Basin, achieving their northernmost limit in Nevada in the park region (Hall 1981). They occur in desert shrub, piñon-juniper, and riparian habitats at low elevations (Zeveloff 1988). There are no museum voucher records from within the park, but the species has been documented at sites in the northern Snake Valley east of Mt. Moriah.

HISTORICAL RECORDS.—3.2 km E Smith Creek Cave, 1707 m (5600 ft), 2 MVZ, collected 1937*; 6.4 km E Smith Creek Cave, 1 MVZ, collected 1937*.

RECENT RECORDS.—none.

Sylvilagus nuttallii (Bachman 1837)

Mountain Cottontail

The mountain cottontail occurs in a wide variety of habitats over a very broad elevational range from sagebrush flats to subalpine coniferous forest (Zeveloff 1988). Historical records and recent observations indicate that it is abundant in the park. Most common at low to mid-elevations, it has a broad elevational range. A specimen from 3170 m (10,400 ft) in the north Snake Range represents the high-elevation record for the species (Hall 1946).

HISTORICAL RECORDS.—Lehman Caves, 2195 m (7200 ft), 1 MVZ, collected 1929; Lehman Creek, 2530 m (8300 ft), 1 MVZ, collected 1929; Baker Creek, 2590 m (8500 ft), 1 MVZ, collected 1929; Snake Creek, 2590 m (8500 ft), 1 MVZ, collected 1963; 1.6 km E Mt. Moriah, 3170 m (10,400 ft), 1 MVZ, collected 1937*.

RECENT RECORDS.—0.8 km W Baker, 1655 m (5430 ft), 1 UMNH, collected 2002*; 2.8 km N, 3.8 km W Lehman Caves Visitors Center, 2590 m (8500 ft), 1 FMNH, collected 2000.

Order Soricomorpha

Sorex merriami Dobson 1890

Merriam's Shrew

In 1983 a single specimen of Merriam's shrew was collected near Baker, east of the park boundary. This widespread but seemingly uncommon species occurs in relatively arid habitats, including sagebrush, arid grassland, and montane shrub communities (Fitzgerald et al. 1994, Armstrong 1999). Although recent pitfall trapping surveys in suitable habitat along Baker, Lehman, and Snake creeks failed to document this species, the proximity of the 1 known record suggests that, although rare, it may occur throughout much of the park region.

HISTORICAL RECORDS.—3.2 km S Baker, 1676 m (5500 ft), 1 MVZ, collected 1983*.

RECENT RECORDS.—none.

Sorex palustris Richardson 1828

American Water Shrew

Water shrews are restricted to riparian habitat, usually along permanently flowing streams at mid- to high elevations (Beneski and Stinson 1987). Although records of occurrence span a broad elevational range, data suggest that water shrews are uncommon in the park region. Despite considerable trapping effort in suitable habitat along several stream drainages, recent surveys produced only 1 record from the upper reaches of Lehman Creek. Past activities in the park region, including stream diversions, extirpation of beavers, and introduction of nonnative trout (potential predators), have certainly affected the riparian habitats occupied by water shrews, causing an alteration of their distribution and relative abundance.

HISTORICAL RECORDS.—Baker Creek, 3383 m (11,100 ft), 3 MVZ, collected 1939; Lehman Creek, 2286 m (7500 ft), 1 MVZ, collected 1929; Hendry Creek, 2.4 km E Mt. Moriah, 2774 m (9100 ft), 7 MVZ, collected 1937*.

RECENT RECORDS.—Lehman Creek, 2972 m (9750 ft), 1 FMNH, collected 2000.

Sorex tenellus Merriam 1895

Inyo Shrew

Throughout its geographic range there are relatively few records of the Inyo shrew. In part this may reflect the difficulty of capturing these tiny shrews using traditional trapping methods (Hoffmann and Owen 1980, Rickart and Heaney 2001). However, a single specimen of this poorly known species was collected in July 2000 along the south fork of Lehman Creek at 3018 m (9900 ft) elevation and represents a significant distributional extension about 200 miles into the central Great Basin (Rickart et al. 2004). This specimen was taken in a pitfall trap in rocky, streamside habitat in spruce-fir forest. Several *Sorex vagrans* also were taken at this locality. Elsewhere, Inyo shrews have been found in a wide variety of habitats from piñon-juniper woodland to high-elevation alpine meadows (summarized by Hoffmann and Owen 1980). The species may have a relatively broad distribution within the park, but apparently it is uncommon.

HISTORICAL RECORDS.—none.

RECENT RECORDS.—South fork Lehman Creek, 0.3 km S, 0.2 km W Wheeler Peak Campground, 3018 m (9900 ft), 1 UMNH, collected 2000.

Sorex vagrans Baird 1857

Vagrant Shrew

Vagrant shrews have been captured in a wide variety of habitats throughout their range (Gillihan and Foresman 2004). In the Intermountain region, this species generally is most common at low to mid-elevations (Zeveloff 1988), but on many of the isolated mountain ranges in the interior Great Basin, it occurs at high elevations as well (Rickart 2001). This is true in the park region, where it has been documented across an elevational range of more than 1219 m (4000 ft; Table 1). Vagrant shrews occupy a wide variety of microhabitats but are most common in relatively moist situations with abundant invertebrates. In recent surveys the species was

TABLE 1. Elevational distribution of nonvolant small and medium-sized mammals in the Great Basin National Park region by 150-m intervals (labeled by midpoint) within 4 elevation zones. Historical records (H) are from 1929 to 1983, and recent records (R) are from 2000 to 2003.

	Low elevation (1600–1950 m)			Mid-elevation (1951–2450 m)			High elevation (2451–3200 m)					Alpine (3201–3950 m)				
Species	1600	1750	1900	2050	2200	2350	2500	2650	2800	2950	3100	3250	3400	3550	3700	3850
Brachylagus idahoensis			H													
Sylvilagus audubonі		H														
Sylvilagus nuttallii	R				H		H,R	H			H					
Lepus californicus		H	R	R			R					R				
Sorex merriami	H															
Sorex palustris					H				H	R			H			
Sorex tenellus										R						
Sorex vagrans				H,R	R	R	R	H,R		H,R	R		H			
Vulpes macrotis				H												
Bassariscus astutus				R	R	R	R									
Mustela erminea								H					H,R			
Mustela frenata				H		R										
Mephitis mephitis										R						
Spilogale gracilis		H														
Tamias dorsalis			H	H,R	H,R	H,R										
Tamias minimus	H	H	H	H	H	H	H,R	H	R							
Tamias umbrinus			H	H	H	H,R	H,R	H	H,R	H,R	H,R	R	H			
Ammospermophilus leucurus	R	H	H,R	H												
Spermophilus lateralis				H		H	H	H			H,R	H,R	H			R
Spermophilus mollis	H,R	H	H													
Spermophilus variegatus		H			H,R	H,R	H		R							
Marmota flaviventris				R	R		R	R	H,R						H	
Chaetodipus formosus		H	H													
Perognathus longimembris	R	H														
Perognathus parvus	R	H	H,R	H,R	H,R	H,R	H									
Dipodomys microps	H,R	H	H,R													
Dipodomys ordii	R	H	H	H												
Microdipodops megacephalus		H	H													
Thomomys bottae				H	H		H,R	H		H,R	H					
Reithrodontomys megalotis	R	H	H,R	H,R	H,R	H,R										
Peromyscus crinitus		H	H	H,R	H,R	H										

TABLE 1. Continued.

Species	Low elevation (1600–1950 m)			Mid-elevation (1951–2450 m)			High elevation (2451–3200 m)					Alpine (3201–3950 m)				
	1600	1750	1900	2050	2200	2350	2500	2650	2800	2950	3100	3250	3400	3550	3700	3850
Peromyscus maniculatus	R	H	R	H,R	H,R	H,R	H,R	R	R	H,R	H,R	H,R	H,R	H		
Peromyscus truei	R			H,R	H,R	R	R					R				
Onychomys leucogaster	H,R	H	H													
Neotoma cinerea					H	H	H		R			H				
Neotoma lepida		H	H,R	H	H,R	H	H	H	H							
Microtus longicaudus				H,R	R	H,R	H	H	H	H,R	H,R	H,R	H			
Microtus montanus	H	H	H	H	R	H,R	R			H	R					
Lemmiscus curtatus	H			H	H					H						
Ondatra zibethicus	H															
Number of species (150-m interval).	16	19	18	22	20	16	18	11	9	10	8	7	7	1	1	1
Number of species (elevation zone)		27			26				23					11		

common along stream margins, in wet meadows adjacent to springs, and on moist forest floors. The majority of recent captures were made using pitfall traps, which are much more effective for capturing small shrews than standard small mammal traps (Rickart and Heaney 2001). Because of this, the wide disparity in numbers recorded during historical and recent surveys probably is attributable to improved survey methods rather than to changes in relative abundance.

HISTORICAL RECORDS.—Spring Valley, 2 MVZ, collected 1929*; Baker Creek, 2012 m (6600 ft), 1 MVZ, collected 1929; Baker Creek, 2743 m (9000 ft), 2 MVZ, collected 1930; Baker Creek, 3383 m (11,100 ft), 4 MVZ, collected 1939; Lehman Creek, 2941 m (9650 ft), 1 UMNH, collected 1969.

RECENT RECORDS.—Baker Creek, 2271–2301 m (7450–7550 ft), 6 UMNH, collected 2000; Lehman Creek, 2004 m (6575 ft), 1 UMNH, collected 2002; Lehman Creek, 2972–3109 m (9750–10,200 ft), 12 FMNH, 10 UMNH, collected 2000; 0.1 km N Stella Lake, 3155 m (10,350 ft), 1 UMNH, collected 2000; Snake Creek Canyon, 2545–2598 m (8350– 8525 ft), 12 UMNH, collected 2002; Strawberry Creek, 2118– 2423 m (6950–7950 ft), 2 UMNH, collected 2002.

Order Chiroptera

Antrozous pallidus (Le Conte 1856)

Pallid Bat

Pallid bats are found in a broad range of habitats from low desert to coniferous forest and utilize a wide variety of roosting sites (Hermanson and O'Shea 1983, Anonymous 2004). Records from the park region represent the northern limit of the known distribution of this species within the central Great Basin (Ports and Bradley 1996).

HISTORICAL RECORDS.—Rose Guano Cave, W slope of Snake Range, 2012 m (6660 ft), 1 UMNH, collected 1965*.

RECENT RECORDS.—Snake Creek Cave, 1890 m (6200 ft), Ports and Bradley 1996*.

Corynorhinus townsendii (Cooper 1837)

Townsend's Big-eared Bat

Big-eared bats occur in a wide variety of habitats across a broad elevational range (Kunzand Martin 1982). They utilize a variety of roosting sites but are particularly dependent on caves and mines for hibernacula and maternity sites (Zeveloff 1988, Sherwin et al. 2000). The species has been recorded at several sites throughout the park region, where it is undoubtedly common given the large number of mines and caves.

HISTORICAL RECORDS.—Cleveland Ranch, Spring Valley, 1829 m (6000 ft), 1 MVZ, collected 1930*; Lehman Caves, 2134 m (7000 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—Snake Creek Cave, 1890 m (6200 ft), Ports and Bradley 1996*; mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*; Murphy Wash, 2249 m (7380 ft), Ports and Bradley 1996*. Also recorded at Old Man's Cave (Ports and Bradley 1996)*, Can Young Cave, Crevasse Cave, Halliday's Deep, Lincoln Adit, Lincoln Canyon Mine, Lower Pictograph Cave, Rudolph Cave, Systems Key, Three Hole Cave, Upper Pictograph Cave, and Wheeler's Deep (Krejca and Taylor 2003).

Eptesicus fuscus (Beauvois 1796)

Big Brown Bat

This widespread species is more abundant in coniferous forests than in deciduous forests (Kurta et al. 1989). Big brown bats forage in a variety of habitats and utilize many different types of roosts, including hollow trees, caves, and mines. The big brown bat is also one of the most common species roosting in buildings (Zeveloff 1988, Kurta and Baker 1990). Big brown bats are widespread in eastern Nevada (Hall 1946). There are several unvouchered records from mines and caves within the park, and the species has been documented from sites on the western side of the Snake Range.

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*; Murphy Wash, 2249 m (7380 ft), Ports and Bradley 1996*. Also recorded at Lincoln Adit, Lincoln Canyon Mine, Mount Washington, and Upper Pictograph Cave (Krejca and Taylor 2003).

Euderma maculatum (J.A. Allen 1891)

Spotted Bat

Although relatively uncommon, the spotted bat occurs throughout much of Nevada (Geluso 2000). It forages in a wide variety of habitats and roosts primarily in rocky cliff faces (Watkins 1977). Although there are no specimen records of this distinctive species from the park region, it was sighted in 1966 at Model Cave in the Baker Creek cave system (Geluso 2000). Spotted bats were again sighted in 2000 at a cave in the Grey Cliffs area along lower Baker Creek (park staff, personal communication).

HISTORICAL RECORDS.—Model Cave, sighting reported 1966.

RECENT RECORDS.—Grey Cliffs, Baker Creek, ca. 2165 m (7100 ft), sighting 2000.

Lasionycteris noctivagans (Le Conte 1831)

Silver-haired Bat

This species occurs throughout North America (Kunz 1982) and is widespread in Nevada (Hall 1946). It is migratory in many areas of its distributional range. Silver-haired bats often roost singly or in small groups within hollow trees, under bark, and occasionally in buildings or caves. They prefer both forested and grassland habitats and often forage over water (Kunz 1982, Zeveloff 1988). The species has been recorded at sites along the western slope of the south Snake Range. It is probably an uncommon but regular seasonal visitor to the region.

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*; Murphy Wash, 2249 m (7380 ft), Ports and Bradley 1996*.

Lasiurus cinereus (Beauvois 1796)

Hoary Bat

Although distributed throughout Nevada, this solitary and migratory species has been recorded at few localities in the park region. Nonetheless, it has a broad elevational and latitudinal range and occurs in a wide variety of habitats, but most frequently in forested areas (Zeveloff 1988). As a seasonal migrant, it is probably a regular but uncommon visitor.

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*. Also recorded at Shoshone Ponds (Krejca and Taylor 2003)*.

Myotis californicus (Audubon and Bachman 1842)

California Myotis

In Nevada the California myotis principally occurs in low-elevation desert habitat and utilizes a wide variety of sites as day roosts and hibernacula (Simpson 1993). Most Nevada records of this species are from the western and southern portion of the state (Hall 1946, 1981). Although there are few records from within the park, the species probably is widespread, particularly at lower elevations.

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Snake Creek Cave, 1890 m (6200 ft), Ports and Bradley 1996*. Also recorded at Mount Washington (Krejca and Taylor 2003).

Myotis ciliolabrum Merriam 1886

Western Small-footed Myotis

This species is one of the most common and widespread myotis in the western United States (Halloway and Barclay 2001), with many records from throughout Nevada (Hall 1946, as *M. subulatus*). The small-footed myotis occurs mainly in forested areas and utilizes a variety of roosting sites but is not as arid adapted as the California myotis (Bogan 1999). There are records from throughout the park region, principally at low elevations.

HISTORICAL RECORDS.—3.2 km E Smith Creek Cave, Mt. Moriah, 1707 m (5600 ft), 2 MVZ, collected 1937*; 3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 1 MVZ, collected 1937*; S side Mt. Moriah, 2134 m (7000 ft), 1 MVZ, collected 1930*; Lehman Caves, 1 KU, 3 MVZ, collected 1929.

RECENT RECORDS.—Snake Creek Cave, 1890 m (6200 ft), Ports and Bradley 1996*; mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*; Murphy Wash, 2249 m (7380 ft), Ports and Bradley 1996*. Also recorded at Lincoln Adit, Lincoln Canyon Mine, Shoshone Ponds, Upper Pictograph Cave, and Wheeler's Deep (Krejca and Taylor 2003).

Myotis evotis (H. Allen 1864)

Long-eared Myotis

The long-eared myotis is one of the more common bats found in the western United States, occurring throughout Nevada, where it is principally found in forest (Hall 1946). It is often associated with coniferous forest but may also occur in arid plant communities at low elevations, and it utilizes a wide variety of roosting sites (Manning and Jones 1989). The species probably occurs throughout the park region.

HISTORICAL RECORDS.—3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 2 MVZ, collected 1937*; Baker Creek, 2438 m (8000 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—Kious Spring, 1 UMMZ, collected 2001; Snake Creek Cave, 1890 m (6200 ft), Ports and Bradley 1996*; mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*; Murphy Wash, 2249 m (7380 ft), Ports and Bradley 1996*. Also recorded at Lincoln Adit, Lincoln Canyon Mine, Mount Washington, Shoshone Ponds, Upper Pictograph Cave, and Wheeler's Deep (Krejca and Taylor 2003).

Myotis volans (H. Allen 1866)

Long-legged Myotis

This large species of myotis occurs throughout the western states where it typically is associated with montane, coniferous forest habitats but can be found in riparian and desert habitats (Hall 1946, Warner and Czaplewski 1984). Based on the number of records from the park region, this clearly is a common species that spans a broad elevational range.

HISTORICAL RECORDS.—3.2 km E Smith Creek Cave, Mt. Moriah, 1707 m (5600 ft), 2 MVZ, collected 1937*; 3–4 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 22 MVZ, collected 1937*; Hendry Creek, 12 km S Mt. Moriah, 2073 m (6800 ft), 2 MVZ, collected 1937*; Lehman Cave, 2195 m (7200 ft), 4 MVZ, collected 1929; Lehman Creek, 2377 m (7800 ft), 1 MVZ, collected 1938; Baker Creek, 2377–2644 m (7800–8675 ft), 6 MVZ, collected 1929 and 1939; Stella Lake, 3200 m (10,500 ft), 1 MVZ, collected 1938.

RECENT RECORDS.—Snake Creek Cave, 1890 m (6200 ft), Ports and Bradley 1996*; mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*; Murphy Wash, 2249 m (7380 ft), Ports and Bradley 1996*; Old Man's Cave, Ports and Bradley 1996. Also recorded at Lincoln Adit, Lincoln Canyon Mine, Rowland Spring, Shoshone Ponds, Upper Pictograph Cave, and Wheeler's Deep (Krejca and Taylor 2003).

Pipistrellus hesperus H. Allen 1864

Western Pipistrelle

This tiny bat is most commonly found in low-elevation desert habitats but also occurs at high elevations in grasslands and adjacent forests (Barbour and Davis 1969). Most Nevada records are from localities in the western and southern portions of the state (Hall 1981). The species has been documented at a single site on the western slope of the Snake Range, which represents the northernmost record for eastern Nevada (Ports and Bradley 1996). It is probably an uncommon bat at low elevations throughout the park region.

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*.

Tadarida brasiliensis (I. Geoffroy 1824)

Mexican Free-tailed Bat

Free-tailed bats are broadly distributed and occur in a variety of habitats (summarized by Wilkins 1989). These bats are abundant in the southwestern United States, where they form very large colonies in caves and mines (Davis et al. 1962). Rose Guano Cave, located on the western slope of the Snake Range, is a major roost site that supports an estimated 75,000 bats of this species (Anonymous 2002a). Records from the park region are near the northern distribution limit for this species in the central Great Basin (Ports and Bradley 1996).

HISTORICAL RECORDS.—Rose Guano Cave, W slope of Snake Range, 2012 m (6660 ft), 3 UMNH, collected 1965*.

RECENT RECORDS.—Mouth of Swallow Canyon, 1905 m (6250 ft), Ports and Bradley 1996*; Murphy Wash, 2249 m (7380 ft), Ports and Bradley 1996*; Rose Guano Cave, Anonymous 2002a*.

Order Carnivora

Canis latrans Say 1823

Coyote

Coyotes are widespread in the Intermountain West and occur across a broad habitat spectrum but probably are most abundant in open habitats at low to mid-elevations (Zeveloff 1988). Although there is only 1 historical specimen record from the park region, there are numerous records of sightings and vocalizations (Allan 2004). Coyote scat collected at 2213 m (7260 ft) in Snake Creek Canyon in 2002 contained remains of *Sylvilagus.*

HISTORICAL RECORDS.—Pole Canyon, W slope Snake Range, 1 MVZ, collected 1929.

RECENT RECORDS.—Snake Creek Canyon, 2213 m (7260 ft), sign recorded 2002. Multiple sightings within the park (Allan 2004).

Urocyon cinereoargenteus (Schreber 1775)

Gray Fox

This species has a broad distribution and occupies a wide variety of habitats (summarized by Fritzell and Haroldson 1982). There are many reports of gray fox from within the park region (Allan 2004). In 2000 we observed an individual several times in the Grey Cliffs area along lower Baker Creek. In 2001 a specimen was salvaged north of Stella Lake. Gray fox generally occupy brushy or rocky habitat (Zeveloff 1988) and probably are most common at low to mid-elevations.

HISTORICAL RECORDS.—Lexington Creek, 2042 m (6700 ft), 1 MVZ, collected 1962; Mouth of Snake Creek, 1 MVZ, collected 1931*.

RECENT RECORDS.—Baker Creek, 2164 m (7100 ft), sightings in 2000; 0.4 mi N Stella Lake, 3210 m (10,533 ft), 1 UMNH, collected 2003; multiple sightings in the park, 1844–2621 m (6050–8600 ft), Allan 2004.

Vulpes macrotis Merriam 1888

Kit Fox

Kit fox prefer areas of shrubsteppe or shrubgrass communities (McGrew 1977, Clark and Stromberg 1987). Although no specimens are known from the south Snake Range, there are early sight records of kit fox in Spring Valley (Hall 1946) and multiple recent sightings from the region, mainly at low elevations (Allan 2004). Kit fox are most often associated with sagebrush, shadscale, and greasewood communities (Zeveloff 1988). They appear to be fairly common in such habitats at low elevations within the park and in adjacent areas outside park boundaries.

HISTORICAL RECORDS.—Spring Valley near Osceola, ca. 1890 m (6200 ft), Hall 1946*.

RECENT RECORDS.—Multiple sightings in park region, 1615 m to ca. 2428 m (5300 ft to ca. 8000 ft), Allan 2004.

Vulpes vulpes Linnaeus 1758

Red Fox

The red fox is one of the most widespread and adaptable carnivores, occurring in a great variety of habitats. The species has been widely transplanted, and within North America its geographic range has expanded during the historical period (Larivière and Pasitschniak-Arts 1996). Although there have been sightings in the region, there are no confirmed records from within park boundaries. In the past, a fox farm was apparently located on lower Strawberry Creek (park staff, personal communication). This, plus the few early records from the central Great Basin (Hall 1946, 1981), have led to speculation that this species might have been introduced into the region. Although animals now sighted may be derived from escaped captives, remains of this species in deposits at Lehman Caves (Ziegler 1964) and in Snake Valley (Heaton 1990) confirm its native prehistoric presence in the region.

HISTORICAL RECORDS.—None

RECENT RECORDS.—Multiple sightings in park region, 1608–2073 m (5275–6800 ft), Allan 2004.

Bassariscus astutus (Lichtenstein 1830)

Ringtail

Ringtails are found in a variety of semiarid habitats (Poglayen-Neuwall and Toweill 1988) and occur principally in the southern and eastern portions of the Great Basin, reaching a distributional limit in eastern Nevada (Hall 1981). There are no historical specimen records of ringtails from the south Snake Range; however, there are numerous reports of the species within the region (Allan 2004), and a park reference collection includes a specimen from Baker Creek (park staff, personal communication). Ringtails primarily occupy rocky habitats at low to mid-elevations (Zeveloff 1988) and probably occur in such habitat throughout much of the park. Scats attributed to this species were collected on a rock outcrop at 2286 m (7500 ft) near Strawberry Creek and contained seeds and insect chitin typical of this omnivore's diet.

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Baker Creek trail, park voucher specimen, collected 1993; Strawberry Creek, 2286 m (7500 ft), sign recorded 2002; multiple sightings in park region, ca. 1890–2316 m (ca. 6200–7600 ft), Allan 2004.

Mustela erminea Linnaeus 1758

Ermine

Ermine are distributed throughout most of the Intermountain West and occur in a wide variety of habitats with the exception of desert (King 1983). In the interior Great Basin, they principally occur at high elevations in forested habitat (Zeveloff 1988). None were trapped during recent surveys. However, a small weasel seen near Lincoln Peak at 3414 m (11,200 ft) elevation was probably an ermine. Most of the recent sightings of weasels at higher elevations in the park (Allan 2004) likely include this species.

HISTORICAL RECORDS.—Baker Creek, 2644 m (8675 ft), 2 MVZ, collected 1929; Baker Creek, 3383 m (11,100 ft), 1 MVZ, collected 1939.

RECENT RECORDS.—Ridge north of Lincoln Peak, 3414 m (11,200 ft), probable sighting in 2003; multiple sightings in park region, reported in Allan 2004.

Mustela frenata Lichtenstein 1831

Long-tailed Weasel

Long-tailed weasels occur over a broad elevational range from desert shrub to alpine meadows (Sheffield and Thomas 1997). However, they are most abundant in open habitats at lower elevations (Zeveloff 1988). Although none were trapped during recent surveys, the number of reported weasel sightings (Allan 2004) suggests that they are quite common throughout the park region.

HISTORICAL RECORDS.—4.8 km E Baker, 1737 m (5700 ft), 1 MVZ, collected 1929*; Baker Creek, 2012–2576 m (6600–8450 ft), 8 MVZ, collected 1929; Strawberry Creek, 2591 m (8500 ft), 1 MVZ, collected 1964.

RECENT RECORDS.—Multiple sightings in park and park region (Allan 2004).

Taxidea taxus (Schreber 1777)

American Badger

Badgers occur over a broad elevational range and in a variety of habitats (Lindzey 1982, Zeveloff 1988). During recent surveys, extensive badger diggings were noted in desert shrub habitat at the park administrative site near Baker and on the bajada east of the park boundary. There have been many recent sightings, mainly at low and mid-elevations (Allan 2004). American badgers are probably most common in areas with high densities of ground squirrels or pocket gophers.

HISTORICAL RECORDS.—Spring Valley, 4.8 km W Osceola, 1981 m (6500 ft), 1 MVZ, collected 1929*; S end Spring Valley, 4 MVZ, collected 1929*; Lehman Creek, 2469 m (8100 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—Park administrative site, Baker, 1628 m (5340 ft), sign recorded 2002*; 1.6 km N, 3 km E Lehman Caves, 1875 m (6150 ft), sign recorded 2000; multiple sightings, 1615–2774 m (5300–9100 ft), Allan 2004.

Mephitis mephitis (Schreber 1776)

Striped Skunk

Striped skunks are found in a wide variety of habitats (Wade-Smith and Verts 1982), but they are less common in arid areas; apparently, they are absent from much of southern Nevada (Zeveloff 1988). Although there are no historical records, there have been multiple recent sightings within the park region (Allan 2004). In July 2000 we observed 1 foraging at night in Wheeler Peak Campground. The species probably occurs in more mesic habitats throughout the park.

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Wheeler Peak Campground, 3002 m (9850 ft), sighting in 2000; multiple sightings, 1608–3002 m (5275–9850 ft), Allan 2004.

Spilogale gracilis Merriam 1890

Western Spotted Skunk

Spotted skunks are common throughout the intermountain region, particularly in foothills and canyons at low elevations, where they occupy rocky riparian areas (Zeveloff 1988, Verts et al. 2001). Although there are no historical records of this species from within the park itself, there are specimens from elsewhere in the Snake Range (Hall 1946) and reported sightings at low elevations in Snake Valley to the east (Allan 2004). The availability of appropriate habitat suggests that this species is probably common at low elevations throughout the region.

HISTORICAL RECORDS.—Pole Canyon, W slope Snake Range, 1 MVZ, collected 1929; 1.6 km W Smith Creek Cave, Mt. Moriah, 1829 m (6000 ft), 2 MVZ, collected 1937*.

RECENT RECORDS.—Multiple sightings in park region, 1608–2012 m (5275–6600 ft), reported in Allan 2004.

Lynx rufus (Schreber 1777)

Bobcat

Bobcats occur throughout the Intermountain West but most commonly in brushy or rocky habitats where they are principal predators of rabbits and hares (Zeveloff 1988); habitat choice appears to be influenced by prey abundance (see Larivière and Walton 1997). Numerous reports from the region (Allan 2004) suggest that the species is common, particularly in rocky areas at low to mid-elevations.

HISTORICAL RECORDS.—8 km W Garrison, Utah, 1 MVZ, collected 1929*; mouth of Snake Creek, 1 MVZ, collected 1931*; Pole Canyon, Spring Valley, 1 MVZ, collected 1929*.

RECENT RECORDS.—Multiple sightings in park region, 1646 m to ca. 3048 m (5400 ft to ca. 10,000 ft), reported in Allan 2004.

Puma concolor (Linnaeus 1771)

Cougar or Mountain Lion

In addition to historical museum records, there are many recent reports (sightings and sign) of cougars within the park (Allan 2004). In western North America, this species is the principal predator of mule deer and other ungulates (Currier 1983, Zeveloff 1988). All scats collected from sites at low to mid-elevations contained fragments of large bone and ungulate hair (presumably deer). Given the abundance of deer, there is probably a relatively large regional population of cougar.

HISTORICAL RECORDS.—1.6 km SW head of Choke Cherry Creek, 1 MVZ, collected 1939; south end Snake Range, 1 MVZ, collected 1939; Snake Range, 1 MSU, collected 1968; "Wheeler Range," 2 MVZ, collected 1969.

RECENT RECORDS.—Baker Creek, 2158 m (7080 ft), sign recorded 2000; Snake Creek Canyon, 2213 m (7260 ft), sign recorded 2002; Strawberry Creek, 2286 (7500 ft), sign recorded 2002; multiple sightings in the park, ca. 2073 m to ca. 3048 m (ca. 6800 ft to ca. 10,000 ft), Allan 2004.

Order Rodentia

Tamias dorsalis Baird 1855

Cliff Chipmunk

The cliff chipmunk generally occurs in areas of rock outcrops and cliffs and is strongly associated with piñon pine and juniper woodland (Hart 1992). Compared to other chipmunk species, there are relatively few historical specimen records from the region, most being from areas in the north Snake Range. Recent surveys indicate that the species is relatively uncommon. However, given the broad extent of appropriate habitat, it is probably widespread at low to mid-elevations.

HISTORICAL RECORDS.—2–3 km W Smith Creek Cave, Mt. Moriah, 1829–1920 m (6000–6300 ft), 5 MVZ, collected 1937*; Smith Creek, Mt. Moriah, 2012 m (6600 ft), 1 MVZ, collected 1937*; Sacramento Pass, 2042 m (6700 ft), 1 UMNH, collected 1966*; Lexington Creek, 2042 m (6700 ft), 1 MVZ, collected 1962*; Hendry Creek, 12 km SE Mt. Moriah, 2073 m (6800 ft), 1 MVZ, collected 1937*; 0.8 km S Lehman Caves, 2195 m (7200 ft), 1 MVZ, collected 1929; Lehman Caves, 2256–2286 m (7400–7500 ft), 3 MVZ, collected 1929; Baker Creek, 2286 m (7500 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—Lehman Creek, 2012 m (6600 ft), 1 UMNH, collected 2003; North Fork Big Wash, 2084 m (6838 ft), 1 UMNH, collected 2003; North Fork Big Wash, 2127 m (6979 ft), 1 UMNH, collected 2003; Baker Creek, 2158 m (7080 ft), sighting in 2000; Snake Creek Canyon, 2240 m (7350 ft), 1 UMNH, collected 2002; Snake Creek Canyon, 2347 m (7700 ft), 1 UMNH, collected 2002.

Tamias minimus Bachman 1839

Least Chipmunk

Among North American chipmunks, this species has the widest geographic range and ecological distribution (Verts and Carraway 2002). It occurs over a wider elevational gradient than do most other species of chipmunk, but in the Great Basin it is most often found in areas dominated by big sagebrush (Zeveloff 1988). Near Snake Creek at 2550 m (8365 ft), we found least chipmunks in an area of dense sagebrush, but they were replaced by Uinta chipmunks in immediately adjacent stands of spruce and aspen. Numbers of least chipmunks appear to have declined in the years since the early MVZ surveys; in 1929 least chipmunks were common along lower portions of Baker Creek in areas where the species was not recorded in recent surveys.

HISTORICAL RECORDS.—Baker, 1615 m (5300 ft), 2 MVZ, collected 1929*; 1.6 km N Baker, 1768 m (5800 ft), 4 MVZ, collected 1929*; Spring Valley, 11.3 km SW Osceola, 1859–1905 m (6100–6250 ft), 9 MVZ, 1 ROM, collected 1929*; Baker Creek, 2012–2591 m (6600–8500 ft), 19 MVZ, collected 1929; Smith Creek, 4.8 km W Smith Creek Cave, 2042 m (6700 ft), 1 MVZ, collected 1937*; Willard Creek, 2347 m (7700 ft), 2 MVZ, collected 1929*; Strawberry Creek, 2438 m (8000 ft), 1 MVZ, collected 1962; Lehman Creek, 2499 m (8200 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—Snake Creek Canyon, 2550 m (8365 ft), 3 UMNH, collected 2002; 1.9 km N, 4 km W Lehman Caves Visitors Center, 2804 m (9200 ft), 1 FMNH, collected 2000.

Tamias umbrinus J.A. Allen 1890

Uinta Chipmunk

The Uinta chipmunk has a very broad ecological distribution, but where it occurs with other species of chipmunks, it generally is restricted to forested habitats (Bergstrom and Hoffmann 1991). In the Great Basin this species has a discontinuous distribution within the forested zones of the major mountain ranges (Hall 1946). It is one of the most abundant and widespread small mammals in the park, occurring in habitats ranging from piñon-juniper woodland and riparian corridors at low elevations to areas at or above timberline (Table 1). In recent surveys it was a dominant species at virtually all localities where it was recorded.

HISTORICAL RECORDS.—Baker Creek, 1820 m (6200 ft), 2 UMNH, collected 1983; Lehman Caves, 2088 m (6850 ft), 1 UWBM, collected 1941; Baker Creek, 2438–2591 m (8000–8500 ft), 16 MVZ, collected 1929; Baker Creek, 2621–2743 m (8600–9000 ft), 4 MVZ, collected 1929; mouth of Pole Canyon, S side Baker Creek, 2286 m (7500 ft), 7 MVZ, collected 1929; mouth of Pole Canyon, S side Baker Creek, 2438 m (8000 ft), 1 MVZ, collected 1929; Hendry Creek, Mt. Moriah, 2438–2987 m (8000–9800 ft), 9 MVZ, collected 1937*; Deadman Creek, Mt. Moriah, 2469–2774 m (8100–9100 ft), 2 MVZ, collected 1937*; Lehman Creek, 2469 m (8100 ft), 2 UMNH, collected 1985; Lehman Creek, 2652 m (8700 ft), 1 MVZ, collected 1929; Lehman Creek, 2974 m (9560 ft), 1 UMNH, collected 1969; E side Wheeler Peak, 2835 m (9300 ft), 1 MVZ, collected 1929; 1.6 km E Mt. Moriah, 3170 m (10,400 ft), 1 MVZ, collected 1937*; vicinity of Stella Lake, 3170–3200 m (10,400–10,500 ft), 11 MVZ, collected 1938; Teresa Lake, 3200 m (10,500 ft), 1 MVZ, collected 1929; head of

Baker Creek, 3383 m (11,100 ft), 1 MVZ, collected 1936.

RECENT RECORDS.—Lehman Caves residential area, 2073 m (6800 ft), 1 UMNH, collected 2000; Baker Creek, 2158 m (7080 ft), sighting in 2000; Baker Creek, 2301 m (7550 ft), 3 UMNH, 1 FMNH, collected 2000; Strawberry Creek Canyon, 2370 m (7775 ft), 1 UMNH, collected 2002; Strawberry Creek Canyon, 2414 m (7920 ft), 1 UMNH, collected 2002; Snake Creek Canyon, 2545 m (8350 ft), 3 UMNH, collected 2002; 1.9 km N, 4 km W Lehman Caves Visitors Center, 2804 m (9200 ft), 6 FMNH, 6 UMNH, collected 2000; Lehman Creek, 2972 m (9750 ft), 4 UMNH, 4 FMNH, collected 2000; Brown Lake, 3109 m (10,200 ft), 18 FMNH, collected 2000; 1.5 km S, 0.8 km E summit Washington Peak, 3246 m (10,650 ft), 10 UMNH, 2003; 0.6 km N, 0.5 km W summit Pyramid Peak, 3249 m (10,660 ft), 1 UMNH, collected 2003; ridge near Washington Peak, 3292 m (10,800 ft), 1 UMNH, collected 2003; 0.3 km S, 0.3 km W Stella Lake, 3383 m (11,100 ft), 1 UMNH, 2 FMNH, collected 2000.

Ammospermophilus leucurus (Merriam 1889)

Antelope Ground Squirrel

This species occurs throughout the Great Basin in open desert habitat dominated by sagebrush, greasewood, and shadscale, and occasionally in juniper (Hoffmeister 1986). Historical specimen records from the region are all from areas below 2134 m (7000 ft) elevation. In July 2000 we found it in desert shrub communities on the bajada east of the park entrance and in the Snake Valley north of Baker. These squirrels are common at lower elevations, but principally in areas outside the park boundaries.

HISTORICAL RECORDS.—1.6 km SE Smith Creek Cave, Mt. Moriah, 1768 m (5800 ft), 2 MVZ, collected 1937*; 1.5–2 km W Smith Creek Cave, Mt. Moriah, 1829 m (6000 ft), 2 MVZ, collected 1937*; Spring Valley, 11.3 km SW Osceola, 1913 m (6275 ft), 2 MVZ, collected 1929*; Baker Creek, 2103–2134 m (6900–7000 ft), 2 MVZ, collected 1929; 1.6 km E Lehman Caves, 2134 m (7000 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), 1 FMNH, 1 UMNH, collected 2000*; 1.6 km S, 3 km E Lehman Caves Visitors Center, 1875 m (6150 ft), 1 FMNH, collected 2000*.

Spermophilus lateralis (Say 1823)

Golden-mantled Ground Squirrel

Golden-mantled ground squirrels occur in a wide variety of habitats from piñon-juniper woodland to alpine tundra (Bartels and Thompson 1993). Within the park region, historical records indicate a very broad elevational range for this species (Table 1). In recent surveys, it was encountered only at sites above 3050 m (10,000 ft). Several individuals were seen near timberline and 1 at the summit of Wheeler Peak, the highest point in the park. This species appears to have declined in abundance since the early surveys. In the 1920s it was present along the Lehman and Baker creek drainages in areas where it was not encountered in recent surveys. Golden-mantled ground squirrels most commonly occur in open coniferous forest; they avoid dense timber and may decline under conditions of increasing tree density that have resulted from fire suppression (Yensen and Sherman 2003).

HISTORICAL RECORDS.—Willard Creek, Spring Valley, 2134–2347 m (7000–7700 ft), 5 MVZ, collected 1937*; Lehman Creek, 2499 m (8200 ft), 1 MVZ, collected 1929; Rye Grass Canyon, 8 km N Mt. Moriah, 2560 m (8400 ft), 1 MVZ, collected 1937*; Baker Creek, 2560–2644 m (8400–8675 ft), 9 MVZ, collected 1929; Hendry Creek, 2.4 km E Mt. Moriah, 2865 m (9400 ft), 2 MVZ, collected 1937*; 1.6 km E Mt. Moriah, 3048–3231 m (10,000–10,600 ft), 3 MVZ, collected 1937*; 0.8 km E Stella Lake, 3170 m (10,400 ft), 4 MVZ, collected 1929; Stella Lake, 3277 m (10,750 ft), 1 MMNH and 5 MVZ, collected 1929; 1.2 km N Stella Lake, 3414 m (11,200 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—0.2 km N, 0.3 km E Stella Lake, 3109 m (10,200 ft), 1 UMNH, collected 2000; vicinity of Brown Lake, 3109 m (10,200 ft), sighting reported 2000; ridge near Mount Washington, 3261 m (10,700 ft), sighting reported 2003; 0.3 km S, 0.3 km W Stella Lake, 3383 m (11,100 ft), 2 UMNH, collected 2000; Wheeler Peak summit, 3982 m (13,063 ft), sighting reported 2003.

Spermophilus mollis Kennicott 1863

Piute Ground Squirrel

In Nevada the Piute ground squirrel occurs in low-elevation desert shrub communities dominated by sagebrush, shadscale, or greasewood (Rickart 1987). Most of the appropriate habitat for this species lies outside the current park boundaries. These squirrels have a prolonged period of aestivation/hibernation that lasts for up to 8 months, and they are normally active aboveground only during late winter and spring. Accordingly, they were not recorded in recent surveys conducted during summer months. However, their characteristic burrow systems were seen at sites in Snake Valley and at the park administrative site north of Baker, areas where specimens had been collected in the past.

HISTORICAL RECORDS.—1.6 km N Baker, 1591 m (5220 ft), 1 MVZ, collected 1929*; 4 km E Baker, 1737 m (5700 ft), 2 MVZ, collected 1929*; Spring Valley, 11.3 km SW Osceola, 1859 m (6100 ft), 1 MVZ, collected 1929*; Spring Valley, 2 SDNHM, collected 1939*.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), sign reported 2000*; park administrative site, Baker, 1628 m (5340 ft), sign reported 2002.

Spermophilus variegatus (Erxleben 1777)

Rock Squirrel

As its name implies, the rock squirrel is most abundant in rocky habitats such as boulder fields, talus, rocky hillsides, cliffs, and steep canyons (Oaks et al. 1987). Rock squirrels occur over a broad elevational gradient in the Snake Range (Table 1), as is the case on several other isolated mountain ranges of the interior Great Basin (Rickart 2001). However, most regional records are from mid-elevation sites dominated by piñon-juniper, mountain mahogany, or manzanita.

HISTORICAL RECORDS.—1.6 km W Smith Creek Cave, Mt. Moriah, 1829 m (6000 ft), 1 MVZ, collected 1937*; Baker Creek, 2225–2576 m (7300–8450 ft), 5 MVZ, collected 1929 and 1930; Willard Creek, Spring Valley, 2347 m (7700 ft), 5 MVZ, collected 1929*; Snake Creek, 2560 m (8400 ft),1 MVZ, collected 1962.

RECENT RECORDS.—Baker Creek, 2158 m (7080 ft), 1 FMNH, collected 2000; Upper Lehman Campground, 2316 m (7600 ft), road kill reported 2002; Snake Creek Canyon, 2377 m (7800 ft), sighting reported 2002; 1.9 km N, 4 km W Lehman Caves Visitors Center, 2804 m (9200 ft), sighting reported 2000.

Marmota flaviventris (Audubon and Bachman 1841)

Yellow-bellied Marmot

Although marmots are typically found at mid- to high elevations in rocky habitat such as talus or rock outcrops adjacent to meadows, within the Great Basin region they often occur in semiarid habitat at low elevations (summarized by Frase and Hoffmann 1980). There are only 2 historical records of marmots from the region, neither of which is supported by a voucher specimen (Hall 1946). These include a sighting near Hendry Creek in the northern Snake Range and a reported marmot sign near "Treasury Lake" in the southern Snake Range; the latter presumably refers to Treasure Lake, a small pond located immediately east of Baker Lake (U.S. Geological Survey 2004). Currently, marmots are uncommon in the Snake Range, with most recorded sightings from mid-elevations in the Baker and Strawberry creek drainages (Darby 2004, Floyd 2004, Floyd et al. 2005). Some reports of marmots or their sign elsewhere in the park may, in fact, represent rock squirrels, which are much more common and more widely distributed within the region. The apparent rarity of marmots in the Snake Range, with the predominance of records from what appear to be suboptimal mid-elevation sites as opposed to more typical high-elevation rock outcrops and meadows, is mysterious (Grayson 2006).

HISTORICAL RECORDS.—0.8 km N Treasury Lake (= Treasure Lake), 3719 m (12,200 ft), sign reported in Hall 1946; Hendry Creek, 2.4 km E Mt. Moriah, 2774 m (9100 ft), Hall 1946, sighting*.

RECENT RECORDS.—Baker Creek, 2134 m (7000 ft), 1 UMNH, collected 2004; Baker Creek, 2286–2591 m (7500–8500 ft), sightings 2000–2003; Strawberry Creek, 2637–2872 m (8650–9420 ft), sightings and sign reported 2000.

Dipodomys microps (Merriam 1904)

Chisel-toothed Kangaroo Rat

The chisel-toothed kangaroo rat is restricted to the Great Basin region, where it occurs in areas with gravelly soils dominated by saltbush, the leaves of which are a primary food source (Hayssen 1991). Historical specimen records are from sites in the Spring and Snake valleys and adjacent bajadas of the Snake

Range; these are low-elevation areas outside the park boundaries. In recent surveys, the species was relatively common at sites in the Snake Valley, and it was trapped at the park administrative site in 2002.

HISTORICAL RECORDS.—1.6 km N Baker, 1591 m (5220 ft), 15 MVZ, collected 1929*; 4.8 km E Smith Creek Cave, Mt. Moriah, 1676 m (5500 ft), 1 MVZ, collected 1937*; near Smith Creek Cave, Mt. Moriah, 1707–1768 m (5600–5800 ft), 22 MVZ, collected 1937*; 4.0 km E Baker, 1737 m (5700 ft), 1 MVZ, collected 1937*; 11.3 km SW Osceola, Spring Valley, 1859 m (6100 ft), 9 MVZ, collected 1929*; Spring Valley, 8.9 km NW Shoshone Post Office, 1859 m (6100 ft), 2 MVZ, collected 1929*; 4 mi S Shoshone, Spring Valley, 1798 m (5900 ft), 2 MVZ, collected 1929*; Hendry Creek, 12.9 km SE Mt. Moriah, 1890 m (6200 ft), 1 MVZ, collected 1937*; 3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 1 MVZ, collected 1937*.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), 4 FMNH and 3 UMNH, collected 2000*; park administrative site, Baker, 1628 m (5340 ft), 1 UMNH, collected 2002; 1.6 km N, 3.0 km E Lehman Caves Visitors Center, 1875 m (6150 ft), 1 FMNH and 3 UMNH, collected 2000*.

Dipodomys ordii Woodhouse 1853

Ord's Kangaroo Rat

Ord's kangaroo rat occurs in desert shrub communities and piñon-juniper woodland but is generally most abundant in areas with deep, sandy soils (Garrison and Best 1990). Within the region the species was recorded at sites in Snake Valley and on the eastern slopes of the Snake Range. In July 2000 the species was trapped in desert shrub habitat north of Baker along with the more abundant *D. microps.* Elsewhere within the park, it is most likely to be found at low elevations near canyon mouths in areas with appropriate soils. A specimen from the vicinity of Lehman Caves in the collection at University of Washington is the only record that may fall within the park boundaries.

HISTORICAL RECORDS.—Near Smith Creek Cave, Mt. Moriah, 1768 m (5800 ft), 1 MVZ, collected 1937*; 6.4 km S Shoshone, Spring Valley, 1798 m (5900 ft), 6 MVZ, collected 1929*; Hendry Creek, 12.9 km SE Mt. Moriah, 1890 m (6200 ft), 1 MVZ, collected 1937*; 3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 1 MVZ, collected 1937*; Lehman Caves, 2088 m (6850 ft), 1 UWBM, collected 1948.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), 2 FMNH and 2 UMNH, collected 2000*.

Microdipodops megacephalus (Merriam 1891)

Dark Kangaroo Mouse

Kangaroo mice are endemic to the Great Basin. This species generally occurs in low-elevation shrub communities, occupying areas with sandy soils (Zeveloff 1988). The only historical records from the park region are from Spring Valley on the west side of the Snake Range, where we did no recent survey work. The species was not recorded during our recent surveys, although sites in the Snake Valley appeared to have appropriate habitat.

HISTORICAL RECORDS.—11.3 km SW Osceola, Spring Valley, 1913 m (6275 ft), 24 MVZ, collected 1929*.

RECENT RECORDS.—None.

Chaetodipus formosus Merriam 1889

Long-tailed Pocket Mouse

This species has been documented from the northern Snake Valley east of Mt. Moriah where a few specimens were collected in 1937 (Hall 1946). There are no historical records from the southern Snake Range or adjacent areas in the Spring or Snake valleys. Long-tailed pocket mice most commonly occupy areas of rocky soil or rock outcrops at low to mid-elevations, principally in areas dominated by sagebrush (Zeveloff 1988, Geluso 1999). In our surveys, extensive trapping in what appeared to be suitable habitat failed to detect this species. However, as there is an abundance of such habitat within the park, we believe its occurrence there is possible.

HISTORICAL RECORDS.—Near Smith Creek Cave, Mt. Moriah, 1768 m (5800 ft), 3 MVZ, collected 1937*; 3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 2 MVZ, collected 1937)*.

RECENT RECORDS.—None.

Perognathus longimembris (Coues 1875)

Little Pocket Mouse

The little pocket mouse generally occurs in low-elevation, open-desert shrub habitat with sandy or gravelly soils (Zeveloff 1988). All historical records are from areas in the Snake Valley east of the northern portion of the Snake Range. In July 2000, 1 animal was trapped north of Baker at 1608 m (5275 ft) elevation at a site with sandy soil that supported a mix of sagebrush, greasewood, and saltbush. Although there are no records for this species from within the park, it may occur in areas at low elevation within suitable habitat.

HISTORICAL RECORDS.—6.4 km E Smith Creek Cave, 1 MVZ, collected 1937*; 3.2 km E Smith Creek Cave, 1707 m (5600 ft), 3 MVZ, collected 1937*; near Smith Creek Cave, Mt. Moriah, 1768 m (5800 ft), 2 MVZ, collected 1937*; 1.6 km SE Smith Creek Cave, Mt. Moriah, 1768 m (5800 ft), 1 MVZ, collected 1937*.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), 1 FMNH, collected 2000*.

Perognathus parvus (Peale 1848)

Great Basin Pocket Mouse

The Great Basin pocket mouse occurs in a wide variety of open habitats but most commonly in areas with sandy soils dominated by sagebrush (Verts and Kirkland 1988). In the park region these mice have a relatively broad elevational range (Table 1). Our recent surveys found them in low-elevation valley floor and foothill shrub communities, canyon bottoms, and piñon-juniper woodland, and on open slopes at nearly 2438 m (8000 ft) elevation, but invariably in areas near sagebrush. Nonetheless, judging from the larger number of historical records, the species appears to have declined over time.

HISTORICAL RECORDS.—Spring Valley, 11.3 km SW Osceola, 1859–1913 m (6100–6275 ft), 3 MVZ, collected 1929*; 3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 1 MVZ, collected 1937*; 3.2 km SE Lehman Caves, 2042 m (6700 ft), 3 MVZ, collected 1929; Lehman Caves, 2088 m (6850 ft), 1 UWBM, collected 1941; Smith Creek, 6.4 km W Smith Creek Cave, 2103 m (6900 ft), 1 MVZ, collected 1937*; Willard Creek, 2179–2530 m (7150–8300 ft), 10 MVZ, collected 1929*; mouth of Pole Canyon, E slope Snake Mountains, 2195 m (7200 ft), 1 MVZ, collected 1929; Baker Creek, 2195–2438 m (7200–8000 ft), 11 MVZ, collected 1929.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), 1 FMNH, collected 2000*; 1.6 km N, 3.0 km E Lehman Caves Visitors Center, 1875 m (6150 ft), 5 FMNH and 7 UMNH, collected 2000*; Snake Creek Canyon, 1922 m (6305 ft), 1 UMNH, collected 2002; Snake Creek Canyon, 2347 m (7700 ft), 1 UMNH, collected 2002; 0.5 km N, 1 km E Lehman Caves Visitors Center, 2006 m (6580 ft), 1 FMNH, collected 2000; South Fork Big Wash, 2137 m (7010 ft), 1 UMNH, collected 2003; Strawberry Canyon, 2423 m (7950 ft), 1 UMNH, collected 2002.

Thomomys bottae (Eydoux and Gervais 1836)

Botta's Pocket Gopher

Botta's pocket gopher is a widespread species that occurs in a variety of habitats (Jones and Baxter 2004). Within the Intermountain Region, it usually occurs in areas with deep soils at relatively low elevations (Zeveloff 1988). In the Snake Range and some other interior mountains of the Great Basin, this species also occurs in high-elevation, montane habitat in areas with thinner, rockier soils. Typically, such habitat supports the northern pocket gopher (*Thomomys talpoides*), which is locally absent (Hall 1946, Rickart 2001). Accordingly, Botta's pocket gophers have a broad elevation distribution in the park region (Table 1), occurring in habitats ranging from arid valley floor sites to high alpine meadows.

HISTORICAL RECORDS.—1–3 km W Smith Creek Cave, Mt. Moriah, 1829–1920 m (6000–6300 ft), 4 MVZ, collected 1937*; Smith Creek, Mt. Moriah, 2012–2042 m (6600–6700 ft), 4 MVZ, collected 1937*; Baker Creek, 2012 m (6600–6700 ft), 7 MVZ, collected 1929; Baker Creek, 2560–2591 m (8400–8500 ft), 2 MVZ, collected 1929; Willard Creek, 2179–2256 m (7150–7400 ft), 7 MVZ, collected 1929–1930*; Pole Canyon, 2286 m (7500 ft), 3 MVZ, collected 1929; Lehman Creek, 2560 m (8400 ft), 1 MVZ, collected 1929; Hendry Creek, Mt. Moriah, 2408–2987 m (7900–9800 ft), 14 MVZ, collected 1937*; head of Shingle Creek, 2048 m (10,000 ft), 2 MVZ, collected 1930; Stella Lake, 3200 m (10,500 ft), 1 MVZ, collected 1938.

RECENT RECORDS.—Snake Creek Canyon, 2545 m (8350 ft), 3 UMNH, collected 2002; Baker Creek, 2591 m (8500 ft), sign recorded 2003; Wheeler Peak Campground, 3002 m

(9850 ft), sign recorded 2003; Stella Lake, 3200 m (10,500 ft), sign recorded 2003.

Castor canadensis Kuhl 1820

American Beaver

Food availability is perhaps the most important factor that determines habitat suitability for beavers (Jenkins and Busher 1979). There are no specimen records of beaver from the Snake Range or surrounding areas in eastern Nevada, although they have been reported in the Humboldt and Colorado drainages and in the past were abundant in northern Nevada (Hall 1946). The nearest historical records are from the Ruby Mountains, ca. 150 km NW of the park (Borell and Ellis 1934) and the Virgin River drainage, ca. 150 km to the south in Utah (Stock 1970). Beaver remains have not been recovered from any regional cave deposits. Despite the absence of local records, there is direct evidence that beaver formerly occurred within the Snake Range. In 2000 we found vegetated dam terraces and very old gnawed stumps of aspen at 2347 m (7700 ft) along Baker Creek. Old beaver sign has also been reported from the Lehman, Shingle, and Strawberry creek drainages (park staff, personal communication). The site on Baker Creek was dominated by aspen and included many trees with 20- to 30-cm trunk diameters that must have become established only after beavers were absent. Trees in this size range may be considerably older than 100 years (Bartos and Lester 1984, Mueggler 1989), which indicates that beaver probably disappeared from this site more than a century earlier. This is a strong indication that the species was native to the region rather than introduced for commercial or management purposes. With the development of ranching and local irrigation in Nevada, beavers were apparently eliminated in some areas in the mistaken belief that this would increase local availability of water (Hall 1946), and such may have been the situation in the Snake Range. In any event, they apparently disappeared before the MVZ fieldwork in 1929 because they were not encountered in those surveys. In 2003 beavers from an unknown source colonized Strawberry Creek near the park boundary, but they have since left this area (Darby 2004).

HISTORICAL RECORDS.—Baker Creek, 2347 m (7700 ft), old sign recorded 2000; Lehman Creek, Shingle Creek, Strawberry Creek, old sign reported 2000.

RECENT RECORDS.—Strawberry Creek, 0.4 km within park boundary, 2088 m (ca. 6850 ft), sightings reported 2003, 1 UMNH, collected 2005.

Reithrodontomys megalotis (Baird 1857)

Western Harvest Mouse

Harvest mice occur in a wide variety of habitats but are most common in open, mesic habitats that are dominated by grasses and other herbaceous vegetation (Webster and Jones 1982). Regional records indicate they are most abundant at low elevations. In our recent surveys they were relatively common in grass-sedge meadows near springs or seeps at elevations of 1981–2438 m (6580–8000 ft). Specimens also were taken at the park administrative site near Baker and at sites in foothill shrub communities east of the park boundary. These last sites had extensive cheatgrass, which indicates that the distribution and abundance of harvest mice may be increasing with the spread of nonnative annual plants.

HISTORICAL RECORDS.—1.6 km N Baker, 1737 m (5700 ft), 3 MVZ, collected 1929*; Hendry Creek, 12.87 km SE Mt. Moriah, 1890 m (6200 ft), 2 MVZ, collected 1937*; 3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 2 MVZ, collected 1937*; Smith Creek, 4–6.5 km W Smith Creek Cave, 2042–2103 m (6700–6900 ft), 3 MVZ, collected 1937*; Baker Creek, 2012–2195 m (6600–7200 ft), 6 MVZ, collected 1929; Sacramento Pass, 2042 m (6700 ft), 1 UMNH, collected 1966*; Lehman Caves, 2256 m (7400 ft), 1 MVZ, collected 1929; Willard Creek, 2347 m (7700 ft), 1 MVZ, collected 1929*.

RECENT RECORDS.—Park administrative site, Baker, 1623 m (5340 ft), 1 UMNH, collected 2003; 1.6 km N, 3.0 km E Lehman Caves Visitors Center, 1875 m (6150 ft), 2 UMNH, collected 2000; 0.5 km N, 1 km E Lehman Caves Visitors Center, 2006 m (6580 ft), 6 FMNH and 1 UMNH, collected 2000; Baker Creek, 2271 m (7450 ft), 3 UMNH, collected 2000; Strawberry Canyon, 2423 m (7950 ft), 2 UMNH, collected 2002.

Peromyscus crinitus (Merriam 1891)

Canyon Mouse

Canyon mice are restricted to rocky areas, including talus, boulder fields, cliffs, and rock outcrops, often over a very broad range of elevations (Johnson and Armstrong 1987, Zeveloff 1988). There are many historical records from sites at low to mid-elevations within the park region, but few from the southern portion of the Snake Range. In our recent surveys, canyon mice were recorded at only 2 localities in the park.

HISTORICAL RECORDS.—Near Smith Creek Cave, Mt. Moriah, 1768–2195 m (5800–7200 ft), 18 MVZ, collected 1937 and 1938*; Hendry Creek, 12.9 km SE Mt. Moriah, 1890 m (6200 ft), 2 MVZ, collected 1938*; 3.2 km W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 10 MVZ, collected 1937*; Deadman Creek, Mt. Moriah, 2042 m (6700 ft), 3 MVZ, collected 1937*; Sacramento Pass, 2042 m (6700 ft), 2 UMNH, collected 1966*; Baker Creek, 2225–2347 m (7300–7700 ft), 5 MVZ, collected 1929.

RECENT RECORDS.—North Fork Big Wash, 2088–2128 m (6850–6980 ft), 2 UMNH, collected 2003; Snake Creek Canyon, 2271 m (7450 ft), 2 UMNH, collected 2002.

Peromyscus maniculatus (Wagner 1845)

Deer Mouse

The deer mouse is the most widespread and locally abundant mammal in western North America, occurring in virtually all habitats, from the most arid deserts to alpine tundra (Zeveloff 1988). Within the park region it has been recorded from low-elevation valley bottoms to areas above timberline (Table 1). In historical specimen samples and in recent surveys, this was the most abundant species present at virtually all localities sampled.

HISTORICAL RECORDS.—Near Smith Creek Cave, Mt. Moriah, 1707–1768 m (5600–5800 ft), 13 MVZ, collected 1937*; 4–5 km E Baker, 1737–1768 m (5700–5800 ft), 18 MVZ, collected 1929*; Lehman Creek, 1737–2530 m (5700–8300 ft), 2 MVZ, collected 1929; Spring Valley, 11.3 km SW Osceola, 1859–1905 m (6100–6250 ft), 5 MVZ, collected 1929*; 2 mi W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 9 MVZ, collected 1937*; Baker Creek, 2012–2697 m (6600–8850 ft), 44 MVZ, collected 1929; Baker Creek, 3383 m (11,100 ft), 2 MVZ, collected 1939; 3.2 km SE Lehman Caves, 2042 m (6700 ft), 4 MVZ, collected 1929; Lehman Caves, 2088 m (6850 ft), 13 UWBM, collected 1941; Willard Creek, 2149–2499 m (7150–8200 ft), 4 MVZ, collected 1929; Lehman Caves, 2195 m (7200 ft), 2 MVZ, collected 1929; Pole Canyon, E slope Snake Range, 2210–2286 m (7250–7500 ft), 3 MVZ, collected 1929; Hendry Creek, Mt. Moriah, 2682–2987 m (8800–9800 ft), 15 MVZ, collected 1937*; head of Lehman Creek, 2914 m (9560 ft), 1 UMNH, collected 1969; 3.2 km E Mt. Moriah, 3200 m (10,500 ft), 1 MVZ, collected 1937*; vicinity of Stella Lake, 3170–3277 m (10,400–10,750 ft), 9 MVZ, collected 1929; 1.6 km N Stella Lake, 3505 m (11,500 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), 1 FMNH, collected 2000*; park administrative site, Baker, 1628 m (5340 ft), 2 UMNH, collected 2003; 1.6 km N, 3.0 km E Lehman Caves Visitors Center, 1875 m (6150 ft), 1 FMNH and 4 UMNH, collected 2000*; Snake Creek Canyon, 2073–2550 m (6800–8365 ft), 21 UMNH, collected 2000; 0.5 km N, 1 km E Lehman Caves Visitors Center, 2006 m (6580 ft), 4 FMNH, collected 2000; Lehman Creek, 2012–3018 m (6600–9900 ft), 23 FMNH and 23 UMNH, collected 2000; Baker Creek, 1951–2301 m (6450–7550 ft), 17 FMNH and 18 UMNH, collected 2000; South Fork Big Wash, 2137–2156 m (7010–7075 ft), 16 UMNH, collected 2003; Strawberry Creek, 2286–2423 m (7500–7950 ft), 16 UMNH, collected 2002; 2.8 km N, 3.8 km W Lehman Caves Visitors Center, 2591 m (8500 ft), 10 FMNH, collected 2000; 1.9 km N, 4 km W Lehman Caves Visitors Center, 2804 m (9200 ft), 19 UMNH, collected 2000; Brown Lake, 3109 m (10,200 ft), 22 FMNH, collected 2000; 0.3 km N, 0.3 km E Stella Lake, 3109 m (10,200 ft), 2 UMNH, collected 2000; spring west of Lincoln Peak, 3117 m (10,225 ft), 2 UMNH, collected 2003; 0.1 km N Stella Lake, 3155 m (10,350 ft), 1 UMNH, collected 2000; 1.5 km S, 0.8 km E Washington Peak summit, 3246 m (10,605 ft), 16 UMNH, collected 2003; 0.6 km N, 0.5 km W Pyramid Peak summit, 3249 m (10,660 ft), 8 UMNH, collected 2003; ridge near Washington Peak, 3271–3292 m (10,700–10,800 ft), 24 UMNH, collected 2003; 0.3 km S, 0.3 km W Stella Lake, 3383 m (11,100 ft), 7 FMNH and 5 UMNH, collected 2000; ridge 0.4 km N, 0.1 km W Lincoln Peak summit, 3422 m (11,226 ft), 3 UMNH, collected 2003.

Peromyscus truei (Shufeldt 1885)

Piñon Mouse

Piñon mice are broadly distributed in the southwestern United States and are most closely associated with rocky areas in piñon-juniper woodland (Hoffmeister 1981, Zeveloff 1988). Recent surveys recorded them in such habitat at several localities between 2042 m and 2347 m (6700–7700 ft) elevation. However, the species was also documented over a broader elevation and habitat range (Table 1). In 2003, 1 specimen was trapped at 3249 m (10,660 ft) near timberline north of Pyramid Peak on an open, rocky slope with scattered bristlecone and limber pines. Another was taken at 3261 m (10,700 ft) in a stand of bristlecone pine near Mount Washington. These may represent the highest elevation records for this species in eastern Nevada, and they verify earlier reports of its occurrence at elevations well above the piñon-juniper zone (Hall 1946, Hoffmeister 1981). In addition, recent specimens from the park administrative site near Baker (1628 m elevation) represent low-elevation records for the region. Compared to the few historical records, piñon mice are now relatively common.

HISTORICAL RECORDS.—Sacramento Pass, 2042 m (6700 ft), 1 UMNH, collected 1966*; Lehman Caves, 2088 m (6850 ft), 2 UWBM, collected 1941; Lehman Caves, 1951 m (7400 ft), 1 MVZ, collected 1929; 0.8 km W Lehman Caves, 2286 m (7500 ft), 2 MVZ, collected 1929.

RECENT RECORDS.—Park administrative site, Baker, 1628 m (5340 ft), 2 UMNH, collected 2003; Baker Creek, 2042–2134 m (6700–7000 ft), 7 FMNH and 1 UMNH, collected 2000; South Fork Big Wash, 2137–2156 m (7010–7075 ft), 2 UMNH, collected 2003; Snake Creek Canyon, 2240–2347 m (7350–7700 ft), 5 UMNH, collected 2002; Strawberry Creek Canyon, 2286 m (7500 ft), 1 UMNH, collected 2002; 0.6 km N, 0.5 km W Pyramid Peak summit, 3249 m (10,660 ft), 1 UMNH, collected 2003; ridge near Washington Peak, 3261 m (10,700 ft), 1 UMNH, collected 2003.

Onychomys leucogaster (Wied-Neuwied 1841)

Northern Grasshopper Mouse

Grasshopper mice are usually found in open habitats, including arid grassland and desert shrub communities (Zeveloff 1988). Records from the park region are all from low elevations. In June 2003, 2 specimens were caught in reptile pitfall traps at the park administrative site near Baker. The species probably occurs elsewhere in the park at the lowest elevations.

HISTORICAL RECORDS.—1.6 km N Baker, 1591 m (5220 ft), 6 MVZ, collected 1929*, 1.6 km N Baker, 1591 m (5220 ft), 1 UMNH, collected 1985*; 1.8 km N, 0.6 km W Baker, 1628 m (5340 ft), 5 MSB, collected 1987*; 4.8 km E Smith Creek Cave, Mt. Moriah, 1676 m (5500 ft), 1 MVZ, collected 1937*; Spring Valley, 11.3 km SW Osceola, 1913 m (6275 ft), 1 MVZ, collected 1929*.

RECENT RECORDS.—Park administrative site, Baker, 1628 m (5340 ft), 2 UMNH, collected 2003.

Neotoma cinerea (Ord 1851)

Bushy-tailed Woodrat

Bushy-tailed woodrats usually occur in sheltered rocky areas, including cave entrances or rock crevices in cliffs, talus slopes, and boulder fields, in habitats ranging from piñon-juniper woodland to alpine communities (Smith 1997). In 2000 a single specimen of this species was taken in a rock outcrop at 2804 m (9200 ft) elevation. We failed to trap any woodrats or find any recent evidence of them along Baker Creek where they were abundant 70 years earlier, even in places where we saw old nests and other sign. The cause of this dramatic decline or disappearance at low elevations is unknown. Bushy-tailed woodrats normally exhibit a fairly wide elevational distribution (Rickart 2001) but may be subject to heat stress and local population extinction (Brown 1968, Grayson 1999).

HISTORICAL RECORDS.—Baker Creek, 2195–2645 m (7200–8675 ft), 26 MVZ, collected 1929; mouth of Pole Canyon, S side Baker Creek, 2225–2286 m (7300–7500 ft), 8 MVZ, collected 1929; Willard Creek, Spring Valley, 2347 m (7700 ft), 1 MVZ, collected 1929*; 1.2 km SE Stella Lake, 3292 m (10,800 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—1.9 km N, 4 km W Lehman Caves Visitors Center, 2804 m (9200 ft), 1 UMNH, collected 2000.

Neotoma lepida Thomas 1893

Desert Woodrat

The desert woodrat occurs in arid desert shrub and piñon-juniper habitats on open, rocky slopes or in sheltered areas near rock outcrops and cliffs (Verts and Carraway 2002). Regional records are from sites at low to mid-elevations (Deacon et al. 1964). In our recent surveys they were found in the bajada shrub community east of the park boundary. The presence of many large stick nests at this site indicates they were fairly abundant. As with *Neotoma cinerea,* historical records show that *Neotoma lepida* was once common in limestone cliffs along the lower portion of Baker Creek, where woodrats are now either absent or very rare.

HISTORICAL RECORDS.—3.2 km E Smith Creek Cave, 1707 m (5600 ft), 1 MVZ, collected 1937*; near Smith Creek Cave, Mt. Moriah, 1768 m (5800 ft), 10 MVZ, collected 1937*; Hendry Creek, Mt. Moriah, 1890 m (6200 ft), 2 MVZ, collected 1937*; Hendry Creek, Mt. Moriah, 2774 m (9100 ft), 1 MVZ, collected 1937*; 2 mi W Smith Creek Cave, Mt. Moriah, 1920 m (6300 ft), 6 MVZ, collected 1937*; 3 mi W Smith Creek Cave, Mt. Moriah, 1981 m (6500 ft), 1 MVZ, collected 1937*; Deadman Creek, Mt. Moriah, 2042 m (6700 ft), 2 MVZ, collected 1937*; Sacramento Pass, 2042 m (6700 ft), 1 UMNH, collected 1966*; Willard Creek, Spring Valley, 2179 m (7150 ft), 2 MVZ, collected 1929*; 3.2 km W Baker, 1 MVZ, collected 1929; Baker Creek, 2012–2591 m (6600–8500 ft), 22 MVZ, collected 1929.

RECENT RECORDS.—1.6 km N, 3.0 km E Lehman Caves Visitors Center, 1875 m (6150 ft), 1 FMNH and 1 UMNH, collected 2000*; North Fork Big Wash, 2137 m (7010 ft), 1 UMNH, collected 2003.

Microtus longicaudus (Merriam 1888)

Long-tailed Vole

The long-tailed vole occurs in habitats ranging from semiarid grassland to alpine meadows (Smolen and Keller 1987, Zeveloff 1988). It is one of the most abundant and widespread species in the region, occurring over a very broad elevational gradient (Table 1). In recent surveys it was caught in relatively dry, grassy areas near the eastern park boundary, riparian habitat along creek drainages between 2134 m and 3018 m (7000–9900 ft) elevation, wet subalpine meadows, and alpine tundra above timberline. Comparison of historical and current records suggests that this species may be expanding into low elevations, possibly in response to the spread of nonnative annual grasses.

HISTORICAL RECORDS.—Smith Creek, Mt. Moriah, 1981–2103 m (6500 –6900 ft), 6 MVZ, collected 1930*; Baker Creek, 2438–2644 m (8000–8675 ft), 7 MVZ, collected 1929 and 1930; Baker Creek, 3383 m (11,100 ft), 4 MVZ, collected 1939; Willard Creek, 2499 m (8200 ft), 2 MVZ, collected 1929; 2.4 km E Mt. Moriah, 2774 m (9100 ft), 26 MVZ, collected 1937; Lehman Creek, 2941 m (9650 ft), 2 UMNH, collected 1969; Hendry Creek, Mt. Moriah, 2987 m (9800 ft), 3 MVZ, collected 1937; vicinity of Stella Lake, 3200–3277 m (10,500 –10,750 ft), 3 MVZ, collected 1929 and 1938.

RECENT RECORDS.—0.5 km N, 1 km E Lehman Caves Visitors Center, 2006 m (6580 ft), 4 FMNH, collected 2000; South Fork Big Wash, 2137 m (7010 ft), 1 UMNH, collected 2003; Baker Creek, 2134–2301 m (7000–7550 ft), 4 UMNH, collected 2000 and 2003; Strawberry Canyon, 2423 m (7950 ft), 1 UMNH, collected 2002; Lehman Creek, 2972–3018 m (9750–9900 ft), 4 FMNH and 3 UMNH, collected 2000; 0.1 km N Stella Lake, 3155 m (10,350 ft), 6 UMNH, collected 2000; 0.6 km N, 0.5 km W Pyramid Peak summit, 3249 m (10,660 ft), 4 UMNH, collected 2003; 0.3 km S, 0.3 km W Stella Lake, 3383 m (11,100 ft), 1 UMNH, collected 2000.

Microtus montanus (Peale 1848)

Montane Vole

This widespread species is found throughout the mountain west, occurring in wet meadows, forests, and riparian habitat (Clark 1973, Jannett 1999). This species has been documented over a broad range of elevations (Table 1). However, records indicate that montane voles are less common and widespread than are long-tailed voles, reflecting greater ecological restriction to wet habitats (Zeveloff 1988). In recent surveys, only a few individuals were trapped in very wet meadows and adjacent to streams.

HISTORICAL RECORDS.—1 mi N Baker, 1591 m (5220 ft), 3 MVZ, collected 1929*; Baker, 1615 m (5300 ft), 2 MVZ, collected 1929*; Baker Creek, 2012–2438 m (6600–8000 ft), 10 MVZ, collected 1929 and 1930; east side Wheeler Peak, 2941 m (9650 ft), 2 UMNH, collected 1966; Spring Valley, 11.3 km SW Osceola, 1859 m (6100 ft), 2 MVZ, collected 1929*.

RECENT RECORDS.—Lehman Creek, 2182 m (7160 ft), 1 UMNH, collected 2003; Baker

Creek, 2271 m (7450 ft), 1 UMNH, collected 2000; Strawberry Canyon, 2423 m (7950 ft), 2 UMNH, collected 2002; Snake Creek Canyon, 2545–2550 m (8350–8365 ft), 4 UMNH, collected 2002; 0.3 km N, 0.3 km E Stella Lake, 3109 m (10,200 ft), 1 UMNH, collected 2000.

Lemmiscus curtatus (Cope 1868)

Sagebrush Vole

Sagebrush voles are generally restricted to areas dominated by various species of sagebrush and bunchgrasses (Hall 1928, 1946, O'Farrell 1972). Records from the region describe a very broad elevational range (Table 1), from the floor of Snake Valley to 3048 m (10,000 ft) on Mt. Moriah. The species was not recorded during our 2000–2003 surveys despite considerable trapping effort in many sites dominated by sagebrush. Sagebrush voles are colonial, their distribution is highly patchy, and their populations fluctuate drastically (Hall 1946, Smith 1999). They may be adversely affected by livestock grazing (Dobkin and Sauder 2004). Consequently, sagebrush voles might benefit from the recent removal of cattle from the park (Danielson 2000) as well as proposed management practices aimed at reversing the spread of piñon-juniper woodland and the loss of sagebrush habitat (Great Basin National Park 2003).

HISTORICAL RECORDS.—3.2 km S Baker, 1676 m (5500 ft), 2 MVZ, collected 1983*; NW Sacramento Pass, 2128 m (6980 ft), 1 UMNH, collected 1967*; Baker Creek, 2195 m (7200 ft), 2 MVZ, collected 1929; Hendry Creek, Mt. Moriah, 2987–3048 m (9800–10,000 ft), 23 MVZ, collected 1937*.

RECENT RECORDS.—None.

Ondatra zibethicus (Linnaeus 1766)

Muskrat

There are no specimen records for this species from the Snake Range or surrounding areas in eastern Nevada. The nearest historical records are from Ruby Lake, ca. 150 km NW of the Snake Range (Borell and Ellis 1934). However, muskrats have been reported in the southern Snake Valley along Big Spring Creek and in Pruess Lake (Anonymous 2002b), and in 2002 they were sighted on Baker Creek (park staff, personal communication 2002). In the past, muskrats were introduced into some Great Basin wetlands for commercial purposes (Hall 1946), so it is possible that populations in the park region originated from introductions. However, the species has been recovered from a prehistoric site in the Snake Valley (Heaton 1990).

HISTORICAL RECORDS.—None.

RECENT RECORDS.—Pruess Lake, ca. 1646 m (5400 ft), sightings reported 2000*; Big Spring Creek and Baker Creek, sightings reported 2002*.

Erethizon dorsatum (Linnaeus 1758)

Porcupine

Porcupines are found throughout the Great Basin, occurring in habitats ranging from desert shrub communities to alpine tundra (Hall 1946, Zeveloff 1988). There are several historical records from the southern Snake Range, suggesting at one time they were common over a broad elevational gradient (Table 1). In our recent surveys, we found no sign of this species, although there were recent reports from the Snake Valley, including the town of Baker (Allan 2004). Currently, porcupines are apparently quite rare within the park. They appear to have declined dramatically throughout the Great Basin, possibly due to increased predation by cougars (Sweitzer et al. 1997).

HISTORICAL RECORDS.—Baker Creek, 2225–2491 m (7300–8500 ft), 7 MVZ, collected 1929; Lehman Creek, 2438–2530 m (8000–8300 ft), 2 MVZ, collected 1929; Snake Creek, 2560 m (8400 ft), 1 MVZ, collected 1962; Treasury Lake [= Treasure Lake], 3200 m (10,500 ft), 4 MVZ, collected 1939; Stella Lake, 3231 m (10,600 ft), 1 MVZ, collected 1929.

RECENT RECORDS.—Baker, 1615 m (5300 ft), sightings reported 2004*.

Order Artiodactyla

Cervus elaphus Linnaeus 1758

Wapiti or Elk

Wapiti probably occurred throughout the Great Basin before the arrival of European-Americans, but were extirpated shortly after settlement in the region (Hall 1946). The earliest historical report of wapiti in the Snake Range was a sighting in Strawberry Canyon in 1859 (Simpson 1876). Animals from the Yellowstone region were used to establish a herd in the Schell Creek Range in the 1930s, and the species subsequently recolonized the Snake Range. There is now a sizable, and apparently growing, resident herd in the park (Darby 2004). In 2002, wapiti were common in the Strawberry Canyon area, where most of the recent sightings have been reported (Allan 2004).

HISTORICAL RECORDS.—Red Canyon [= Strawberry Canyon], 1859 sighting (Simpson 1876).

RECENT RECORDS.—Strawberry Canyon, 2423 m (7950 ft), sightings reported 2002; Strawberry Canyon, 2225–2438 m (7300–8000 ft), multiple sightings reported in Allan 2004.

Odocoileus hemionus (Rafinesque 1817)

Mule Deer

Currently, mule deer are abundant throughout the region, occurring over a broad elevational gradient from valley bottoms to above timberline. It has been argued that both mule deer and mountain lion populations have increased dramatically during recent historical times as a result of habitat changes following the introduction of nonnative livestock (Berger and Wehausen 1991).

HISTORICAL RECORDS.—Lehman Creek, 2682 m (8800 ft), 1 MVZ, collected 1929; Baker Creek, 9000 ft, 1 MVZ, collected 1929.

RECENT RECORDS.—Snake Creek Canyon, 2545 m (8350 ft), salvaged skull, collected 2002; Snake Creek Canyon, 1981–3658 m (6500–12,000 ft), multiple sightings reported in Allan 2004.

Antilocapra americana (Ord 1815)

Pronghorn

Pronghorn are most abundant in open habitats, particularly in areas dominated by sagebrush (Zeveloff 1988). Hall (1946) reported sightings from both the Snake and Spring valleys. During recent surveys they were seen regularly on the bajada on the east side of the Snake Range and at lower elevations in Snake Valley north of Baker. They are apparently common at low elevations, mainly outside park boundaries.

HISTORICAL RECORDS.—East side of Mt. Moriah; west side of Mt. Moriah, south end Spring Valley, multiple sightings reported in Hall 1946*.

RECENT RECORDS.—2.7 km N, 0.9 km W Baker, 1608 m (5275 ft), 1 UMNH, salvaged skull, collected 2000*; 1.6 km S, 3.0 km E Lehman Caves Visitors Center, 1875 m (6150 ft), sightings reported 2000.

Ovis canadensis Shaw 1804

Bighorn Sheep

Bighorn sheep first were reported in Strawberry Canyon in 1859 (Simpson 1876). The species likely was extirpated from the Snake Range during the early 20th century; Hall (1946) reported finding droppings and tracks on Wheeler Peak in 1929 but failed to find any evidence of living bighorn sheep in 1938. The only historical specimen records consist of salvaged skulls or skull fragments (Hall 1946), some of which may be prehistoric. In 1979 animals from Colorado were introduced into the Snake Range, but the species remains rare (Anonymous 2002b). In August 2003 we observed 1 individual near Mount Washington; occasionally they are seen elsewhere at high elevations (Allan 2004). The regional herd is almost certainly at risk from diseases transmitted by domestic sheep that are seasonally grazed in the western portion of the park (Danielson 2000), the principal threat being transmission of *Pasteurella* pneumonia (Foreyt 1989, Monello et al. 2001).

HISTORICAL RECORDS.—Strawberry Canyon, 1859 sighting reported in Simpson 1876; Wheeler Peak, 1928 sighting reported in Hall 1946; Baker Creek, 2743 m (9000 ft) and 3780 m (12,400 ft), 3 MVZ, salvaged skulls; 0.4 km SW Stella Lake, 11,800 ft, 1 MVZ, salvaged skull.

RECENT RECORDS.—South of Mount Washington, 3261 m (10,700 ft), sighting reported 2003; south of Mount Washington, 3292–3353 m (10,800–11,000 ft), multiple sightings reported in Allan 2004.

POTENTIAL, QUESTIONABLE, EXTIRPATED, AND NONNATIVE SPECIES

The following miscellaneous group includes (1) native species that potentially occur in the park region but are as yet undocumented, (2) species documented from regional prehistoric sites but now extirpated in the park region, (3) species erroneously attributed to the regional fauna, and (4) nonnative species that have

TABLE 2. Recent species of mammals with documented prehistoric (late Quaternary) occurrence but which are no longer present in the Great Basin National Park region.

Species	Records	Source(s)	Comments
Gulo luscus	Snake Creek Burial Cave	Barker and Best 1976	
Martes americana	Lehman Cave	Zielger 1964	may represent the extinct *Martes nobilis* (Grayson 1993)
	Crystal Ball Cave	Heaton 1990	may represent the extinct *Martes nobilis* (Grayson 1993)
Mustela vison	Crystal Ball Cave	Heaton 1990	
Lepus cf. *americana*	Crystal Ball Cave	Heaton 1990	
Lepus cf. *townsendii*	Crystal Ball Cave	Heaton 1990	species identification uncertain (may be *L. californicus*)
Ochotona princeps	Smith Creek Cave	Thompson and Mead 1982	
	Crystal Ball Cave	Heaton 1990	
Thomomys cf. *talpoides*	Lehman Cave	Zielger 1964	not verified (may be *T. bottae*)
	Smith Creek Cave	Miller 1979	not verified (may be *T. bottae*)
Phenacomys intermedius	Smith Creek Cave	Thompson and Mead 1982	
Synaptomys borealis	Smith Creek Cave	Mead et al. 1992	

become established since the arrival of European-Americans.

Order Lagomorpha

Ochotona princeps (Richardson 1828)

Pika

Pikas occurred throughout much of the Great Basin well into the Holocene and were present in the park region as recently as 6900 years BP (Table 2; Grayson 1993, 2005). The presence of this diurnal and highly vocal species is documented easily, and there is no doubt that it is no longer present despite an abundance of what appears to be suitable high-elevation habitat. The nearest historical records are from the Ruby and White Pine Mountains (Lawlor 1998). Exactly when the species disappeared in the Snake Range is an open question, but presumably it was during the mid-Holocene when conditions were much warmer and drier than now. Elsewhere in the Great Basin there have been local extinctions of pikas during the past century (Beaver et al. 2003).

Lepus americanus Erxleben 1777

Snowshoe Hare

There are no historical records for snowshoe hare anywhere in the interior Great Basin, the nearest verified records being from the Wasatch and Sierra Nevada ranges (Hall 1981). The species has been reported from a prehistoric cave site in Snake Valley (Table 2), but there is no reason to suspect it has been present in the region during the historic period.

Lepus townsendii Bachman 1839

White-tailed Jackrabbit

Based on its presence in the White Pine Mountains (Hall 1946), ca. 90 km W of the Snake Range, the white-tailed jackrabbit has been listed as potentially occurring within the park (Anonymous 2002b). Heaton (1990) erroneously reported that the species presently occurs in the Snake Range, but there is no evidence of its historical occurrence there. This species was reported in a regional prehistoric cave fauna (Table 2). However, positive identification of species of jackrabbit from isolated skeletal elements is highly uncertain (Grayson 1987), and these remains may actually represent the more widespread black-tailed jackrabbit.

Order Chiroptera

Nyctinomops macrotis (Gray 1840)

Big Free-tailed Bat

The big free-tailed bat reaches its northwestern distributional limit in the southern Great Basin (Hall 1981). Although there are no records of this species from the immediate park region, a specimen from a site ca. 50 km to the east in Millard County, Utah (UMNH specimen record), suggests that it may occur in the park.

Lasiurus blossevillii (Lesson and Garnot 1826)

Western Red Bat

This species has been documented in southern and western Nevada (Hall 1946; MSU specimen record), but there are no records from the central Great Basin. The red bat may occur in a wide variety of habitats (Shump 1999) and, as a seasonal migrant, may visit the park occasionally.

Myotis lucifugus (Le Conte 1831)

Little Brown Myotis

The nearest specimen records of this widespread species are from Ruby Lake, ca. 150 km NW of the Snake Range (Borell and Ellis 1934). Although apparently uncommon in the Great Basin, the species is known from several sites in northern Nevada (Hall 1946) and very likely occurs in the region.

Myotis thysanodes Miller 1897

Fringed Myotis

This species has a broad geographic distribution and broad ecological tolerances (O'Farrell and Studier 1980). The nearest specimen records of fringed myotis are from southern Nevada (Hall 1946). This species most often occurs in high-elevation montane forest habitats and most commonly roosts in mines or caves (O'Farrell 1999), characteristics suggesting that it may be found within the Snake Range.

Myotis yumanensis (H. Allen 1864)

Yuma Myotis

The nearest specimen records for the Yuma myotis are from southwestern Utah, ca 160 km SSE of the Snake Range, and most Nevada records are from western counties (Hall 1981). This species typically occurs at lower elevations, forages over open water, and utilizes a wide variety of roost sites, including crevices, mines, and buildings (Harris 1999). Apparently, they are rare in the interior Great Basin; however, recently they were reported from eastern Nevada (Anonymous 2004) and may occur infrequently within the park.

Order Carnivora

Canis lupus Linnaeus 1758

Gray Wolf

There are no historical records of wolves from the immediate park region. A specimen from Elko County represents the only museum record from Nevada, but there are other unvouchered historical records including 1 from White Pine County (Hall 1946). In all likelihood, by the turn of the 20th century the species was exterminated locally. Although wolves have been reintroduced into the Rocky Mountain region and are spreading, their reappearance in the park is unlikely.

Procyon lotor (Linnaeus 1758)

Raccoon

Historically, raccoons appear to have been absent or at least very rare in the interior Great Basin (Hall 1946, Durrant 1952). Elsewhere they have been purposefully introduced (Lotze and Anderson 1979), and clearly they are expanding into the interior Great Basin (Zeveloff 1988). Although often closely associated with human-modified habitats, they are capable of crossing intervening desert to reach isolated mountain ranges (UMNH collection records). A recent report of this species from the Snake Valley near Garrison, Utah (Allan 2004), suggests that it is only a matter of time before it appears in the park, where it will probably thrive at low and mid-elevations.

Gulo gulo (Linnaeus 1758)

Wolverine

The inclusion of the wolverine in a list of species potentially occurring in the park (Anonymous 2002b) is based on a report of tracks found in snow near Wheeler Peak in 1878 (Muir 1918). We do not consider this credible evidence. The nearest verified historical records are quite distant, from central Utah and the Sierra Nevada (Hall 1981). Although this species occurred prehistorically in the Snake Range (Table 2), based on its behavior and known habitat requirements (Banchi 1994), it is highly unlikely that it was present in the region during historic times.

Martes americana (Turton 1806)

American Marten

Martens are typically denizens of coniferous forests and in the Intermountain West are restricted to high elevations, even above the treeline (Clark et al. 1987, Zeveloff 1988, Buskirk and Powell 1994). There is no evidence of their occurrence in the park region or anywhere in the interior Great Basin during historic times. The nearest confirmed records of this species are from the Wasatch Range in Utah and from the Sierra Nevada region (Hall 1981). Although remains of marten have been recovered from prehistoric cave deposits (Table 2), it has been suggested that these represent the extinct noble marten (*Martes nobilis*), which survived in the region into the mid-Holocene (Grayson 1993).

Neovison vison (Schreber 1777)

American Mink

There are no historical records or recent reports of mink from the immediate park region; the nearest records are from Ruby Lake, ca. 150 km NW of the Snake Range (Borell and Ellis 1934). Prehistorically, this species did occur in the region (Table 2). Riparian habitat within the park is probably sufficient to support mink, and their future reappearance is possible.

Order Rodentia

Thomomys talpoides (Richardson 1828)

Northern Pocket Gopher

Based on its presence in the nearby Schell Creek and White Pine Mountains, *T. talpoides* has been listed as potentially occurring within the park (Anonymous 2002b). This species is an ecological generalist that may occur in habitats from sagebrush to subalpine communities over a broad elevational range (Maser et al. 1978, MacMahon 1999). However, historical and recent surveys have verified that it does not occur anywhere in the Snake Range, where it is replaced by *Thomomys bottae*, a species that typically occurs only at lower elevations (Hall 1946, this report). The regional absence of this species was attributed to prehistoric colonization failure rather than local extinction (Hall 1946, Rickart 2001). However, remains of pocket gophers recovered from 2 regional cave deposits dated to the late Pleistocene have been identified as *Thomomys talpoides* (Table 2). These identifications have not been verified, but if correct, the extinction of this species in the Snake Range is perplexing (Grayson 2006).

Phenacomys intermedius Merriam 1889

Heather Vole

The heather vole is not known to occur historically within the Great Basin (Hall 1981). However, prehistoric remains dating from the last glacial epoch were recovered from Snake Creek Cave in the northern portion of the range (Table 2; Mead et al. 1982). Heather voles occur in a wide variety of boreal forest and alpine tundra habitats (Hallett 1999). High-elevation habitat that appears to be suitable for this species currently exists within the park, but repeated trapping surveys have failed to document it, and there is no doubt that it is now extirpated from the Snake Range.

Synaptomys borealis (Richardson 1828)

Northern Bog Lemming

This species has been reported from deposits at Smith Creek Cave dating from the last glacial epoch (Table 2; Mead et al. 1992). This extralimital record for the park region is extreme, with the closest existing populations far to the north in Montana and Idaho.

Mus musculus Linnaeus 1758

House Mouse

Although there are no verified records of the nonnative house mouse from within the park, it reportedly occurs in some buildings (park staff, personal communication), and there are specimens from the town of Baker (Hall 1946). House mice probably occur inside many park buildings and in adjacent disturbed habitats during warm seasons. However, they are not likely to survive winter outside buildings, and thus are unlikely to form an established feral population.

Zapus princeps Allen 1893

Western Jumping Mouse

This species occurs in the Ruby and Toiyabe ranges in Nevada (Hall 1946), and on that basis alone, it has been listed as potentially occurring within the park (Anonymous 2002b). However, repeated surveys in appropriate habitat throughout the Snake Range have failed to document the species, nor is there evidence of prehistoric occurrence within the region.

Order Perissodactyla

Equus caballus Linnaeus 1758

Horse

Feral horses are common in many areas of the eastern Great Basin (Berger 1986). Although there have been a few reports of wild horses (Anonymous 2002b), there do not appear to be established herds in the region.

Order Artiodactyla

Bos taurus (Linnaeus 1758)

Domestic Cattle

Ranching was a primary livelihood for early European-American settlers in the park region, and for more than 100 years, high-elevation areas of the Snake Range constituted important summer grazing for livestock. The park was established in 1986 with the stipulation that grazing would continue. However, due to the impact on ecology and esthetics, an agreement with local ranchers in 1999 resulted in the removal of cattle (Danielson 2000).

Ovis aries Linnaeus 1758

Domestic Sheep

Along with cattle, early settlers brought domestic sheep into the park region. High-elevation meadows in the western portion of the park continue to be used as summer range for sheep (Danielson 2000). As previously discussed, their continued presence may constrain efforts to establish a healthy population of bighorn sheep within the park.

DISCUSSION

Elevational Distributions

Available data enable us to examine species distributions across the full elevational gradient of the park region. Combined occurrence records for 39 small and medium-sized mammals are shown in Table 1, with records grouped by 150-meter-elevation intervals. Bats and large nonvolant mammals were excluded because they are either very poorly known or so mobile that they may occur over the entire elevational gradient and thus are uninformative.

Species richness is greatest (26–27 species) within low and mid-elevations below 2430 m (8000 ft), with slight attenuation in the high-elevation zone (23 species), and a dramatic decline in the highest alpine zone (11 species). The regional assemblage includes some species with relatively narrow elevational ranges (e.g., *Tamias dorsalis, Peromyscus crinitus*, and the majority of the heteromyid rodents). Most of these are specialists that are restricted to areas with particular substrate or plant associations. Several park species have much broader elevational ranges (e.g., *Sorex vagrans, Tamias umbrinus, Peromyscus maniculatus, Microtus longicaudus*). Most of these are ecological generalists that inhabit a wide variety of microhabitats. As we later discuss in more detail, some of these species have broader elevational ranges in the Snake Range compared with their distributions elsewhere (such as in central Utah), apparently due to upward expansion in the absence of more specialized high-elevation species.

Historical Biogeography and Community Structure

Although a relatively large number of species have been documented in the park and surrounding areas, there are fewer species of mammals occupying the southern Snake Range than would be expected based on current habitat diversity and the pool of potential species occurring within the broader Intermountain Region. In particular, many nonvolant species that elsewhere are restricted to high-elevation habitats are not present. This pattern, which generally is reflected among the isolated mountain ranges of the Great Basin, has been attributed to post-Pleistocene "faunal relaxation," or the selective extinction of high-elevation species (Brown

1971, 1978). Theoretically, the shift toward warmer and drier conditions as the Pleistocene ended, some 10,000 radiocarbon years ago, first reduced and then eliminated dispersal corridors, effectively isolating local populations. By the mid-Holocene (ca. 8000–5000 radiocarbon years ago) when conditions were considerably warmer and drier than they are now, areas of suitable habitat were reduced further to the point that they could no longer support viable populations of mesic-adapted species (Grayson 1993, Grayson personal communication). The prehistoric record indicates that diversity of mammal species within the Snake Range has been reduced by extinctions since the end of the Pleistocene, and those species that became extinct were closely associated with high-elevation habitat (Table 2).

With the accumulation of more information on species distributions, both past and present, Brown's model is now recognized as an over-simplification. While there have been repeated cycles of extinction among montane mammals, there also have been instances of subsequent recolonization of isolated montane systems (Grayson 1993, Lawlor 1998, Grayson and Madsen 2000). Furthermore, many other montane species such as tree squirrels, flying squirrels, red-backed mice, jumping mice, and numerous others are absent from the Snake Range, despite the fact that seemingly suitable habitat is plentiful. Although some may have been present in the past but have yet to be documented from prehistoric sites, most were unable to colonize the Snake Range during the Pleistocene, even during periods most favorable for immigration across intervening lowlands. We now know that the current faunas of the Great Basin mountain systems were shaped by both selective colonization and extinction (Rickart 2001).

Although the park has relatively few obligate montane mammals, the high-elevation communities are hardly barren. In addition to species that normally have very broad habitat tolerances and elevational ranges, a number of others normally restricted to low or mid-elevations in mountains with "saturated" local faunas have expanded their ranges upward in the absence of their montane relatives (Rickart 2001). Within the Snake Range, *Sorex vagrans*, *Lepus californicus*, *Spermophilus variegatus*, and *Thomomys bottae* illustrate this phenomenon (Table 1).

The mammal fauna of the park is highly dynamic and has been shaped by ongoing colonization, selective extinction, and shifting local community structure. In the future these processes will continue to influence the park's biota, especially with the important addition of human activities.

Recent Faunal Change

Records from Smith Creek Cave in the north Snake Range indicate that the first humans may have arrived in the park region at the end of the Pleistocene, ca. 11,500 years ago or perhaps even earlier (Beck and Jones 1997). Prehistoric people undoubtedly had a major impact on natural communities. There is evidence of ancient fire throughout the park (park staff, personal communication), and prehistoric people may have used fire to modify habitat for hunting or agriculture (Griffin 2002). Although the extinction of large mammals at the end of the Pleistocene has been attributed to human hunting, reliably dated remains of extinct species from the region are considerably older than the earliest human records, and there are no sites where extinct mammals are clearly associated with human artifacts (Grayson 1993, 2006). However, the arrival of European-Americans in the mid-19th century introduced hunting with firearms, livestock, nonnative plants, mining, logging, watershed modification, and suppression of natural fires. These activities have had both direct and indirect impacts on native mammals. By the early 20th century, several large mammals were exterminated in the park region; however, all but the gray wolf have since been reintroduced or have recolonized without human assistance.

Museum specimen records and associated collection documents provide direct information on the historical state of biological communities, and their use as a source of information on biotic change is a novel and exciting direction in museum-based research (Shaffer et al. 1998, Museum of Vertebrate Zoology 2004). The rich historical data on the mammals of the park region provide an opportunity to examine changes in community structure during the recent past. Although there are inherent limitations on how such data can be utilized and interpreted, most of the early regional records are from a single source (MVZ) and were obtained over a 2-year period (1929–1930).

TABLE 3. Comparison of numbers of specimens and rank abundances of small mammals in historical and recent samples from low-elevation (1600–1950 m) sites in Great Basin National Park, Nevada.

	Historical records (1929–1939)		Recent records (2000–2003)		
Species	Number	Rank	Number	Rank	*P*-value[a]
Sorex vagrans	1	9.5	1	11.5	
Tamias minimus	12	3	0		<0.01
Ammospermophilus leucurus	1	9.5	3	7	
Dipodomys microps	15	1	12	2	
Dipodomys ordii	0		4	5.5	<0.05
Perognathus longimembris	0		1	11.5	
Perognathus parvus	3	8	14	1	<0.01
Reithrodontomys megalotis	5	6	9	4	
Peromyscus maniculatus	7	4	11	3	
Peromyscus truei	0		2	9	
Onychomys leucogaster	6	5	2	9	
Neotoma lepida	4	7	2	9	
Microtus longicaudus	0		4	5.5	<0.05
Microtus montanus	13	2	0		<0.01
Number of records	67		65		
Number of species	10		12		

[a]χ^2 tests comparing abundance in both time periods

The MVZ surveys utilized equipment and protocols comparable to those used in our recent surveys and had basic objectives entirely consistent with modern efforts to assess biodiversity (Hall 1946). Localities were described with enough detail to allow thorough description of historical communities. Finally, the surveys were conducted over an interval narrow enough to be viewed as a temporal “snapshot” at a time in the past sufficiently distant (ca. 70 years) to be informative of faunal changes.

Comparisons of historical and recent data indicate significant changes in small mammal assemblages over the past 70 years but also reveal unevenness in where these have occurred along the elevational gradient (Table 3; Fig. 2). Pooled sites at low elevations (below 6700 ft) exhibited only a slight change in the total number of species (from 10 to 12), but major changes in species composition. *Microtus montanus* and *Tamias minimus*, the 2nd- and 3rd-most abundant species in the historical sample, were not recorded in the recent surveys, whereas *Dipodomys ordii* and *Microtus longicaudus* were recent additions not recorded historically. In addition, *Perognathus parvus* showed a significant increase in relative abundance in the recent sample. These differences may reflect shifts in plant community composition at low elevations (e.g., a general shift in the relative abundance of shadscale versus sagebrush), or perhaps the influence of beta diversity (habitat patchiness) where pooled samples are taken from a mosaic of local sites which may support different species (i.e., *Microtus montanus* versus *Microtus longicaudus*, or *Dipodomys microps* versus *Dipodomys ordii*).

The most dramatic shifts in community composition are apparent at mid-elevation sites, where the number of species documented declined by half (Table 4; Fig. 2). Although there is considerable disparity in sample sizes for this elevational zone (recent sample ca. 50% smaller), the rarefaction procedure provides robust assessment of faunal change over time. Four of the 5 most abundant species in the historical group (*Neotoma cinerea, Neotomoa lepida, Perognathus parvus,* and *Tamias minimus*) were not recorded in recent surveys, whereas 3 species (*Peromyscus maniculatus, Peromyscus truei,* and *Sorex vagrans*) were significantly more common in recent surveys than in historic surveys. The significant increase in *Sorex* may reflect greater sampling effort in appropriate habitat during recent surveys. However, based on habitat occupancy of these species, we believe that some differences reflect a shift in mid-elevation plant assemblages from open habitat dominated by sagebrush (occupied by *Tamias minimus* and *Perognathus parvus*) to piñon-juniper woodland (occupied by *Peromyscus truei*). This is consistent with a general pattern of floristic change involving the spread of piñon and/or juniper at the expense of sagebrush that is well documented at sites

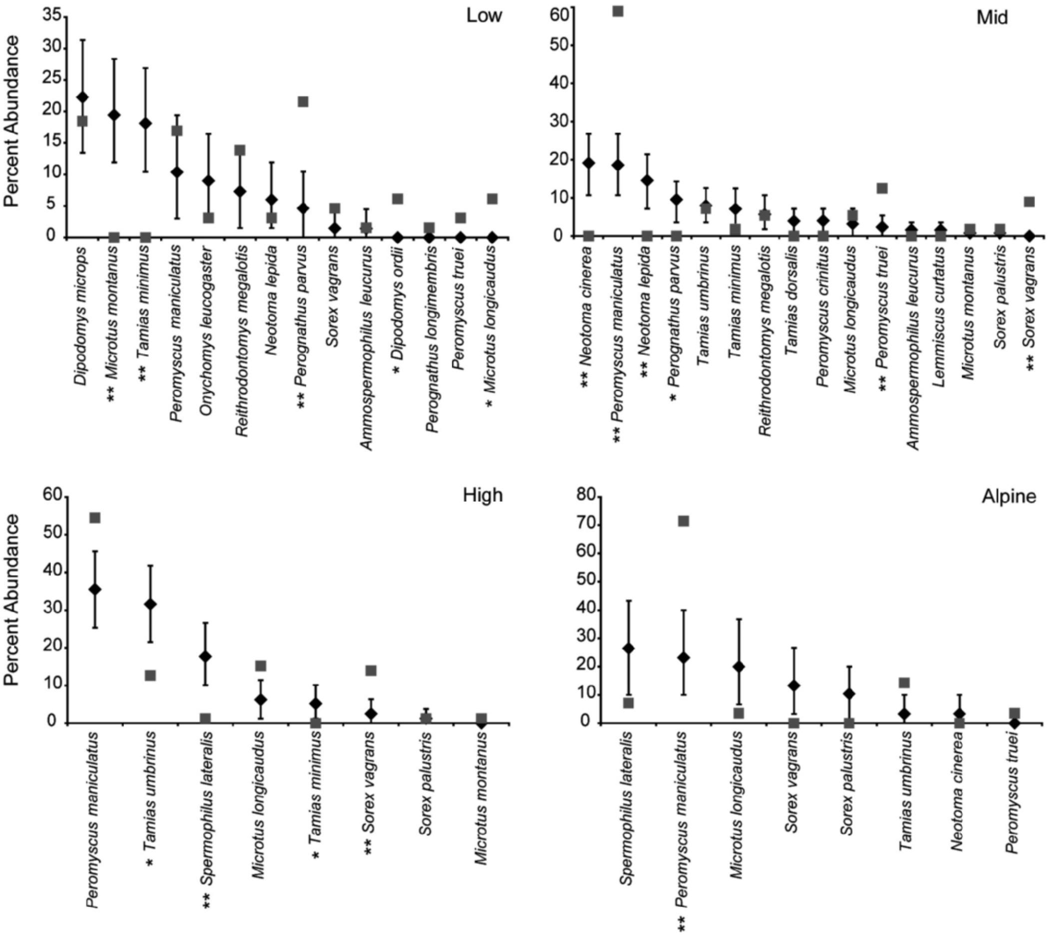

Fig. 2. Comparisons of historical (diamonds) and recent (squares) abundance data from survey localities in 4 elevation zones in the Great Basin National Park region. Historical data were used to establish expected frequencies with 95% confidence intervals (generated through resampling) for comparison to recent data. Species departing from expected are denoted by a single star ($P < 0.05$) or double stars ($P < 0.01$).

throughout the Intermountain West (e.g., Blackburn and Tueller 1970, Miller and Wigand 1994, Soulé and Knapp 1999), and it is a major resource management concern within the park (park staff, personal communication).

The cause of the catastrophic decline in *Neotoma* species at mid-elevations is unknown and perplexing. Analyses of middens reveal that woodrat species may respond to climate change through in situ adaptation (i.e., altered body size and thermal tolerance), or through geographic range shifts and local species replacement (Smith and Betancourt 2003). However, regional climate change (warming) is unlikely to be a primary cause in the present situation, which involves decline or disappearance of both species of *Neotoma* rather than a shift in their relative abundance (i.e., replacement of *Neotoma cinerea* by *Neotoma lepida*). Furthermore, both species are habitat generalists (Smith 1997, Verts and Carraway 2002) and would be expected to persist at many of the more protected mid-elevation sites we surveyed. Although we have no direct evidence, disease of some sort may be involved. Woodrats are hosts for a variety of infectious diseases, including plague (Smith 1997, Verts and Carraway 2002), and local die-offs have been reported for both species (Linsdale 1938, Nelson and Smith 1976).

In contrast to the low- and mid-elevation groups, comparison within the high-elevation

TABLE 4. Comparison of numbers of specimens and rank abundances of small mammals in historical and recent samples from mid-elevation (1950–2450 m) sites in Great Basin National Park, Nevada.

	Historical records (1929–1939)		Recent records (2000–2003)		
Species	Number	Rank	Number	Rank	*P*-value[a]
Sorex vagrans	0		5	3	<0.01
Sorex palustris	1	14.5	0		
Tamias dorsalis	5	8.5	0		
Tamias minimus	9	6	0		<0.05
Tamias umbrinus	10	5	4	4	
Ammospermophilus leucurus	2	12.5	0		
Perognathus parvus	12	4	0		<0.05
Reithrodontomys megalotis	7	7	3	5.5	
Peromyscus crinitus	5	8.5	0		
Peromyscus maniculatus	23	2	33	1	<0.01
Peromyscus truei	3	11	7	2	<0.01
Neotoma cinerea	24	1	0		<0.01
Neotoma lepida	18	3	0		<0.01
Lemmiscus curtatus	2	12.5	0		
Microtus longicaudus	4	10	3	5.5	
Microtus montanus	1	14.5	1	7	
Number of records	126		56		
Number of species	15		7		

[a]χ^2 tests comparing abundance in both time periods

TABLE 5. Comparison of numbers of specimens and rank abundances of small mammals in historical and recent samples from high-elevation (2450–3200 m) sites in Great Basin National Park, Nevada.

	Historical records (1929–1939)		Recent records (2000–2003)		
Species	Number	Rank	Number	Rank	*P*-value[a]
Sorex palustris	1	7	1	6.5	
Sorex vagrans	2	6	11	3	<0.01
Tamias minimus	4	5	1	6.5	
Tamias umbrinus	25	2	10	4	<0.05
Spermophilus lateralis	14	3	1	6.5	<0.01
Peromyscus maniculatus	28	1	43	1	
Microtus longicaudus	5	4	12	2	
Microtus montanus	0		1	6.5	
Number of records	79		80		
Number of species	7		8		

[a]χ^2 tests comparing abundance in both time periods

and alpine zones suggests that the small mammal assemblages were relatively stable over the 65- to 70-year interval between survey efforts (Tables 5 and 6; Fig. 2). In the high-elevation forest zone, a decline in *Spermophilus lateralis* may be in response to increasing forest density due to fire suppression (Yensen and Sherman 2003). Other significant differences in both the high-elevation and alpine zones involve changes in rank abundance that likely reflect biases in retaining specimens of common species (e.g., *Peromyscus maniculatus*), or different sampling intensities in certain microhabitats (e.g., *Sorex vagrans* and *Tamias umbrinus*).

Management Recommendations

Available data indicate some regional mammals have declined during recent decades, others never were abundant, and some have increased. Some (e.g., piñon mice) respond to specific habitat changes and thus are good indicator species. Others represent ecological keystones or are simply charismatic members of the regional fauna (e.g., porcupines and cougars). Species in each of the categories

TABLE 6. Comparison of numbers of specimens and rank abundances of small mammals in historical and recent samples from alpine (3200–3950 m) sites in Great Basin National Park, Nevada.

	Historical records (1929–1939)		Recent records (2000–2003)		
Species	Number	Rank	Number	Rank	*P*-value[a]
Sorex palustris	3	5	0		
Sorex vagrans	4	4	0		
Tamias umbrinus	1	6.5	4	2	
Spermophilus lateralis	8	1	2	3	
Peromyscus maniculatus	7	2	20	1	<0.01
Peromyscus truei	0		1	4.5	
Neotoma cinerea	1	6.5	0		
Microtus longicaudus	6	3	1	4.5	
Number of records	30		28		
Number of species	7		5		

[a]χ^2 tests comparing abundance in both time periods

warrant monitoring, and some would benefit from direct management.

The reappearance of beaver in the Snake Range is significant, and if they become established, certainly they will have a major impact on riparian communities. Over time, beaver activities increase local habitat diversity and species richness. They also improve stream hydrology by moderating seasonal cycles of flow and reducing the severity of seasonal flooding and drought. We recommend that the reestablishment of beaver should be made a management priority, but only in watersheds where their former native occurrence can be demonstrated with certainty.

Our comparisons of historical and current survey data support the general impression of park staff that open shrub communities at low to mid-elevations are being replaced by piñon-juniper and mountain-mahogany woodland. Localized management to reduce woodland coverage in some areas (through removal, prescribed burns, or management of natural fires) and to encourage reestablishment of sagebrush and native grasses might benefit a number of species that apparently have declined in recent decades, and otherwise serve to increase local biodiversity.

The invasion and spread of exotic plants, particularly cheatgrass and other annuals, represents a major environmental threat and conservation challenge throughout the Great Basin (Mack 1986, D'Antonio and Vitousek 1992). Exotic annuals alter the fuel base, increasing the frequency and intensity of fires that may impact natural communities throughout the park. At low elevations, an increase in exotic annuals likely will depress certain species, particularly heteromyid rodents that require open shrub habitat, while promoting the spread of some grass-loving species such as harvest mice and long-tailed voles. Although this represents a region-wide ecological crisis, current efforts to halt and reverse the spread of invasive non-native plants within the park should continue.

Current efforts by park staff to monitor carnivores and ungulates are important activities that should continue. We recommend extending these efforts to include beaver (as discussed previously) and porcupine, both of which have significant influences on the broader structure of local communities. The role of the porcupine in the dynamics of mid-elevation woodland and high-elevation forest communities is certainly worthy of investigation. Management programs usually focus on particular species. While it is logical to target recognized keystone species in this manner, programs that integrate activities within particular ecological communities are likely to have wider impact. An example would be an integrative riparian management program involving beaver, native trout, invertebrates, and riparian plants. Furthermore, management activities need to extend beyond park boundaries to account for the full range of regional habitats and natural processes (such as vertical and regional animal migration). This requires interagency cooperation and, if possible, eventual extension of park boundaries to encompass more low-elevation habitat.

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