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## MAMMALS OF THE GRAND STAIRCASE–ESCALANTE NATIONAL MONUMENT: A LITERATURE AND MUSEUM SURVEY

Jerran T. Flinders<sup>1</sup>, Duke S. Rogers<sup>1,2</sup>, Jackee L. Webber-Alston<sup>1</sup>, and Harry A. Barber<sup>3</sup>

**ABSTRACT.**—This is the first treatment of the mammals of the Grand Staircase–Escalante National Monument (GSENM). GSENM was established in 1996 as a 1.7-million-acre (680,000-ha) federal land reserve under the jurisdiction of the Bureau of Land Management (BLM). To successfully manage this new monument, the BLM is presently developing a management action plan. To provide information for the proper management of mammal species of the area, we have reviewed background literature for each mammal potentially found within the Monument boundaries. We propose that a core area, surrounded by a buffer matrix, be used in GSENM and surrounding public lands to preserve ecological processes in their natural state. One hundred thirteen mammalian species are categorized as follows: 82 contemporary species, 21 species questionably present, 4 introduced species reportedly in the Monument, and 6 historical species. Altogether, potentially 107 mammalian species exist there currently. Of 82 contemporary species, 11 are listed in the Utah State Sensitive Species List, 1 in the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), and 1 in the World Conservation Union (IUCN) Red Book. Mammals listed under the 1973 Endangered Species Act (ESA) are noted when applicable, as well as State of Utah listings as endangered, threatened, sensitive, or extirpated. For each mammalian species listed, we present in telegraphic style a life history account, sensitivity status, and currently accepted nomenclature.

*Key words:* mammals, Grand Staircase–Escalante National Monument, Utah, Mammalia, Rodentia, Carnivora, Artiodactyla, Insectivora, Chiroptera.

### INTRODUCTION

As part of the Colorado Plateau, the Grand Staircase–Escalante National Monument (hereafter referred to as GSENM or the Monument) is a fascinating region, brimming with biodiversity. Little, however, is known of the mammals of the area, their distributions, and their population densities. The Grand Staircase–Escalante area was established in 1996 under the Federal Antiquities Act as a 1.7-million-acre (688,000-ha) national monument under jurisdiction of the Bureau of Land Management (BLM). The Monument spans 3 distinct physiographic regions of south central Utah (Fig. 1). The Grand Staircase region is a series of multi-colored cliffs, starting from the Grand Canyon rim and ascending about 5500 feet to the southwest. The “stairs” consist of the Pink Cliffs, Gray Cliffs, White Cliffs, Vermillion Cliffs, and Chocolate Cliffs. The Kaiparowits Plateau is a remote area of mesas and steep cliffs. Because of its remoteness, many species of plants have evolved in isolation, away from human inter-

ference. Such extraordinary flora potentially sustains unique species of animals. The Canyons of Escalante are a maze of winding, connecting canyons of the Escalante River and its tributaries. These riparian canyons are vital corridors for many animals and sanctuaries for relict, isolated plant communities (Visitor Information 1998).

The GSENM spans biotic zones, from semi-arid deserts to coniferous forests, with sparse, scattered water sources in between (Presidential Proclamation 1996). The distinctness of these zones allows unequaled opportunity for scientific and ecological study. Approximately 880,000 acres (352,000 ha) of Wilderness Study Areas exist to preserve the most remote areas within the Monument until a management agenda is established.

Few records exist on mammal collections and sightings in GSENM. The earliest records of mammalian wildlife in the Monument are rock art (Fig. 2) left by ancient Native Americans: bighorn sheep, deer, bison, and elk (Rawley 1986). Although the Monument is given

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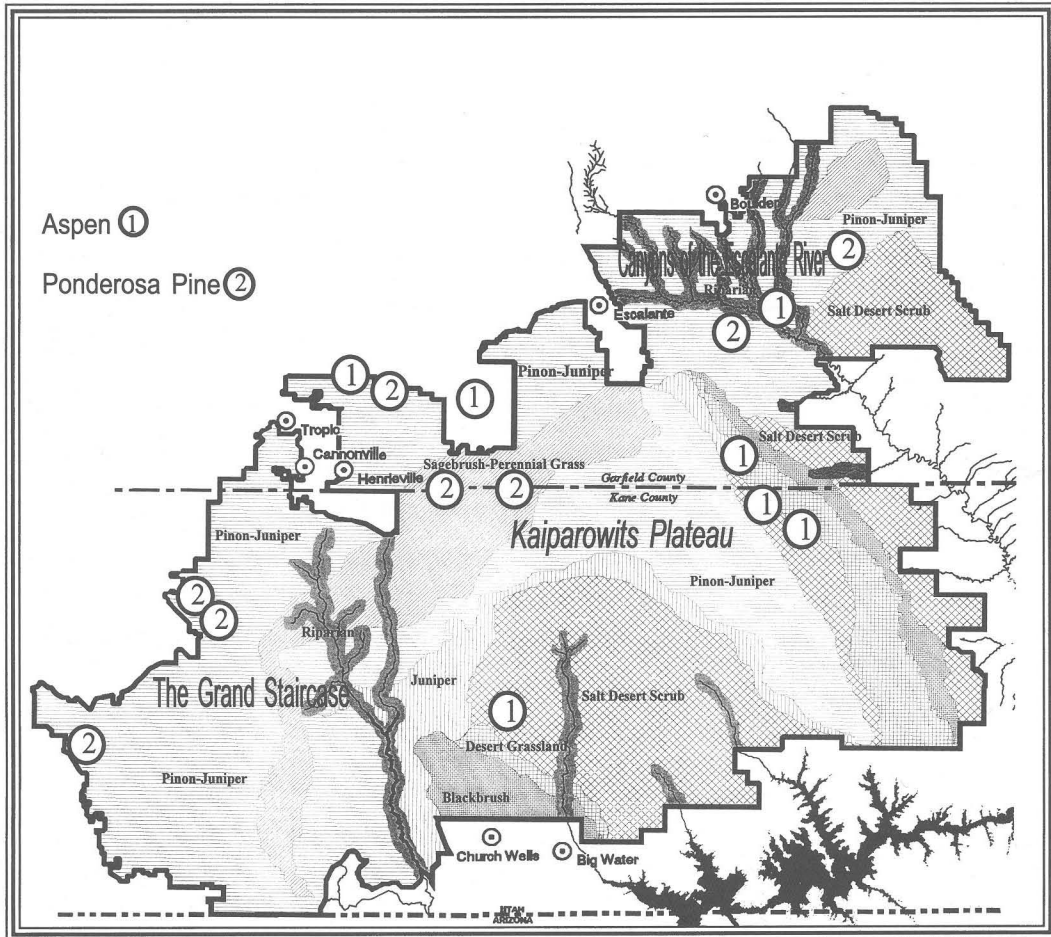


Fig. 1. Three distinct physiographic regions of the Monument: Grand Staircase, Kaiparowits Plateau, and Canyons of Escalante.

Escalante's name, the Dominguez-Escalante party of 1776 did not pass through the present boundaries of GSENM. Rather, the party bypassed present-day borders in southern Kane County. In this area they record eating "hares, rabbits, and wild sheep."

The first nonnative settlements in the region were established by Mormon pioneers in the early 1860s. Explorations by 2 of these pioneers, Jacob Hamblin and John D. Lee, aided in improving knowledge of the area. John D. Lee established the now abandoned settlements of Paria in 1870, one at the mouth of the Paria River in 1871, and Adairville in 1873. These sites are now located within the Monument. In 1871 and 1886, John Wesley Powell navi-

gated the Colorado River and bypassed the border of the Monument en route to Arizona. The discovery of gold in the late 1880s south of Glen Canyon brought people farther into the area. Speculation about geologic wealth of the region brought a later influx into the Kaiparowits area. Mineral exploration, such as petroleum, began in the 1920s, with oil drilling starting in 1921. The first significant drilling in the Monument was in the Upper Valley incline in 1948. In the late 1950s Glen Canyon Dam required better road access and U.S. Highway 89 was constructed. This provided accessibility to the GSENM, inasmuch as the highway skirts around or through the southern and western borders (Murdock et al. 1974).



Fig. 2. Rock art found in GSENM has contributed to knowledge of the cultures of early Native Americans who inhabited the region.

Presnall (1938) conducted a survey of the mammals in Zion National Park, Bryce Canyon National Park, and the Cedar Breaks areas surrounding the Monument. Durrant (1952) surveyed throughout the state for mammalian occurrence, but relied heavily on Tanner's (1940) small mammal work for the Kaiparowits Plateau and Paria River basin. Pritchett (1962) collected mammals throughout Kane County. Raines (1976), Atwood and Pritchett (1974), and Murdock et al. (1974) studied the fauna of all the Kaiparowits region. However, their collection sites were located primarily on the east side of the Colorado River, and only 3 were located in GSENM. Hayward, Killpack, Coffery, and Pritchett (unpublished data) kept mammalian population records in the area of the Monument between 1952 and 1960 as well. More recently, surveys have been conducted for chiropteran species by the BLM in the summers of 1997 and 1998. In the following sections describing species in GSENM, records of occurrence for each species are listed as Specimens Examined for museum records of specimens, and Additional Records for occurrences cited in the above literature. Where no

records of occurrence for the species are available, these headings are not included.

#### PRESENT STATUS OF GSENM

Three main controversial issues plague the new GSENM: (1) the designation of Wilderness Study Areas within the Monument, (2) existing coal mining rights within the boundaries of the Monument, and (3) continuance of grazing allotments within the Monument. The first issue, wilderness designations, strongly influences the other 2 major issues and thus will be first in this discussion.

Wilderness is herein defined (Wilderness Act 1964) as any designated area "without permanent improvements or human habitation" where the "imprint of man's work is substantially unnoticeable" in contrast to areas where "man and his own works dominate the landscape." It is also described as a place that "contains ecological, geological, or other scientific, educational, scenic, and historical value." We propose that, to preserve biodiversity, wilderness areas be designated based on the criteria discussed by Davidson et al. (1996). Davidson et al. (1996)

described how wilderness designations on BLM land in Utah are based on ensuring long-term population viability of native species, maintaining critical ecological and evolutionary processes, and preserving the full range of communities, successional stages, and environmental gradients. Wilderness should be preserved with the understanding that it is easier and more cost-effective to protect species in intact and thus functioning ecosystems.

Designated wilderness areas may serve as core zones for metapopulations of large mammals, particularly carnivores, that maintain some genetic flow through public land buffer zones, connected and serving as a formal or informal regional reserve network. It must be recognized that large carnivores have large home ranges and can be expected to disperse over long distances in appropriate habitats. For example, annual, individual home ranges in the Rocky Mountains are on the order of 150 km<sup>2</sup> for black bear, more than 400 km<sup>2</sup> for mountain lion and wolverine, and nearly 900 km<sup>2</sup> for grizzly bear (Noss et al. 1996). Because of their requirements for space, position in the food web, and need for some management protection, large mammalian predators have been considered indicators of the health or integrity of ecosystems (e.g., Eisenberg 1980, Noss 1995). Long-term management plans for GSENM should allow the Monument to serve as a refugium for native wildlife and plants (Newmark 1985, 1995, Davidson et al. 1996). Critical areas of wilderness designation are centers for native and endemic species. Eighty-six percent of Utah's indigenous plant species are found in arid and semiarid areas like GSENM (Davidson et al. 1996). Many parts of GSENM are low-elevation areas of extensive native species diversity, and thus vital for preservation.

Preservation of corridors for wildlife movement is a major benefit of wilderness designations for mammalian species. If corridors are lost, this creates an island effect on the diversity of species and could result in a genetic bottleneck and ultimately a loss of biodiversity. Although public lands are not true isolates, patterns of mammalian extinction exceed the number of colonizations, and the rate of extinction is inversely related to size of the protected area, as is the case of true isolates (e.g., Newmark 1995). Wilderness designation serves to maintain areas as pristine as possible, thus limiting roads and other such barriers that cut

off gene flow and divide population corridors (Mader 1984).

Among the preserve areas proposed in the Redrock Wilderness Act are the Grand Staircase, Escalante Canyons, and Kaiparowits Plateau, much of which are in the borders of GSENM (Comparison of Utah Wilderness Bills 1996). The Utah Wilderness Coalition and Southern Utah Wilderness Alliance also include the White Cliffs as proposed wilderness along with the above-mentioned areas (Stegner 1990).

Wilderness designation honors pre-existing mining and grazing claims on the land. Fear of loss of mineral exploration leaves some cautious of promoting wilderness designations in the GSENM, as future exploration would not be allowed under the Wilderness Act (1964). However, these deposits, if found upon exploration, are likely too remote and difficult to reach, and thus undoubtedly are more costly than profitable to find and to extract. Goerold (1990) reported that coal resources of Utah are abundant. Yet, the high cost of extraction coupled with inexpensive reserves from neighboring states may hamper local expansion in the Monument anyway. Goerold (1990) also stated that most current coal mines contain enough reserves for long periods of production at present rates or at increased outputs. He indicated that the coal industry contributed about 4% to Utah's economy and oil and gas less than 2%.

Grazing, by law, cannot be phased out once an area is designated wilderness. Grazing allotments also can be increased if the grazing does not have adverse effects on ecosystems. Wilderness can even benefit livestock operations by decreasing accessibility to stock and thus decreasing theft and harassment. Livestock grazing, however, if improperly managed in wilderness areas, may lead to ecological alterations such as introductions of exotic species, soil erosion, competition with indigenous species, and deterioration of water quality (LeGate 1990).

Since no ground truth studies have yet been completed in GSENM, this paper relied heavily on literature and museum records to create a species inventory. Historical locations of specimen records are sometimes vague; therefore, no accurate distributions could be constructed for mammals in GSENM. Scanty and obscure data led to noting mammals as introduced, probable, or questionable species present in GSENM. Table 1 lists mammals that

have voucher specimens or are documented as being in GSENM in the literature. These are mammals known to be in the Monument, whereas other mammals listed herein are included based on distributions reviewed in the literature. The following species accounts are organized in a modified telegraphic style under the headings Historical, Contemporary, Questionable, and Introduced Species. Non-GSENM mammals are noted by common name. Plant species are indicated only by common name, following designations in Welsh et al. (1987). Scientific names of avian species also are not included; the species are referred to by accepted American Ornithological Union checklist names. All other species are referred to by common name. Table 2 identifies citations, and their acronyms, for specimens examined.

#### SPECIES OF HISTORICAL OCCURRENCE

##### *Homo sapiens* Linneaus, 1758

Particularly Fremont, Virgin River Anasazi, Kayenta Anasazi, and Southern Paiute Native American Cultures

*Homo sapiens* Linneaus, 1758. Syst. Nat., 10th ed., 1:20. Type locality in Uppsala, Sweden (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Characteristics pertain to those described as early North American cultures of the SW U.S.

DISTRIBUTION.—The Fremont group lived in the Escalante area from 500 A.D. to 1100 A.D. Two cultures of Anasazi existed in GSENM, the Kayenta Anasazi and the Virgin River Anasazi. The Virgin River Anasazi (100 B.C.–1200 A.D.) dwelt on the Grand Staircase portion of the Monument, and the Kayenta Anasazi (1050–1200 A.D.) lived in the Escalante area, particularly the Kaiparowits Plateau, toward the end of the Fremont occupation. The Southern Paiute group was established in S Utah following the Fremont and Anasazi (1300 A.D.; D.A. McFadden personal communication 1998).

REPRODUCTION.—Usually single, altricial young born after 9-month gestation. Mating system variable with tribes. Early Southern Paiute had a polyandrous mating system when they were especially prosperous or when women were scarce. Polygamy was accepted,

although monogamy was more common in all 4 groups (Thomas et al. 1993).

ECOLOGY.—From about 500 A.D. and for 8 centuries following, Fremont people lived in Utah, W Colorado, and E Nevada. Dwelt along Escalante River, its tributaries, and Kaiparowits Plateau. Lived to the north of contemporaries, the Virgin River Anasazi, and were influenced greatly by their culture. Shared traits were pithouses, surface adobe houses, figurines, and black-on-gray painted pottery. Fremont were adapted to life style of mixed hunting, gathering, and farming. Range likely constrained to water availability. Moved between farming locations of watered canyons and winter homes in uplands where hunted game. By 14th century the people had disappeared (Waldman 1985, Fahey et al. 1995, McFadden 1997). Early Anasazi utilized cliffs and canyon walls as homes. Subsisted on opportunistic diet including yucca, fruits, nuts, berries, mushrooms, mule deer, antelope, leporids, fish, turkey and other birds, and rodents. Cultivated corn, cotton, and Indian rice grass. Anasazi consisted of 2 distinct cultures in GSENM, the Kayenta and the Virgin Anasazi. In Grand Staircase area, Virgin Anasazi relied heavily on agriculture. Patterns of settlement reflected residential mobility that allowed changes in various agricultural environments. Next Anasazi group migrated from Kayenta area and occupied Kaiparowits Plateau region after or immediately before disappearance of Fremont. Because of adaptation to conditions, group likely had mixed agricultural and hunter/gather program like Fremont (McFadden 1996, 1997). Early Southern Paiute people immigrated in ca 1300 A.D. into GSENM. Jackrabbits were hunted by chasing them into long, low nets made from twisted fiber cordage. Paiutes were hunters, fishers, and gatherers who ate diverse foods. Paiutes adept in knowing healing properties of certain plants. Built valley homes of willow sticks and woven tule reeds in summer and lived in foothills in winter. Tule reeds also used to craft boats and duck decoys for hunting (e.g., Waldman 1985, Josephy 1994, Fahey et al. 1995, McFadden personal communication 1998).

REMARKS.—Treatment only for native tribes prior to European contact. Also evidence of human presence before cultures listed. Remains found in GSENM dating back to 6000 B.C. near Big Water (McFadden personal communication 1998).

TABLE 1. List of mammals with records in GSENM.

INSECTIVORA	RODENTIA
Northern Water Shrew ( <i>Sorex palustris</i> )	White-tailed Antelope Squirrel ( <i>Ammospermophilus leucurus</i> )
CHIROPTERA	Golden-mantled Ground Squirrel ( <i>Spermophilus lateralis</i> )
Pallid Bat ( <i>Antrozous pallidus</i> )	Rock Squirrel ( <i>Spermophilus variegatus</i> )
Townsend's Big-eared Bat ( <i>Corynorhinus townsendii</i> )	Cliff Chipmunk ( <i>Tamias dorsalis</i> )
Big Brown Bat ( <i>Eptesicus fuscus</i> )	Least Chipmunk ( <i>Tamias minimus</i> )
Spotted Bat ( <i>Euderma maculatum</i> )	Colorado Chipmunk ( <i>Tamias quadrivittatus</i> ) <sup>1</sup>
Allen's Big-eared Bat ( <i>Idionycteris phyllotis</i> )	Hopi Chipmunk ( <i>Tamias rufus</i> )
Silver-haired Bat ( <i>Lasionycteris noctivagans</i> )	Uintah Chipmunk ( <i>Tamias umbrinus</i> )
Hoary Bat ( <i>Lasiurus cinereus</i> )	Valley Pocket Gopher ( <i>Thomomys bottae</i> )
California Myotis ( <i>Myotis californicus</i> )	Southern Pocket Gopher ( <i>Thomomys umbrinus</i> )
Long-eared Myotis ( <i>Myotis evotis</i> )	Ord's Kangaroo Rat ( <i>Dipodomys ordii</i> )
Fringed Myotis ( <i>Myotis thysanodes</i> )	Northern Grasshopper Mouse ( <i>Onychomys leucogaster</i> )
Long-legged Myotis ( <i>Myotis volans</i> )	Long-tailed Pocket Mouse ( <i>Chaetodipus formosus</i> )
Yuma Myotis ( <i>Myotis yumaensis</i> )	Little Pocket Mouse ( <i>Perognathus longimembris</i> )
Western Pipestrel ( <i>Pipistrellus hesperus</i> )	Great Basin Pocket Mouse ( <i>Perognathus parvus</i> )
Mexican Free-tailed Bat ( <i>Tadarida brasiliensis</i> )	Montane Vole ( <i>Microtus montanus</i> )
CARNIVORA	Bushy-tailed Woodrat ( <i>Neotoma cinerea</i> )
Coyote ( <i>Canis latrans</i> )	Sonoran Woodrat ( <i>Neotoma devia</i> )
Gray Fox ( <i>Urocyon cinereoargenteus</i> )	Desert Woodrat ( <i>Neotoma lepida</i> )
Red Fox ( <i>Vulpes vulpes</i> )	Brush Mouse ( <i>Peromyscus boylii</i> )
Bobcat ( <i>Lynx rufus</i> )	Canyon Mouse ( <i>Peromyscus crinitus</i> )
Mountain Lion ( <i>Puma concolor</i> )	Deer Mouse ( <i>Peromyscus maniculatus</i> )
Striped Skunk ( <i>Mephitis mephitis</i> )	Pinyon Mouse ( <i>Peromyscus truei</i> )
Long-tailed Weasel ( <i>Mustela frenata</i> )	Western Harvest Mouse ( <i>Reithrodontomys megalotis</i> )
Badger ( <i>Taxidea taxus</i> )	LAGOMORPHA
American Black Bear ( <i>Ursus americanus</i> )	Black-tailed Jackrabbit ( <i>Lepus californicus</i> )
ARTIODACTYLA	Desert Cottontail ( <i>Sylvilagus audubonii</i> )
Pronghorn ( <i>Antilocapra americana</i> )	
Mule Deer ( <i>Odocoileus hemionus</i> )	
Bighorn Sheep ( <i>Ovis canadensis</i> )	

<sup>1</sup>Recorded as this species, but name likely since changed.

TABLE 2. Citations for specimens examined.

Acronym	Citation and location
BLM	<i>Bureau of Land Management</i> . 1998 Grand Staircase–Escalante Monument bat survey summary. June–July. Unpublished data.
BYU	<i>Monte L. Bean Life Science Museum</i> . Brigham Young University, Provo, Utah.
MVZ	<i>Museum of Vertebrate Zoology</i> , University of California–Berkeley, Berkeley, California.
USNM	<i>National Museum of Natural History</i> , Vertebrate Zoology Department of U.S. Fish and Wildlife Service, Washington, D.C.
UU	<i>Utah Museum of Natural History</i> , University of Utah, Salt Lake City, Utah.

### *Canis lupus* Linnaeus, 1758

#### Gray Wolf

*Canis lupus* Linnaeus, 1758. Syst. Nat., 10th ed., 1:39. Type locality Sweden (Mech 1974).

GENERAL CHARACTERISTICS.—Largest member of the canid family. Fur long and coloration variable from pure white through mottled gray

and brown to coal black. However, coloration usually grizzled gray. Males slightly larger than females. Total length: 1300–1835 mm; length of tail: 300–450 mm; length of hind foot: 250–275 mm; body mass: 18–80 kg (Mech 1974, Clark and Stromberg 1987).

DISTRIBUTION.—Formerly throughout all of Northern Hemisphere in all habitats and topography except extreme deserts and high

mountain tops, now only disjunct populations. Reintroductions in progress in North America for select portions of W U.S., such as Yellowstone National Park (Mech 1974, Wilson and Reeder 1993). Originally statewide distribution in Utah, except west desert region; no known occurrence in Utah at present (Durrant 1952).

**REPRODUCTION.**—Mated pairs likely breed for life. Breeding January to April with typical copulation lasting up to 30 minutes. Gestation ca 63 days with 1–11 young. Sexually mature at 2 years of age, but usually breeds at 3 years (Fitzgerald et al. 1994). Breeding controlled by social hierarchy in each pack.

**ECOLOGY.**—Historically occupied most habitats across Northern Hemisphere. Primary predators of deer, moose, wapiti, caribou, muskox, mountain sheep, mountain goat, domestic livestock, and beaver. Most of time spent in search of prey. Prey located by scent, tracking, and chance. Can survive up to 2 weeks without prey. Consumes all of prey except largest bones and fur. Social animals, living in packs of a few wolves up to 30, consisting of at least 1 pair of breeding adults, pups, and extra adults. Packs establish linear dominance hierarchies for both males and females. Dominant animals have first selection in feeding, breeding, and bedding sites; often lead the pack when hunting or traveling. Species establishes home ranges of variable sizes, larger home range for larger packs. Has no natural predators except man. Three main methods of communication: (1) howling and similar vocalizations, (2) visual displays of postures and positions, (3) scent marking (Mech 1974, Fitzgerald et al. 1994).

**STATUS.**—Registered in Appendix II in CITES, U.S.A. ESA lists it as Endangered in the USA (48 conterminous states, excluding Minnesota); and IUCN lists it as vulnerable (Wilson and Reeder 1993). In Utah, listed as extirpated on the Sensitive Species List (Kimball 1997).

*Gulo gulo* (Linnaeus, 1758)

Wolverine

[*Mustela*] *gulo* Linnaeus, 1758. Syst. Nat., 10th ed., 1:45. Type locality Sweden, Lapland (Pasitschniak-Arts and Lariviere 1995).

**GENERAL CHARACTERISTICS.**—Largest mustelid. Large head, broad forehead, short stout neck, relatively short legs, arched back, and heavy musculature. Short, round, well-furred ears. Small, beady eyes. Bushy tail. Pelage

thick, colored medium brown to black. Head, saddle, tail, and legs usually darker with blackish facial mask and lighter upper body stripe. Stripe may be creamy to yellowish, light brown, or reddish; extends from head and shoulders to base of tail. Light patches on throat and chest also common. Cream-colored animals with brown feet also have been trapped, but thought to be rare. Males larger than females. Total length: 940–1070; length of tail: 218–260; length of hind foot: 178–190; body mass: 6.6–16.2 kg (Pasitschniak-Arts and Lariviere 1995).

**DISTRIBUTION.**—Historically extended down the Rocky Mountains from Alaska to New Mexico and Arizona. Extirpated by the 20th century, but now reestablishing populations in Montana and rare sightings in Colorado. Commonly thought never abundant in all other W U.S. states (Pasitschniak-Arts and Lariviere 1995). No records since 1950 in Utah. Formerly found in high Wasatch, Uinta, and Boulder Mountains (Durrant 1952).

**REPRODUCTION.**—Apparently polygynous mating system. Breeds in May to August. Monestrous with delayed implantation. Parturition in spring with ca 2–3 young. Young weaned 7–8 weeks. Females reproduce after 2 years and exclusively raise young (Pasitschniak-Arts and Lariviere 1995).

**ECOLOGY.**—Found in remote areas of mature forests such as Douglas-fir, alpine fir, and lodgepole pine. Opportunistic feeder relying heavily on carrion, but will kill own food. Follows predators such as gray wolf or lynx to scavenge remains. Feeds on caribou, moose, lemmings, shrews, voles, snowshoe hare, magpies, other birds and fish, beaver, lynx, ground squirrels, and any available carcass or small mammal. Though scavenger, reported to have successfully attacked and killed big game such as caribou. Kills larger prey by biting on back of neck, back, and withers. Wolverine urine odor reported to affect feeding areas of mule deer and snowshoe hare. Gray wolf, black bear, brown bear, cougar, and golden eagle are potential predators, though most frequently killed by man. Solitary, nocturnal, large home ranges, and no territorial defense. Caches food when excess amount is available. Scent marking important form of communication (Pasitschniak-Arts and Lariviere 1995).

**STATUS.**—Listed by IUCN as vulnerable, and in Utah listed as a threatened species (Wilson and Reeder 1993, Kimball 1997).



*Mustela nigripes* (Audubon  
and Bachman, 1851)

Black-footed Ferret

*Putorius nigripes* Audubon and Bachman, 1851. Viviparous Quadrupeds of North America, 2:297. Type locality Fort Laramie, Goshen Co., Wyoming (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Mink size and shape. Upperparts yellowish buff or whitish. Venter paler. Feet, mask over eyes, and crown of head black. Tail long and tipped with black. Distinguished from weasels by blending of color changes instead of sharp boundaries. Females smaller than males. Total length: 500–533; length of tail: 114–127; length of hind foot: 60–73; length of ear: 29–31; body mass: 530–1300 g (Hillman and Clark 1980, Fitzgerald et al. 1994).

DISTRIBUTION.—Formerly throughout Great Plains, mountain basins, and semiarid grasslands of North America, coinciding with prairie dog range. Few remnant populations still mark the range (Hillman and Clark 1980). However, viable populations only in captivity and current reintroduction efforts are underway on the Colorado-Utah border (Wilson and Reeder 1993, Bates personal communication 1999).

REPRODUCTION.—Breeding late February to early April. Gestation 42–45 days with 2–4 young born in May. Presumed polygynous system with sexual maturity reached at 1 year (Hillman and Clark 1980, Fitzgerald et al. 1994).

ECOLOGY.—In close association with occurrence of prairie dog. Preys on prairie dogs and uses their burrows for dens and shelter. Also takes ground squirrels, cottontail rabbits, deer mice, and small birds. Ferret number declines directly related to habitat destruction, secondary poisonings, and prairie dog population control. Predators reported as coyote, golden eagle, and great horned owl. Highly antagonistic to same sex conspecifics. Habits secretive and nocturnal. Less active in winter and solitary except when breeding in spring. Vocalizations include chatters, hisses, and whimpers. Odor recognition aids in night travel (Hillman and Clark 1980).

STATUS.—Listed in CITES (Appendix I), and Endangered in U.S.A. ESA (Wilson and Reeder 1993). Listed in the State of Utah as an endangered species (Kimball 1997).

*Ursus arctos* Linnaeus, 1758  
Grizzly Bear

*Ursus arctos* Linnaeus, 1758. Syst. Nat., 10th ed., 1:47. Type locality "Sweden" (Pasitschniak-Arts 1993).

GENERAL CHARACTERISTICS.—Massive head with dished face, rounded ears, small eyes, and prominent nose. Exhibits heavy shoulder hump, short tail, and a powerful, large body. Coloration of pelage variable from tan, blond, gold, gray, silver, cinnamon, and all shades of brown to almost black. Interior animals tend to be lighter than coastal and have pale-tipped guard hairs, giving a grizzled appearance. Head and shoulders usually paler than darker sides, belly, and legs. Males larger than females (Pasitschniak-Arts 1993). Total length: 1700–2800; length of tail: 70–80; length of hind foot: 230–280; length of ear: 100–130; body mass: 135–275 kg (Fitzgerald et al. 1994).

DISTRIBUTION.—Historically in W and C North America from Arctic Ocean to C Mexico. Now found in Eurasia, Alaska, Canada (except open prairies), and disjunct populations in Washington, Montana, Idaho, and Wyoming. Extirpated in Mexico in 1960s, but possibly a few in N Mexico (Pasitschniak-Arts 1993). Prior to extinction in Utah, occurrence in Sanpete and Washington counties as well as NE Utah and SE Idaho borders (Durrant 1952, Russell 1955).

REPRODUCTION.—Polygamous system with several males competing for estrous females. Breeding mid-May to July. Delayed implantation. Young born January to March in female dens and stay with mother for 2–3 years. Females bear young at ca 7 years (Pasitschniak-Arts 1993).

ECOLOGY.—Inhabits any area with sufficient resource availability from prairie grassland to alpine tundra. Today, however, found in more remote areas where contact with people is limited. Diet mainly vegetation such as grasses, succulent herbs, tender shoots, flowers, leaves, roots, bulbs, tubers, mosses, horsetails, willows, and berries. Also takes insects, larvae, birds, eggs, acorns, cones, nuts, fish, small mammals, moose, caribou, elk, deer, pronghorn, bison, big-horn sheep, mountain goat, and domestic livestock. Caches food. Strictly terrestrial mammal; does not climb trees like the black bear. Solitary except mother with young. Active in day, but mainly at night. Dens in winter months in response to food scarcity. Establishes home

ranges that overlap with conspecifics but shows no territorial defense, but rather maintains range by mutual avoidance. Only natural reported predator is Siberian tiger. Habitat loss, genetic bottleneck due to isolation, habituation to humans, and illegal hunting are major human-induced threats to populations. Low reproductive rate and slow compensatory response to these threats are serious problems. Intolerance and aggression in males during mating season is due to a nonfamilial bond experienced as cubs. Communicates by visual, auditory, and vocalizations, but relies heavily on olfaction (Pasitschniak-Arts 1993, Fitzgerald et al. 1994).

STATUS.—Listed in CITES as threatened in USA (Wilson and Reeder 1993). Listed in the State of Utah as an extirpated species (Kimball 1997).

*Bison bison* (Linnaeus, 1758)

American Bison

*Bos bison* Linnaeus, 1758. Syst. Nat., 10th ed., 1:72. Type locality "Mexico" (=C Kansas, "Quivira"), redesignated as Canadian River Valley, E New Mexico (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Largest North American artiodactyl. Body massive, accentuated by shoulder hump. Pelage brown, long over forehead, neck, hump, and front quarters; shorter over rump, tail, and hind legs. Tail narrow with tufted tip. Head large and neck thick and short. Males and females possess horns that curve upward and inward, tapering to sharp tip. Eyes anterolateral. Legs short and stout. Hooves black and circular shaped on bottom. Females slightly smaller than males. Total length: 2130–3800; length of tail: 300–910; length of hind foot: 500–680; length of ear: 110–150; body mass: 410–910 kg (Meagher 1986, Clark and Stromberg 1987).

DISTRIBUTION.—Formerly throughout North America from Canada and W Canada to N Mexico. Reintroductions occurring within historic range (Meagher 1986). Fairly extensive ranching of domesticated bison in U.S. and Canada. Found in Utah on Antelope Island (Great Salt Lake) and in E Utah from the San Rafael Swell to the Henry Mountains (Durrant 1952).

REPRODUCTION.—Breeding season late June–September, but strong seasonal variance. Gestation ca 285 days with usually 1 young born in mid-April to May. Calves more ruddy pelage (Meagher 1986).

ECOLOGY.—Estimates indicate 30–50 million bison occurred in North America prior to European colonization but were nearly exterminated due to overhunting (Nowak 1991). In 1887, Hornaday reported just 541 bison remained from the vast herd (Shaw and Meagher 2000). Prehistoric distribution primarily central grasslands and northern parklands of North America. Now reintroduced herds in habitats ranging from semidesert to boreal forests where suitable grazing is available. Foraging generally nonselective grazing on grasses, sedges, and forbs. Many herds managed as domestic livestock. Free-ranging wild herds now in Alaska, Canada, Yellowstone National Park, and the Henry Mountains of southern Utah (Shaw and Meagher 2000). Wallows in dry or muddy soil. Predators man and gray wolf (Meagher 1986, Clark and Stromberg 1987).

REMARKS.—Prehistoric rock art has been found depicting bison at Johnson Canyon within GSENM in C Kane Co. (Rawley 1986). Presnall (1938) refers also to a herd in House Rock Valley within GSENM in S Kane Co., brought in from Texas in 1905.

STATUS.—*Bison b. athabasca* listed in CITES (Appendix I), in U.S.A. ESA as Endangered (Wilson and Reeder 1993). Geist (1996) considers the species *Bison bison* to be without subspecies; identified variations attributed to differences in nutrition.

*Cynomys parvidens* (Allen, 1905)

Utah Prairie Dog

*Cynomys parvidens* Allen, 1905. Bull. Mus. Sci., Brooklyn Inst. Arts and Sci., 1:117–122. Type locality Buckskin Valley, Iron Co., Utah (Pizzimenti and Collier 1975).

GENERAL CHARACTERISTICS.—Small prairie dog with each hair composed of several colors. Upperparts cinnamon-clay to buff and darker on rump. Underparts paler cinnamon or buff. Whitish mouth, chin, and tail tip; diagnostic dark cheek patches. Total length: 305–360; length of tail: 30–60; length of hind foot: 55–66; length of ear: 12–16; body mass 650–1050 g (Pizzimenti and Collier 1975, Jacquart 1986).

DISTRIBUTION.—SC Utah (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Breeding early spring with ca 4–5 young. Reproduction may be delayed 2–4 weeks at higher elevations. Annual parturition (Pizzimenti and Collier 1975).

ECOLOGY.—Once widely distributed throughout range, now occurs only sparsely

along the Sevier River and E Iron Co. Because of poisoning and disease, populations have dwindled from 95,000 in 1920 to 3500 in 1976. Dense vegetation northward and possible competition with Uinta ground squirrel are probable reasons for lack of successful dispersal and range expansions (Zelveloff 1988). Primary diet mostly forbs and grasses. Habits are diurnal and colonial. Burrows similar to *C. leucurus* with little design of mound (Pizzimenti and Collier 1975).

STATUS.—Listed in U.S.A. ESA as Threatened; IUCN as vulnerable; in Utah it is a threatened species (Wilson and Reeder 1993, Kimball 1997).

## SPECIES OF CONTEMPORARY OCCURRENCE

### INSECTIVORA

#### *Notiosorex crawfordi* (Coues, 1877)

##### Desert Shrew

*Notiosorex* Coues, 1877. Bull. U.S. Geol. Geogr. Surv. Terr., 3:631. Type locality 2 mi above El Paso, El Paso Co., Texas (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Color grayish with brown above. Short grayish tail, paler below. Three unicuspid teeth in upper jaw, unlike members of *Sorex* genus. Ears relatively large. Prominent flank glands. Largest shrew in North America. Total length: 81–90; length of tail: 24–26; length of hind foot: 9–11; length of ear: 8–9; body mass 3–5 g (Jameson and Peeters 1988).

DISTRIBUTION.—Broad distribution throughout SW U.S., C and N Mexico (Hall 1981). At the same latitude as this portion of Utah, there is a record for Nye Co., Nevada (Durrant 1952).

REPRODUCTION.—Breeds in warmer months. Gestation length not known. Litter size 3–5 young (Armstrong and Jones 1972).

ECOLOGY.—Semidesert scrub association of mesquite, agave, and scrub oaks. Does not require permanent water sources and uses a wide variety of food including most insects and even carrion. Habitat cover variable from brush piles to woodrat dens. Predators mostly owls, especially great horned and barn owls (Armstrong and Jones 1972).

STATUS.—Utah State Sensitive Species List due to limited distribution (restricted to southernmost portion of Utah; Kimball 1997).

#### *Sorex merriami* Dobson, 1890

##### Merriam's Shrew

*Sorex merriami* Dobson, 1890. Monogr. Insectivora, pt. 3 (Soricidae), fasc. 1, pl. 23. Type locality [1 1/2 mi] above Fort Custer [Hardin], Big Horn Co., Montana (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Small shrew. Pelage pale gray above, with paler flanks; whitish below. Long, distinctly bicolored tail (Jameson and Peeters 1988). Total length: 88–107; length of tail: 33–42; length of hind foot: 11–13; length of ear: 8–9; body mass: 4.4–6.5 g (Armstrong and Jones 1971).

DISTRIBUTION.—All W United States; W Oregon to S New Mexico (Jung and Hoffmann 1981). Possibly statewide distribution in Utah within sagebrush, mountain mahogany, and arid grassland communities, often in association with sagebrush vole (Sparks 1974, Zelveloff 1988).

REPRODUCTION.—Pregnant females mid-March to early July. Males with enlarged testes and prominent flank glands (reproductive attractant) caught in March–June (Armstrong and Jones 1971).

ECOLOGY.—Found in drier habitats, usually sagebrush, some grasslands, mountain mahogany, pinyon, and pine/fir/aspen areas. Utilizes microtine runways and burrows. Feeds on spiders, beetles, larval lepidopterans, and ichneumonid wasps. Caterpillars most often used in summer (Armstrong and Jones 1971).

#### *Sorex monticolus* Merriam, 1890

##### Montane Shrew

*Sorex monticolus* Merriam, 1890. N. Amer. Fauna, 3:43, September 11. Type locality San Francisco Mtn., 11,500 ft. [3450 m], May 15, Coconino Co., Arizona (Hall 1981).

GENERAL CHARACTERISTICS.—Color varies with seasons. Summer: short fur, rust brown, paler below; winter: gray fur longer and darker above than below. Tail bicolored. Total length: 111–120; length of tail: 46–55; length of hind foot: 13–15; length of ear: 6–7; body mass: 4–7 g (Jameson and Peeters 1988).

DISTRIBUTION.—Mesic habitats from Alaska throughout Rocky Mountains to New Mexico with isolated populations in C Mexico (Fitzgerald et al. 1994). Found throughout Utah in all mountain ranges and adjacent valleys (Durrant 1952).

REPRODUCTION.—Breeds from April to August. More than 1 litter per year. Gestation 20–22 days with ca 6 young per litter (Fitzgerald et al. 1994).

ECOLOGY.—Found in mesic habitats of aspen, willow, moist meadows of subalpine forests, and riparian communities. Greatly affected by temporal variation in groundcover; when herbaceous cover declines, increases use in adjacent, mesic aspen areas. Active all year, subnivian in winter. Food consists of small insects, especially soil-dwelling larvae (Jameson and Peeters 1988).

*Sorex nanus* Merriam, 1895

Dwarf Shrew

*Sorex tenellus nanus* Merriam, 1895. N. Amer. Fauna, 10:81, December 31. Type locality from Estes Park, Larimer Co., Colorado (Hall 1981).

GENERAL CHARACTERISTICS.—Tiny shrew. Coloration gray-brown above. Long tail. Total length: 82–105; length of tail: 27–45; length of hind foot: 10–11; body mass: 1.8–3.2 g (Fitzgerald et al. 1994).

DISTRIBUTION.—Found in Montana, Wyoming, Utah, Colorado, New Mexico, and Arizona (Fitzgerald et al. 1994). Found only in southern half of Utah (Schafer 1991).

REPRODUCTION.—Breeding begins after snowmelt, with usually 2 litters produced per season; gestation period unknown. Litter size 6–7 young (Zaveloff 1988).

ECOLOGY.—Variety of habitats in the Rocky Mountains, from alpine edges and subalpine rockslides to spruce-fir bogs, coniferous forests, sedge marshes, dry, bushy hillsides, and open woodlands. Can also tolerate semiarid to arid areas, and thus might be more widely distributed than records show. Paucity of ecological data on this shrew (Fitzgerald et al. 1994).

STATUS.—Species of special concern in Utah due to limited distribution (Kimball 1997).

*Sorex palustris* Richardson, 1828

Northern Water Shrew

*Sorex palustris* Richardson, 1828. Zool. J., 3:517. Type locality “marshy places from Hudson’s Bay to the Rocky Mountains” (Beneski and Stinson 1987).

GENERAL CHARACTERISTICS.—Relatively large shrew. Pelage dark or black above; belly silvery white. Long tail. Hind feet have a fringe of stiff hairs for air buoyancy when swimming. Total length: 130–170; length of tail: 57–89;

length of hind foot: 18–22; body mass: 8–14 g (Beneski and Stinson 1987).

DISTRIBUTION.—Boreomontane distribution throughout Rocky Mountain range and much of Canada and Hudsonian life zones (Beneski and Stinson 1987). Found throughout Utah in permanent water source (Sparks 1974).

REPRODUCTION.—Two to 3 young per litter with a gestation <10 weeks. Average life span 18 months (Beneski and Stinson 1987).

ECOLOGY.—Found along the edges of swift-flowing streams with rocks, logs, crevices, and overhanging banks; often in association with willow-grass or willow-sedge areas. Insectivorous, yet will feed on small fish. Predators include garter snake, water snake, weasels, trout, accipiter hawks, owls, mink, black bass, pickerel, walleye, and larger frogs (Beneski and Stinson 1987).

ADDITIONAL RECORDS.—Kane Co.: Kaiparowits Plateau (Tanner 1940).

*Sorex vagrans* Baird, 1858

Vagrant Shrew

*Sorex vagrans* Baird, 1858. Mammals, in Repts. Expl. Surv. . . . , 8(1):15, July 14. Type from Shoalwater Bay [known also as Willapa Bay], Pacific Co., Washington (Hall 1981).

GENERAL CHARACTERISTICS.—Color variable with seasons. Summer: grayish to brown above, grayish tinged in brown or red below. Long tail uniform color. Winter: uniformly grayish to blackish. Total length: 95–108; length of tail: 36–41; length of hind foot: 8–13; body mass: 3–8.5 g (Clark and Stromberg 1987).

DISTRIBUTION.—Riparian and montane areas of the Great Basin and Columbia Plateau, S British Columbia east to Montana, W Wyoming, and Wasatch Mountains of Utah; C Nevada to Sierra Nevada (Wilson and Reeder 1993).

REPRODUCTION.—Breeds in early January. Three to 8 young per litter with 2 or more litters per year (Jameson and Peeters 1988). Life span no longer than 16 months (Zaveloff 1988)

ECOLOGY.—Prefers montane habitat, usually in ponderosa pines at higher elevations. Commonly along streams associated with wet humus and thick herbaceous cover. Can also be found in more arid areas (Cockrum 1982, Zaveloff 1988). Feeds opportunistically, taking small arthropods, earthworms, and slugs (Jameson and Peeters 1988). Predators include snakes and barn owls (Zaveloff 1988).

## CHIROPTERA

*Antrozous pallidus* (Le Conte, 1856)

## Pallid Bat

*Antrozous pallidus* Le Conte, 1856. Proc. Acad. Nat. Sci. Philadelphia, 14:248 (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Large bat. Coloring pale beige above, nearly white below. Big ears separated at base. Total length: 90–113; length of tail: 40–47; length of hind foot: 10–12; length of ear: 28–32; length of forearm: 48–60; body mass: 14–17 g (Fitzgerald et al. 1994).

DISTRIBUTION.—Generally common throughout riparian habitats in arid deserts and grasslands of SW U.S. (Hermanson and O'Shea 1983). Distributed in E and S Utah (Sparks 1974).

REPRODUCTION.—Breeding October to December, with sperm stored in female reproductive tract until spring. Parturition May–June, female hanging upright while altricial young are born breech. Weaned 6–8 weeks (Hermanson and O'Shea 1983).

ECOLOGY.—Characteristic of desert areas, less abundant in evergreens and mixed forests. Co-roosts at night with other species of bats. Forms large maternity colonies. Preys on flightless arthropods, moths, and sometimes small lizards and smaller bats. Predators include snakes and owls. Echolocation main source of orientation. Isolation calls show individual distinctiveness and aid in localization of offspring. Squabble notes and irritation buzzes audible at night roosts (Hermanson and O'Shea 1983).

SPECIMENS EXAMINED.—Kane Co.: 42 mi S, 18 mi W, Paria River, 1 (USNM); mouth of Paria Canyon, 1 (USNM); Paria, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co: Paria (Pritchett 1962); Paria, 2 (Hasenyager 1980); Fin Little Spring, 3 (BLM); Pink Cove, 1 (BLM).

*Corynorhinus townsendii*  
(Cooper, 1837)

## Townsend's Big-eared Bat

*Plecotus townsendii* Cooper, 1837. Ann. Lyc. Nat. Hist. New York, 4:73, November, paratypes from Columbia River, Oregon (Hall 1981).

GENERAL CHARACTERISTICS.—Pelage paler gray or brown above, buff below. Largest eared bat in U.S. Two distinct, glandular lumps on

nose. Total length: 89–112; length of tail: 35–54; length of hind foot: 10–13; length of ear: 30–41; length of forearm: 39–47; body mass: 7–12 g (Jameson and Peeters 1988).

DISTRIBUTION.—W U.S. from Washington to Idaho, Wyoming, Colorado, New Mexico, Oklahoma, and Texas; scattered populations in Missouri, Arkansas, Kentucky, West Virginia, and Virginia (Jameson and Peeters 1988). Found in S Utah (Hasenyager 1980, Mollhagen and Bogan 1997).

REPRODUCTION.—Copulation throughout winter in hibernacula. Females store sperm until after hibernation, when fertilization occurs. Single young born in early summer (Zeveloff 1988). Gestation ranges from 56 to 100 days, depending on climatic factors and temperature variations (Schmidly 1991).

ECOLOGY.—Common in highlands of the W U.S. in scrublands as well as pine, pinyon-juniper, and deciduous forests; uncommon in deserts. Feeds mostly on moths although will take other insects in late evening. Roosts solitary or in small groups (Zeveloff 1988). Species very intolerant to disturbance. Shelter a limiting factor in distribution (Hasenyager 1980).

REMARKS.—Wilson and Reeder (1993) cite no evidence on why *Corynorhinus* should not be used. Herein, *Corynorhinus* is chosen based on parsimony analysis of the phylogeny of *Plecotus* by Tumlison and Douglas (1992).

ADDITIONAL RECORDS.—Kane Co.: Pink Cove, 1 (BLM); Pete's Cove, 2 (BLM).

STATUS.—Registered as sensitive species in Utah due to limited distribution and declining populations (Kimball 1997).

*Eptesicus fuscus*  
(de Beauvois, 1796)

## Big Brown Bat

*Vespertilio fuscus* Palisot de Beauvois, 1796. Cat. Raisonne Mus. Peale Philadelphia, p. 18. Type locality "Les environs de Philadelphia," Pennsylvania (Kurta and Baker 1990).

GENERAL CHARACTERISTICS.—Large bat. Pelage brown above, varying from light (in deserts) to dark (in forests), usually glossy; belly paler, with hairs dark at base. Black wings and membrane (not furred). Total length: 98–138; length of tail: 34–56; length of hind foot: 11–13; length of ear: not given; length of forearm: 39–54; body mass: 12–20 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—From S Canada to N Venezuela, Colombia, and Brazil. Found in arid W and SW U.S. and forested highlands (Kurta and Baker 1990). Records throughout whole state of Utah, with great variation in color (Hasenyager 1980).

**REPRODUCTION.**—Copulation occurs in September to March, with ovulation and fertilization delayed until after arousal from torpor. Gestation about 60 days with litter size 1 in W North America and 2 in Cuba and E U.S. (Kurta and Baker 1990).

**ECOLOGY.**—More abundant in deciduous forests and more forested, dry regions in W U.S. In mountainous regions, males occur at higher elevations than females. Observed leaving roosting site when temperature exceeds 33–35°C. Forages at night with no preference for over-water feeding sites. Generalist feeder and has opportunistic predators. Post-sunset glow and spatial memory might be relied on for finding foraging grounds. Isolation and feeding ultrasonic calls utilized. May also identify prey by low-frequency flight sounds of prey (Kurta and Baker 1990).

**SPECIMENS EXAMINED.**—Garfield Co.: 5 mi W Escalante, 3 (Hasenyager 1980); Kane Co.: Kaiparowits Plateau, 2 (Hasenyager 1980).

**ADDITIONAL RECORDS.**—Kane Co.: Fin Little Spring, 5 (BLM); Pete's Cove, 3 (BLM); Pink Cove, 12 (BLM); Nipple Spring, 1 (BLM); Drip Tank Spring, 11 (BLM); Paria River #2 Site, 10 (BLM).

*Euderma maculatum* (Allen, 1892)

Spotted Bat

*Histortius maculatus* J. A. Allen, 1892. Bull. Am. Mus. Nat. Hist., 3:195. Type locality Santa Clara Valley, Casrac Creek mouth, Los Angeles Co., California (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—White spots on black body. Large ears. Total length: 107–115; length of tail: 47–50; length of hind foot: not given; length of ear: 44–50; length of forearm: 48–51; body mass: 9–11 g (Watkins 1977).

**DISTRIBUTION.**—Rocky Mountain range from S Montana to S Mexico ranging from desert rubble to coniferous montane forests (Watkins 1977). Found in S portions of Utah (Hasenyager 1980).

**REPRODUCTION.**—Fertilization occurs in summer months. Single offspring born mid- to late summer (Watkins 1977).

**ECOLOGY.**—Wide variety of habitats but most often collected in dry desert terrains. Commonly feeds on moths, but also June beetles, flies, mealworms, katydids, and grasshoppers. With moths, spotted bat generally pulls wings and head off before eating. Predators most often include kestrel, red-tailed hawk, and peregrine falcon. Has high injury rate and greater-than-average speed. Vocalization a high-pitched, metallic squeak audible to the human ear (Watkins 1977).

**STATUS.**—Species of special concern in Utah due to declining populations (Kimball 1997).

*Idionycteris phyllotis* (Allen 1916)

Allen's Big-eared Bat

*Corynorhinus phyllotis* G. M. Allen, 1916. Bull. Mus. Comp. Zool., 60:352. Type locality Mexico, San Luis Potosi (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Large ears with lobes able to fold into ram's horn fashion for protection (Sparks 1974). Pelage soft blackish with yellowish tips (Czaplewski 1983). Total length: 103–121; length of tail: 46–55; length of hind foot: 9–12; length of ear: 38–43; length of forearm: 43–49; body mass: 10–12 g (Jameson and Peeters 1988, Fitzgerald et al. 1994).

**DISTRIBUTION.**—Mountainous regions of SW U.S. and Mexico (Czaplewski 1983). Distributed in Utah in southernmost counties (Hasenyager 1980, Mollhagen and Bogan 1997).

**REPRODUCTION.**—Single young born in maternity colonies between June and August (Czaplewski 1983).

**ECOLOGY.**—Primarily dwells in forested mountains from pine, fir, and oak to more riparian woodlands of sycamore, cottonwood, willow, and walnut. In Utah, also found in drier habitats. Roosts in rocky cliffs, outcroppings, boulder piles, or lava flows. Food consists of moths, soldier beetles, dung beetles, leaf beetles, roaches, and flying ants gleaned from vegetation or pursued in flight. Variable flying capabilities and speeds for adaptive foraging. Emits "peeps" similar to *Euderma maculatum* but lower in pitch. Echolocation has large range of signal types used by nearly all other bat species, allowing for versatility in orientation sounds (Czaplewski 1983).

**ADDITIONAL RECORDS.**—Kane Co.: Pink Cove, 1 (BLM); Pete's Cove, 2 (BLM).

STATUS.—Registered as a species of special concern in Utah due to limited distribution (Kimball 1997).

*Lasionycteris noctivagans*

(Le Conte, 1831)

Silver-haired Bat

*Vespertilio noctivagans* Le Conte, 1831. In: McMurtrie, Anim. Kingdom, 1(App.):431. Type locality eastern United States (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Medium-sized bat. Pelage nearly black with silver-tipped dorsal hair. Interfemoral membrane slightly furred. Short, rounded, naked ears (Kunz 1982). Total length: 90–112; length of tail: 35–48; length of hind foot: 8–11; length of ear: 13–16; length of forearm: 37–44; body mass: 7–15 g (Fitzgerald et al. 1994).

DISTRIBUTION.—S Canada, SE Alaska, and U.S. except southernmost regions, NE Mexico, Bermuda (Wilson and Reeder 1993). Likely statewide distribution for Utah (Hasenyager 1980).

REPRODUCTION.—Mating in temperate zones likely in autumn, with sperm storage over winter. Fifty- to 60-day gestation in May to June. Two young born in early summer. Unknown if species forms maternity colonies (Kunz 1982).

ECOLOGY.—Found in riparian and coniferous woodlands near streams and ponds (Hasenyager 1980). Thought to be solitary. Tree-rooster, but utilizes mines, caves, tree hollows and crevices in winter. Food habits opportunistically insectivorous. Forages comparatively in coniferous and deciduous forests adjacent to streams or ponds in bimodal activity of 2–4 hours before sunset then 4–6 hours after sunset. Probable that presence of red and hoary bats alters foraging time (Kunz 1982).

SPECIMENS EXAMINED.—Kane Co.: 42 mi S, 18 mi W, Paria River, 1 (USNM).

ADDITIONAL RECORDS.—Kane Co.: Water Tank Springs, Kaiparowits Plateau, 50 mi SE Escalante (Tanner 1940); Tommy Water, 3 (BLM); Drip Tank Spring, 7 (BLM); Paria River #2 Site, 1 (BLM).

*Lasiurus borealis* (Muller, 1776)

Western Red Bat

*Vespertilio borealis* Muller, 1776. Linne's Vollstand. Natur. System, Suppl., p. 20. Type locality New York (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Male coloring bright red to orange-red; females dull red or chestnut; both with frost-colored back and breast. Characterized by white patch on each shoulder. Ears small and rounded with small tragus (Shump and Shump 1982a). Total length: 107–128; length of tail: 40–60; length of hind foot: 8–11; length of ear: 8–11; length of forearm: 35–46; body mass: 7–16 g (Fitzgerald et al. 1994).

DISTRIBUTION.—S Canada through U.S., Mexico, Central America, and South America to Chile and Argentina (Shump and Shump 1982a). Utah records indicate presence in S two-thirds of state (Durrant 1952).

REPRODUCTION.—Breeding August–September with fertilization in spring. Gestation 80–90 days with 3–5 young born in June–July (Shump and Shump 1982a).

ECOLOGY.—Wide range of habitats used, preferring riparian areas where roosts available in tree foliage (Schmidly 1991). Solitary bat. Foraging begins 1–2 hours after sunset, feeding mostly on moths, crickets, flies, beetles, cicadas, and grain moths. Highly migratory. Predators include falcons, hawks, opossums, domestic cats, owls, and roadrunners (Shump and Shump 1982a).

STATUS.—Considered sensitive species in Utah due to limited distribution and declining populations (Kimball 1997).

*Lasiurus cinereus*

(Palisot de Beauvois, 1796)

Hoary Bat

*Vespertilio cinereus* Palisot de Beauvois, 1796. Cat. Rasionne Mus. Peale Philadelphia, p. 18. Type from Philadelphia, Pennsylvania (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Larger bat. Pale brown above with heavily frost-tipped pelage (Shump and Shump 1982b). Small, rounded ears and interfemoral membrane well furred. Total length: 120–145; length of tail: 49–60; length of hind foot: 9–12; length of ear: 9–14; length of forearm: 46–56; body mass: 18–32 g (Jameson and Peeters 1988, Fitzgerald et al. 1994).

DISTRIBUTION.—Covers the U.S. and Canada to Guatemala, and South America from Brazil to Argentina and Chile in desert canyons, coniferous and deciduous forests (Shump and Shump 1982b). Statewide distribution in Utah (Durrant 1952).

REPRODUCTION.—Breeding in fall and perhaps winter. Two young born in late May to early June that cling to mother in day and are left hanging on a twig or leaf while mother feeds at night (Shump and Shump 1982b).

ECOLOGY.—Found in forested areas of the West (Hasenyager 1980). Solitary bat that usually roosts in tree foliage. Forage primarily includes moths and some beetles, flies, grasshoppers, termites, dragonflies, and wasps. Has been observed when feeding on moths to bite from behind, thus engulfing abdomen and thorax and shearing off head and wings. Occasionally taken by hawks or owls (Shump and Shump 1982b).

ADDITIONAL RECORDS.—Kane Co.: Drip Tank Springs, 1 (BLM).

*Myotis californicus*  
(Audubon and Bachman, 1842)

California Myotis

*Vespertilio californicus* Audubon and Bachman, 1842. J. Acad. Nat. Sci. Philadelphia, ser. 1, 8:285. Type locality "Monterey, California, U.S.A." (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Light to brown fur with rusty tint above and paler below. Dark wings, ears, and interfemoral membrane. Small feet. Total length: 70–84; length of tail: 30–40; length of hind foot: 5.5–8.2; length of ear: 11–15; length of forearm: 29–36; body mass: 3–5 g (Fitzgerald et al. 1994).

DISTRIBUTION.—W North America from Alaskan Panhandle to Baja California and Chiapas, Mexico (Simpson 1993). Records in Utah include counties from the S three-fourths of state (Hasenyager 1980).

REPRODUCTION.—Delayed fertilization with 1 young per year; breeding in late autumn to early spring. Maternity colonies form June to July (Simpson 1993).

ECOLOGY.—Inhabits desert, semidesert, grasslands, ponderosa pine, and lower Sonoran through transitional life zones. Rocky canyons, crevices, and caves used for roosting. Forages before sundown (Hasenyager 1980). Feeds mainly on lepidopteran and dipteran species, but will take coleopterans, trichopterans, and hemipterans. Roosts alone or in small groups (Simpson 1993).

SPECIMENS EXAMINED.—Kane Co.: Willow Tank Spring, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Nipple Spring, 1 (BLM).

*Myotis ciliolabrum*  
(Merriam, 1886)

Western Small-footed Myotis

*Vespertilio ciliolabrum* Merriam, 1886. Proc. Biol. Soc. Washington, 4:2, Dec. 17. Type from a bluff on Hackberry Creek, about 1 mi from Castle Rock, near Banner, Trego Co., Kansas (Hall 1981).

GENERAL CHARACTERISTICS.—Small bat with yellow-brown pelage and black face, ears, wings, and interfemoral membrane. Keeled calcar. Dark facial mask on some individuals. Total length: 75–88; length of tail: 33–42; length of hind foot: 5–8; length of ear: 12–15; length of forearm: 30–35; body mass: 3.5–5.5 g (Fitzgerald et al. 1994).

DISTRIBUTION.—Throughout all W U.S. and across the state of Utah (Wilson and Reeder 1993, Mollhagen and Bogan 1997).

REPRODUCTION.—Single young born in May to June in small maternity colonies. Very little known about their reproductive activity (Schmidly 1991).

ECOLOGY.—Widely distributed in many different western habitats. Also found near forested areas. Small maternity colonies formed; otherwise habits generally solitary. Low flier and insectivorous, opportunistic feeder. Feeding habits similar to California myotis (Schmidly 1991). Various roosts, especially man-made structures. Relatively high toleration to cold temperatures; therefore shorter hibernation than other bats (Hasenyager 1980).

REMARKS.—*Myotis ciliolabrum* and *M. leibii* synonymized by Wilson and Reeder (1993). Herein, separated based on data presented by van Zyll de Jong (1984) and revised as *M. leibii* (eastern race) and *M. ciliolabrum* (western race) according to diagnostic bacula size, vaulted braincase, upper incisor width, and DNA work using UPGMA clustering. Best and Jennings (1997), in Mammalian Species account of *M. leibii*, also considered them separate species.

*Myotis evotis* (H. Allen, 1864)

Long-eared Myotis

*Vespertilio evotis* H. Allen, 1864. Smithson. Misc. Coll., 7:48. Type locality restricted to Monterey, Monterey Co., California (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Light brown to brown, glossy, long pelage. Longest ears in genera, usually black with long, tiny tragus (Zeloff 1988). Total length: 88–92; length of tail: 41–46; length of hind foot: 8–10; length of



ear: 18–23; length of forearm: 35–41; body mass: 5–7 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—Ranges from British Columbia and Alberta to New Mexico (Manning and Jones 1989). Recorded in Utah in E and S areas of the state (Durrant 1952).

**REPRODUCTION.**—Small maternity colonies formed early summer. Single young born in late June–July (Fitzgerald et al. 1994).

**ECOLOGY.**—Dry forests to subalpine with prevailing rock outcrops, semiarid shrublands, sage, chaparral, agricultural areas, riparian willow areas, and coniferous to deciduous forests. Major food source is moths, but the species is opportunist. Foraging hours start at sunset and continue 2 hours or more after. Yellow-bellied racer reported as predator (Manning and Jones 1989).

**ADDITIONAL RECORDS.**—Kane Co.: Pink Cove, 9 (BLM); Kitchen Corral, 1 (BLM); Fin Little Spring, 4 (BLM).

*Myotis lucifugus* (Le Conte, 1831)

Little Brown Myotis

*Vespertilio lucifugus* Le Conte, 1831. In: McMurtrie, Anim. Kingdom, 1(App.):431. Type locality Georgia, probably the Le Conte Plantation, near Riceboro, Liberty County (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Fur glossy brown above with tips brushed brown; buff below. Tragus rounded and short. Hairs on toes protrude past ends (Zaveloff 1988). Total length: 90–100; length of tail: 36–47; length of hind foot: 8–10; length of ear: 12–14; length of forearm: 33–41; body mass: 4.5–5.5 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—Most of North America except SE U.S. and N Canada (Fenton and Barclay 1980). Statewide distribution in Utah (Sparks 1974).

**REPRODUCTION.**—Delayed fertilization with actual gestation of 50–60 days. Young weaned after 3 months. Births in maternity colonies with single young (Fenton and Barclay 1980).

**ECOLOGY.**—Habitat mountainous regions of ponderosa pine, pine-oak woodlands, and other montane forests. Utilizes any roosting site available. Predators include small carnivores, birds, carnivorous mice, and snakes. Populations found to have drastically declined due to pesticides. Flexible, opportunistic feeding habits, feeding on most aquatic insects (Fenton and Barclay 1980).

*Myotis thysanodes* Miller, 1897

Fringed Myotis

*Myotis thysanodes* Miller, 1897. N. Am. Fauna, 13:80. Type locality Old Fort Tejon, Tehachapi Mtns., Kern Co., California (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Pelage red-brown or brown above; paler below. Only myotis with fringe of hairs on interfemoral membrane (Hasenyager 1980). Total length: 77–100; length of tail: 34–45; length of hind foot: 9–11; length of ear: 16–19; length of forearm: 39–46; body mass: 6–7 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—W North America from British Columbia to Veracruz and Chiapas, Mexico; disjunct population in Wyoming and Dakota Black Hills (O'Farrell and Studier 1980). Generally distributed throughout Utah but not in abundance (Sparks 1974).

**REPRODUCTION.**—Ovulation, fertilization, and implantation between April and May. Gestation 50–60 days with parturition June to July when females become solitary. Females give birth with head down and consume placenta (O'Farrell and Studier 1980).

**ECOLOGY.**—Low desert scrub to pine-fir associations, although oak and pinyon woodlands common. Roost sites caves, mine tunnels, and buildings (O'Farrell and Studier 1980). Opportunistic feeder with ability to detect ground-dwelling insects. Emerges to feed based on phototrophic response directly related to sunset (Hasenyager 1980).

**ADDITIONAL RECORDS.**—Kane Co.: Drip Tank Spring, 2 (BLM); Tibbets Spring, 6 (BLM); Pink Cove, 1 (BLM).

*Myotis volans* (H. Allen, 1866)

Long-legged Myotis

*V[espertilio]. volans* H. Allen, 1866. Proc. Acad. Nat. Sci. Philadelphia, 18:282. Type locality Cabo San Lucas, Baja California, Mexico (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Large myotis. Pelage tawny or reddish to nearly black above; grayish to paler buff below. Underarm and interfemoral membrane furred to elbow and knee. Total length: 87–103; length of tail: 37–49; length of hind foot: 8–10; length of ear: 10–14; length of forearm: 35–42; body mass: 5–7 g (Jameson and Peeters 1988).

**DISTRIBUTION.**—W North America from SE Alaska and W Canada to C Mexico at elevations from 60 to 3770 m, but usually between

2000 and 3000 m. Found statewide in Utah (Hasenyager 1980).

REPRODUCTION.—Copulation begins in late August with sperm storage overwinter in female reproductive tract. Ovulation March to May (Warner and Czaplewski 1984). Large nursery colonies. Single young born June to early August (Hasenyager 1980).

ECOLOGY.—Mainland races typically in montane areas and rarely in arid zones. Feeds primarily on moths, but known to consume other soft-bodied invertebrates. Fast, direct flier that pursues prey long distances adjacent to primarily coniferous forest canopies, though sometimes foraging in riparian and desert habitats. Roosts include abandoned buildings, crevices, caves, cracks beneath exfoliating tree bark, and mine tunnels (Warner and Czaplewski 1984).

ADDITIONAL RECORDS.—Kane Co.: Fin Little Spring, 8 (BLM); Pink Cove, 10 (BLM).

*Myotis yumaensis* (H. Allen, 1864)

Yuma Myotis

*Vespertilio yumaensis* H. Allen, 1864. *Smithson. Misc. Coll.*, 7(Publ. 165):58, June. Type from Old Fort Yuma, Imperial Co., California, on right bank of Colorado River, opposite present town of Yuma, Arizona (Hall 1981).

GENERAL CHARACTERISTICS.—Short, dull fur, paler below; throat sometimes whitish. Total length: 82–88; length of tail: 32–38; length of hind foot: 7–9; length of ear: 11–15; length of forearm: 32–38; body mass: 6–8 g (Jameson and Peeters 1988).

DISTRIBUTION.—W North America from British Columbia to California westwardly to Colorado and Texas (Wilson and Reeder 1993). Occurs throughout Utah except Wasatch Mountains (Hasenyager 1980).

REPRODUCTION.—Single young born May–July (Fitzgerald et al. 1994). Large nursery colonies (Hasenyager 1980).

ECOLOGY.—Associated with riparian areas of W North America; some occurrence, however, may be in dry and shrubby habitat. Day roosts in rock crevices, buildings, caves, mines, and swallow nests. Night roosts include buildings and structure ledges. Gregarious by habit. Forages late evening on moths, flies, grasshoppers, and beetles (Fitzgerald et al. 1994). Forages in trees above perennial water. Will desert roosts with slightest disturbance (Hasenyager 1980).

ADDITIONAL RECORDS.—Kane Co.: Cottonwood Creek, 3 (BLM); Pete's Cove, 1 (BLM).

*Pipistrellus hesperus* (Allen, 1864)

Western Pipistrelle

*Scotophilus hesperus* H. Allen, 1864. *Smithson. Misc. Coll.*, 7(Publ. 165):43, June. Type from Old Fort Yuma, Imperial Co., California, on right bank of Colorado River, opposite present town of Yuma, Arizona (Hall 1981).

GENERAL CHARACTERISTICS.—Smallest bat in U.S. Pelage pale yellow-gray. Hairs tricolored with dark base, pinkish in middle, and dark at tip. Total length: 60–86; length of tail: 25–36; length of hind foot: 5.5–7; length of ear: 10–11; length of forearm: 27–33; body mass: 4–6 g (Fitzgerald et al. 1994).

DISTRIBUTION.—W U.S. from Oregon to Baja California, Texas to C Mexico (Fitzgerald et al. 1994). Records for Utah in S and W portions (Durrant 1952).

REPRODUCTION.—Gestation ca 40 days. Maternity colonies in rock crevices or buildings. Usually 2 young in June–July. Weaned in August (Davis and Schmidly 1994).

ECOLOGY.—More common in canyon and desert country. Roosts in loose rock, rock crevices, caves, and buildings. Has butterfly-like flight patterns; thus stays in roosts in windy weather when difficult to fly. Diurnal activity, early evening and dawn feeding on insects. Sedentary bat that roosts close to summer range (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Garfield Co.: 10 mi E Escalante, 1 (UU); Kane Co.: 42 mi S, 18 mi W, Paria River, 3 (USNM).

ADDITIONAL RECORDS.—Kane Co.: Willow Tank Springs between Kaiparowits Plateau (Tanner 1940); Paria, 2 (Hasenyager 1980); Willow Tank Springs, 1 (BYU); Paria, 1 (BYU); Fin Little Spring, 2 (BLM); Tommy Water, 5 (BLM); Pete's Cove, 10 (BLM); Tibbetts Spring, 5 (BLM); Nipple Spring, 9 (BLM); Drip Tank Spring, 24 (BLM); Paria River #2 Site, 10 (BLM); Cottonwood Creek, 3 (BLM).

*Nyctinomops macrotis*  
(Gray, 1839)

Big Free-tailed Bat

*Nyctinomus macrotis* Gray, 1839. *Ann. Nat. Hist.*, 4:5, September. Type from Cuba (Hall 1981).

GENERAL CHARACTERISTICS.—Large bat with reddish, dark brown, or black fur; hairs white

at base. Total length: 125–140; length of tail: 48–54; length of hind foot: 14–16; length of ear: 26–29; length of forearm: 58–64; body mass: 12–18 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—Covers Four Corners states and surrounding edges of Nevada, California, Texas, Nebraska, and Oklahoma; throughout Mexico and Baja California (Fitzgerald et al. 1994). Known to be in SW and extreme W Utah (Durrant 1952).

**REPRODUCTION.**—Single young born in June to July in nursery colonies. Young emerge from colony by August (Zelveloff 1988).

**ECOLOGY.**—Rare species. Typically inhabits rugged, rocky environments with steep canyon walls. Also arid sagebrush flats and riparian areas. Primarily a lowland species. Moths main food source, but also other ground insects such as ants and crickets. Call an audible, loud, piercing noise when feeding after dark (Zelveloff 1988). Powerful flier; foraging late evening (Schmidly 1991).

**STATUS.**—Sensitive species in Utah due to limited distribution and declining populations (Kimball 1997).

*Tadarida brasiliensis*  
(Geoffroy Saint-Hilaire, 1824)

Mexican Free-tailed Bat

*Nyctinomus brasilensis* Geoffroy Saint-Hilaire, 1824. Ann. Sci. Nat., 1:343. Type locality Brazil (Hall 1981).

**GENERAL CHARACTERISTICS.**—Smallest free-tailed bat. Pelage dark brown or dark gray above, hairs whitish at base. Ears separated at base. Tail extends past interfemoral membrane. Total length: 88–112; length of tail: 31–41; length of hind foot: not given; length of ear: 14–20; length of forearm: 36–46; body mass: 8–14 g (Jameson and Peeters 1988).

**DISTRIBUTION.**—One of most widely distributed mammals in Western Hemisphere from S Oregon to Nevada to Utah to N Nebraska to Arkansas, Georgia, and Florida southward to Argentina and Chile (Wilkins 1989). Distributed statewide in Utah (Durrant 1952, Sparks 1974).

**REPRODUCTION.**—Ovulation February to March, mating during a 5-week interval during ovulation. Parturition with 1 young in June (Wilkins 1989).

**ECOLOGY.**—Found in lower and upper Sonoran life zones (Hasenyager 1980). Feeds mostly on moths, but also takes flying ants, beetles, leafhoppers, and true bugs (Schmidly 1991).

Predators include hawks, roadrunner, owls, skunks, rat snake, raccoon, opossum, coach-whip, coral snake, and copperhead. Roosts vary from man-made structures to caves and crevices, yet must be large for colony aggregations (Wilkins 1989). Fast and high flier; usually forages at dusk. Migrates during winter months (Sparks 1974, Wilkins 1989). Vocalizations loud, piercing calls audible to human ear when feeding (Fitzgerald et al. 1994).

**ADDITIONAL RECORDS.**—Kane Co.: Drip Tank Spring, 1 (BLM).

**STATUS.**—Species of special concern in Utah due to declining numbers and limited distribution (Kimball 1997).

CARNIVORA

*Canis latrans* Say, 1823

Coyote

*Canis latrans* Say, 1823. In: Long, Account of an Exped. from Pittsburgh to the Rocky Mtns., 1:168. Type locality Engineer Containment, about 12 mi SE of present town of Blair, Washington Co., Nebraska, on W bank of Missouri River (Honacki et al. 1982).

**GENERAL CHARACTERISTICS.**—Medium-sized canid with appearance similar to gray wolf. Hair banded giving appearance of blended color, gray mixed with reddish tint; pelage overall brownish with black. Tail well furred. Long, pointed ears (Clark and Stromberg 1987). Males slightly larger than females. Total length: 1050–1400; length of tail: 300–400; length of hind foot: 175–220; length of ear: 80–130; body mass: 9–16 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—Following removal of the wolf, the coyote dispersed to now occupy all of U.S. except SE region; has statewide distribution in Utah (Durrant 1952, Fitzgerald et al. 1994).

**REPRODUCTION.**—Courtship 2–3 months before mating in January to March. Pairing for several years, but not necessarily permanent. Gestation about 63 days with ca 5–6 young. Compensatory reproduction likely in areas subject to population control (Fitzgerald et al. 1994).

**ECOLOGY.**—Occurs in wide range of habitats from high mountains to low deserts, also numerous in suburbs of cities. Active early in morning and later afternoon; some activity at night. Foods range from carrion to juniper berries, cactus fruit, other berries, rodents, rabbits, deer, and insects. Depredation on domestic livestock (especially sheep) may be a problem

(Cockrum 1982). Forms social packs in times of food abundance, solitary when food sources are dispersed. Basic social unit includes adult male, female, and pups; less social than wolf (Clark and Stromberg 1987). Communication involves olfactory, facial, and postural expressions. Yips, howls, and barks characterize vocalizations; olfactory communication with scent marking. Territorial as mated pairs and familial packs (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Kane Co.: 1 mi E Glen Canyon City, Wah Weep Creek, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Kaiparowits Plateau (Tanner 1940); Last Chance Creek, 1 (Atwood and Pritchett 1974).

*Urocyon cinereoargenteus*  
(Schreber, 1775)

Gray Fox

*Canis cinereo argenteus* Schreber, 1775. Die Saugthiere, teil 2, heft 13, pl. 92. Type locality E North America (Hall 1981).

GENERAL CHARACTERISTICS.—Pelage grizzled gray with red on sides and head; chest whitish; legs rust colored. Ears prominent. Black mane on black-tipped tail (Fritzell and Haroldson 1982). Total length: 800–1125; length of hind foot: 100–150; length of tail: 275–443; length of ear: 65–70; body mass: 3–7 kg (Clark and Stromberg 1987).

DISTRIBUTION.—Wooded, brushy, and rocky habitats from S Canada to N Venezuela and Colombia, excluding mountainous W U.S., Great Plains, and E Central America (Fritzell and Haroldson 1982). Range in S and E Utah (Durrant 1952).

REPRODUCTION.—Breeding varies geographically, generally January to March. Likely monogamous mating system. Gestation about 53 days with average litter size 4 (Fritzell and Haroldson 1982, Clark and Stromberg 1987).

ECOLOGY.—Carnivore most closely associated with deciduous forests, but occupies wide range of habitats from deserts to various woodlands and agricultural areas. Omnivorous diet, but relies on prey of small mammals (especially rabbits and rodents when available) and other material such as fruit, birds, carrion, and insects. Studies in Utah show heavy dietary dependence on berries of Utah juniper (White 1997). Dens in rocky outcroppings, brush piles, hollow trees, or burrows. Good climber. Main predator is man, but also golden eagle, coyote,

and bobcat. Nocturnal and social family groups. Urine and feces important communication mediums (Fritzell and Haroldson 1982).

SPECIMENS EXAMINED.—Kane Co.: Little Valley Canyon, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Cottonwood Wash, 1 (Atwood and Pritchett 1974); Cockscomb, 1 (Atwood and Pritchett 1974); Brigham Plains, 1 (Atwood and Pritchett 1974).

*Vulpes macrotis* Merriam, 1888

Kit Fox

*Vulpes macrotis* Merriam, 1888. Proc. Biol. Soc. Washington, 4:135–138. Type locality “Riverside, San Bernardino Co., California.” More exactly, on the western margin of the San Jacinto Plain in the vicinity of Box Springs, within 10 mi SE of Riverside (McGrew 1979).

GENERAL CHARACTERISTICS.—Vulpine appearance; slim body. Relatively large ears and long, bushy tail. Pelage light grizzly gray to yellowish gray, underparts light to buff, ears buff. Tail black tipped with distinct black spot covering supracaudal gland. Total length: 730–840; length of tail: 260–323; length of hind foot: 113–137; length of ear: 78–94; body mass: ca 2 kg (McGrew 1979).

DISTRIBUTION.—C North America from SE British Columbia, SC Alberta, and SW Saskatchewan to NW panhandle of Texas and E New Mexico, east of the Rocky Mountains (Wilson and Reeder 1993). According to Durrant (1952) found only in W Utah. However, Atwood and Pritchett (1974) thought some tracks found in Fivemile Valley in GSENM were likely kit fox.

REPRODUCTION.—Breeding December–February. Parturition in February or March with 4–5 young. Life span maximum 10–12 years (McGrew 1979). Monestrous females. Pair in late fall when females select and clean out dens, but monogamous pairing questionable (Chapman and Feldhamer 1982).

ECOLOGY.—Closely associated with steppe or desert climates and shrub to shrub-grasslands. Opportunistic diet mostly of leporids and small, nocturnal rodents, especially kangaroo rats (*Dipodomys* spp.). Also will feed on ground-nesting birds, reptiles, and insects (O’Neal et al. 1987). Coyote, golden eagle, and man main predators (McGrew 1979). Semi-fossorial and digs own dens. Dens clustered and not randomly distributed. Individuals move from one den complex to another. Active year-round. Establishes home ranges yet provides

little evidence of typical territoriality (Fitzgerald et al. 1994).

REMARKS.—Wilson and Reeder (1993) considered *V. velox* and *V. macrotis* conspecific. Discussed by Escogue (1979) and McGrew (1979) and revised by Dragoo et al. (1990), who defined them as separate species. Herein, regarded as separate species.

*Vulpes vulpes* Baird, 1852

Red Fox

*Vulpes macrourus* Baird, 1852. Stansbury's Exploration and Survey of the Valley of the Great Salt Lake of Utah, publ. 309. Type locality Wasatch Mountains bordering Great Salt Lake, Utah (Durrant 1952).

GENERAL CHARACTERISTICS.—Vulpine shaped. Long, pointed ears. Elongated muzzle and bushy tail red with white tip. Pelage reddish yellow, whiter chest and black legs. Two other morphs not as common: cross with yellowish dorsum and dark cross of hairs over shoulder and dorsal midline; and silver with black coloring and silver-tipped guard hairs (Cockrum 1982, Fitzgerald et al. 1994). Total length: 827–1015; length of tail: 291–461; length of hind foot: 124–182; length of ear: 65–102; body mass: 3–7 kg (Clark and Stromberg 1987).

DISTRIBUTION.—Perhaps native to Europe and North America with documented releases from Europe into New England. Now found throughout most of North America (Voight 1987). Durrant (1952) noted greater abundance in S Utah than in the rest of the state. Utah Furbearer Harvest Report (1997) indicates abundance in N Utah, even in higher mountain regions.

REPRODUCTION.—Breeding December to March. Gestation 51–54 days with ca 5.5 young. Longevity 4–5 years (Clark and Stromberg 1987).

ECOLOGY.—Characteristic habitats include edges between forests and shorter vegetation, and riparian zones in semidesert scrublands and brushlands. Feeds mainly on small rodents, birds, and insects, but occasionally fruits and leporids (Cockrum 1982). In winter male hunting groups form though generally solitary and crepuscular. May cache prey. Main predator is man; occasionally young foxes taken by coyotes and raptors (Zaveloff 1988). Foxes establish home ranges, males defend territories. Dens are usually burrows dug by other mammals or themselves. Do not use dens in warmer

months, but sleep on ground surface (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Kane Co.: Wah Weep Creek, 1 (UU); Kaiparowits Plateau, W side of Colorado River, 1 (USNM).

ADDITIONAL RECORDS.—Kane Co.: Wah Weep Creek, 15 mi S Henrieville (Durrant 1952).

*Lynx rufus* (Schreber, 1777)

Bobcat

*Felis rufa* Schreber, 1777. Die Saugthiere . . . , tiel 3, heft 95, pl. 109b. Type locality New York (Hall 1981).

GENERAL CHARACTERISTICS.—Medium- to large-sized feline. Upper coloration grayish, buffy, or reddish, usually with black spots; color prominent middorsally, lightening laterally. Tufted ears blackish with white spot near tip. Rump and hind legs buff, eyelids white. Underparts whitish with black spots. Tail indistinct with black rings, tipped with black (Hall 1981). Total length: 700–1000; length of tail: 95–150; length of hind foot: 130–220; length of ear: 50–85; body mass: 5–15 kg (Jameson and Peeters 1988).

DISTRIBUTION.—Disjunct distribution from east to west and from S Canada to C Mexico, with more robust populations in W U.S. (Jameson and Peeters 1988). Found statewide in Utah (Durrant 1952).

REPRODUCTION.—Annual breeding in February. Gestation about 60 days with 2–7 young, average litter size 3. Weaned at 2 months (Davis and Schmidly 1994). Seasonally polyestrous and previously thought to be induced ovulators, as are domestic cats. Females have 3 estrous cycles in a 4-month period if not bred (Fitzgerald et al. 1994).

ECOLOGY.—Found in mountainous regions, shrublands, coniferous forests, and dispersed rocky habitat. Food mostly rabbits and hares, but also ground squirrels, mice, domestic animals, birds, insects, lizards, crayfish, and frogs. Solitary and nocturnal mostly with territorial home ranges, males overlapping females (Blackwell 1991, Wassnik 1993). Active year-round, hunting mostly from dusk to dawn. Predators recorded as man, mountain lion, and coyote (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Kane Co.: Cottonwood Canyon, Navajo Project, 25 mi S of Cannonville Canyon, 1 (BYU); Paria River, S of Highway 89, 1 (BYU).

*Puma concolor* (Kerr, 1792)

## Mountain Lion

*Felis cougar* Kerr, 1792. The Anim. Kingdom . . . , p. 151.  
Type locality Pennsylvania (Hall 1981).

GENERAL CHARACTERISTICS.—Large felid, slender in form. Ears small, rounded. Pelage upperparts grizzled gray or dark brown to shades of buff, cinnamon-rufous, or ferruginous; color most prominent on middorsal line. Underparts whitish, overlaid with buff abdomen, chin and throat white. Muzzle sides, tail, and ears black. Young spotted with black or buff ground color (Hall 1981). Total length: 1500–2500; length of tail: 550–775; length of hind foot: 220–275; length of ear: 50–115; body mass: 40–100 kg (Jameson and Peeters 1988).

DISTRIBUTION.—W North America from British Columbia, S Alberta through Wyoming to California to Texas southwardly through Mexico to Patagonias. Small, now isolated population in Everglades of Florida (Jameson and Peeters 1988). Occurs throughout Utah with mule deer and elk distributions (Durrant 1952).

REPRODUCTION.—Usually breeds winter to early spring. Two to 4 spotted young born in spring in dens located in caves, rock ledges, or beneath windfalls. Kittens weaned after 18–22 months (Wassnik 1993).

ECOLOGY.—Best suited for remote, forested, and brushy mountainous habitat. Most widely ranging mammal in the Americas. Solitary and nocturnal by habit. Primarily preys on deer and other mammals (one of few predators that take skunks and porcupine [Jameson and Peeters 1988]). Adult males often kill juveniles, but in North America man is only real predator. Habitat fragmentation poses greatest threat to many populations. Maintains continuous home ranges, and same sex behavioral intolerance accounts for low densities. Little active defense in maintaining ranges, instead keeps conspecifics out by scent marking (Fitzgerald et al. 1994). Communication both olfactory and vocalized (Chapman and Feldhamer 1982).

REMARKS.—Genus addressed in Currier (1983) and placed in *Puma* by Pocock (1917), Weigel (1961), Hemmer (1978), Kratochvil (1982), and Wilson and Reeder (1993).

ADDITIONAL RECORDS.—Kane Co.: Nipple Creek, 1 (Atwood and Pritchett 1974); Tibbett Creek, 1 (Atwood and Pritchett 1974); Willow Creek (Atwood and Pritchett 1974).

*Lontra canadensis* (Schreber, 1776)

## Northern River Otter

*Mustela lutra canadensis* Schreber, 1776. Die Saugthiere . . . , teil 3, heft 18, pl. 126b. Type locality eastern Canada [=Quebec] (Hall 1981).

GENERAL CHARACTERISTICS.—Aquatic mustelid with elongated body. Thick, long tail and webbed feet. Broad, flattened head. Pelage dark brown, paler belly with silvery throat. Ears and eyes small. Total length: 889–1300; length of tail: 300–500; length of hind foot: 100–145; length of ear: 12–24; body mass: 5–10 kg (Jameson and Peeters 1988).

DISTRIBUTION.—Historically ranged from Alaska and Canada through most of U.S., now uncommon throughout Midwest and W U.S., yet reintroductions are spreading range (Clark and Stromberg 1987). Findlay (1992) noted successful reintroduction and reproduction by otters brought in from near Cordova, Alaska, and NE Nevada into the Green River below Flaming Gorge Dam. Dispersal of these likely in the Colorado River system in Utah.

REPRODUCTION.—Mates late winter to early spring. Gestation 61–63 days without delayed implantation. One to 5 young born between February and April (Lariviere and Walton 1998). Weaned at 90–100 days (Clark and Stromberg 1987).

ECOLOGY.—Relies on lakes, streams, and rivers in habitats ranging from semidesert shrublands to montane to subalpine forests (Fitzgerald et al. 1994, Lariviere and Walton 1998). Notorious wanderer, nocturnal and solitary. Dens usually holes in riverbanks under roots or eroded areas. Food mainly fish, but also frogs, birds, small mammals, forbs, and aquatic invertebrates (Cockrum 1982, Findlay 1992). Western predators include bobcat, cougar, coyote, and domestic dog. Active year-round. Not territorial, but exhibits interspecific intolerance. Dens in burrows dug by other mammals (Fitzgerald et al. 1994).

REMARKS.—van Zyll de Jong (1987) and van Zyll de Jong and Wright (1991) argued New World otters represent single radiation and questioned whether *Lutra* or *Aonyx* was the closest sister group; thus should be left in its own genus of *Lontra*.

STATUS.—Designated a sensitive species due to declining populations and limited distribution in Utah (Kimball 1997). Included in

CITES within Appendix II (Wilson and Reeder 1993).

*Mephitis mephitis* (Schreber, 1776)

Striped Skunk

*Viverra mephitis* Schreber, 1776. Die Saugthiere . . . , teil 3, heft 17, pl. 121. Type locality eastern Canada [=Province of Quebec] (Wade-Smith and Verts 1982).

GENERAL CHARACTERISTICS.—Pelage black with 2 white stripes on back meeting as cap on head and shoulders; thin, white stripe down face. Bushy black tail, often white tipped. Total length: 575–800; length of tail: 185–390; length of hind foot: 60–90; length of ear: 25–35; body mass: 1800–2700 g (Jameson and Peeters 1988).

DISTRIBUTION.—Throughout S Canada, U.S., and N Mexico (Wade-Smith and Verts 1982). Statewide distribution in Utah (Durrant 1952).

REPRODUCTION.—Breeds February to March. Gestation 60–77 days, with short period of delayed implantation. Parturition May to early June with 2–10 young per litter per year (Wade-Smith and Verts 1982). Polygamous mating system (Fitzgerald et al. 1994).

ECOLOGY.—Highly adaptive to many types of habitat, even areas developed by humans. Predators include great horned owl, mountain lion, eagles, coyote, badger, foxes, and bobcat, but not their prey of predilection (prey of preference and/or specialization). Often considered vermin and sometimes carries diseases (e.g., rabies) and parasites. Opportunistic feeder, primarily insectivorous. Utilizes underground dens in fall, winter, and spring. Lives aboveground in summer months. Usually silent, but can make squeals, low churrings, growls, dovelike cooings, shrill screechings, birdlike twitters, and hissing noises (Wade-Smith and Verts 1982). Primarily crepuscular and nocturnal. Inactive in winter months with periodic arousals (Fitzgerald et al. 1994).

ADDITIONAL RECORDS.—Kane Co.: Little Valley Creek (Atwood and Prichett 1974).

*Spilogale gracilis* Merriam, 1890

Western Spotted Skunk

*Spilogale gracilis* Merriam, 1890. N. Amer. Fauna, 3:83, September 11, 1890. Type locality Grand Canyon of the Colorado, north of San Francisco Mountain, Coconino Co., Arizona (Durrant 1952).

GENERAL CHARACTERISTICS.—Small black skunk with white horizontal stripes on neck and shoulders, irregular stripes and spots on

sides and head. Total length: 270–610; length of tail: 80–280; length of hind foot: 32–59; length of ear: 25–26; body mass: 2–3.5 kg (Jameson and Peeters 1988).

DISTRIBUTION.—Found in SW British Columbia throughout West to Texas. Usually found among waterways, but also in developed, urban areas (Clark and Stromberg 1987). Statewide distribution in Utah (Durrant 1952).

REPRODUCTION.—Mating September to October. Delayed implantation about 1 month with gestation of 210–230 days. Parturition in May with ca 4 kits per litter (Fitzgerald et al. 1994).

ECOLOGY.—Found in semiarid West in montane forest, pinyon-juniper, semidesert shrubland and common in broken shrub habitats. Omnivorous diet with arthropods, small mammals, and birds preferred. Solitary and generally nocturnal (Fitzgerald et al. 1994, Kinlaw 1995). Predators same as for striped skunk. Dens established in rock crevices and human structures.

REMARKS.—Van Gelder (1959) synonymized the western (*S. gracilis*) and eastern (*S. putorius*) species but Mead (1968a, 1968b, 1989) presented physiological, cytological, morphological, and reproductive data supporting distinctness of the species. Research by Mead (1968a, 1968b) found *S. gracilis* (western race) to have a gestation period of 210–230 days with delayed implantation and 64 chromosomes while *S. putorius* (eastern race) has a gestation of 50–65 days with no delayed implantation and 60 chromosomes. Wilson and Reeder (1993) classify *S. putorius* and *S. gracilis* as a monotype but cite no sources to refute the reproductive isolation demonstrated by Mead (1968a, 1968b, 1989).

*Mustela erminea* Linnaeus, 1758

Ermine

*Mustela erminea* Linnaeus, 1758. Syst. Nat., 10th ed., 1:46. Type locality Europa and Asia frigidiora (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—A small, short-tailed weasel with elongated body. Pelage dark brown above, white below; feet white; tail black tipped. All white in north except black tip on tail. Total length: 190–275; length of tail: 50–75; length of hind foot: 23–34; length of ear: 13–16; body mass: 28–60 g (Jameson and Peeters 1988).

DISTRIBUTION.—Throughout the Holarctic region in circumboreal habitat; introduced to New Zealand (King 1983); and in the Nearctic south to C California, N New Mexico, N Iowa, and Maryland (Wilson and Reeder 1993). Likely occurrence in all high mountains of Utah (Durrant 1952).

REPRODUCTION.—Mating June to July with implantation delayed 9–10 months. Gestation about 1 month with 4–9 young per litter (Clark and Stromberg 1987). Parturition May to July. Females sexually active after 2.5 months (Fitzgerald et al. 1994).

ECOLOGY.—Ecological requirements poorly understood but thought to favor mesic areas in early successional stages and adjacent habitats (Fitzgerald et al. 1994). Active year-round, mainly at night. Feeds on rodents, rabbits, birds, bird eggs, amphibians, earthworms, and even fish. Takes over burrows of prey such as pocket gophers and microtine rodents. Exhibits population cycles correlated with population numbers of voles and relatives; thus, considered prey of predilection (Banfield 1974, Fitzgerald et al. 1994).

*Mustela frenata* Lichtenstein, 1831

Long-tailed Weasel

*Mustela frenata* Lichtenstein, 1831. Darst. Saugth., Text: "Das gezaunte Wiesel" [not paginated], and pl. 42 (and accompanying unnumbered page of text). Type locality "Nahe von Mexico" [Ciudad Mexico, Mexico] (Sheffield and Thomas 1997).

GENERAL CHARACTERISTICS.—Largest weasel in GSENM. Elongated body with long tail equal to body length. Pelage brown above, white to deep yellow below; feet brownish and tail brown with black tip. In Southwest, white on face. Several southern races have blackish brown marks across eyes and nose; can be mistaken for small black-footed ferrets (Findley et al. 1975). Sexual dimorphism where male is 25% larger than female. Total length: 330–450; length of tail: 125–180; length of hind foot: 32–50; length of ear: 12–27; body mass 115–345 g (Jameson and Peeters 1988).

DISTRIBUTION.—S British Columbia, all of U.S. and Mexico to N South America. Largest range of any mustelid; inhabits all life zones, alpine to tropical (Sheffield and Thomas 1997). Range statewide in Utah (Durrant 1952).

REPRODUCTION.—Delayed implantation, but fertilization usually 53–80 hours after copula-

tion. Gestation 205–337 days with ca 4–5 young (Sheffield and Thomas 1997).

ECOLOGY.—Inhabits most terrestrial habitat types except hottest deserts, but more at home in mid- to higher elevations (Pritchett unpublished). Expert hunter in burrow systems. Occurs wherever rodents are abundant year-round but regularly preys on cottontail rabbits and snowshoe hares. Generalist predator that feeds on wide variety of prey, usually small mammals, birds, bird eggs, carrion, insects, and small reptiles, with diet varying seasonally and geographically according to prey availability. Primary predators are foxes and raptors. Vocalizations usually a trill, a squeal as a distress call, and a repeated screech when disturbed (Sheffield and Thomas 1997).

ADDITIONAL RECORDS.—Kane Co.: Fivemile Valley (Pritchett 1962).

*Taxidea taxus* (Schreber, 1778)

Badger

*Ursus taxus* Schreber, 1778. Die Saugthiere . . . , 3:520. Type locality "pays des Esquimaux" from Buffon, 1776: 243–244 (Long 1973).

GENERAL CHARACTERISTICS.—Large mustelid with short, bowed legs. Flattened body, gray to brown above, lighter below with white stripe prominent on nose, fading to tail. Tail bushy and grayish to brown. Long claws for digging, and relatively long snout and ears. Total length: 600–730; length of tail: 105–135; length of hind foot: 95–128; length of ear: not given; body mass: 6–14 kg (Long 1973, Fitzgerald et al. 1994).

DISTRIBUTION.—SW Canada to N and C Mexico, all of U.S. from California to Michigan to Texas. From arctic-alpine to austral life zones (Long 1973). Statewide distribution in Utah (Durrant 1952).

REPRODUCTION.—Breeding summer to early autumn with delayed implantation. Parturition in March to early April (Long 1973). One to 7 young per litter (Clark and Stromberg 1987).

ECOLOGY.—Makes burrows that are key structures for dens, predation, and escape. Burrows found in wide range of habitats and elevations from tundra to desert areas, but most common in grasslands and sagebrush areas (Clark and Stromberg 1987, Long 1987). Nocturnal, but can be active all hours; does not hibernate. Captures fossorial prey such as



ground squirrels, prairie dogs, mice, rats, leporids, squirrels, chipmunks, marmots, gophers, coyotes, and skunks by excavating burrow systems (Clark and Stromberg 1987). Many animals (e.g., burrowing owl) use these excavations for reproduction and escape. Mortality occurs mainly by automobiles, hunting, exterminations, and sometimes predation by coyote and golden eagle. When disturbed, takes on a ferocious appearance and emits aggressive growls and snarls (Long 1973, Banfield 1974). Solitary by habit (Chapman and Feldhamer 1982).

**SPECIMENS EXAMINED.**—Kane Co.: Cottonwood Wash, 1 (BYU).

**ADDITIONAL RECORDS.**—Kane Co.: 50 mi S Escalante, Kaiparowits Plateau (Tanner 1940).

*Bassariscus astutus*  
(Lichtenstein, 1830)

#### Ringtail

*B[assariscus] astutus* Lichtenstein, 1830. Abh. Pruess. Akad. Wiss., Berlin, 1827, p. 119. Type from near Mexico City (Hall 1981).

**GENERAL CHARACTERISTICS.**—Feline-like appearance. Long, bushy tail alternating with 8 black and white rings and black tip. Total length: 620–800; length of tail: 315–504; length of hind foot: 55–75; length of ear: 45–50; body mass: 900–1150 g (Jameson and Peeters 1988).

**DISTRIBUTION.**—Prefers rock- or cliff-dominated habitats along watercourses in areas of W U.S. from Oregon to Colorado south to Central America (Jameson and Peeters 1988). State-wide distribution in Utah (Durrant 1952).

**REPRODUCTION.**—Gestation period about 53 days. Two to 4 altricial young born in May or June (Cockrum 1982).

**ECOLOGY.**—Inhabits arid and semiarid habitats associated with rocky canyons and foothills of pinyon-juniper woodlands, montane shrublands, or mixed conifer-oakbrush (Fitzgerald et al. 1994). Food primarily small rodents, especially mice and woodrats, but includes various invertebrates, *Opuntia* cactus fruit, and various berries when available (Cockrum 1982). Dens usually in rock crevices, brush piles, or caves, sometimes hollow logs or unused buildings (Sparks 1974). Habits nocturnal but also active at dusk and dawn (Clark and Stromberg 1987). Agile climber and runner, thus adapted for arboreal and terrestrial life. Predators include great horned owl, snakes, bobcat, domes-

tic dog and cat, and man (Chapman and Feldhamer 1982).

**STATUS.**—Listed in Utah as a sensitive species due to limited distribution (Kimball 1997). Atwood and Pritchett (1974) observed tracks within GSENM on Fivemile Valley.

*Procyon lotor* (Linnaeus, 1758)

#### Raccoon

*Ursus lotor* Linnaeus, 1758. Syst. Nat., 10th ed., 1:48. Type locality "Americae maritimis," restricted to Pennsylvania (Lotze and Anderson 1979).

**GENERAL CHARACTERISTICS.**—Stocky, catlike shape. Pelage gray-brown or orange-brown with black above; grayish below. Black masked face with 4–6 alternating black and brown rings on tail. Ears small. Total length: 780–930; length of tail: 300–390; length of hind foot: 100–130; length of ear: 50–60; body mass: 4–8 kg (Jameson and Peeters 1988).

**DISTRIBUTION.**—S Canada through most of U.S., except some areas in the Rocky Mountains. Also found in N borders of Mexico (Wilson and Reeder 1993). Found in various wooded and wetland habitats (Jameson and Peeters 1988). Greatly increased distribution and abundance in Utah during last 25 years. Reviews of early accounts of trappers and explorers in Utah do not mention raccoon presence (Rawley 1986), although Durrant (1952) considered it native to Utah, especially in southern portions of the state.

**REPRODUCTION.**—Breeding early spring to late summer. Gestation 63–65 days with 1–9 young, weaned by 16 weeks. About 50% of females breed 1st year, while males do not breed until 2nd year. Males promiscuous and display territorial behaviors when confronted by other males (Clark and Stromberg 1987).

**ECOLOGY.**—Found anywhere water is available but seldom above 2000 m; common in urban areas (Clark and Stromberg 1987). Omnivorous and feeds on wide range of plant and animal matter, selective to crayfish, crabs, nuts, berries, eggs of ground-nesting birds, wounded waterfowl, or confined animals (e.g., chickens) as available. Predators include humans, owls, red fox, coyote, and bobcat. Diseases of raccoons carefully monitored; they serve as indicator species for zoonoses (e.g., rabies) and pollutants (Lotze and Anderson 1979). Establishes home ranges. Solitary by habit except mother with young (Chapman and Feldhamer 1982).

*Ursus americanus* Pallas, 1780

## American Black Bear

*Ursus americanus* Pallas, 1780. Spicil. Zool., 14:5. Type locality eastern North America (Honacki et al. 1982).

GENERAL CHARACTERISTICS.—Largest surviving carnivore of the area. Pelage colors vary from black (most common) to cinnamon, brown, beige, and blond (rare). Lacks long hairs on shoulders. May have white patches on chest and neck. Total length: 1000–2000; length of tail: 85–130; length of hind foot: 185–290; length of ear: 130–150; body mass: 40–157 kg (Clark and Stromberg 1987, Bates 1991). Males larger than females (Fitzgerald et al. 1994).

DISTRIBUTION.—Sparsely populated in forested and brushy mountainous areas of Canada along W U.S. to Mexico (Clark and Stromberg 1987, Jameson and Peeters 1988). Found in all high mountains of Utah, though less common in S and SE portions (Durrant 1952).

REPRODUCTION.—Mates in summer with delayed implantation until midwinter. Gestation 210–240 days, with most fetal development lasting 42–56 days. Young born in January–February. Litter size 1–5, usually 1–2. Promiscuous mating (Jameson and Peeters 1988, Zeveloff 1988). Males larger than females (Fitzgerald et al. 1994).

ECOLOGY.—Can survive in practically any habitat with sufficient food and cover (Bates 1991), from Arizona deserts to coniferous forests of Canada. Most common in montane shrublands, subalpine forests, oakbrush stands, serviceberry and chokecherry associations. Yet also found in lower foothills and canyon country (Fitzgerald et al. 1994). Most active at dusk and dawn. Foraging omnivorous mainly of grasses, forbs, buds, fruits, roots, carrion, fish, insects, and occasionally will take other mammals but not an active hunter (Clark and Stromberg 1987). Typically solitary habits except a female with cubs or aggregations at a concentrated food source. Activity closely tied to nutritional needs with season of torpor in winter. Can go more than 200 days without eating during hibernation with fecal plug blocking intestinal tract until emergence. Also sheds outer layer of foot pads during hibernation, with new ones hardening in the spring. Secretive animal; stays close to rough topography and dense vegetation cover (Bates 1991). Historically, predators would have been gray wolf,

grizzly bear, and man. Now man is only threat (Fitzgerald et al. 1994). Establishes home ranges; male ranges 2–3 times larger than overlapping female ranges (Schaller et al. 1989, Bates 1991).

STATUS.—Remains reportedly found near Smokey Mountain, Andalex site in SW GESNM.

## ARTIODACTYLA

*Antilocapra americana* (Ord, 1818)

## Pronghorn

(Figure 3)

*Antelope americanus* Ord, 1818. N. Amer. Zool. Pages 292 and 308 in Guthrie's Geography, 2nd Amer. ed., Johnson and Warner, Philadelphia, vol. 2. Type locality plains and highlands of Missouri River (O'Gara 1978).

GENERAL CHARACTERISTICS.—Hoofed mammal with decidedly large head and prominent, laterally positioned eyes. Pelage tan colored with 2 white bands across throat; white ventral and rump. Black jaw patches on sides of cheeks next to neck; underfur woolly. Male dorsal muzzle often dark. Two hooves on each foot, dew claws lacking (Fitzgerald et al. 1994). Supra-orbital horns on males and females. Female horns usually short, unforked nubs. Males have forward-oriented large tine and smaller backward-oriented tine (O'Gara 1978). Height: ca 900; total length: 1000–1500; length of tail: 75–180; length of hind foot: 400–432; length of ear: 140–150; body mass: 36–70 kg (Fitzgerald et al. 1994).

DISTRIBUTION.—Formerly found S Canada to C Mexico; now disjunct populations in Washington, S Alberta to C Mexico, Baja California eastwardly to E Texas (O'Gara 1978). Found throughout W Utah (Durrant 1952).

REPRODUCTION.—Polygynous system with breeding season from mid-September to early October. Gestation ca 252 days (O'Gara 1978). Females polyestrous. Usually 2 young born in late May to July (Fitzgerald et al. 1994).

ECOLOGY.—Inhabits grasslands and semi-desert shrublands on open topography, most abundant in shortgrass or midgrass prairies. Diet consists of forbs, shrubs (particularly sagebrush and especially in winter), some cactus, and grass. Can travel at speeds of 60 mph. Dominant males have territorial rutting seasons. Species forms herds, but dominant males are more solitary and younger males form bachelor bands in spring and summer. Females form nursery bands after fawning season (Fitzgerald



Fig. 3. The pronghorn, found throughout western Utah, forms herds and inhabits grassland and semidesert shrublands.

et al. 1994). Several different forms of communication, from hairs on rump that can be erected for alerting others of potential danger and postural movements to vocalizations for threats, rutting, fawn communication, and forewarning of danger (O'Gara 1978).

ADDITIONAL RECORDS.—Kane Co.: Cottonwood Wash (Atwood and Pritchett 1974); West Clark Bench (Atwood and Pritchett 1974); Coyote Creek (Atwood and Pritchett 1974); Nipple Spring, 2 (Atwood and Pritchett 1974).

*Cervus elaphus* Linnaeus, 1758

Rocky Mountain Elk or Wapiti

*Cervus elaphus* Linnaeus, 1758. Syst. Nat., 10th ed., 1:67.  
Type locality unknown (Honaki et al. 1982).

GENERAL CHARACTERISTICS.—Large, 2-hoofed ungulate with dew claws (Jameson and Peeters 1988). Upperparts tan to brown; head, mane, neck, and legs dark blackish brown. Rump patch whitish to tawny. Lighter underside. Summer pelage more tawny (Hall 1981). Antlers present in males. Total length: 2100–2800; length of tail: 100–220; length of hind foot: 460–700; length of ear: 180–220; body mass: 220–450 kg (Fitzgerald et al. 1994).

DISTRIBUTION.—*Cervus e. nelsoni* (Rocky Mountain elk) found in all W U.S. states from

N British Columbia and Alberta to S Arizona and N Texas and extreme N Mexico (Hall 1981). This race found throughout the state of Utah (Durrant 1952, Hall 1981).

REPRODUCTION.—Ovarian cycle initiated by shorter day length in fall. Polygynous system with older males as breeders. Four probable estrous cycles during rutting season. Rutting starts in fall with social groups of 2–26; bulls gain possession of harem by bugling, thrashing, digging, rubbing antlers, sparring, wallowing, and other aggressive displays (Clark and Stromberg 1987). Single young born ca June (Jameson and Peeters 1988).

ECOLOGY.—Associated with semi-open forests and forest edges next to parks, meadows, and alpine tundra. Both browser and grazer. Winter diet of grasses and shrubs, summer diet of mostly forbs, shrubs, and green grasses. Has considerable impact on aspen stands due to browsing on seedlings, bark, and twigs during fall and winter, sometimes allowing fungi to invade the trees. Intraspecific competition minimal (e.g., deer and elk diets different and elk avoid domestic sheep grazing areas [Beck et al. 1996]). Summer habitat selection strongly influenced by biting flies. Inhabits higher elevations spring and summer and migrates to lower elevations in fall and winter. Generally crepuscular

or nocturnal. Favors foraging on steep slopes and ridges for bedding. Bedding sites detected by distinct urine odor and trampled vegetation. Mortality occurs due to motor vehicles, hunters, black bear (on young calves), grizzly bear, starvation, coyote, and disease (Fitzgerald et al. 1994, Beck et al. 1996).

STATUS.—Elk antlers found on Willis Creek in 1932 and 1 killed between 1900 and 1910 at same location (NW GSENM). Previous evidence of elk in C GSENM is supported along the Paria River, which means “elk river” in Paiute.

*Odocoileus hemionus*  
(Rafinesque, 1817)

Mule Deer

(Figure 4)

*Cervus hemionus* Rafinesque, 1817. Extracts from the journal of Mr. Charles LeRaye, relating to some new quadrupeds of the Missouri region. Amer. Monthly Mag., 1:435–436. Type locality near mouth of the Big Sioux River, South Dakota (Anderson and Wallmo 1984).

GENERAL CHARACTERISTICS.—Medium-sized cervid with pelage ranging from gray to reddish to dark brown. Rump patch white or yellow. One or 2 chest patches whitish. Dichotomously branching antlers present in males. Tail whitish with black tip. Western subspecies (black-tailed deer) raises tail when running; tail well furred. Males larger than females (Anderson and Wallmo 1984). Total length: 1200–1675; length of tail: 100–220; length of hind foot: 380–530; length of ear: 180–230; height to shoulder: 710–1060; body mass: 57–102 kg (Fitzgerald et al. 1994).

DISTRIBUTION.—All biomes of W North America north of C Mexico except Arctic tundra, Sonoran, Mojave, and Great Salt Lake deserts (Anderson and Wallmo 1984).

REPRODUCTION.—Gestation 200–208 days. Parturition June to July with 1–2 young. Polygynous system with male-male competition. Breeding males determined by body size and antler size. Breeds in fall during rut. Social systems comprise related females and individual bucks; or systems can be small groups of unrelated individuals (Anderson and Wallmo 1984).

ECOLOGY.—Browser and intermediate grazer with winter diet of shrubs (especially sagebrush) and forbs in warmer months (Dasmann 1971). Daily movements set in home ranges with only

migration, dispersal, and breeding season travel as movements outside home range. Migration caused by plant phenology, rate of snowmelt, rainfall patterns, and impending birth periods. Predators include mountain lion, coyote, bobcat, feral and domestic dog, golden eagle, and black bear. Communication olfactory, postural, and vocal (Anderson and Wallmo 1984).

ADDITIONAL RECORDS.—Kane Co.: Fivemile Valley (Pritchett 1962).

*Ovis canadensis* Shaw, 1804

Bighorn Sheep

*Ovis canadensis* Shaw, 1804. The Canadian Sheep. Plate 610, the description, and the index, in Nat. Misc. Type locality Exshaw, Alberta, Canada (Shackleton 1985).

GENERAL CHARACTERISTICS.—Color reddish brown to dark chocolate, but usually dull brown. Muzzle, rump patch, inner legs, and belly white. Short tail with dark underside. Male horns massive and spirally curled forward alongside face, female horns short and pointed backwards. Males larger than females. Total length: 1245–1953; length of tail: 70–127; length of hind foot: 315–440; length of ear: 90–130; body mass: 50–125 kg (Shackleton 1985).

DISTRIBUTION.—S British Columbia and SW Alberta to C Mexico (Wilson and Reeder 1993). Found in Utah as small herd in Uinta Mountains; otherwise limited around Lake Powell and the Green, San Juan, and Colorado rivers, portions in the Wasatch Mountains, as well as Zion National Park (Smith and Flinders 1992). Also reported near the Utah-Nevada border (Sparks 1974).

REPRODUCTION.—Breeding November–December, although may initiate season as early as July. Promiscuous behavior with dominant males at 7–8 years typically mating. Gestation 174–180 days, females monestrous. Ewes separate and give birth on rocky cliffs for protection of neonates from predators. One to 2 young per year (Shackleton 1985). Weaned after 5–6 months (Fitzgerald et al. 1994).

ECOLOGY.—Habitat typified by mesic to xeric grasslands in mountain, foothill, and river canyon grassland associations from high alpine areas to deserts. Rocks and cliffs are essential to habitat. Primarily graminivorous diet, but will take wide range of shrubs and forbs. Predators are wolf (historically), coyote, golden eagle, bobcat, cougar, and wolverine. Gregarious in male and female herds, but maternal groups separate with neonates. Males establish



Fig. 4. The mule deer is distributed throughout GSENM. Both antler size and body size determine a male's breeding status.

dominance hierarchies, females have weak dominance relationships. Communication is limited vocally to bleats and low male gutturals, but is also olfactory and visual. Rutting season consists of males sniffing vulva and urine of females in estrus. Fighting among males during rut is aggressive as opposed to displays previously used for establishing social status. Females prefer males by courtship behaviors and status of males. Species has diurnal activity, home ranges, and seasonal migrations (Shackleton 1985, Smith and Flinders 1991).

STATUS.—Herd in GSENM between Kaiparowits Plateau and Escalante Canyon, upon examination, may prove to be *O. c. mexicana* (Durrant 1952, Atwood and Pritchett 1974).

#### RODENTIA

##### *Marmota flaviventris*

(Audubon and Bachman, 1841)

##### Yellow-bellied Marmot

*Arctomys flaviventer* Audubon and Bachman, 1841. J. Acad. Nat. Sci. Philadelphia, Ser. 1, 8:1–43. Type locality “Mountain between Texas and California,” but fixed as Mount Hood, Oregon. Type locality Black Hills at Custer, Custer Co., South Dakota (Frase and Hoffmann 1980).

GENERAL CHARACTERISTICS.—Small to medium broad body size. Color yellow-brown to tawny or russet. Buffy patches on sides and white markings between eyes. Total length: 470–700; length of tail: 130–220; length of hind foot 70–90; length of ear: 18–22; body mass: 2–4 kg (Frase and Hoffmann 1980).

DISTRIBUTION.—SC British Columbia and S Alberta, Canada, south to N New Mexico and California (Wilson and Reeder 1993). Found throughout Utah in higher mountain ranges (Durrant 1952).

REPRODUCTION.—Mating first 2 weeks after hibernation emergence. Gestation about 30 days with litter size 3–8. Young weaned 20–30 days after parturition (Frase and Hoffmann 1980).

ECOLOGY.—Semi-fossorial inhabiting talus slopes to rock outcrops near meadows. Colonial living in burrow systems and side satellite burrows. Mostly herbivorous diet of a wide variety of grasses, forbs, flowers, and seeds. Predators include gray wolf, coyote, badger, bobcat, hawks, owls, and especially golden eagle. Bimodal activity in morning and late afternoon. Often territorial with harem social

systems. Communication largely visual but also with 3 distinct calls of whistling at 6 different tones, undulated screams for alerting, and threatening tooth chatters (Frase and Hoffmann 1980).

##### *Ammospermophilus leucurus*

(Merriam, 1889)

##### White-tailed Antelope Squirrel

*Tamias leucurus* Merriam, 1889. North Am. Fauna, 2:1–52. Type locality “San Gorgonio Pass [Riverside Co.], California” (Belk and Smith 1991).

GENERAL CHARACTERISTICS.—Short, rounded ears with relatively long legs. White median coloration on underside of tail with 1 black sub-terminal band. Total length: 188–220; length of tail: 42–71; length of hind foot: 37–40; length of ear: 8.5–10; body mass: 104–117 g (Belk and Smith 1991).

DISTRIBUTION.—E California and SE Oregon to Colorado and New Mexico, south to Baja California Sur (Wilson and Reeder 1993). Found throughout Utah except Wasatch and Uinta Mountains (Sparks 1974).

REPRODUCTION.—Breeds February–June. Gestation 30–35 days. Litter size 5–14 with average of 8 (Belk and Smith 1991).

ECOLOGY.—Inhabits desert habitats from valley floors to juniper belts; common in rocky to sandy areas. Omnivorous feeder, varying with season from green vegetation to seeds, insects, and vertebrate flesh. Predators include desert-dwelling raptors, coyote, foxes, many snakes, and badger. Bimodal activity in mid-morning and late afternoon. Movements fast or running to reduce heat gain by sun exposure. Excavates own burrow but will utilize burrows dug by kangaroo rats. Establishes dominance hierarchies. Alarm vocalizations include trills and chitters (Belk and Smith 1991).

SPECIMENS EXAMINED.—Garfield Co.: 8 mi S Escalante, 1 (UU); 2 mi SE Escalante, 1 (UU); Henrieville, 1 (BYU); Kane Co.: 9 mi NE Adairville, 2 (BYU); 3 mi E Site #12, Tippet Canyon, 1 (BYU); 45 mi SE Escalante, 1 (BYU); 43 mi SE Escalante, 1 (BYU); Wah Weep River, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: 50 mi SE Escalante, Willow Tank Spring (Tanner 1940); Smokey Mountain (Atwood and Pritchett 1974); Fivemile Valley (Pritchett 1962); Cockscomb Ridge (Pritchett 1962).

*Sciurus aberti* Woodhouse, 1853

## Abert Squirrel

*Sciurus aberti* Woodhouse, 1853. Proc. Acad. Nat. Sci. Philadelphia, 6:110, 220. Type locality "in San Francisco Mountains, New Mexico" [Coconino, Co., Arizona] (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Large tree squirrel with ear tufts and long, bushy tail (Armstrong 1987). Pelage salt-and-pepper gray (long hairs have black and white tips); venter white, pronounced black lateral line. Tail black and white above and pure white below (Armstrong 1982). Total length: 450–580; length of tail: 200–300; length of hind foot: 65–75; length of ear: 35–45; body mass: 550–750 g (Fitzgerald et al. 1994).

DISTRIBUTION.—SE and SC Utah, S and W Colorado, SE Wyoming, W and C New Mexico, Arizona, and NW Mexico (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Breeding season spring, March to May. Gestation of 6 weeks, litter of 2–5. Young weaned at 4.5 months (Armstrong 1982). Courtship marked by frantic chases around trees with aggressive behaviors and vocalizations. Antagonistic displays by females and males to males (Fitzgerald et al. 1994).

ECOLOGY.—Ecologically dependent on ponderosa pine for both nesting and food. Feeds on inner bark (phloem) of terminal ends of branches, as well as seeds, twigs, and cones. Also eats fungi, carrion, bones, and antlers (gnawed for mineral content). Food caches not established. Diurnal activity and active year-round. Nests in pine twig constructions or twig clusters created by mistletoe infestations, usually in stands with ca 60% canopy cover and 5–18 m aboveground. Solitary by habit and non-territorial. Uses several vocalizations and visual communications such as tail flaring, flicking, and foot stomping. Vocalizations include alarm barks, tooth chattering, screams, and clucks (Fitzgerald et al. 1994). Predators mainly hawks and terrestrial carnivores (Armstrong 1982).

STATUS.—Records exist for specimens taken from Garfield and Kane counties, just outside GSENM (UU). Registered species of special concern as *S. a. navajo* in the Manti-La Sal National Forest (Kimball 1997).

*Spermophilus lateralis* (Say, 1823)

## Golden-mantled Ground Squirrel

*Sciurus lateralis* Say, 1823. In: Early Western Travels, 1748–1846, vol. 16, part III. Type locality "Arkansas

River, near Canyon City [Fremont Co.], Colorado" (Bartels and Thompson 1993).

GENERAL CHARACTERISTICS.—Appearance of a large chipmunk with no white stripe on head. Pelage coloration with 1 longitudinal white stripe bordered by black stripe. Golden to tawny or russet mantle on head and shoulders. Underparts yellow to white. White eye rings. Total length: 235–295; length of tail: 61–120; length of hind foot: 35–46; length of ear: 12–24; body mass: 120–394 g (Bartels and Thompson 1993).

DISTRIBUTION.—Montane W North America, from C British Columbia to S New Mexico; also in the Columbia River areas south to S California and Nevada (Wilson and Reeder 1993). Except SE corner of Utah, statewide distribution (Durrant 1952).

REPRODUCTION.—Breeding after hibernation, March or April, with gestation 26–33 days; 2–9 young. Life span about 7 years (Bartels and Thompson 1993).

ECOLOGY.—Found in sunny, forested, or sparsely brushed habitats, from sagebrush steppe and pinyon belt to meadows with rock outcroppings and tundra. Omnivorous diet of seeds, fungi, herbaceous plants, bird eggs, insects, lizards, carrion, and young voles. Usually silent but vocalizations include variety of calls such as high-pitched "tk tk tk" and "tsp." Creates dominance hierarchies for food competition. Dustbathes frequently. Burrows usually self-constructed, but occasionally modifies gopher holes (Bartels and Thompson 1993).

SPECIMENS EXAMINED.—Kane Co.: Long Valley, 1 (BYU).

*Spermophilus variegatus*

(Erxleben, 1777)

## Rock Squirrel

*Sciurus variegatus* Erxleben, 1777. Systema regni animalis . . . , 1:421. Type locality restricted to "Valley of Mexico, near the City of Mexico" (Oaks et al. 1987).

GENERAL CHARACTERISTICS.—Pelage variegated pattern of black, white, and buff. Head and eyes large. Tail long and bushy. Total length: 466–503; length of tail: 189–233; length of hind foot: 57–63; length of ear: 17–26; body mass: 450–875 g (Oaks et al. 1987).

DISTRIBUTION.—S Nevada to SW Texas and S two-thirds of Utah to C Mexico (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Breeding March to August with 2 litters per year with short winters, 1 with long winters. Parturition of 1–7 young (Oaks et al. 1987).

ECOLOGY.—Inhabits semiarid to transition zones; absent in plains, wide valleys, deserts, and higher montane forests. Prefers dwellings in rocky areas, burrowing under rocks, bushes, trees, and such cover. Wide variety in food choice: seeds, grains, nuts, berries, roots, green vegetation, cactus, invertebrates, and carrion. Predators include diurnal raptors, bobcat, ring-tail, gray fox, raccoon, coyote, badger, domestic dog and cat, rattlesnakes, bull snake, and man. Colonial. Mainly diurnal activity. Communicates by posture and vocal combinations. Calls (reportedly by females only) include “chucks,” whistles, squeals, growls, and tooth chattering. Self-grooms and dustbathes. May hibernate or estivate due to dependence on food availability and harshness of season (Oaks et al. 1987).

SPECIMENS EXAMINED.—Garfield Co.: Henrieville, 2 (BYU); Moki Tanks, Circle Cliffs, 1 (BYU); Kane Co.: Cottonwood Canyon, 27 mi SE Cannonville, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Cottonwood Wash (Atwood and Pritchett 1974); Grosvenor Arch (Atwood and Pritchett 1974); Last Chance (Atwood and Pritchett 1974).

*Tamiasciurus hudsonicus*

(Erxleben, 1777)

Red Squirrel

[*Sciurus vulgaris*] *hudsonicus* Erxleben, 1777. *Systema regni animalis* . . . , 1:416. Based on the Hudson Bay Squirrel of Pennant, 1771. Type locality mouth of the Severn River, Ontario (Hall 1981).

GENERAL CHARACTERISTICS.—Small tree squirrel reddish with prominent black stripe along side. Tail narrow, shorter than body with black edge and tip. Lighter underside (Cockrum 1982). Total length: 270–385; length of tail: 95–158; length of hind foot: 35–57; length of ear: 19–30; body mass: 145–260 g (Clark and Stromberg 1987).

DISTRIBUTION.—Alaska through Canada and W U.S. in mountainous states and NE U.S. south to South Carolina (Wilson and Reeder 1993). Found throughout Utah (Durrant 1952).

REPRODUCTION.—Single litter March to May of 1–10 young following ca 36-day gestation. Weaned 9–11 weeks (Clark and Stromberg 1987).

ECOLOGY.—Common throughout subalpine and montane forests, especially those dominated by ponderosa pine. May occur with Abert squirrel and rock squirrel in ponderosa pine-dominated communities. Displays interspecific territorial defense of 1–2 ha. Vocalized “chatter” barks common as defense. Stores conifer cones in middens. Makes leaf nests or dens in trees. Utilizes subnivean tunnels in winter. Feeds on evergreen terminal buds, seeds, fungi, insects, old bones, and occasionally small birds. Predators same as for Abert squirrel (Clark and Stromberg 1987).

*Tamias dorsalis* Baird, 1855

Cliff Chipmunk

*Tamias dorsalis* Baird, 1855. *J. Acad. Nat. Sci. Philadelphia*, 7:331–333. Type locality “Fort Webster, Coppermines of the Mimbres,” near present site of Santa Rita, Grant Co., New Mexico, lat. 32°47', long. 108°4' (Hart 1992).

GENERAL CHARACTERISTICS.—Colored with dark dorsal stripes. Lighter dorsal stripes faint grayish to creamy white. Upper pelage smoke gray, ears paler; hind legs cinnamon. Long, bushy tail tawny-cinnamon above and light below. Total length: 217–249; length of tail: 85–115; length of hind foot: 34–37; length of ear: 18–23; body mass: 50–70 g (Hart 1992).

DISTRIBUTION.—Rocky Mountains in W U.S. to N Mexico (Hart 1992). Found throughout Utah, except in higher Uinta and Wasatch Mountains (Durrant 1952, Flinders 1968).

REPRODUCTION.—Breeds March to May, likely to depend on winter length and precipitation amount. Parturition April–July (Hart 1992).

ECOLOGY.—Common in pinyon-juniper, ponderosa pine, oak, and maple associations; also found in sagebrush, aspen, saltbrush, snakeweed, downy brome, madrone, manzanita, Mexican white fir, and Douglas-fir. Opportunistic forager using seeds, berries, nuts, herbaceous vegetation, insects, frogs, larvae, salamanders, snakes, birds, and eggs. Caches seeds and dustbathes. Establishes interspecific dominance hierarchies and territorial defense behaviors. Predators include hawks, badger, coyote, rattlesnakes, and weasels. Diurnal activity. Dens and nests made in rocky areas or trees. Vocalizations high-pitched screams, chirps, and barks (Hart 1992).

SPECIMENS EXAMINED.—Garfield Co.: Henrieville, 13 mi NE, T36S, R01W, 7 (USNM); 8



mi S Escalante, 1 (UU); Kane Co.: Cottonwood Canyon, 27 mi SE Cannonville, 4 (BYU); Paria Basin, Cottonwood Canyon Road, 2 (BYU); Adairville (Cockscomb area), 40 mi E Kanab, 3 (BYU); Catstairs Canyon, 1 (BYU); Cockscomb Ridge, 1 (BYU); Henrieville, 1 (BYU); mouth of Calf Creek, Escalante River, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Cockscomb Ridge (Hayward et al. 1958); Cockscomb Ridge (Prichett 1962).

*Tamias minimus* Bachman, 1839

Least Chipmunk

*Tamias minimus* Bachman, 1839. J. Acad. Nat. Sci. Philadelphia, 8:71. Type locality "Green River, near mouth of Big Sandy Creek [Sweetwater Co.], Wyo[oming] (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Smallest chipmunk in W U.S. Multiple stripes down back with white outermost side stripe and distinctly dark next stripe. Underside white. Carries long tail upright when running (Clark and Stromberg 1987). Total length: 190–212; length of tail: 74–91; length of hind foot: 26–33; length of ear: 15–16; body mass: 29–53 g (Clark and Stromberg 1987).

DISTRIBUTION.—C Yukon (Canada) southward to Sierra Nevada and S New Mexico, east to Michigan and W Quebec (Wilson and Reeder 1993). Statewide distribution in Utah (Durrant 1952).

REPRODUCTION.—Breeding March to May. Gestation ca 29 days with young born May to June. Average litter size 5.5 young (3–9 range), single litter per year (Clark and Stromberg 1987).

ECOLOGY.—Inhabits sagebrush and rocky hillside areas. Lives in greater elevation range and diversity of biotic communities than any other chipmunk. Hibernates in winter. Individuals not territorial and have overlapping home ranges. Forages mainly on plant material of herbs, roots, nuts, fruits, and berries. Also takes variety of insects and fungi. Predators include northern harrier, mustelids, hawks, and red fox (Clark and Stromberg 1987).

SPECIMENS EXAMINED.—Garfield Co.: Henrieville, 13 mi NE, T36S, R01W, 1 (USNM).

ADDITIONAL RECORDS.—Kane Co.: 8 mi S Escalante, 1560 m, 1 (Durrant 1952).

*Tamias quadrivittatus* (Say, 1823)

Colorado Chipmunk

*Sciurus quadrivittatus* Say, 1823. In: Long, Account of an Exped. from Pittsburgh to the Rocky Mtns., 2:45. Type

locality Arkansas River, Colorado, about 26 mi below Canon City (Hall 1981).

GENERAL CHARACTERISTICS.—Medium-sized chipmunk. Head coloration gray with reddish shade; distinctive dorsal stripes; underside of tail reddish (Hall 1981). Stripe through eye black with white border; other facial stripes narrow and dark or cinnamon. Dark dorsal stripes black with tawny margins. Lateral stripe fuscous, fuscous black, or tawny. Total length: 211–221; length of tail: 91–100; length of hind foot: 32–33; length of ear: 18–21; body mass: 57–58 g (Best et al. 1994).

DISTRIBUTION.—Occurs in NE Arizona, C and S Colorado, and N and C New Mexico (Best et al. 1994).

REPRODUCTION.—Bimodal reproductive activity in February and July, coinciding with seasons of reduced water stress. One litter of 2–6 young born each year, with evidence of 2 litters possible (Best et al. 1994).

ECOLOGY.—Occupies variety of habitats including desert scrub, grassland-chaparral, pinyon-juniper, scrub oak, ponderosa pine, quaking aspen, mixed conifer of spruce-fir, and alpine tundra. Omnivorous but feeds mostly on fruits and seeds. Most active early morning and late afternoon. Caches food in caches dug by other animals, though in winter caches food close to nest chamber. Partially hibernates in colder areas of range. Vocalizations include a chip, trill, chipper, and squeal. Establishes dominance hierarchies and displays status by chasing subordinates (Best et al. 1994).

REMARKS.—*Tamias hopiensis*, described by Merriam (1905), is considered a *nomen dubium* (either junior synonym for *T. q. quadrivittatus* or a senior synonym for *T. rufus* [Patterson 1984]). Thus, specimens listed below are either *T. quadrivittatus* or *T. rufus*. Listed in *T. quadrivittatus* as no evidence is adequate to separate the trinomen.

SPECIMENS EXAMINED.—Garfield Co.: mouth of Calf Creek, Escalante River, 1 (BYU).

*Tamias rufus*

(Hoffmeister and Ellis, 1980)

Hopi Chipmunk

*Eutamias quadrivittatus rufus* Hoffmeister and Ellis, 1980. Southwestern Nat., 24:655–665. Type locality "10 mi SW Page, Coconino Co., Arizona" (Burt and Best 1994).

GENERAL CHARACTERISTICS.—Bright tawny color with dark stripes lighter. Medial stripe

chestnut and light stripes grayish white. Sides buffy with gray. Tail black with chestnut and dark tip. Underside lighter, crown pale gray. Carries tail horizontally when running. Total length: 93–148; length of tail: 83–95; length of hind foot: 30–35; length of ear: 16–23; body mass: ca 59 g (Burt and Best 1994, Fitzgerald et al. 1994).

**DISTRIBUTION.**—N Arizona, E and S Utah, and W Colorado (Wilson and Reeder 1993, Burt and Best 1994).

**REPRODUCTION.**—Mating February to March. Gestation 30–33 days with parturition in April. Weaned at 6–7 weeks (Burt and Best 1994).

**ECOLOGY.**—Habitat sagebrush and pinyon-juniper but restricted to rocky areas. Feeds extensively on juniper berries, green vegetation, and pinyon nuts but opportunistic in feeding habits. Predators are several snakes, coyote, Swainson's hawk, and long-tailed weasel. Diurnal behavior. Water availability likely plays key role in habitat selection for rocky areas where water will collect. Needs separate water source because food has little water content and will die within 2 days without water (Burt and Best 1994).

**REMARKS.**—Formerly in *quadrivittatus* (Patterson 1984, Wilson and Reeder 1993).

**SPECIMENS EXAMINED.**—Garfield Co.: 22 mi SSE Escalante, Death Ridge, 1 (USNM).

*Tamias umbrinus* Allen, 1890

Uintah Chipmunk

*Tamias umbrinus* J. A. Allen, 1890. Bull. Amer. Mus. Nat. Hist., 3:96. Type locality "Uintah Mountains, south of Ft. Bridger." Restricted by Howell (1929:94) to Blacks Fork, about 8000 ft. [2438 m], Summit Co., Utah [USA] (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Coloration outermost back stripe black, next dorsal stripe on side white with fur dark brown below; underparts white. Long, bushy tail. Prominent facial stripes (Clark and Stromberg 1987). Total length: 200–243; length of tail: 90–115; length of hind foot: 30–35; length of ear: 16–19; body mass: 55–80 g (Clark and Stromberg 1987).

**DISTRIBUTION.**—Dispersed throughout California and N Arizona to N Colorado, SE and NW Wyoming, and extreme SW Montana (Wilson and Reeder 1993). Found in mountain ranges in N and C Utah (Durrant 1952).

**REPRODUCTION.**—Mates shortly after hibernation. Gestation about 30 days with 1 litter of 3–5 young (Clark and Stromberg 1987, Fitzgerald et al. 1994).

**ECOLOGY.**—Uses open canopy/closed understory avoided by least chipmunks. Only females territorial (around nest sites). Diurnal and solitary. Eats seeds from wide variety of plants, buds, tender shoots, berries, and nuts. Often tree-dwelling; flattens body on branches when alarmed. Complicated distribution reflects contraction of interglacial areas leaving boreal coniferous forest patches broken by arctic grasslands that now are arid lowlands (Clark and Stromberg 1987, Fitzgerald et al. 1994).

**REMARKS.**—Formerly subspecies *T. quadrivittatus adsitus*, now subspecies included in *T. umbrinus* (Patterson 1984, Wilson and Reeder 1993).

**SPECIMENS EXAMINED.**—Garfield Co.: Henrieville, 1 (BYU); Henrieville, 13 mi NE T36S, R01W, 1 (USNM).

**ADDITIONAL RECORDS.**—Kane Co.: Kaiparowits Plateau (Tanner 1940).

*Castor canadensis* Kuhl, 1820

North American Beaver

*Castor canadensis* Kuhl, 1820. Beitrage zur Zoologie und vergleichenden Anatomie, Abth. 1, pg. 64. Type locality Hudson Bay, Canada (Jenkins and Busher 1979).

**GENERAL CHARACTERISTICS.**—Dark brown, dense fur. Webbed feet. Large, scaled, and flattened tail. Total length: 1000–1200; length of tail: 90–200; length of hind foot: 156–205; length of ear: 23–29; body mass: 11–26 kg (Jenkins and Busher 1979).

**DISTRIBUTION.**—Occurs in North America north of Mexico; introduced in Eurasia (Jenkins and Busher 1979). Statewide distribution in Utah in streams, lakes, and ponds (Durrant 1952).

**REPRODUCTION.**—Monogamous mating system. Gestation about 107 days with parturition in May to June. Litter size 3–4 (Jenkins and Busher 1979).

**ECOLOGY.**—Unique ability to create nests, lodges, and burrows important to ecosystems where the species is found. Generalist forager with preference for aspens and willows but will eat bark, leaves, twigs, and herbaceous aquatic plants. Caches food in fall. Predators include wolves, coyote, wolverine, cougar, black bear, and mink on kits. Forms colonies of related individuals. Communicates by postures, vocalizations, tail-slapping, and scent-mounding (Jenkins and Busher 1979).

*Thomomys bottae*  
(Eydoux and Gervais, 1836)

Valley Pocket Gopher

*Oryctomys (Saccophorus) bottae* Eydoux and Gervais, 1836. Mag. de Zool., Paris, 6:23. Type locality coast of California; name applied by Baird (Proc. Acad. Nat. Sci. Philadelphia, 7:335, April 1855) to the gopher occurring in the vicinity of Monterey (Hall 1981).

GENERAL CHARACTERISTICS.—Medium-sized rodent with external fur-lined cheek pouches. Claws on feet smaller than other members of genus. Coloration varying from pale gray to russet or blackish; underparts grayish white, white, buff, or mottled. Reduced eyes and ears (Davis and Schmidly 1994). Total length: 200–260; length of tail: 60–85; length of hind foot: 28–33; length of ear: 5–7; body mass: 110–215 g (Fitzgerald et al. 1994).

DISTRIBUTION.—Throughout SW U.S., W Mexico, and Baja California in areas of sandy soil (Zaveloff 1988). Occurs throughout Utah (Durrant 1952).

REPRODUCTION.—Breeding March to July. Two to 5 young born after ca 19-day gestation. Usually 1 litter per year (Fitzgerald et al. 1994).

ECOLOGY.—Found in a variety of vegetation types: agricultural areas, pinyon-juniper, grasslands, open parklands, roadsides, open montane forests, montane-shrub, and semidesert shrublands. Distribution linked to soil preferences and competition with other gopher species. Digs complex burrow systems with shallow and deep portions. Active year-round with highly territorial and solitary habits. Diet of seeds, tubers, roots, green vegetation, grasses, forbs, pinyon nuts, and insects. Food stored in burrow system. Utilizes coprophagy. Predators include coyote, badger, foxes, owls, and hawks. Especially vulnerable to predation during spring male-male aggression and during juvenile dispersal (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Kane Co.: near junction of Paria and Adairville roads, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Cockscomb Ridge (Hayward et al. 1958); 50 mi SE Escalante, Willow Tank Springs (Tanner 1940).

*Thomomys talpoides*  
(Richardson, 1828)

Northern Pocket Gopher

*Cricetus talpoides* Richardson, 1828. Zool. Jour., 3:518. Type locality fixed at Fort Carlton (Carlton House), Saskatchewan (Hall 1981).

GENERAL CHARACTERISTICS.—Small ears and eyes. Strongly clawed front feet. Fur soft brown to yellowish tan. Fur-lined cheek pouches. Total length: 165–253; length of tail: 40–75; length of hind foot: 25–33; length of ear: 5–6; body mass: 75–180 g (Clark and Stromberg 1987).

DISTRIBUTION.—Subterranean habitats in S Canada to C South Dakota and N New Mexico, N Arizona, N Nevada, and NE California (Wilson and Reeder 1993). Occurs in Utah in N, C, and E mountain ranges (Sparks 1974).

REPRODUCTION.—Young born in grass of fur-lined nest underground. Gestation 18–20 days. Females deliver young by separating pubic bones of otherwise slender hips. Four to 7 young of 1 litter per year. Weaned ca 14 days (Zaveloff 1988).

ECOLOGY.—Inhabits various environments; selects deep, soft soils. Herbivore that feeds on roots, tubers, bulbs, leaves, stems, and prickly pear cactus. Establishes extensive tunnel systems up to 150 m long. Plugs unused entrances for keeping out unwanted visitors, alerting to disturbances of visitors, stabilizing temperatures and moisture levels. Predators are great horned owl, badger, and coyote (Zaveloff 1988). Solitary and entirely subterranean lifestyle. Genus important for adding organic matter to soil, aerating soil, and promoting water storage (Clark and Stromberg 1987).

*Thomomys umbrinus*  
(Richardson, 1829)

Southern Pocket Gopher

*Geomys umbrinus* Richardson, 1829. Fauna Boreali-Americana, 1:202. Type locality southern Mexico; probably in vicinity of Boca del Monte, Veracruz; type said to have come from "Cadaquouis, a town in southwestern Louisiana"; see V. Bailey, Proc. Biol. Soc. Washington, 19:3–6, January 29, 1906 (Hall 1981).

DISTRIBUTION.—SC Arizona and SW New Mexico south to N Mexico (Wilson and Reeder 1993).

REMARKS.—General characteristics, reproduction, and ecology same as for *T. bottae*. Considered a species separate from *bottae* by Wilson and Reeder (1993), Anderson (1966, 1972), and Hall (1981). Phylogenetic relationships among geographic races examined by Hafner et al. (1987).

SPECIMENS EXAMINED.—Kane Co.: Adairville, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: E side of Cockscomb Ridge (Tanner 1940); Fivemile

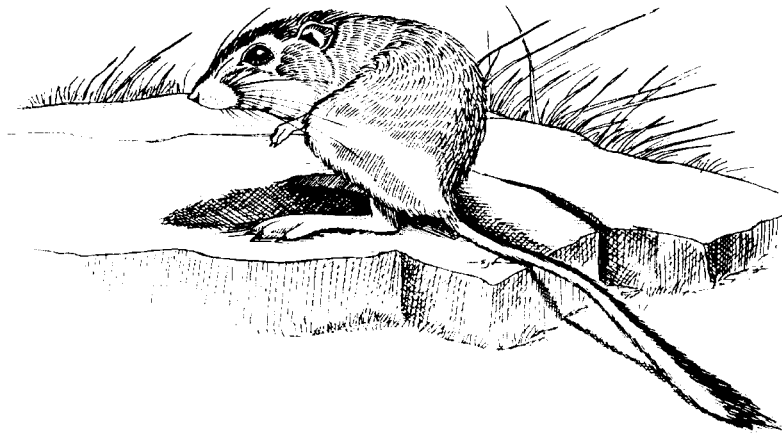


Fig. 5. One of the defining characteristics of the kangaroo rat is its disproportionately long hind feet and legs, which are used for jumping.

Valley (Pritchett 1962); Adairville, 1 (Pritchett 1962).

STATUS.—Registered by IUCN as a rare species (Wilson and Reeder 1993).

*Dipodomys ordii* Woodhouse, 1853

Ord's Kangaroo Rat

(Figure 5)

*Dipodomys ordii* Woodhouse, 1853. Proc. Acad. Nat. Sci. Philadelphia, 6:235–236. Type locality "El Paso on the Rio Grande," El Paso Co., Texas (Garrison and Best 1990).

GENERAL CHARACTERISTICS.—Relatively short tail. Five toes, with hind feet and legs disproportionately long for jumping. Pelage color buffy, reddish, or blackish with ventral surface, back of hind feet, supraorbital and postarticular spots, forelimbs, hip stripes, lateral stripes of tail, and tail base all white. Has fur-lined cheek pouches, characteristic of all geomyids and heteromyids. Total length: 242–243; length of tail: 127–129; length of hind foot: 38–39; length of ear: 12–13; body mass: ca 52 g (Garrison and Best 1990).

DISTRIBUTION.—S Alberta and Saskatchewan (Canada) to S Hildago (Mexico), and from S Oregon and E California to C Kansas and Oklahoma (Garrison and Best 1990). Found statewide in Utah (Durrant 1952, Hall 1981).

REPRODUCTION.—Breeding and parturition in August–May. Gestation 28–32 days with 2 litters of 1–6 young each year (Garrison and Best 1990).

ECOLOGY.—Various habitats with affinity for open shrublands, grasslands with sandy soil, *Larrea*, *Artemisia* or *Atriplex* communities, and pinyon-juniper woodlands. Diet primarily granivorous with grass and forb seeds and green vegetation. Sometimes feeds on arthropods and cactus. Resides with many other granivorous small mammals (Garrison and Best 1990). Studies have been done to determine intraspecific competition and found that when *D. ordii* was removed, *O. leucogaster* flourished in open microhabitats of short vegetation (Rebar and Conley 1983). Predators include kit fox, owls, coyote, and snakes. Habits nocturnal and year-round. Dustbathes to remove oils. Vocalization used in aggression (teeth chattering) and neonate to parental communication. When neonates are born early or ill and cannot vocalize, they are ignored or devoured by mother (Garrison and Best 1990).

SPECIMENS EXAMINED.—Garfield Co.: Ten Mile Spring, 1 (BYU); mouth of Calf Creek, Ecalante River, 1 (BYU); Little Egypt, 1500 m, 1 (BYU); Kane Co.: 1 mi W Site #12, Nipple Bench, 1 (BYU); Adairville (Cockscomb area), 7 (BYU); Wah Weep River, 1 (BYU); Catstairs Canyon, 1 (BYU); Paria Basin, Cottonwood Creek, 4 (BYU); Cottonwood Canyon, 1 (BYU); Fivemile Valley, 1 (BYU); Tibbet Spring, 1 (USNM); near junction Paria and Adairville roads, 9 (BYU); Cottonwood Canyon, 27 mi SE Cannonville, 20 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Willow Tank Spring, 1 (Tanner 1940); Fourmile Bench,

27 (Murdock et al. 1974); Smokey Mountain (Atwood and Pritchett 1974); Paria Plateau (Hayward et al. 1958); Fivemile Valley, 20 (Pritchett 1962); Adairville, 52 (Pritchett 1962).

*Onychomys leucogaster* (Weid, 1841)

Northern Grasshopper Mouse

*Hypudaus leucogaster* Maximilian Prinz zu Weid, 1841. Reise in das innere Nord America in den Jahren 1832. J. Holhescher, Coblenz, xxiv + 687 pp. Type locality Mandan Indian village, near Fort Clark, Oliver Co., North Dakota (McCarty 1978).

GENERAL CHARACTERISTICS.—Short-tailed, stocky mouse, with distinctly bicolored pelage. Upperparts pale brown to grayish or light cinnamon; underparts white. Tip of tail often white. Total length: 119–190; length of tail: 29–62; length of hind foot: 17–25; length of ear: 12–17; body mass: 35–45 g (McCarty 1978).

DISTRIBUTION.—SW Canada south to extreme N Mexico, west into NE California and C Oregon, and east to W Minnesota and Iowa (McCarty 1978). Occurs throughout Utah, except higher mountain ranges (Durrant 1952).

REPRODUCTION.—Gestation 26–42 days, depending on race. Mean litter size 4 with multiple litters associated with food abundance (McCarty 1978).

ECOLOGY.—Diet comprises a strong affinity for insects and small mammals (thus minimizing intraspecific competition by more predatorial feeding), but will also cache seeds for winter months. Has large home range for hunting purposes. Engages in extensive competition, both interspecific and intraspecific. Nocturnal habits, most active when moon is below horizon, absent, or concealed by heavy cloud cover. Vocalizations include short, sharp squeaks when pursuing prey or threatened, and a long, shrill whistle as either a hunting call or mating call; nestlings have a variety of calls (McCarty 1978).

SPECIMENS EXAMINED.—Garfield Co.: mouth Calf Creek, Escalante River, 1 (BYU); Kane Co.: near junction Paria and Adairville roads, 1 (BYU); Adairville (Cockscomb area), 40 mi E Kanab, 2 (BYU); Cottonwood Canyon, 27 mi SE Cannonville, 1 (BYU); Nipple Bench, 1 (BYU); Site #14, Nipple Bench, 1 (BYU); 27 mi S Cannonville, 1 (BYU); Adairville, 2 (BYU); Fivemile Valley, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Willow Tank Spring, 1 (Tanner 1940); Wah Weep Creek,

10 mi N Arizona border, 1 (BYU); Fivemile Valley, 3 (Pritchett 1962); Adairville, 3 (Pritchett 1962).

*Chaetodipus formosus* Merriam, 1889

Long-tailed Pocket Mouse

*Chaetodipus formosus* Merriam, 1889. N. Amer. Fauna, 1:17. Type locality USA, Utah, Washington Co., St. George (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Pelage gray-brown above and white-yellow below. Bicolored tail crested and long with dark tufted hairs over last one-third. Long feet and ears (Zevuloff 1988). Total length: 181–194; length of tail: 90–105; length of hind foot: 23–25; length of ear: 10–11; body mass: 17–25 g (Durrant 1952, Hall 1981).

DISTRIBUTION.—S Nevada, California (including Baja), SW and extreme CW Utah, and N Arizona (Sparks 1974, Zevuloff 1988).

REPRODUCTION.—Breeding May to July following emergence of grasses and forbs. Four to 6 young (Jameson and Peeters 1988, Zevuloff 1988).

ECOLOGY.—Inhabits rocky or gravelly slopes and desert canyons up to 2400 m. Sometimes found in open mesquite-juniper or sandy riverbanks. In Lake Bonneville basin, species accounts for 20% of entire mammalian biomass in black sage communities. Piles of soil or sand at rock bases indicate species presence (Zevuloff 1988). Diet consists of seeds from grasses and forbs, insects, and green leaves in the spring. Active midwinter, becoming torpid in cold months, although activity varies geographically (Jameson and Peeters 1988).

SPECIMENS EXAMINED.—Kane Co.: 9 mi NE Adairville, 2 (BYU); Cockscomb Ridge, 1 (BYU); 50 mi E Kanab, Catstairs Canyon, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Cockscomb Ridge, 1 (Pritchett 1962).

*Perognathus longimembris*  
(Coues, 1875)

Little Pocket Mouse

*Cricetodipus longimembris*, Coues, 1875. Proc. Acad. Nat. Sci. Philadelphia, 27:305. Type locality Old Fort Tejon, Tehachapi Mts., Kern Co., California (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Soft-furred rodent colored pinkish yellow to buff with dark

wash, depending on habitat soil coloration. Underparts buff, brownish, or white. Two diagnostic white patches at base of each ear. Tail usually uniformly pale brown. Smallest member of genus, except for silky pocket mouse, and palest colored (Zelveloff 1988). Total length: 112–138; length of tail: 50–76; length of hind foot: 17–20; length of ear: 6–8; body mass: 7–10 g (Jameson and Peeters 1988).

DISTRIBUTION.—SE Oregon and all of W U.S. to N Mexico and Baja California (Wilson and Reeder 1993). Found in extreme W and S Utah (Sparks 1974).

REPRODUCTION.—Has potential to be most abundant mammal in ideal habitat. Breeding April to September, with a gap in breeding in hotter months. Gestation ca 23 days. Litter size 2–8, with possibly 2 litters per year. (Jameson and Peeter 1988, Zelveloff 1988).

ECOLOGY.—Lives in sandy and gravelly soil areas, usually in rolling terrain broken by ravines and rocks. Plant associations include rabbitbrush, mustards, blackbrush, Mormon tea, yucca, creosote, sagebrush, desert lilies, Joshua tree, cactus, and verbena. Greatest activity 2–5 hours after sunset and just before sunrise. Hibernates in winter or for a few nights when food is scarce (Hoffmeister 1986, Clark and Stromberg 1987). Excluding bats, *P. longimembris* is the smallest mammal to hibernate. Diet consists of seeds from various desert plants and grasses. Also takes soil-dwelling insects (Jameson and Peeter 1988). Predators likely the same as for other pocket mice (Zelveloff 1988).

SPECIMENS EXAMINED.—Kane Co.: Hall Cave, 1 (BYU); Wah Weep Creek, 10 mi N Arizona border, 1 (BYU); Adairville, 40 mi E Kanab, 4 (BYU); Cottonwood Canyon, 1 (BYU); Cottonwood Canyon, 27 mi SE Cannonville, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Willow Tank Springs, 1 (Tanner 1940); Fourmile Bench, 6 (Murdock et al. 1974); Nipple Bench (Atwood and Pritchett 1974); Smokey Mountain (Atwood and Pritchett 1974); Paria Plateau (Hayward et al. 1958); Adairville, 15 (Pritchett 1962).

*Perognathus parvus* (Peale, 1848)

Great Basin Pocket Mouse

*Critetodipus parvus* Peale, 1848. Mammalia and ornithology, in U.S. Expl. Exped. . . . , 8:53. Type from Oregon, probably near The Dalles, Wasco Co. (Hall 1981).

GENERAL CHARACTERISTICS.—Despite Latin name, largest member of genus. Coloration upperparts pinkish buff to ochraceous buff, overlaid lightly with blackish coloring. Underparts whitish to buffy. Tail long, pectinate, and bicolored. Antitragus lobed (Hall 1981). Total length: 169–190; length of tail: 85–97; length of hind foot: 22–24; length of ear: 7–9; body mass: 17–31 g (Verts and Kirkland 1988).

DISTRIBUTION.—S British Columbia, south to E California and east to SE Wyoming and NW Arizona (Wilson and Reeder 1993). Occurs in Utah in western half of state (Durrant 1952).

REPRODUCTION.—Breeds soon after spring emergence from dormancy in about April; breeding can continue to September. One to 2 litters per year with 3–4 young. Success and litter size tied to food abundance (Fitzgerald et al. 1994).

ECOLOGY.—Inhabits arid and semiarid areas of sagebrush communities, but found in other scrub-steppe associations as well, if there is light-textured soil for burrowing. Diet includes seeds from large variety of plants, grasses, wild beans, borage, composites, pigweeds, *Solanum*, nettles, docks, wild mustard and insects. Like *Peromyscus maniculatus*, *P. parvus* is one of the most abundant small mammal species of the Great Basin. Predators consist of various rattlesnakes, burrowing and short-eared owls, weasel, skunk, badger, northern grasshopper mouse, and foxes. Carries food by filling cheek pouches using forefeet, then caches food in burrows. Burrows typically at bases of shrubs where roots provide protection or sparsely vegetated sandy soil. Active only 8–9 months of year; in torpor in winter, relying on 1 or more food storage chambers. Has set home range and is solitary. Vocalizations quiet “que que que” whine when handled roughly or shrill squeal when in confrontation (Verts and Kirkland 1988).

SPECIMENS EXAMINED.—Garfield Co.: Henrieville, 13 mi NE, T36S, R01W, 4 (USNM); Kane Co.: Paria Basin, Cottonwood Canyon Road, 3 (BYU); Paria Basin, Cottonwood Creek, 1 (BYU); Fivemile Valley, 1 (BYU).

ADDITIONAL RECORDS.—Fourmile Bench, 38 (Murdock et al. 1974); Cockscomb Ridge (Hayward et al. 1958); W side of Cockscomb Ridge (Pritchett 1962); Fivemile Valley, 5 (Pritchett 1962).

*Zapus princeps* Allen, 1893

## Western Jumping Mouse

*Zapus princeps* J. A. Allen, 1893. Bull. Amer. Mus. Nat. Hist., 5:71, April 28. Type from Florida, La Plata Co., Colorado (Hall 1981).

GENERAL CHARACTERISTICS.—Dorsal coloring yellowish gray to salmon-brown or ochraceous. Sides paler than back. Lateral line buff, indistinct, or absent; whitish ventrally. Long tail pale brown to grayish brown above, white-yellow below (Hall 1981). Hind legs made for saltatory lifestyle. Total length: 204–260; length of tail: 112–148; length of hind foot: 27–33; length of ear: 13–17; body mass: 19–37 g (Fitzgerald et al. 1994).

DISTRIBUTION.—S Yukon south to NE Dakota, west to C Montana, down to SE Wyoming, south to NC New Mexico, northwest to N and C Utah (with isolated population in E Utah), N and C Nevada, EC California north to SW, C and E Oregon, SE Washington northwest to S Yukon (Sparks 1974, Wilson and Reeder 1993).

REPRODUCTION.—Breeds during summer. Gestation ca 18 days with only 1 litter of 3–8 young. Relatively long-living small rodent because of 8–9 month hibernation (Fitzgerald et al. 1994).

ECOLOGY.—Inhabits riparian areas in alder, willow, and aspen associations with well-grown understory of forbs, grasses, and sedges. Diet mostly arthropods and seeds, although some foliage is taken. Activity nocturnal and occasionally diurnal. Home ranges developed in both sexes. Females moderately territorial. Predators not recorded, but likely terrestrial carnivores and raptors (Fitzgerald et al. 1994).

REMARKS.—Found in Raft River, Uinta, Oquirrh, La Sal, and Wasatch Mountains (Sparks 1974, Hall 1981).

*Lemmiscus curtatus* (Cope, 1868)

## Sagebrush Vole

*Arvicola curtata* Cope, 1868. Proc. Acad. Nat. Sci. Philadelphia, 20:2. Type locality Pigeon Spring, Mt. Magruder, Esmeralda Co., Nevada (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Pelage long and dense with coloring buffy gray to ashy gray, ears and nose often buffy. Sides lighter and venter silvery white to pale buff. Tail distinctly bicolored. Soles of hind feet well furred. Total length: 103–142; length of tail: 16–30; length of hind foot: 14–18; length of ear: 8–16;

body mass: 18–38 g (Carroll and Genoways 1980).

DISTRIBUTION.—Sagebrush steppe and desert from S Alberta and SE Saskatchewan south to NW Colorado and EC California, including interior Washington and Oregon (Wilson and Reeder 1993). Occurs throughout Utah, except for extreme SW region (Hall 1981).

REPRODUCTION.—Breeds year-round. Gestation ca 25 days with multiple litters, depending on resource availability. Young weaned at 17–19 days. After postpartum mating, males excluded from nests. Females share nests and suckle each other's young (Carroll and Genoways 1980).

ECOLOGY.—Restricted to semiarid prairies, hills, and canyons with loose, well-drained soil. Vegetation dominated by sagebrush and bunchgrasses. Diet entirely vegetative, utilizing cheatgrass, wheatgrass, bulbous bluegrass, and any green or seeding vegetation. Burrows in clusters with 8–30 entrances, located under cover such as sagebrush, rockpiles, or sometimes in open areas. Predators mainly owls, terrestrial carnivores, and rattlesnakes. Active year-round, day-round, but primarily 2–3 hours before sunset and sunrise. Does not cache food and keeps runways, nests, and burrows free of debris. Defecates as far from nests and burrows as possible (Carroll and Genoways 1980)

*Microtus longicaudus*

(Merriam, 1888)

## Long-tailed Vole

*Arvicola (Mynomes) longicaudus* Merriam, 1888. N. Am. Nat., 22:934. Type locality Custer, 1650 m, Black Hills, Custer Co., South Dakota (Smolen and Keller 1987).

GENERAL CHARACTERISTICS.—Long, bicolored tail, one-third the length of the body. Pelage color dull grayish to brownish gray, with black tipped hairs on dorsal and lateral portions. Sides more grayish; venter gray whitish to dull buff. Ears and eyes both relatively large, ears haired (Smolen and Keller 1987). Total length: 175–220; length of tail: 55–90; length of hind foot: 20–25; length of ear: 13–17; body mass: 40–55 g (Clark and Stromberg 1987).

DISTRIBUTION.—Throughout most of western states from E Alaska to C California, N Arizona, and SW New Mexico with disjunct populations in S California and S Arizona (Smolen and Keller 1987). Occurs statewide in Utah, except for areas just west of Great Salt Lake (Sparks 1974).

REPRODUCTION.—Breeding May to October with ca 2 litters per year. Young 2–8, usually born in late summer. Life span usually 1 year (Smolen and Keller 1987).

ECOLOGY.—Occurs mostly in coniferous forests, but also found in riparian areas, aspen communities, recently cut or burned areas, and sagebrush ecotones. Population densities multi-annual in 3–4 year cycles, as with other arvicolines. Predators reported mainly as owls and terrestrial carnivores (Smolen and Keller 1987). Diet includes a wide variety of green vegetation, grasses, sedges, and bulbs (Clark and Stromberg 1987).

*Microtus montanus* (Peale, 1848)

Montane Vole

*Arvicola montana* Peale, 1848. Mammalia and ornithology, in Repts. U.S. Expl. Surv., 8:44. Type from headwaters Sacramento River, near Mt. Shasta, Siskiyou Co., California (Webster and Jones 1982).

GENERAL CHARACTERISTICS.—Pelage upperparts grayish, often with buffy or grayish wash with black-tipped hairs; sides more buffy and paler. Undersides white and gray, sometimes with buffy wash. Tail bicolored blackish and gray (Hall 1981). Total length: 140–182; length of tail: 34–62; length of hind foot: 17–22; length of ear: 11–18; body mass: 35–60 g (Fitzgerald et al. 1994).

DISTRIBUTION.—Cascade, Sierra Nevada, and Rocky Mountain ranges: SC British Columbia to EC California, S Utah, and NC New Mexico with disjunct populations in S Nevada, EC Arizona, and NE New Mexico (Wilson and Reeder 1993).

REPRODUCTION.—Breeding spring and summer, varying geographically and with resource availability. Gestation ca 21 days. Three to 8 young per litter (Jameson and Peeters 1988). Females polyestrous with postpartum estrus. Polygynous mating system unless low population densities, then monogamous. Young breed 1st year (Fitzgerald et al. 1994).

ECOLOGY.—Commonly inhabits moist mountain meadows and grassy valleys. Lives in runways and burrows under grassy cover, active at any time. Diet consists of forb leaves, grasses, sedges, rushes, and occasionally fungi (Zaveloff 1988). Builds globular underground nests lined with grass. Nests have 2 entrances and are shallow. Predators include coyote, weasels, kestrel, Swainson's hawk, red-tailed hawk, and great horned owl (Fitzgerald et al. 1994).

Females territorial. In overlapping ranges of meadow and montane voles, montane voles tend to be excluded (Clark and Stromberg 1987).

SPECIMENS EXAMINED.—Garfield Co.: Steep Creek, 3 (BYU).

STATUS.—Listed as a species of special concern in State of Utah as *Microtus montanus rivularis* (Kimball 1997).

*Ondatra zibethicus* (Linnaeus, 1758)

Muskkrat

*Castor moschatus* Linnaeus, 1758. Syst. Nat., 10th ed., 1:1–823. Type locality eastern Canada (Willner et al. 1980).

GENERAL CHARACTERISTICS.—Color from whitish to black-brown. Largest microtine. Small eyes, short ears, and large head. Webbed hind feet with smaller forefeet. Tail long, laterally compressed, scaly, and sparsely haired. Total length: 456–553; length of tail: 200–254; length of hind foot: 65–78; length of ear: 20–21; body mass: 700–1800 g (Willner et al. 1980).

DISTRIBUTION.—North America, sea level to treeline; south to Gulf of Mexico, Rio Grande, and lower Colorado River valleys; introduced into Palearctic and southernmost Argentina (Wilson and Reeder 1993). Found throughout Utah in wetlands (Sparks 1974).

REPRODUCTION.—Breeds throughout year. Gestation 25–30 days. Litter size 4–8 in northern regions with 1–3 litters per year. Young weaned at 4 weeks (Willner et al. 1980).

ECOLOGY.—Constructs aquatic conical houses or digs burrows in banks near streams, lakes, marshes, creeks, and man-made ponds. Builds a feeding house and main dwelling. Mainly herbivorous, but also eats crayfish, fish, mollusks, and turtles. Major predators are man, raccoon, mink, spotted skunk, foxes, and ermine weasel. Establishes breeding territories and dominance hierarchies. Vocalizations are squeaks, a high-pitched “n-n-n-,” and a chattering with the incisors (Willner et al. 1980).

*Neotoma cinerea* (Ord, 1815)

Bushy-tailed Woodrat

*Mus cinereus* Ord, 1815. In: Guthrie, A new geog. hist., Philadelphia, 2nd Amer. ed., 2:292. Type locality near Great Falls, Cascade Co., Montana (Hall 1981).

GENERAL CHARACTERISTICS.—Rodent with large head and body. Upperparts pale gray



washed with buff to brownish black. Underparts white to pinkish to buffy. Dusky above and whitish below (Hall 1981). Total length: 350–450; length of tail: 135–220; length of hind foot: 40–50; length of ear: 30–34; body mass: 240–280 g (Struebel 1989).

DISTRIBUTION.—SW Canada south through N New Mexico and Arizona east to W Dakota (Wilson and Reeder 1993). Distributed statewide in Utah except for West Desert area (Sparks 1974).

REPRODUCTION.—Breeds early spring–late summer, dependent on elevation (Fitzgerald et al. 1994). Breeds at 2 years of age; gestation of 27–35 days. One to 2 litters per year of 4–5 young; lives 3–4 years (Struebel 1989). Mating system harem polygyny or promiscuous with male territories overlapping female territories (Smith 1997).

ECOLOGY.—Inhabits montane, subalpine, and canyon type ecosystems. Most northern occurring of woodrats (Fitzgerald et al. 1994). Solitary, territorial, and mainly nocturnal. Nest areas characterized by deposits of debris, sticks, bones, cones, scat from various animals, and any other objects available. Nests are elaborately made from soft plant material and are cup-shaped. Debris piles also created in nearby caves and crevices, in rocks, packed with feces and urine. Function of this behavior is unknown, perhaps used for territory marking. Opportunistic feeder with broad range from flowering plants to cactus and pine needles (Struebel 1989). Excellent climber and favors cliff walls over ground nests (Fitzgerald et al. 1994). Predators recorded as long-tailed weasel, marten, bobcat, coyote, great horned owl, red-tailed hawk, goshawk, and some species of snakes (Smith 1997).

SPECIMENS EXAMINED.—Garfield Co.: 22 mi S Notom, 1 (BYU).

*Neotoma devia* Goldman, 1927

Arizona Woodrat

*Neotoma devia* Goldman, 1927. Proc. Biol. Soc. Washington, 40:205. Type locality Tanner Tank, 1560 m, Painted Desert, Arizona (Hall 1981).

DISTRIBUTION.—EC and S Utah, W Arizona, and NW Sonora, Mexico (Wilson and Reeder 1993).

REMARKS.—Reproduction, ecology, and general characteristics same as *N. lepida*. Separate from desert woodrat following Mascarello et al. (1976), Mascarello (1978), and Koop et al.

(1985). However, Wilson and Reeder (1993) noted that further research is required to delineate species groups and to delimit geographic ranges. Durrant (1952) included all desert woodrats in *N. lepida* and records subspecies now allocated in *N. devia* as races in GSENM. It is likely that *N. lepida* is not in the Monument.

ADDITIONAL RECORDS.—As *N. lepida monstralbilis*: Garfield Co.: 5 mi W Escalante, 1800 m, 1 (Durrant 1952); 8 mi S Escalante, 1560 m, 1 (Durrant 1952); Kane Co.: Kaiparowits Plateau (Tanner 1940); Cockscomb Ridge (Pritchett 1962).

*Neotoma lepida* Thomas, 1893

Desert Woodrat

*Neotoma lepida* Thomas, 1893. Ann. Mag. Nat. Hist., ser. 6, 12:235, September. Type from somewhere on "Simpson's route" between Camp Floyd [=Fairfield], Utah, and Carson City, Nevada (Hall 1981).

GENERAL CHARACTERISTICS.—Smaller woodrat with bicolored, short-haired tail. Pelage yellow-buff to buffy gray. Underparts whitish to buffy, white hairs on chest usually gray at bases except midventral stripe with white bases. Total length: 266–295; length of tail: 110–126; length of hind foot: 31–33; length of ear: 28–30; body mass: 100–104 g (Fitzgerald et al. 1994).

DISTRIBUTION.—SE Oregon and SW Idaho, south through Nevada and S California to S Baja California (Wilson and Reeder 1993). Occurs in Utah except in C and NE high mountain areas (Sparks 1974, Hall 1981).

REPRODUCTION.—Polyestrous, reproducing in spring–summer. Female reproduces at 3 months. Gestation 30–36 days. Two litters typical, though potentially more. Two to 4 young, weaned at 4 weeks. (Fitzgerald et al. 1994).

ECOLOGY.—Species of semiarid canyonlands and foothills, associated with rocky slopes and cliffs of montane shrublands, pinyon-juniper woodlands, and montane forests (Fitzgerald et al. 1994). In mountainous areas, its ecological niche typically occupied by bushy-tailed woodrat, as both favor rocky areas for nests. Desert woodrat usually associated with cacti, used for food and protection. Also, feeds on forbs (both leaves and seeds), leaves of shrubs, and various berries (Jameson and Peeters 1988). Dens located in horizontal rock crevices, with more than one entrance. Nests ball- or cup-shaped and made from fine shredded bark, grass, or

similar material. Activity mainly nocturnal (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Kane Co.: near junction of Paria and Adairville roads, 1 (BYU); 9 mi NE Adairville, 1 (BYU); Paria Basin, Cottonwood Canyon Road, 3 (BYU); Adairville (Cockscomb area), 40 mi E Kanab, 2 (BYU); Wah Weep Creek, 10 mi N Arizona border, 1 (BYU); Catstairs Canyon, 50 mi E Kanab, 1 (BYU); Cottonwood Canyon, 27 mi SE Cannonville, 8 (BYU); Willow Tank Spring, 1 (BYU); Hall Cave, 1 (BYU); Paria Basin, 1 (BYU); Cockscomb Ridge, 1 (BYU); mouth of Calf Creek, 1 (BYU).

ADDITIONAL RECORDS.—Garfield Co.: 5 mi W Escalante, 1800 m, 1 (Durrant 1952); 8 mi S Escalante, 1560 m, 1 (Durrant 1952); Kane Co.: Fourmile Bench, 13 (Murdock et al. 1974); Cockscomb Ridge (Hayward et al. 1958); Cockscomb Ridge, 2 (Atwood and Pritchett 1974).

*Peromyscus boylii* (Baird, 1855)

Brush Mouse

*Hesperomys boylii* Baird, 1855. Proc. Acad. Nat. Sci. Philadelphia, 7:335. April. Type from Middle Fork American River, near present town of Auburn, Eldorado Co., California (Hall 1981).

GENERAL CHARACTERISTICS.—Medium-sized mouse. Adult coloration variable, but usually ochraceous buff dorsally, sides ruddy. Tail brownish above, whitish below. Underparts and feet whitish. Older individuals usually ruddy; juveniles more dusky (Hoffmeister 1986). Total length: 180–220; length of tail: 80–115; length of hind foot: 20–24; length of ear: 15–22; body mass: 20–30 g (Fitzgerald et al. 1994).

DISTRIBUTION.—California to westernmost Oklahoma south to C Mexico and El Salvador (Wilson and Reeder 1993). Occurs in Utah in E half and SW corner of state (Durrant 1952).

REPRODUCTION.—Breeds late winter–early fall, with peak activity in warm spring months. Multiple litters per year of 1–6 young. Longevity to 18 months, but most die before 1 year (Fitzgerald et al. 1994).

ECOLOGY.—Found in brushy areas from sea level to ca 2000 m. Common in hillsides of brushy, arid areas, rocky slopes, and woodlands of pinyon-juniper, cottonwood-willow, oakbrush, and mountain mahogany. Diet includes any conifer seeds, acorns, berries, cactus fruit, and insects (Zaveloff 1988). Does not hibernate or cache food. Good climber and often forages in trees. Builds nests in shel-

tered areas under rocks, debris, and in crevices. Dens of other *Peromyscus* and woodrats also used for cover (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Garfield Co.: mouth of Calf Creek, Escalante River, 1 (BYU); Kane Co.: Cottonwood Canyon, 27 mi SE Cannonville, 1 (BYU).

*Peromyscus crinitus* (Merriam, 1891)

Canyon Mouse

*Hesperomys crinitus* Merriam, 1891. N. Amer. Fauna, 5:1–127. Type locality Shoshone Falls, N side Snake River, Jerome Co., Idaho (Johnson and Armstrong 1987).

GENERAL CHARACTERISTICS.—Small to medium for genus. Tail longer than head and body and thinly haired. Ears large and sparsely furred. Pelage color variable but likely ochraceous buff to pinkish cinnamon dorsally and whitish ventrally, hairs gray at base with coloration patch on chest. Sometimes anal patch present as well. Tail bicolored (Johnson and Armstrong 1987). Total length: 160–190; length of tail: 82–110; length of hind foot: 18–25; length of ear: 17–23; body mass: 12–30 g (Fitzgerald et al. 1994).

DISTRIBUTION.—From Oregon, Idaho, Wyoming south to NW Mexico and from California east to Colorado and New Mexico (Johnson and Armstrong 1987). Found throughout Utah, except in higher mountains (Sparks 1974, Hall 1981).

REPRODUCTION.—Breeding late winter to late summer, with peak activity in spring. Seasonally polyestrous with 1–8 litters per year. Gestation 29–31 days, litter size 1–5 (Johnson and Armstrong 1987).

ECOLOGY.—Occurs strictly in rocky habitats in almost any ecological association. Vegetation has little or no effect on distribution. Omnivorous diet of insects, green vegetation, and seeds. Perhaps restricted to rocky areas because of intraspecific competition with other *Peromyscus*. Excellent, agile climber, often the lone rodent species in vertically oriented habitats. Male-male aggression strongly due to dispersed social organizations. However, several individuals will share nests except females with young. Vocalizations include neonatal cries, comfort sounds, and warning squeaks. Nonvocal communication includes tooth-chattering and sometimes foot-stomping when threatened. Dustbathes to remove oils from coat (Johnson and Armstrong 1987).

SPECIMENS EXAMINED.—Garfield Co.: mouth of Calf Creek, Escalante River, 1 (BYU); Moki Tanks, Circle Cliffs, 1 (BYU); Kane Co.: Cottonwood Canyon, 27 mi SE Cannonville, 2 (BYU); 9 mi NE Adairville, 3 (BYU); Adairville, 1 (BYU); Site 8, Smokey Mountain, 1 (BYU); Wah Weep Creek, 10 mi N Arizona border, 1 (BYU); Calf Creek Campground, 1 (BYU); Tibbet Spring, ca 40 mi S Escalante, 4 (USNM); 41–105 mi N Lee's Ferry, 1 (BYU).

*Peromyscus maniculatus*  
(Wagner, 1845)

Deer Mouse

*Hesperomys maniculatus* Wagner, 1845. Weigmann's Arch. Fur Naturgesch., Jahg. 11, 1:148. Type locality the Moravian settlements in Labrador (Hall 1981).

GENERAL CHARACTERISTICS.—Characteristics extremely variable externally and physiologically. Dorsal coloration from gray-brown to rufous orange to pale buff. Underparts and feet white. Juveniles darker and more gray than adults. Tail bicolored and shorter than body and head. Ears smaller than pinyon mouse, but relatively large. Total length: 135–180; length of tail: 57–78; length of hind foot: 17–21; length of ear: 14–21; body mass: 14–27 g (Fitzgerald et al. 1994).

DISTRIBUTION.—Panhandle of Alaska and across most of continental U.S., excluding SE and E Seaboard, to Baja California and NC Mexico (Wilson and Reeder 1993). Likely found in every dry land microhabitat throughout Utah (Durrant 1952, Sparks 1974).

REPRODUCTION.—Breeds from April to November or December, determined largely by food abundance. Gestation 24–28 days with several litters. Two to 8 young per litter (Jameson and Peeters 1988). Mortality usually occurs in 1st year (Fitzgerald et al. 1994).

ECOLOGY.—Widest ranging and most common of terrestrial small mammals found in GSENM. Found in any habitat from tundra to deserts, excluding well-developed wetlands. Well adapted to exploit disturbed habitats, yet where other, more specialized members of genus are found, deer mice are absent or fewer in number. Diet consists of almost anything; small invertebrates, fungi, carrion, seeds, and various other plant parts. Utilizes trails repeatedly as runways. Active year-round and uses runways beneath the snow in winter. Nests highly variable as well as home range size, varying with seasons. Predators include

snakes, owls, hawks, coyote, badger, weasels, and grasshopper mouse (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Garfield Co.: mouth of Calf Creek, Escalante River, 2 (BYU); The Blues, ca 18 mi SW Escalante, 5 (USNM); Moki Tanks, 2 (BYU); Tenmile Spring, S of Escalante, 1 (BYU); Henrieville, 13 mi NE T36S, R01W, 5 (USNM); Kane Co.: Cottonwood, 8 mi NW Kanab, 1440 m, 4 (MVZ); Five-mile Valley, 1 (BYU); near junction of Paria and Adairville, 15 (BYU); Cottonwood Canyon, 27 mi SE of Cannonville, 38 (BYU); Fourmile Bench, 1 (BYU); Adairville, 7 (BYU); 50 mi SE Escalante at Willow Tank Spring and Hall Cave, 1 (BYU); Wah Weep Creek, 10 mi N Arizona border, 1 (BYU); Willow Tank Spring, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: Cottonwood, 8 mi NW Kanab, 1440 m, 2 (Durrant 1952); Fourmile Bench, 84 (Murdock et al. 1974); Cockscomb Ridge (Hayward et al. 1958); Adairville, 9 (Pritchett 1962); Fivemile Valley, 18 (Pritchett 1962).

*Peromyscus truei*  
(Schufeldt, 1885)

Pinyon Mouse

*Hesperomys truei* R. W. Shufeldt, 1885. Proc. U.S. Natl. Mus., 8:403–408. Type locality Fort Wingate, McKinley Co., New Mexico (Hoffmeister 1981).

GENERAL CHARACTERISTICS.—Largest ears of genus. Color varies from pale yellow-brown to brown dorsally with white underparts and feet. Tail bicolored with dorsal color darker than back of body (Hoffmeister 1981). Total length: 177–195; length of tail: 87–98; length of hind foot: 22–24; length of ear: 24–27; body mass: 20–29 g (Jameson and Peeters 1988).

DISTRIBUTION.—SW Oregon to W and SE Colorado, south to Baja California, Arizona, New Mexico, and NC Texas (Wilson and Reeder 1993). Found statewide in Utah except in Uinta and Wasatch mountain ranges (Sparks 1974).

REPRODUCTION.—Breeding April to September with multiple litters, dependent on food availability. Gestation 25–27 days. Three to 6 young per litter (Hoffmeister 1981). Eyes open at 3 weeks and young weaned at about 5 weeks. Females breed at ca 3 months (Fitzgerald et al. 1994).

ECOLOGY.—Most commonly associated with pinyon and juniper belts where trees grow close to rocky outcroppings and slopes. Where

pinyons absent, habitat consists of rocky outcrops in junipers and sage, such as in C Oregon; in California, found associated with chaparral, redwood woodlands, Douglas-fir, California laurel, madrone, oak, and desert scrub. Food consists of small invertebrates, acorn mast, juniper seeds, and carrion (Hoffmeister 1981). Predators same as *P. maniculatus*.

SPECIMENS EXAMINED.—Garfield Co.: 13 mi NE Henrieville, T36S, R01W, 6 (USNM); 5 mi W Escalante, 1800 m, 1 (Durrant 1952); 8 mi S Escalante, 1560 m, 1 (Durrant 1952); Kane Co.: Adairville (Cockscomb area), 9 (BYU); Catstairs Canyon, 50 mi E Kanab, 1 (BYU); Cockscomb Ridge, 2 (BYU); Cottonwood Canyon, 27 mi SE Cannonville, 24 (BYU); Paria Basin, Cottonwood Canyon Road, 9 (BYU); Fourmile Bench, 1 (BYU); Fourmile Bench, 3/4 mi S Airstrip, 1 (BYU); Cockscomb Ridge (Hayward et al. 1958); Paria Basin, 1 (BYU); Paria Basin, Cottonwood Canyon Road, 1 (BYU); Wah Weep Creek, 10 mi N Arizona border, 1 (BYU).

ADDITIONAL RECORDS.—Garfield Co.: 5 mi W Escalante, 1800 m, 1 (Durrant 1952); 8 mi S Escalante, 1560 m, 1 (Durrant 1952); Kane Co.: Fourmile Bench, 24 (Murdock et al. 1974); Fivemile Valley, 3 (Pritchett 1962).

*Reithrodontomys megalotis*  
(Baird, 1858)

Western Harvest Mouse

*Reithrodon megalotis* S. F. Baird, 1858. *Mammalia in Repts. U.S. Expl. Surv.*, 8(1):451. Type locality between Juanos, Chihuahua, and San Luis Springs, Grant Co., New Mexico (Webster and Jones 1982).

GENERAL CHARACTERISTICS.—Small, long-tailed rodent with diagnostic medial grooves on front surface of upper incisors. Ears prominent. Tail long, slender, scaled, and bicolored but sparsely haired. Dorsal pelage gray or brown-black to pale buff. Total length: 114–154; length of tail: 50–83; length of hind foot: 15–18; length of ear: 12–15; body mass: 9–21 g (Webster and Jones 1982).

DISTRIBUTION.—SW Canada southward to S Mexico, and from California east to Indiana (Webster and Jones 1982). Occurrence throughout Utah except in NE corner of state (Hall 1981).

REPRODUCTION.—Breeding early spring to late autumn. Females polyestrous and sexually mature after 4 months. Males polygynous with dominance hierarchies. Gestation 23–24 days, with ca 4 young per litter. Mortality usually

occurs within 1st year (Webster and Jones 1982).

ECOLOGY.—Typically inhabits grassy and weedy habitats as well as deserts, salt marshes, and pine-oak forests. Primarily granivorous, but consumes herbaceous material and lepidopteran larvae. Predators include hawks, snakes, owls, canids, mustelids, felids, and scorpions. Displays no territoriality and tolerant of individuals and other small mammal species unless restricted resource availability. Microtine runways used for travel. Nocturnal habits, especially active on moonless nights (Webster and Jones 1982).

SPECIMENS EXAMINED.—Garfield Co.: 1.5 mi S Upper Valley 13 mi SW Escalante, 1 (UU); Calf Creek Campground, 1 (BYU); Kane Co.: Cottonwood Canyon, 27 mi SE Cannonville, 1 (BYU); Adairville, 2 (BYU); Fivemile Valley, 1 (BYU); 34–56 mi N Lee's Ferry, 1 (UU).

ADDITIONAL RECORDS.—Kane Co.: Fivemile Valley, 3 (Pritchett 1962); Adairville, 2 (Pritchett 1962).

*Erethizon dorsatum*  
(Linnaeus, 1758)

American Porcupine

*Hystrix dorsatum* Linnaeus, 1758. *Syst. Nat.*, 10th ed., 1:57. Type locality eastern Canada (Hall 1981).

GENERAL CHARACTERISTICS.—Moderately large, stout body. Short legs and tail. Tail covered with spines. Pelage gray-brown with lighter underside. Total length: 645–1030; length of tail: 145–300; length of hind foot: 75–91; length of ear: 25–41; body mass: 3.5–18 kg (Woods 1973).

DISTRIBUTION.—C Alaska to S Hudson Bay and Labrador, south to E Tennessee, C Iowa, C Texas, N Mexico, and S California (Wilson and Reeder 1993). Found statewide in Utah (Durrant 1952, Sparks 1974).

REPRODUCTION.—Seasonally polyestrous. Gestation 205–217 days. Parturition April to June with single young. Quills soft when born and harden within an hour after birth (Woods 1973).

ECOLOGY.—Hardwood-softwood habitats selected (Stricklan et al. 1995). No territorial defense except over feeding trees. Often follows trails, waterways, or animal runways. Urinates in paths, at bases of trees, and near dens. Predators primarily man and the fisher, sometimes also mustelids, coyote, wolf, dog, bear, mountain lion, lynx, bobcat, eagles, and great horned owl. Solitary except during mass

migrations and shared winter dens. Vocalizations include moans, grunts, whines, squeaks, sniffs, coughs, mews, chatters, shrieks, snorts, barks, owl-like hoo-hoos, and shrill screeches (Woods 1973).

#### LAGOMORPHA

##### *Lepus americanus* Erxleben, 1777

##### Snowshoe Hare

[*Lepus*] *americanus* Erxleben, 1777. *Systema regni animalis* . . . , 1:330. Type locality Hudson Bay, Canada. Restricted to Fort Severn, Ontario, by V. Bailey, N. Amer. Fauna, 49:138, January 8, 1927 (Hall 1981).

GENERAL CHARACTERISTICS.—Medium-sized with disproportionately large hind feet and only moderately large ears. Summer pelage rusty brown to gray-brown above, white below. Tips of ears black. Feet usually whitish gray stockings. During fall, molt turns to white winter pelage with only tips of ears remaining black. During molting (spring and fall), coloration is mottled brown and white. Total length: 365–525; length of tail: 25–55; length of hind foot: 110–150; length of ear: 60–80; body mass: 1–1.5 kg (Fitzgerald et al. 1994).

DISTRIBUTION.—S and C Alaska to S and C Hudson Bay to Newfoundland, south to Appalachians, S Michigan, North Dakota, NC New Mexico, and EC California (Wilson and Reeder 1993). Found in Utah in Wasatch and Uinta Mountains, and central mountains of the state as far south as Kane Co. (Durrant 1952).

REPRODUCTION.—Breeding spring to late summer. Gestation 34–40 days, producing 2–18 young. Litter size affected greatly by variety of factors from latitude to deepness of snow prior to breeding. One to 4 litters per year. Young weaned after 1 month (Chapman and Feldhamer 1982).

ECOLOGY.—Restricted to boreal coniferous forests (especially mature forests) and alpine areas near tree cover. Characteristically found in willow and alder thickets. Diet includes willows, alders, and various low-growing shrubs, grasses, and forbs (Hansen and Flinders 1969). During winter months diet becomes more restricted to woody browse. Coprophageal digestive system for more efficient nutrient intake. Mostly nocturnal habits; avoids large, open areas. Spends day hours in scrapes located in concealed, protected areas of dense, tangled shrubs or young conifers. Night activity centralized in well-used runways. Solitary with intersexual overlapping home ranges. Displays

territorial aggression and dominance hierarchies. Dramatic 10-year population cycles occur for largely unknown reasons. Predators include coyote, wolverine, fisher, bobcat, lynx, weasel, golden eagle, hawks, and marten (Fitzgerald et al. 1994).

##### *Lepus californicus* Gray, 1837

##### Black-tailed Jackrabbit

*Lepus californicus* J. E. Gray, 1837. *Mag. Nat. Hist.* [Charlesworth's], 1:586. Type locality "St. Antoine" [probably near Mission of San Antonio, California] (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Medium-sized to large jackrabbit with grayish black dorsum and white venter. Black dorsal stripe extends from rump to tail. Ears dark on outer tips. Young have pronounced white spot on forehead. Winter pelage paler than summer pelage but never white. Long, powerful hind legs for saltatory lifestyle. Size varies geographically, as with all jackrabbits. Total length: 470–630; length of tail: 50–112; length of hind foot: 110–145; length of ear: 100–130; body mass: 1.3–3.2 kg (Fitzgerald et al. 1994).

DISTRIBUTION.—From W Arkansas and Missouri westward to Pacific Coast, and from Washington and Idaho south to C Mexico (Best 1996). Occupies entire state of Utah (Durrant 1952).

REPRODUCTION.—Promiscuous breeder, breeding January to August, depending on severity of winter. Gestation ca 40 days with litter size of 1–6. Multiple litters of precocial young (Best 1996).

ECOLOGY.—Favors habitats where grasses are not as abundant and cacti and low shrubs are scattered about. An animal of open areas and found in honey mesquite, sagebrush, pinyon-juniper, grazed areas, and desert scrub (Flinders and Hansen 1972). Utilizes sparse shrubs as shade by building horizontal excavations in sand beneath them. For first 2 months young have nocturnal activity and are motionless in day. As adults, revert to diurnal activity (Best 1996). Diet consists of grasses, shrubs, forbs, sedges; coprophagic digestive system for more efficient nutrient intake. Coyote closely tied to jackrabbit abundance; predation on other mammals decreases with availability of jackrabbits. Foxes, badgers, and eagles also take black-tails (Fitzgerald et al. 1994).

SPECIMENS EXAMINED.—Kane Co.: 9 mi NE Adairville, 1 (BYU).

ADDITIONAL RECORDS.—Kane Co.: 50 mi SE Escalante, Willow Tank Spring, 1 (Tanner 1940).

*Lepus townsendii*  
Bachman, 1839

White-tailed Jackrabbit

*Lepus townsendii* J. Bachman, 1839. J. Acad. Nat. Sci. Philadelphia, 8:75–105. Type locality “on the Wallawalla, one of the sources of the Columbia River,” near present town of Wallula, Walla Walla Co., Washington (Lim 1987).

GENERAL CHARACTERISTICS.—Pelage yellowish to grayish brown underparts, white or pale gray underparts, excluding darker throat. Winter pelage thick and white, usually with buffy tinge on ears, face, back, and feet. Tail remains white throughout the year, usually with buffy or dusky stripe dorsally. Tips of ears always black. Total length: 565–618; length of tail: 72–102; length of hind foot: 146–165; length of ear: 100–113; body mass: 2.5–3.5 kg (Lim 1987).

DISTRIBUTION.—SC Canada south to SW Wisconsin, Iowa, NW Missouri, west through C Kansas to NC New Mexico, west to C Nevada and EC California (Wilson and Reeder 1993). In Utah, found statewide except for W and SE parts of the state (Sparks 1974).

REPRODUCTION.—Breeding February to August. Maximum of 4 litters produced each year, contingent on breeding conditions and environmental factors. Gestation 30–42 days, dependent on elevation and latitude, with litter size 1–11, 4–5 most common. Longevity 8 years maximum (Lim 1987).

ECOLOGY.—Habitat generally open plains, but also found in alpine tundra, forested areas, sagebrush communities, and rabbitbrush associations (Hansen and Flinders 1969, Flinders and Hansen 1972). Herbivorous, feeding on succulent grasses and forbs when available; shrubs consumed in dry months. Predators include those listed for black-tailed jackrabbit. Solitary and nocturnal habits. When pursued by predator, several behaviors used, from tonic immobility to zigzag flight pattern (Lim 1987). Often runs short distance on hind legs only when fleeing, especially uphill.

*Sylvilagus audubonii*  
(Baird, 1858)

Desert Cottontail

*Lepus audubonii* S. F. Baird, 1858. Mammalia, in Repts. U.S. Expl. Surv., 8(8):608. Type locality San Francisco, California (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Relatively large for genus. Hind legs long, feet slender, hair not as dense as other *Sylvilagus* members. Ears long and sparsely haired. Tail large and dark above, white underneath. Vibrissae all black (Chapman and Willner 1978). Pelage dorsally pale gray with yellowish tinge, with black wash; sides lighter and lower parts whitish; orange-brown throat patch (Zaveloff 1988). Total length: 372–400; length of tail: 39–60; length of hind foot: 81–94; length of ear: 70–75; body mass: 756–1250 g. Females usually larger than males (Chapman and Willner 1978).

DISTRIBUTION.—C Mexico to NC Montana and SW North Dakota, Utah, C Nevada, and NC California (Wilson and Reeder 1993). Found in Utah in eastern counties on both sides of the Colorado and Green rivers (Durrant 1952).

REPRODUCTION.—Breeding likely year-round. Gestation ca 28 days. Young born in cavities lined with grass and layered with rabbit fur on inside. Litter size 2–5 young with multiple litters (5 litters average in Arizona). Young precocial. Sexual maturity reached at 3 months (Chapman and Willner 1978, Zaveloff 1988).

ECOLOGY.—Occurs in xeric woodlands, riparian zones, grasslands, grazed pastures, and deserts at all lower elevations of the Southwest. Predators include terrestrial carnivores, owls, eagles, hawks, and rattlesnakes (Chapman and Willner 1978). Diet of grasses and forbs in warmer months and shrubs (especially sagebrush) in winter. Most active during dawn and dusk, typically remaining in burrows during day (Zaveloff 1988). Capable of climbing trees and brush, swimming, and communicating with visual tail movements. Tolerates high temperatures and cools down by seeking shade and by evaporation through skin and lungs. Maintains home ranges but not aggressively territorial. Active year-round (Clark and Stromberg 1987).

SPECIMENS EXAMINED.—Garfield Co.: Henrieville, 13 mi NE T36S, R01W, 1 (USNM); 7 mi SW Tropic, 1 (Durrant 1952); Adairville, 1 (Pritchett 1962).

*Sylvilagus nuttallii*  
(Bachman, 1837)

Mountain Cottontail

*Lepus nuttallii* J. Bachman, 1837. J. Acad. Nat. Sci. Philadelphia, 7:282–361. Type locality west of the Rocky Mountains in the Columbia and Shoshone river drainage (Chapman 1975).

GENERAL CHARACTERISTICS.—Relatively large for genus. Hind legs large. Feet densely covered with fur. Ears rounded at tips and relatively short, inner surfaces noticeably haired. Vibrissae never all black. Tail grizzled, large and dark above, white beneath. Total length: 345–390; length of tail: 30–54; length of hind foot: 87–110; length of ear: 55–65; body mass: 628.5–871 g (Chapman 1975).

DISTRIBUTION.—Confined to Intermountain areas of North America from SW Canada to E California, Nevada, C Arizona, and NW New Mexico (Wilson and Reeder 1993). Found throughout state of Utah in mountainous and foothill regions, but not in dry, semidesert areas (Sparks 1974).

REPRODUCTION.—Breeding begins early spring. Gestation 28–30 days with variable litter size of 1–8. Females may produce up to 5 litters a year. Young weaned by 4–5 weeks (Clark and Stromberg 1987). Nests cuplike cavities lined with fur and dried grass (Chapman 1975).

ECOLOGY.—Inhabits rocky, wooded, or bushy areas of willow and sagebrush associations. Food variable with time of year. Sagebrush primary food in winter, grasses preferred in warmer months. Species uses shallow burrows, but spends most of time aboveground in suitable cover of vegetation (farms). Unknown if species digs its own burrows, as does *Brachylagus idahoensis*. Predators consist of coyote, bobcat, owls, hawks, golden eagle, and rattlesnakes. Highly solitary rabbit. Feeds near cover, usually in early morning or late afternoon (Chapman 1975). When disturbed, *S. nuttali* will run 15–20 feet and then freeze, facing away from danger. Will then proceed to hop away in a circular path, presumably to “trick” pursuer into following direction it was previously running (Chapman 1975, Zeveloff 1988).

SPECIES OF QUESTIONABLE  
OCCURRENCE

*Sorex preblei* (Jackson, 1922)

Preble's Shrew

*Sorex preblei* Jackson, 1922. J. Washington Acad. Sci., 12: 263. Type locality “Jordan Valley, altitude 4,200 ft. [1260 m] Malheur County, Oregon” (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Tiny shrew. Coloration brownish above, paler below. Tail

bicolored. Total length: 85–95; length of tail: 35–36; length of hind foot: 11; length of ear: not given; body mass: not given (Struebel 1989).

DISTRIBUTION.—Washington, Oregon, Idaho, Montana, California, Nevada, Colorado, and Utah. Records of Pleistocene deposits from S New Mexico (Tomasi and Hoffman 1984, Cornely et al. 1992). Southernmost record for Utah near Great Salt Lake in Tooele Co. (Tomasi and Hoffman 1984).

ECOLOGY.—Found in arid and semiarid habitats, but also in marsh and riparian areas, sagebrush, and bunchgrass habitats (Cornely et al. 1992). Little is known of this shrew.

*Eumops perotis* (Schinz, 1821)

Greater Mastiff Bat

*Molossus perotis* Schinz, 1821. In: Cuvier, Das Tierreich, 1:870. Type locality “Brazil, Rio de Janeiro, Campos de Goita Cazes, Villa Sao Salvador” (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Largest bat in U.S. Pelage dark grayish brown with long guard hairs on rump. Total length: 100–108; length of tail: 35–80; length of hind foot: not given; length of ear: 21–24; length of forearm: 73–80; body mass: 9–13 g (Jameson and Peeters 1988, Best et al. 1996).

DISTRIBUTION.—S California, Nevada, Arizona, Texas, New Mexico, and N Mexico (Best et al. 1996). Not known to occur in Utah.

REPRODUCTION.—Mates early spring. Gestation 80–90 days with single young usually in June to July. Nurses until September (Jameson and Peeters 1988, Schmidly 1991).

ECOLOGY.—Small colonies in rocky areas of chaparral, oak, buckwheat, greasewood, black sage, white sage, and coastal sagebrush (Best et al. 1996). Forages high above and great distances from roosting sites on moths, crickets, and long-horned grasshoppers. Vocalizations continuous, high-pitched calls while hunting (Jameson and Peeters 1988).

*Myotis velifer* (Allen, 1890)

Cave Myotis

*Vespertilio velifer* J. A. Allen, 1890. Bull. Am. Mus. Nat. Hist., 3:177. Type locality Santa Cruz del Valle, Guadalupe, Mexico (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Largest member of genus. Males usually slightly smaller than females. Pelage dull brown, underparts paler and tips of hairs creamy buff. Lack keeled

calcar (Davis and Schmidly 1994). Total length: 90–104; length of tail: 39–47; length of hind foot: 9–10; length of ear: 13–15; length of forearm: 40–42 (Fitch et al. 1981); body mass: ca 15 g (Schmidly 1991).

**DISTRIBUTION.**—Inhabits low elevations of SW U.S., from S Nevada and SE California, southward through Mexico to Honduras (Fitch et al. 1981). In Utah known only from Utah Co. (Durrant 1952).

**REPRODUCTION.**—Breeding likely in fall and winter, but sperm stored until birth of single young in late spring. Active gestation 60–70 days. Species forms large maternity colonies (Fitch et al. 1981).

**ECOLOGY.**—Occurs in large colonies of 2000–5000 individuals in arid habitats. Hibernates in large congregations. Diet mostly moths, but also takes beetles and any other available insects. Forages directly after sunset and just before sunrise. Predators reported as hawks, barn owl, raccoon, bullsnake, wood rat, ringtail, gray fox, and skunks (Fitch et al. 1981).

*Lynx canadensis* Kerr, 1792

Canada Lynx

*Lynx canadensis* Kerr, 1792. In: Linnaeus, Anim. Kingdom, 1:157. Type locality "Canada" (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Thick-coated felid with double-pointed beard, long ear tufts, and white eyelids. Pelage buffy to tawny, washed dark brown, black, or white above and cinnamon-brown below. Large feet are well furred. Stubby tail has distinctive black tip. Similar in appearance to bobcat, but larger and longer legged (Zaveloff 1988). Males generally larger than females. Total length: 825–1545; length of tail: 95–245; length of hind foot: 190–250; length of ear: not given; body mass: 5–17 kg (Tumlison 1987).

**DISTRIBUTION.**—Occurs in patchy taiga and montane zones of North America (Wilson and Reeder 1993). Ranges in Uinta Mountains and central mountains of Utah, from N border of ranges to headwaters of Paria River (Durrant 1952).

**REPRODUCTION.**—Breeding season varies with geographic location, but usually spring. Gestation 63–74 days with litter size usually of 3–4. Young remain with mother until next breeding season (Tumlison 1987).

**ECOLOGY.**—Primary habitat deep within mature boreal forests, in areas with openings, rugged rock outcroppings, bogs, and thickets.

Diet consists mostly of snowshoe hares, but also takes other small mammals, deer, carrion, young moose, and birds (Galliformes and Anseriformes; Tumlison 1987). Population cycles generally affected by snowshoe hare availability in a predator-prey interaction. Synchronous oscillations were found to occur every 9.6 years (Elton and Nicholson 1942, Bulmer 1974). Habits solitary and nocturnal. Various purrs and meows characterize vocalizations (Tumlison 1987).

**REMARKS.**—In Wilson and Reeder (1993), Kurtén and Anderson (1980), Matyushkin (1979), Werdelin (1981), Garcia-Perea (1992), and this account, *L. canadensis* is considered separate from *L. lynx* based on differences in size, osteology, and external characters, as well as absence of transitional forms. Kurtén and Anderson (1980) indicated that *L. canadensis* likely evolved from the Nearctic *L. isiodorensis*, which gradually diverged from the lineage of *L. lynx*.

**STATUS.**—Listed in Appendix II in CITES (Wilson and Reeder 1993) and Utah Sensitive Species List due to limited distribution and declining populations (Kimball 1997).

*Mustela vison* Schreber, 1777

Mink

*Mustela vison* Schreber, 1777. Die Saugthiere, 3(19):pl. 127. B[1777]; text, 3(26):463[1777]. Type locality Canada and Pennsylvania (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Similar to marten in size and appearance, but with less conspicuous ears. Short legs and long, slender body. Fur short and soft with thick underfur and long guard hairs. Glands at bases of hairs produce water-repellent oils. Pelage coloration varies from chestnut brown to blackish. Some individuals may have white patches on throat, chest, or abdomen. Tail long and furred. Toes partially webbed. Total length: 491–720; length of tail: 158–194; length of hind foot: 57–75; length of ear: not given; body mass: 525–780 g. Males 10% larger than females (Fitzgerald et al. 1994).

**DISTRIBUTION.**—North America from Alaska and Canada through all of U.S. except in SW U.S. deserts (Wilson and Reeder 1993). Occurs sparsely throughout Utah in the Uinta and Wasatch Mountains, southeast to the La Sal Mountains, and reported in the Dixie and Fishlake national forests in Utah (Durrant 1952).

**REPRODUCTION.**—Polygynandry (both polygyny and polyandry) mating between February



and March with no pair bonding. Exhibits delayed implantation, but shorter and more variable than most weasels. Gestation 40–75 days with 3–6 young. Offspring reproductively mature by 10 months and mate the same year. However, young males may not mate without establishing territories (Zeloff 1988, Fitzgerald et al. 1994).

**ECOLOGY.**—Closely tied to riparian ecosystems in most habitat types. Generalist with diet consisting of muskrats, deer mice, cottontails, voles, ground-nesting birds (especially waterfowl), eggs, frogs, snakes, fish, insects, crayfish, and a small amount of plant material. Abandoned beaver and muskrat lodges important dens for mink. Surplus prey cached. Presence relies heavily on these and other factors such as permanence of water, wetland vegetation availability (e.g., willow), crayfish and muskrat abundance, and logjams for hunting sites. Active year-round in day hours and occasionally at night. Inactive only after periods of heavy snows. Maintains territories by scent marking. Predators include great horned owl, bobcat, gray wolf, mountain lion, and fisher. Trapping greatest cause of mortality in most areas. Very sensitive to water pollution by mercury and polychlorinated biphenyls (PCBs; Fitzgerald et al. 1994).

*Cynomys leucurus* Merriam, 1890

White-tailed Prairie Dog

*Cynomys leucurus* Merriam, 1890. N. Amer. Fauna, 3:59. Type locality "Fort Bridger, [Uinta Co.,] Wyoming" (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Medium-large rodent, easily distinguished from other prairie dogs by white to grayish tip on tail. Rest of pelage yellowish buff and distinctive, dark facial markings. Ventral faintly paler than dorsal side. Males typically larger than females. Total length: 315–400; length of tail: 40–65; length of hind foot: 60–65; length of ear 8–14; body mass: 650–1700 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—SC Montana, W and C Wyoming, NE and SC Utah, and NW Colorado (Wilson and Reeder 1993).

**REPRODUCTION.**—Monestrous, breeding in late March and April, after hibernation emergence. Ca 5–6 young born late April to early May (Fitzgerald et al. 1994).

**ECOLOGY.**—Rodent of open shrublands, semidesert grasslands, agricultural lands, and mountain valleys. Feeds on large variety of

grasses, sedges, forbs, and woody plants. Among these are sagebrush, saltbrush, winterfat, rabbitbrush, goosefoot, and dandelions. Dwells in loosely organized clans, but sociality not pronounced and mostly restricted to female-young and young-young. Spends two-thirds of life in colonial burrows. Members of clan benefit from group organization by alarm calls and burrowing activities. Burrowing colonies important to over 60 vertebrates. Individuals have established home ranges. Overgrazing by livestock conducive to population density increases in prairie dogs. Diurnal with bimodal activity in warm months and unimodal activity in colder months. Predators include eagles, hawks, badger, coyote, black-footed ferret, and rattlesnakes (Fitzgerald et al. 1994).

**REMARKS.**—Historically reported in Kaiparowits region, but never in abundance (Gregory and Moore 1931).

*Glacomys sabrinus* (Shaw, 1801)

Northern Flying Squirrel

*Sciurus sabrinus* Shaw, 1801. Gen. Zool., 2:157. Type locality not specified, but restricted by Howell to the mouth of Severn River, Ontario, Canada (Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Pelage dorsally cinnamon to grayish brown; venter whitish with hairs gray at base. Tail uniform gray-buff and darker on upperparts. Furred patagium extends from forelegs to hind legs, from ankle to wrist. Ears large and broadly pointed. Geographical variation in sizes. Total length: 263–290; length of tail: 145–161; length of hind foot: 38–44; length of ear: 25–30; body mass: ca 190 g (Wells-Gosling and Heaney 1984, Fitzgerald et al. 1994).

**DISTRIBUTION.**—Boreal forests of Canada, Alaska, and upper Midwest. Extends southward through the Sierra Nevada, Northern and Middle Rockies, and Appalachians (Fitzgerald et al. 1994). Known from Uinta, Wasatch, Boulder, and Cedar Mountains; possibly occurs in all higher mountains of Utah (Durrant 1952, Hall 1981).

**REPRODUCTION.**—Breeding late March to May with 1 litter per year, usually 2–4 young. Gestation 37–42 days. Young weaned at 2 months. Normal longevity less than 4 years (Wells-Gosling and Heaney 1984).

**ECOLOGY.**—Inhabits wide variety of woodlands of spruce, fir, birch, hemlock, pine, cottonwood, maple, and white cedar swamps. Diet

includes nuts, seeds, buds, staminate cones, sap, catkins of trees, fruits, roosting birds, eggs, fungi, lichens, and insects. May cache food. Establishes 2 types of nests: tree cavity nests and nests outside a protective enclosure when warm enough. Nests lined with shredded bark, moss, and other such debris. Females defend nests by aggression from males and other intruders. Predators include owls, marten, gray wolf, lynx, weasels, and foxes. Exhibits biphasic nocturnal habits, one period of activity immediately after sundown and the next just before sunrise. Individuals active year-round and aggregate in winter for warmth. Females raise young alone. Call is soft, low chirp, also a clucking sound when disturbed, though not a very vocal species (Wells-Gosling and Heaney 1984).

STATUS.—Listed in U.S.A. ESA and IUCN as Endangered as *G. s. coloratus* and *G. s. fuscus* (Wilson and Reeder 1993). In Utah, listed as a species of special concern due to limited distribution (Kimball 1997).

*Spermophilus spilosoma*  
Bennett, 1833

Spotted Ground Squirrel

*Spermophilus spilosoma* Bennett, 1833. Proc. Zool. Soc. Lond., 13:589. Type locality "that part of California which adjoins to Mexico." Restricted to Durango, Mexico (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Small ground squirrel with nonlinear spots on brownish to gray dorsal, whitish underparts. Total length: 185–253; length of tail: 55–92; length of hind foot: 28–30; length of ear: 6–8; body mass: 100–200 g (Struebel and Fitzgerald 1978, Fitzgerald et al. 1994).

DISTRIBUTION.—Occurs in SC South Dakota, Nebraska, SE Wyoming, E Colorado, NW Oklahoma, W Kansas, W Texas, New Mexico, SE corner of Utah, E Arizona, and S to C Mexico (Durrant 1952, Struebel and Fitzgerald 1978).

REPRODUCTION.—Breeding 2–3 weeks after hibernation emergence. Gestation likely 27–28 days with litter size ca 7 young (Struebel and Fitzgerald 1978, Fitzgerald et al. 1994).

ECOLOGY.—Generally found in deep, sandy soils, sparse vegetation, and desert scrub associations. Diet less omnivorous than that of the thirteen-lined ground squirrel, consisting more of herbaceous material, seeds from various grasses, some grasshoppers, other insects, kangaroo rats, and insect larvae. Males and females

establish home ranges. Predators reported as bullsnake and red-tailed hawk. Constructs separate burrows with 2–3 entrances at bases of shrubs and establishes surface runways between them (Struebel and Fitzgerald 1978, Fitzgerald et al. 1994).

*Spermophilus townsendii*  
Bachman, 1839

Townsend's Ground Squirrel

*Spermophilus townsendii* Bachman, 1839. J. Acad. Nat. Sci. Philadelphia, 8:61. Type locality "on the Columbia River [near Wallula, Walla Walla Co., Washington]" (Rickart 1987).

GENERAL CHARACTERISTICS.—Smaller ground squirrel lacking dorsal stripes. Coloration buffy gray with pale dotlike spots dorsally. Short tail, dark cinnamon underneath. External ears indistinct. Males larger than females. Total length: 167–271; length of tail: 32–72; length of hind foot: 29–38; length of ear: 7–9; body mass: 202–325 g (Larrison and Johnson 1981, Rickart 1987).

DISTRIBUTION.—Ranges throughout Great Basin and Columbia Plateau in most of Nevada, W Utah, S Idaho, SC Washington, E Oregon, and extreme EC California (Rickart 1987).

REPRODUCTION.—Breeding late January to March with 1 litter per year of 6–11 young. Females breed as yearlings (Rickart 1987).

ECOLOGY.—Primarily occurs in high, arid desert habitats of sagebrush, shadscale, or greasewood. Inhabits areas with well-drained soils (e.g., ridge tops and hillsides), and common along agricultural areas and railroad and canal embankments. Abundance of species is restricted by water availability. Diet consists of green vegetation and seeds. Grasses and forbs main food and then animal matter and shrub parts. Predators include badger, coyote, long-tailed weasel, prairie falcon, hawks, common raven, rattlesnakes, and bullsnake. Estivates in underground burrow systems, entering in late spring–early summer. Good climber and swimmer. Vocalizations single note and then multi-notes (Rickart 1987).

REMARKS.—Found in W Utah mountain ranges (Durrant 1952).

*Dipodomys microps*  
(Merriam, 1904)

Chisel-toothed Kangaroo Rat

*Perodipus microps* Merriam, 1904. Proc. Biol. Soc. Washington, 17:145. Type locality "Lone Pine, Owens Valley, Inyo Co., California" (Hayssen 1991).

GENERAL CHARACTERISTICS.—Medium-sized, small-eared kangaroo rat. Incisors flattened anteriorly, chisel-shaped, and evergrowing. Seeds transported in fur-lined cheek pouches. Large hind legs for saltatory lifestyle. Pelage slightly darker than in other members of genus. Long, bicolored tail. Total length: 268–273; length of tail: 156–160; length of hind foot: 41–42; length of ear: 12–13; body mass: ca 56 g. Males slightly heavier (Hayssen 1991).

DISTRIBUTION.—SE Oregon and SW Idaho, south through NW and SE California, Nevada, and W Utah to NW Arizona (Durrant 1952, Hall 1981, Wilson and Reeder 1993).

REPRODUCTION.—Mating early spring. Gestation 30–34 days with 1–4 young in 1–3 litters per year (Hayssen 1991).

ECOLOGY.—Inhabits arid desert valleys and upland desert regions in saltbrush/shadscale and blackbrush associations. Also found in sagebrush, juniper, and greasewood communities. Primary folivorous diet and secondarily granivorous. Caches seeds and coprophagic. Requires a more mesic environment than cohorts. Nocturnal and semi-fossorial habits. Active throughout day and year-round in underground tunnels. Dustbathes. Uses upper incisors to shred outer layer of bark on saltbrush and consumes inner layers (Hayssen 1991).

*Chaetodipus intermedius*  
Merriam, 1889

Rock Pocket Mouse

*Chaetodipus intermedius* Merriam, 1889. N. Am. Fauna, 1:18. Type locality Mud Spring, Mohave Co., Arizona (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Medium-sized, long-tailed pocket mouse. Pelage coarse with weak spines on rump. Coloration drab dorsally with blackish area on rump and back; narrow lateral line pale fawn color; underparts whitish. Soles of hind feet naked to heel. Bicolored tail crested and tufted. Fur-lined cheek pouches. Saltatory hind legs. Total length: 167–179; length of tail: 95–101; length of hind foot: 21–24; length of ear: 5–6; body mass: 12–18 g (Durrant 1952, Davis and Schmidly 1994).

DISTRIBUTION.—SE Utah and Arizona to W Texas, south to C Sonora and C Chihuahua (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Breeding early spring. Gestation ca 1 month. Three to 6 young born in May to June, weaned by mid-July. Unknown if have more than 1 litter per year (Zelveloff 1988, Davis and Schmidly 1994).

ECOLOGY.—Closely associated with rocky areas and lava flows in sparsely vegetated habitats. Nocturnal habits, feeding at night on seeds of desert plants, especially weeds. Sign of presence is small burrows under rocks with tiny trails leading to the entrance. Burrows highly insulated to protect from desert heat. Predators include owls, snakes, and carnivorous mammals (Zelveloff 1988).

*Perognathus flavus* Baird, 1855

Silky Pocket Mouse

*Perognathus flavus* Baird, 1855. Proc. Acad. Nat. Sci. Philadelphia, 7:332. Type locality "El Paso [El Paso Co., Texas]" (Best and Skupski 1994).

GENERAL CHARACTERISTICS.—Small, extremely silky-furred mouse. Pelage pale reddish yellowish buff above, interspersed with black in northern range. Whitish underneath. Diagnostic, large yellow patch behind ear and often white spot below that. Lateral stripe inconspicuous. Juveniles dull gray coloration. Hind legs and cheek pouches like all other members of genus. Tail shorter than head and body. Largest pocket mouse in its range. Total length: 111–113; length of tail: 51–54; length of hind foot: 16–17; length of ear: 6–7; body mass: 6–10 g (Zelveloff 1988, Best and Skupski 1994).

DISTRIBUTION.—SW Great Plains and Intermountain plateaus from South Dakota, E Wyoming, and SE Utah south to C Mexico (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Sexually active all months of the year except extreme winter months. One litter per year. Gestation 22–26 days with 1–6 young. Weaned at ca 30 days (Best and Skupski 1994).

ECOLOGY.—Inhabits semiarid grasslands, areas of rocky soil, and sagebrush associations. Primarily granivorous diet, but also takes herbaceous vegetation, shrub material, arthropods, cactus, and carrion. Dwells in burrows made by *Dipodomys* spp. Species has dynamic abundance fluctuations among seasons and years. Predators include snakes, raptors, and mammalian carnivores. Nocturnal, but occasionally active in daytime. Dustbathes in loose soil. Caches food (Best and Skupski 1994).

*Perognathus flavescens*  
Merriam, 1889

Plains Pocket Mouse

*Perognathus flavescens* Merriam, 1889. N. Am. Fauna, 1:11.

Type locality Kennedy, Cherry Co., Nebraska (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Soft-furred pocket mouse. Coloration pale buff to yellowish or reddish, with blackish wash dorsally; underparts whitish. Faint lateral line buffy orange. Buffy postauricular patch frequently present, but not as large as silky pocket mouse patch and hair more coarse. Total length: 123–145; length of tail: 52–71; length of hind foot: 16–19; length of ear: 6–8; body mass: 7–12 g (Fitzgerald et al. 1994).

DISTRIBUTION.—Found in Great Plains and Colorado Plateau, from North Dakota and extreme W Minnesota to N Mexico, including all E Utah, W Colorado, and NE Arizona (Durrant 1952, Zeveloff 1988).

REPRODUCTION.—Poorly known. Breeds May to July with 1–2 litters annually. Litter size ca 3–4 young (Zeveloff 1988).

ECOLOGY.—Inhabits sandy or loamy soils of grasslands, yucca, or sagebrush associations. Little is known of this species, but natural history likely similar to *P. falcus*. Food consists primarily of seeds from grasses and forbs. Nocturnal habits. Burrows located at base of vegetation clusters. Plugs burrow entrances for protection. Owls are significant predators (Zeveloff 1988, Fitzgerald et al. 1994).

*Onychomys torridus*

Coues, 1874

Southern Grasshopper Mouse

*Onychomys torridus* Coues, 1874. Proc. Acad. Nat. Sci. Philadelphia, 26:183. Type locality Camp Grant, Graham Co., Arizona (McCarty 1975).

GENERAL CHARACTERISTICS.—Short-tailed, stocky mouse. Whitish underparts and pale brown to grayish or pinkish cinnamon dorsally. Tail thick and bicolored with white tip. Soles of feet haired (McCarty 1975). Total length: 120–165; length of tail: 39–52; length of hind foot: 18–20; length of ear: 11–17; body mass: 20–26 g (Jameson and Peeters 1988).

DISTRIBUTION.—C California, S Nevada, SW Utah, south to N Baja California and N Mexico (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Breeds May to July. Gestation 27–30 days; litter size 1–5 young. Both male and female play an active role in care of young (McCarty 1975, Jameson and Peeters 1988).

ECOLOGY.—Inhabits hot, arid valleys and scrub deserts of the lower Sonoran life zone. Diet composed almost entirely of arthropods such as scorpions, beetles, and grasshoppers. Also takes pocket mice, harvest mice, lizards, frogs, and salamanders. Remarkable strategies used to kill prey with defensive secretions, such as scorpions and shrews. Bites tail off scorpions or bites spinal cord of mammalian prey. Primarily nocturnal. Rich vocal repertoire. Maintains burrow systems abandoned by other mammals (McCarty 1975).

*Neotoma mexicana* Baird, 1855

Mexican Woodrat

*Neotoma mexicana* Baird, 1855. Proc. Acad. Nat. Sci. Philadelphia, 7:333. Type locality mountains near Chihuahua, Mexico (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Upperparts grayish, grayish buff, dull brown, russet, or bright rufous, usually with dark wash. Underparts white and plumbeous basally. Tail black to dusky above and whitish below. Dusky line typically borders mouth. Total length: 307–350; length of tail: 132–154; length of hind foot: 33–38; length of ear: 26–28; body mass: 149–255 g (Hall 1981, Cornely and Baker 1986, Fitzgerald et al. 1994).

DISTRIBUTION.—SE Utah and C Colorado south to W and interior Mexico, highlands of Guatemala, El Salvador, and W Honduras (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Breeds spring to early summer producing 2 litters yearly of 1–3 young. Gestation 31–34 days (Cornely and Baker 1986).

ECOLOGY.—Occurs in upper Sonoran life zones to upper limits of transition zone. Woodland associations are pinyon-juniper, ponderosa pine, Englemann spruce, scrub oak, and Douglas-fir. Diet consists of a great variety of green plants, fruits, seeds, cactus pulp, and mushrooms. Stuffs objects in crevices, as do other woodrats. Dens and nests cup-shaped or ball-shaped, mostly made of shredded bark. Predators include owls and rattlesnakes. Males utilize midventral sebaceous glands to mark territory. Dominant in competition with other woodrats. Mainly nocturnal but reported active during day also (Cornely and Baker 1986).

REMARKS.—Collected by Welsh et al. (1974) in the Kaiparowits region, just outside GSENM.

*Peromyscus eremicus*  
(Baird, 1858)

Cactus Mouse

*Hesperomys eremicus* Baird, 1858. Mamm., N. Amer., Pac. R. R. Repts., 8:479. Type locality from Old Fort Yuma, California, opposite Yuma, Arizona (Durrant 1952).

GENERAL CHARACTERISTICS.—Smaller *Peromyscus* of the area. Long, silky fur colored yellow-buff to cinnamon-buff with black wash dorsally. White underparts and feet. Darker morph on lava flows. Total length: 160–200; length of tail: 84–120; length of hind foot: 18–22; length of ear: 13–20; body mass: 18–30 g (Jameson and Peeters 1988, Zeveloff 1988).

DISTRIBUTION.—S California east to Texas, Mexico, and most of Baja California (Wilson and Reeder 1993). Occurs in extreme SW Utah in Washington Co. (Durrant 1952, Hall 1981).

REPRODUCTION.—Reproductive activity from February to June, varying with length of winter and food availability. Gestation ca 21 days with 1–5 young born, weaned 20–44 days later (Jameson and Peeters 1988, Zeveloff 1988).

ECOLOGY.—Occurs in various arid habitats from desert mountain ranges, desert scrub, creosote, mesquite-grass communities, rocky outcroppings with yucca and cacti. Reported, however, in riparian areas in S Utah. Selects for sandy soils. Diet mostly fruits, flowers, seeds, green vegetation, and insects. Hoards food. Most active on moonlit nights. Highly intolerant of conspecifics. Predators include king snake, barn and screech owls. Estivates in hottest part of summer to conserve water. To cool off, will spread saliva over body. Metabolic rate 20% lower than deer mouse and can tolerate higher temperatures (Zeveloff 1988).

*Microtus richardsoni*  
(DeKay, 1842)

Water Vole

*Arvicola richardsoni* DeKay, 1842. Zool. of New York, Part I, Mammals, p. 91. Type locality "near the foot of the Rocky Mountains." Bailey (1900:60) located type obtained by Drummond near Jasper House, Alberta, Canada (Ludwig 1984).

GENERAL CHARACTERISTICS.—Largest vole of area. Pelage long with upperparts grayish to dark sepia or dark reddish brown. Hairs often black-tipped. Bicolored tail dusky above and gray below. Total length: 198–274; length of tail: 66–98; length of hind foot: 25–34; length of

ear: 15–20; body mass: ca 120 g (Ludwig 1984, Struebel 1989).

DISTRIBUTION.—Subalpine and alpine meadows of the Rocky Mountains, from S British Columbia and Alberta to W Wyoming and NE, C Utah; and from SW British Columbia to WC Oregon (Durrant 1952, Wilson and Reeder 1993).

REPRODUCTION.—Breeding late May to August with ca 3-week gestation and 2–10 young. Likely polygynous mating system. Young appear in July (Zeveloff 1988).

ECOLOGY.—Found in subalpine and alpine life zones in close proximity to water sources. Diet consists of herbaceous parts of grasses, sedges, and willow. Summer diet includes seeds of conifers, insects, and subterranean parts of plants. Well-worn appearance of exposed soil of runways, presence of droppings in runways, cut segments of vegetation, and mounds of recently excavated soil paralleling water indicate presence. Utilizes subterranean burrows and nests. Many species of voles and shrews utilize water vole runways. Predators recorded as short-tailed weasel, marten, and perhaps accipiter hawks. Capable of a semi-aquatic lifestyle. Has cyclic periods of activity, with peak activity during darker periods. Establishes home ranges, with male territories overlapping females (Ludwig 1984).

*Phenacomys intermedius*  
Merriam, 1889

Heather Vole

*Phenacomys intermedius* Merriam, 1889. N. Amer. Fauna, 2:32. Type locality basaltic plateau ca 20 mi NNW of Kamloops, 5500 ft [1650 m], British Columbia (McAllister and Hoffmann 1988).

GENERAL CHARACTERISTICS.—Small and short-tailed. Resembles the montane vole. Two are differentiated dentally. Pelage gray to brown above, white to grayish ventrally (McAllister and Hoffmann 1988). Short, bicolored tail. Feet white (Zeveloff 1988). Total length: 115–145; length of tail: 22–33; length of hind foot: 14–19; length of ear: not given; body mass: 25–40 g (Clark and Stromberg 1987).

DISTRIBUTION.—Boreal areas of SW British Columbia and Alberta, south to N New Mexico, C Utah, and N California; disjunct population in EC California and W Nevada (Wilson and Reeder 1993). Known in Utah in Uinta and Wasatch Mountains (Durrant 1952, Sparks 1974).

REPRODUCTION.—Seasonally polyestrous breeder in May to August. Maximum of 3 litters of ca 4 young per year. Gestation 19–24 days (McAllister and Hoffmann 1988).

ECOLOGY.—Found primarily in coniferous forests from moist to xeric biomes. Diet herbivorous consisting of seeds, twigs, fruits, and succulent parts from white heather, beargrass, willow, birch, laurel, blueberry, soapberry, bearberry, buffaloberry, cranberry, and lichen. Predators reported as marten, long-tailed weasel, short-tailed weasel, owls, and hawks. Occupies short, underground burrow systems connected to runways and defecation “latrines” (McAllister and Hoffmann 1988). Colonial. Active at dusk and during night (Zevloff 1988).

*Brachylagus idahoensis*  
(Merriam, 1891)

Pygmy Rabbit

*Lepus idahoensis*. Merriam, 1891. N. Amer. Fauna, 5:76.  
Type locality Pahsimeroi Valley, Idaho (near Goldberg, Custer Co.; Green and Flinders 1980).

GENERAL CHARACTERISTICS.—Smallest rabbit in North America. Pelage buffy gray with black upperparts. Tail gray above and below. Whitish spots at sides of nostrils. Total length: 252–285; length of tail: ca 25; length of hind foot: 66–75; length of ear: 48–56; body mass: 246–435 g (Green and Flinders 1980, Larrison and Johnson 1981).

DISTRIBUTION.—Great Basin and some adjacent Intermountain areas (Green and Flinders 1980). Found from E shore of Great Salt Lake westwardly from N state border to N tip of Washington County (Durrant 1952).

REPRODUCTION.—Breeding February to late March, dependent on photoperiod and vegetation condition. Gestation ca 27–30 days with ca 6 young per litter (Green and Flinders 1980).

ECOLOGY.—Dispersal along dense stands of big sagebrush adjacent to streams, fence lines, and borrow ditches by roadsides. Close association with big sagebrush. Utilizes runways in sage thickets and extensively uses constructed burrows, even under snow (unlike other western rabbits). Predators are weasels, owls, northern harrier, coyote, red fox, bobcat, and badger. Primary food big sagebrush in winter (99% of diet) and grasses in summer. Emits loud squeals when captured and has a “pika-like” alarm call.

A squeak and a chuckle have also been identified (Green and Flinders 1980).

STATUS.—As of 1993, registered endangered by Washington Wildlife Commission and Candidate Category II species by U.S. Fish and Wildlife Service (McAllister 1995).

*Ochotona princeps*  
(Richardson, 1828)

American Pika

*Lepus (Lagomys) princeps* Richardson, 1828. J. Zool., 3:520. Type locality Rocky Mountains. Restricted to near source of Elk (Athabasca) River, Alberta (Smith and Weston 1990).

GENERAL CHARACTERISTICS.—Small lagomorph with rodent appearance. Short-legged, semi-tailless, and egg-shaped. Moderately large, suborbicular ears haired on both surfaces with darker margins. Dense pelage colored grayish brown with buffy wash. Males larger than females. Total length: 162–216; length of tail: not given; length of hind foot: 25–35; length of ear: not given; body mass: 121–176 g (Zevloff 1988, Smith and Weston 1990).

DISTRIBUTION.—Patchy through mountains of W North America from C British Columbia to N New Mexico, Utah, C Nevada, and EC California. In southern limits of range, not found below 2500 m (Durrant 1952, Smith and Weston 1990).

REPRODUCTION.—Breeding seasonal and depends on food availability and snowmelt. Monogamous. Gestation ca 30 days with parturition as early as March and peaking in June. Average litter size 2–4 young. Weaning 3–4 weeks (Smith and Weston 1990).

ECOLOGY.—Habitat closely associated with talus or broken rock bordered by suitable vegetation in open alpine and tundra areas. Forages forbs and tall grasses. Caches food and constructs hay piles in summer on talus or tucked under rocks. Grass that comprises hay piles is dried there and then stored for winter use. Individuals establish territories and home ranges and defend by vocalizations and aggression. Potential predators are coyote, long-tailed weasel, short-tailed weasel, pine marten, and raptors. Vocalizations short calls and long calls. Short calls used for alarm and to ward off conspecifics. Long calls given by males during breeding season and infrequently by females in autumn. Social cohesion kept by duet calls (Smith and Weston 1990).

OCCURRENCE OF INTRODUCED  
MAMMALIAN SPECIES

*Bos taurus* Linnaeus, 1758

Cattle

*Bos taurus* Linnaeus, 1758. Syst. Nat., 10th ed., 1:71. Type locality Sweden, Uppsala (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Large bovid bearing horns in both sexes. Short hair has great variation in color and form. Males larger than females. Total length: ca 3100; height to shoulder: 900–1150; body mass: 450–1000 kg (Nowak 1991).

DISTRIBUTION.—Originally occurred in Eurasia and N Africa. Now domesticated and found throughout world in association with human habitation (Nowak 1991).

REPRODUCTION.—Not seasonal breeder, but tendency to calve in spring and early summer stems from effects of winter on postpartum anestrus. Gestation 277–290 days with 1–2 young per year, though usually 1. Sexually mature after 18 months and remains so for ca 12 years (Corbet and Harris 1991, Nowak 1991).

ECOLOGY.—Introduced from Europe. Found in association with humans. Grazes on rangelands of grassy, open areas. Grazes ca 8 hours a day, consuming ca 70 kg of grass. Rest of time is spent resting. Predators include larger carnivores (Corbet and Harris 1991, Nowak 1991).

REMARKS.—Grazing permits allowed in GSENM and thus the species becomes an ecological component to habitats where grazing is allotted.

*Equus caballus* Linnaeus, 1758

Domestic and Feral Horse

*Equus caballus* Linnaeus, 1758. Syst. Nat., 10th ed., 1:73. Type locality "habitat in Europa" (likely Sweden), based on domestic horse (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Appearance commonly known. Coloration and size highly variable. Feral horses tend to be small with measurements as follows: height: 1300–1400; body mass: ca 300–500 kg (Jameson and Peeters 1988, Zeveloff 1988, Fitzgerald et al. 1994).

DISTRIBUTION.—Exact distribution unknown. By late 18th century, occurred in all of Europe, Asia, Middle East. Now domesticated worldwide. In W U.S., feral in all states except Washington (Wilson and Reeder 1993, Fitzgerald et al. 1994).

REPRODUCTION.—Breeding spring and summer with polygynous system of stallion with harem. Gestation ca 340 days with foaling late spring to early summer. Postpartum estrus 1 week after birth, but foals usually alternate years. Life span often over 30 years. Sexually mature after 3 years and females bear young up to 22 years (Fitzgerald et al. 1994).

ECOLOGY.—Feral horses are associated with arid grasslands, pinyon-juniper woodlands, and shrublands in W North America. Grasses and sedges most of diet in warmer months. Winter browse includes sagebrush, greasewood, saltgrass, rabbitbrush, mountain mahogany, juniper, Douglas-fir, aspen, and spruce. Starving animals may exhibit coprophagy. Must have major source of free water. Feral horses have complex social behaviors with formations of harems with few males in group. Only dominant male breeds and males older than 3 years are forced out of herd. Bachelor bands are formed. Females less aggressive than males, but breeding females will sometimes expel young females from herd. Dustbathing, self-grooming, and mutual groomings performed. Mutual grooming important for group cohesion. No established territories or defense. Communicates by visual displays, olfaction, and various vocalizations. Dominance and threat displays performed by laying back ears, arching neck, open-mouth exhibits, and head shaking (Fitzgerald et al. 1994).

REMARKS.—Feral horses found in northern areas of state and domesticated stock throughout Utah. Eight to 9 transient wild horses known in GSENM currently but are not considered established.

STATUS.—Found in CITES, Appendix I, and U.S.A. ESA as Endangered as *E. przewalskii*, and IUCN as Extinct? as *E. przewalskii* (Wilson and Reeder 1993).

*Mus musculus* Linnaeus, 1758

House Mouse

*Mus musculus* Linnaeus, 1758. Syst. Nat., 10th ed., 1:62. Type locality Sweden, Uppsala Co., Uppsala (Wilson and Reeder 1993).

GENERAL CHARACTERISTICS.—Small, slender mouse brown to blackish in color. Tail sparsely haired and scaly. Underparts slightly paler without clear bicolored boundary. Strongly odoriferous anal glands. Total length: 130–200; length of tail: 60–105; length of hind foot: 14–21; length of ear: 11–18; body mass: 18–23 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—Spread throughout the world in close association with human presence. Introduced into North America (Wilson and Reeder 1993). Found throughout Utah in correlation with human presence.

**REPRODUCTION.**—Prolific reproductive activity. Sexually mature at 7–8 weeks. Breeds throughout the year. Litter size 4–8 after gestation of 3 weeks. Could potentially have up to 5 litters per year (Jameson and Peeters 1988).

**ECOLOGY.**—Lives alongside human dwellings and structures. Opportunistic feeder on grains, stored food by humans, insects, and carrion. Active year-round. Individuals keep warm in winter by huddling together in communal nests. Mostly nocturnal and secretive. Utilizes runways from foraging areas to nests made of any soft material available. Defecation, feeding, and urination on stored crops cause tremendous economic losses. May cache food. Water not required, yet consumed if available. Predators include terrestrial carnivores, hawks, owls, and snakes. Domestic pets often kill but will not eat, likely because of odor. Communicates by scent, vocalizations, and postures (Fitzgerald et al. 1994).

*Rattus norvegicus*  
(Berkenhuot, 1769)

Norway Rat

*Mus norvegicus* Berkenhout, 1769. Outlines of the Natural History of Great Britain and Ireland, 1:5. Type locality Great Britain (Hall 1981, Wilson and Reeder 1993).

**GENERAL CHARACTERISTICS.**—Large, heavy-bodied rat. Large head and arched back. Tail scaly and sparsely haired. Upper coloration brown to brownish black and underparts paler. Some may have spots of white. Pelage coarse to touch. Ears relatively large and covered with short hair. Anal scent gland creates musky odor. Total length: 300–480; length of tail: 150–255; length of hind foot: 30–44; length of ear: 18–21; body mass: 150–540 g (Fitzgerald et al. 1994).

**DISTRIBUTION.**—Originally in SE Siberia and N China, but now introduced worldwide with close human association. More common in colder areas (Wilson and Reeder 1993). Found in Utah in areas of larger human settlements throughout the state (Durrant 1952).

**REPRODUCTION.**—Prolific year-round breeder, continuous from ca 12 weeks old. Four to 10 young per litter and multiple litters. As in other murids, females may mate immediately

after birthing and thus be nursing and pregnant at same time (Jameson and Peeters 1988).

**ECOLOGY.**—Closely associated with humans; inhabits structures and buildings. Opportunistic diet. Will also kill birds, small mammals, and snakes. Cannibalism not uncommon. Individuals require at least 20–30 g of food per day and potentially consume up to one-third of body weight daily. Nest material same as house mouse but digs elaborate tunnel systems used colonially. Colonies usually 12–15 members. Agile climber and swimmer. Mostly nocturnal but can be active anytime. Predators include terrestrial carnivores, owls, hawks, and large snakes. Carriers of many diseases dangerous to humans. Contamination of crops by urine and defecation also a major problem. Useful, however, for laboratory testing in medical and pharmacological research (Fitzgerald et al. 1994).

#### PROBLEMS ASSOCIATED WITH MAMMALS IN GSENM

Exotic species are a major concern for the survival of native species. Introduced mammalian species of GSENM are all species that compete with native species. These introductions, whether deliberate or accidental, are all human-induced. Cattle are intentionally introduced in the GSENM for grazing purposes by local ranchers. The house mouse and the Norway rat are considered commensals of humans and follow their expansion. Problems associated with introduced species are that they can compete with natives, displace natives, and introduce foreign diseases against which native fauna have little or no natural defenses.

In the GSENM grazing by domestic cattle is a historic practice regulated by the Bureau of Land Management (BLM). This grazing has an ecological impact probably not uniform in its effects on various habitats. In the best situations, cattle, as primary consumers, simply take the place of historic populations of bison, and perhaps elk, that utilized vegetation of the impacted biotic communities. However, sustained overgrazing by cattle can be very detrimental to fragile desert vegetational types, such as riparian zones. Past practices of this nature have influenced many areas now within GSENM. In this region overgrazing is exhibited in various ways, some of the most obvious being development of gullies, desertification



through vegetation removal, siltation of streams, seasonal increase and then reduced flow of streams, reduction in the amount and diversity of native plants palatable to cattle, and increase of exotic and native vegetation either not palatable or poisonous to cattle. Levels of grazing pressure by livestock can be reflected in population dynamics of native wildlife such as black-tailed jackrabbits (Vorhies and Taylor 1933, Sanderson 1959, Hansen and Flinders 1969). Moderate rates of grazing by cattle have proven beneficial to vegetational species utilized by mule deer (Leopold 1950, Smith 1952, Dasmann 1971).

Perpetuation and even expansion of the desert bighorn sheep population in the GSENM should receive managerial priority. These sheep are native to the area, contribute greatly to visitor satisfaction, and are an indicator of overall habitat quality. Obvious limiting factors operating on desert bighorn should be identified and, if possible, removed. With this in mind, a population viability analysis (PVA) ought to be conducted for bighorn. PVA refers to a comprehensive analysis of the environmental and demographic factors that affect survival of a population. Many limiting factors operate on a population, but some obvious ones pertaining to these sheep should be mentioned. Because of the complex etiology of disease transmission, the domestic sheep (*Ovis aries*) and the domestic goat (*Capra hircus*) should not be permitted to intermix with native bighorn sheep, for this consistently leads to disaster for bighorn populations (Jessup 1981, Onderka et al. 1988, Foreyt 1990, Smith and Flinders 1991). For the same reasons, some recommend domestic cattle and bighorn sheep not be permitted to share the same ranges (Onderka et al. 1988, Smith and Flinders 1991). The scabies mite (*Psoroptes ovis*) has already been reported problematic in some herds of desert bighorn in southern Utah as a result of earlier contacts with infected domestic livestock.

Currently, there are no grazing permits for domestic sheep or goats in GSENM, and yet feral individuals may exist due to immigration or unknown resident populations. These individuals should be removed quickly by the most effective means. Grazing allotments for cattle are historic, and seasonal extensions of local ranching operations are honored in the traditional manner. Cattle, though not as disastrous

to bighorn sheep as domestic sheep and goats, must be managed to minimize risk of transmitting disease to desert bighorn populations.

Desert bighorn may suffer from competition when forced to share limited food and water resources with other species of ungulates. Unique adaptations of bighorn allow them to occupy steep, rocky terrains not usually visited by other ungulates. When bighorn sheep visit riparian zones and springs, they may encounter a shortage of forage and/or water (scramble competition) through a hierarchy of use usually dictated by size and/or numbers (Monson and Sumner 1980). Aggressive displays of adult mule deer of both sexes have been known to prevent desert bighorn ewes and lambs from drinking from a limited water supply well used by deer. However, adult rams were not intimidated by the deer behavior (Monson and Sumner 1980). Though desert bighorn may use a wide variety of water sources, they must not be expected to use water supporting excessive human activity (Jorgenson 1974) or water heavily used by domestic livestock and other ungulates (Welles and Welles 1961, Van Dyke et al. 1983). Alkaline water (Jones et al. 1957) and water sources surrounded by dense vegetation (e.g., salt cedar) are not suitable for desert bighorn (Monson and Sumner 1980). If field research identifies a lack of dependable water sources for bighorn in GSENM, then habitat improvements involving seeps, springs, and streams may very well be necessary. Installation of devices to capture all forms of precipitation (e.g., guzzlers) may be required to provide more permanent sources of water, dispersed so that desert bighorn may more fully occupy available and suitable habitat where water sources are located not more than 10 km (6 miles) apart. Close sources of water allow greater densities of sheep and more even use of habitats (Monson and Sumner 1980). To be used by bighorn populations, all water sources must be located within 300 m of rocky escape terrain (Smith and Flinders 1991).

Some individual predators such as mountain lion, black bear, and coyote within GSENM can be expected to periodically prey on cattle (usually calves) legally grazing within GSENM. The Utah Division of Wildlife Resources (UDWR) currently reimburses ranchers for livestock losses caused by mountain lion and black bear. Thus, we do not recommend that these predators be removed by state and

federal Animal Damage and Control (ADC) personnel unless a sustained pattern of livestock predation is exhibited. In this case, removal of nuisance individuals, not populations, should be regulated by the BLM and the UDWR. Even control of coyotes should be limited to nuisance individuals, not population suppression (Wagner 1972). Sport hunting of predators in the GSENM should be regulated by BLM and UDWR biologists working to maintain genetically viable populations with normal age distributions. We can expect individuals of these 3 species to disperse into lands adjacent to the GSENM. These animals would be subject to sport hunting (in areas where hunting is allowed) and ADC control. On state and federal lands, these activities should complement maintenance of genetically viable populations within a regional reserve network of cooperators representing lands owned and administered by private, state, and federal agencies.

An area as large as the GSENM creates an ideal setting for conservation of predator populations. Since the Monument is virtually adjacent to Dixie National Forest, Bryce Canyon National Park, Paria Canyon Primitive Area, Glen Canyon National Recreation Area, and Capital Reef National Park, a large cluster of public land is available to sustain populations. Isolated and semi-isolated portions of GSENM serve as *de facto* wilderness areas and may function as core zones or ecocenters for metapopulations of large mammalian carnivores that maintain some genetic flow through public land buffer zones that are connected and serving as a formal or informal, regional reserve network.

It must be recognized that large carnivores have large home ranges and can be expected to disperse over long distances in appropriate habitat. For example, in the Rocky Mountains, annual individual home ranges are 150 km<sup>2</sup> for black bear; more than 400 km<sup>2</sup> for mountain lion and wolverine, and nearly 900 km<sup>2</sup> for grizzly bear (Noss et al. 1996). Knowlton (1972) reported 80 km<sup>2</sup> as a maximum known home range for the coyote. Young coyotes dispersing from the parental home range may cover a distance of 80–160 km (Nowak 1991). Because of their requirements for space, position in the food web, and need for some management protection, large mammalian carnivores have been considered indicators of health or integrity of an ecosystem (e.g., Eisenberg

1980, Noss 1995). Long-term management plans for the GSENM should allow the Monument to serve as a dynamic refugium for most of its native mammalian predators, as well as other wildlife and plants.

#### CONSERVATION ISSUES ASSOCIATED WITH MAMMALIAN WILDLIFE

Semiarid to arid ecosystems may be rich in species diversity and yet reflect limited plant and animal biomass due to the short, seasonal pulse of productivity associated with moderate ambient temperatures and available (though never abundant) water and soil moisture. Often, we see plant assemblages (including many endemics) representing both annuals and perennials that emerge, flower, and disperse seed during this short period of vernal condition. More woody forms of vegetation (including cacti) also go through this reproductive stage and then become more quiescent during the drier, warmest, and coldest months. Resident mammals must be ecologically tuned to this normally short pulse of vegetative productivity but be able to reproduce and maintain themselves throughout the year.

Each species of plant and animal (including mammals) in the GSENM occupies a specific ecological niche of adaptation that allows it to exist under these harsh conditions and functionally interact with other organisms. To preserve the natural biological diversity of biota in the GSENM is to assure the greatest degree of ecological integrity and longevity. Sometimes we can identify plants and animals that serve in critical ways relative to others in the ecosystem; usually we lack sufficient data on mammalian species to make these associations. One of the greatest values of GSENM is an existing goal (see Presidential Proclamation 1996) to allow further investigation into the interconnecting and interdependent web of life represented within the Monument. Those species known or suspected to have major influences on biotic community structure or function we refer to as key or keystone species (Bond 1992). Wilson (1992) referred to keystone species as the “biggest players” in regard to promoting biodiversity and maintaining integrity of ecosystems.

We are not aware of data generated within the GSENM regarding the keystone status of particular mammals and thus must infer from

other studies. White (1997) identified an essential plant-carnivore relationship between Utah juniper and the gray fox. This fox feeds on mature fruits of Utah juniper, digests portions of the hull of the fruit, and then disperses, in its feces, the viable seed. Thus, the gray fox serves an important role in the dispersal and regeneration of forests dominated by Utah juniper. Utah juniper is an important tree species throughout the GSENM. The relationship between the gray fox and the dynamics of various biotic communities in which it occurs requires additional documentation.

As the most abundant large mammalian predator now in the GSENM, the mountain lion serves as a keystone predator and as an indicator species. Indicator species reflect ecosystem integrity, or stress, and ecological monitoring of these species provides the essential guiding feedback required by scientists and managers (Pickett et al. 1997). Studies of mountain lion food habits and behavior in other regions indicate that the desert bighorn and mule deer are essential preys of predilection (preference) when available (Connolly 1949, Monson and Sumner 1980, Smith and Flinders 1991). Buffer prey species such as pronghorn, hares, rabbits, beaver, porcupine, marmot, and other smaller mammals are taken when lions fail to obtain this prey of predilection or as opportunity affords (Stricklan et al. 1995). Even other predators such as bobcat, fox, and coyote may be included in the food web supporting a population of mountain lion (Blackwell 1991). As previously discussed, a conservation program for mountain lion in GSENM must also take into account the potential impact these top carnivores may have on cattle (usually calves) legally exercising grazing leases within the Monument.

It would be negligent not to recognize the ecological importance of the coyote as a keystone predator within the GSENM. Coyotes have the unusual ability to operate at all consumer levels of a food web. They may form familial packs of 4 or 5 to nearly a dozen and effectively hunt bighorn sheep, mule deer, and pronghorn (Geist 1971, Mitchell 1980, Steigers 1981). When hares and rodents are primary prey, coyotes hunt as singles or pairs. Coyotes may even help truncate the periodically high population density of black-tailed jackrabbits (Wagner and Stoddart 1972). When vertebrate prey are scarce, they readily feed on fruits,

nuts, and seeds as well as insects (Meinzer et al. 1975). They readily feed on carrion, and several coyotes may drive a mountain lion from its kill. Coyotes may harass other predators such as bobcat and gray fox and force these species to occupy habitats providing essential escape cover in the form of trees or rock dens (Karpowitz 1981, White 1997). Through extensive predation on fawns, coyotes may severely limit annual recruitment even in mule deer populations not subject to hunting by man (Steigers 1978, 1981). In the GSENM it would seem imperative to monitor the ecological interactions of the coyote as well as its population dynamics.

Desert bighorn sheep also are an important indicator species in their own right for they exert foraging pressure on grasses, forbs, and woody plant species within their range of distribution. They also serve as essential prey for mountain lion, bobcat, and coyote. Bighorn lambs may even fall prey to gray fox, and the golden eagle has been known to prey on yearlings and lambs (Monson and Sumner 1980). The more arid biotic communities within the GSENM may represent better habitat for desert bighorn than for mule deer. The extent and adequacy of habitat for bighorn (also for mule deer and pronghorn) in the GSENM should be subject to an evaluation similar to that completed for bighorn sheep in Zion National Park (Smith and Flinders 1992). The occurrence, distribution, and quality of water are key habitat factors for bighorn sheep, mule deer, and pronghorn, as well as for most mammalian species within the GSENM. Smith and Flinders (1991) listed some objectives that should be met regarding management of bighorn sheep in the Flaming Gorge National Recreation Area. These could largely be applied to desert bighorn in GSENM.

The diverse guild of bat species within GSENM serves as collective and individual indicators of ecological health. Healthy, favorable habitat produces prey as well as furnishes day, night, and seasonal roosts for each species of bat. Herder et al. (1997) provided evidence regarding the status of 16 species of bats thought to occur in the GSENM. Eight of these are former federal candidates for listing under the Endangered Species Preservation Act, and 6 of the 8 are considered sensitive species by the State of Utah. Herder et al. (1997) also noted studies are needed to monitor longer-

term population trends of bat species within the GSENM. Natural caves and mine tunnels within the GSENM must be surveyed to determine use by bats in order to regulate human use. Usage, particularly recreational, is likely to increase in these sensitive habitats of the GSENM.

The smaller terrestrial mammals assumed resident within the GSENM represent the strengthening links within complex food webs supporting both avian and mammalian predators. They represent as well as support healthy biodiversity. Further study is needed to identify important keystone and indicator species relationships. We know many of these species greatly impact the biomass and species composition of the plant communities in which they reside. Black-tailed jackrabbits impact the occurrence and distribution of some preferred forage plants by dispersing viable seed in fecal pellets (Vorhies and Taylor 1933, Brown 1947). Most rodents (e.g., heteromyids) exhibit some to extensive granivorous feeding behavior and gather and cache seeds of grasses, forbs, and woody plants (including cacti). Cached seeds may be in shallow pits or deep inside burrows (Taylor 1935). Many of these caches provide ideal habitat for germination of seeds. Astute observers can often see that the pattern of emergent and existent vegetation corresponds with food storage activities of rodents. Rodents through burrowing, caching food, placing vegetation for bedding, and maintaining latrine sites greatly enrich desert soils with nutrients and humus (Greene and Murphy 1932, Greene and Raynard 1932). Keystone functions of burrowing mammals in the GSENM may include activities that promote soil development and influence soil chemistry. Burrowing animals also enhance germination of seeds of many plants and thereby help determine the distribution and occurrence of plant communities.

One of the most important conservation projects for mammals in the GSENM should involve extensive fieldwork to determine which species of mammals actually occur within the Monument. Companion to this is the need to obtain ecological and population data for each mammalian species sampled in order to determine actual distribution patterns, associations with habitat types, sex and age ratios, and indications of population density. Specimens of many species need to be collected and housed in prominent museums, readily accessible by

the scientific community. These collections should involve traditional specimens as well as preservation of soft tissues. Soft tissues are required for various DNA-based analyses needed to provide answers regarding systematic status, degree of heterozygosity in populations, and genetic affinities to populations outside the GSENM. Future conservation projects could involve restorations of mammalian species previously extirpated from the area now enclosed by the GSENM. This could include the Utah prairie dog and the black-footed ferret. In its grandeur, the GSENM offers a wealth of not only extraordinary beauty but of opportunities to see, appreciate, and study native populations of mammals in their uniquely distinct ecological settings.

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#### LITERATURE CITED

- ARMSTRONG, D.M. 1982. Mammals of the Canyon Country. Canyonlands Natural History Association, Moab, UT. 263 pp.
- \_\_\_\_\_. 1987. Rocky Mountain mammals: a handbook of mammals of Rocky Mountain National Park and vicinity. Colorado University Press, Boulder. 223 pp.
- ARMSTRONG, D.M., AND J.K. JONES, JR. 1971. Mammalian species: *Sorex merriami*. American Society of Mammalogists 2:1–2.
- \_\_\_\_\_. 1972. Mammalian species: *Notiosorex crawfordii*. American Society of Mammalogists 17:1–5.
- ANDERSON, A.E., AND O.C. WALLMO. 1984. Mammalian species: *Odocoileus hemionus*. American Society of Mammalogists 219:1–9.
- ANDERSON, S. 1966. Taxonomy of gophers, especially *Thomomys*, in Chihuahua, Mexico. Systematic Zoology 15:189–198.
- \_\_\_\_\_. 1972. Mammals of Chihuahua: taxonomy and distribution. Bulletin of the American Museum of Natural History 148:149–410.
- ATWOOD, D., AND C. PRITCHETT. 1974. Terrestrial vertebrate fauna of the Kaiparowits Basin. Pages 170–198 in Navajo-Kaiparowits environmental baseline studies (1971–1974). Public Center for Health and Envi-

- ronmental Studies and Botany and Range Department, Brigham Young University, Provo, UT.
- BANFIELD, A.W.F. 1974. The mammals of Canada. University of Toronto Press. 438 pp.
- BARTELS, M.A., AND D.P. THOMPSON. 1993. Mammalian species: *Spermophilus lateralis*. American Society of Mammalogists 440:1-8.
- BATES, S.B. 1991. Home range, habitat selection, and food habits of central Utah black bears. Master's thesis, Brigham Young University, Provo, UT. 89 pp.
- BECK, J.L., J.T. FLINDERS, D.R. NELSON, C.L. CLYDE, H.D. SMITH, AND P.J. HARDIN. 1996. Elk and domestic sheep interactions in a north-central Utah aspen ecosystem. Research Paper INT-RP-491, U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 114 pp + 3 GIS maps in pocket.
- BELK, M.C., AND H.D. SMITH. 1991. Mammalian species: *Ammospermophilus leucurus*. American Society of Mammalogists 368:1-8.
- BENESKI, J.T., AND D.W. STINSON. 1987. Mammalian species: *Sorex palustris*. American Society of Mammalogists 296:1-6.
- BEST, T.L. 1996. Mammalian species: *Lepus californicus*. American Society of Mammalogists 530:1-10.
- BEST, T.L., AND J.B. JENNINGS. 1997. Mammalian species: *Myotis leibii*. American Society of Mammalogists 547:1-6.
- BEST, T.L., AND M.P. SKUPSKI. 1994. Mammalian species: *Perognathus flavus*. American Society of Mammalogists 471:1-10.
- BEST, T.L., S.L. BURT, AND J.L. BARTIG. 1994. Mammalian species: *Tamias quadrivittatus*. American Society of Mammalogists 466:1-7.
- BEST, T.L., W.M. KISER, AND P.W. FREEMAN. 1996. Mammalian species: *Eumops perotis*. American Society of Mammalogists 534:1-8.
- BLACKWELL, B.H. 1991. Habitat selection, prey base, home range, and reproduction of bobcats in west central Utah. Master's thesis, Brigham Young University, Provo, UT. 100 pp.
- BOND, W.J. 1992. Keystone species. Pages 327-354 in E.D. Schulze and H.A. Mooney, editors, Biodiversity and ecosystem function. Springer-Verlag, New York.
- BROWN, H.L. 1947. Why has the white-tailed jackrabbit, *Lepus townsendii campanius* Hollister, become scarce in Kansas? Transactions of the Kansas Academy of Science 49:455-456.
- BULMER, M.G. 1974. A statistical analysis of the 10-year cycle in Canada lynx. Journal of Animal Ecology 43:701-718.
- BURT, S.L., AND T.L. BEST. 1994. Mammalian species: *Tamias rufus*. American Society of Mammalogists 460:1-6.
- CARROLL, L.E., AND H.H. GENOWAYS. 1980. Mammalian species: *Lagurus curtatus*. American Society of Mammalogists 124:1-6.
- CHAPMAN, J.A. 1975. Mammalian species: *Sylvilagus nuttallii*. American Society of Mammalogists 56:1-3.
- CHAPMAN, J.A., AND G.A. FELDHAMER. 1982. Wild mammals of North America: biology, management, and economics. Johns Hopkins, Baltimore, MD. 1147 pp.
- CHAPMAN, J.A., AND G.R. WILLNER. 1978. Mammalian species: *Sylvilagus audubonii*. American Society of Mammalogists 106:1-4.
- CLARK, T.W., AND M.R. STROMBERG. 1987. Mammals in Wyoming. University of Kansas Museum of Natural History, Lawrence. 314 pp.
- COCKRUM, L.E. 1982. Mammals of the Southwest. University of Arizona Press, Tucson. 176 pp.
- COMPARISON OF UTAH WILDERNESS BILLS. 1996. The battle for the Utah wilderness: bill comparison chart. <http://www.betterworld.com?BWZ/9602/bills.html>. July 1998.
- CONNOLLY, E.J., JR. 1949. The food habits and life history of the mountain lion (*Felis concolor*). Master's thesis, University of Utah, Salt Lake City. 176 pp.
- CORBET, G.B., AND S. HARRIS. 1991. Handbook of British mammals. Blackwell Scientific Publications, Oxford, England. 588 pp.
- CORNELY, J.E., AND R.J. BAKER. 1986. Mammalian species: *Neotoma mexicana*. American Society of Mammalogists 262:1-7.
- CORNELY, J.E., L.N. CARRAWAY, AND B.J. VERTS. 1992. Mammalian species: *Sorex preblei*. American Society of Mammalogists 416:1-3.
- CURRIER, M.J. 1983. Mammalian species: *Felis concolor*. American Society of Mammalogists 200:1-7.
- CZAPLEWSKI, N.J. 1983. Mammalian species: *Idionycteris phyllotis*. American Society of Mammalogists 208:1-4.
- DASMAN, W. 1971. If deer are to survive. Stackpole Books, Harrisburg, PA. 128 pp.
- DAVIDSON, D.W., W.D. NEWMARK, J.W. SITES, JR., D.K. SHIOZAWA, E.A. RICKART, K.T. HARPER, AND R.B. KEITER. 1996. Selecting wilderness areas to conserve Utah's biological diversity. Great Basin Naturalist 56:95-118.
- DAVIS, W.B., AND D.J. SCHMIDLY. 1994. The mammals of Texas. Texas Parks and Wildlife Program, Austin. 337 pp.
- DRAGOO, J.W., J.R. CHAOTE, T.L. YATES, AND T.P. O'FARRELL. 1990. Evolutionary and taxonomic relationships among North American arid-land foxes. Journal of Mammalogy 71:318-332.
- DURRANT, S.D. 1952. Mammals of Utah: taxonomy and distribution. University of Kansas Publications, Museum of Natural History 6:1-549.
- EISENBERG, J.F. 1980. The density and biomass of tropical mammals. Pages 35-55 in M.E. Soulé and B.A. Wilcox, editors, Conservation biology: an evolutionary-ecological perspective. Sinauer, Sunderland, MA.
- ELTON, C., AND M. NICHOLSON. 1942. Ten year cycle in numbers of the lynx in Canada. Journal of Animal Ecology 11:215-244.
- EGOSCUE, H.J. 1979. Mammalian species: *Vulpes velox*. American Society of Mammalogists 122:1-5.
- FAHEY, J.M., JR., ET AL. 1995. The American Indians: Indians of the western range. Timelife Books Collection, Morristown, NJ. 192 pp.
- FENTON, M.B., AND R.M.R. BARCLAY. 1980. Mammalian species: *Myotis lucifugus*. American Society of Mammalogists 142:1-8.
- FINDLAY, W.R. 1992. Ecological aspects and dietary habits of river otter in northeastern Utah. Master's thesis, Brigham Young University, Provo, UT. 30 pp.
- FINDLEY, J.S., A.H. HARRIS, D.E. WILSON, AND C. JONES. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque. 360 pp.
- FITCH, J.H., K.A. SHUMP, JR., AND A.U. SHUMP. 1981. Mammalian species: *Myotis velifer*. American Society of Mammalogists 149:1-5.
- FITZGERALD, J.P., C.A. MEANEY, AND D.M. ARMSTRONG. 1994. Mammals of Colorado. Denver Museum of Natural History and University Press of Colorado, Denver. 467 pp.

- FLINDERS, J.T. 1968. Mammals of the Lakeside Mountains, Utah. Master's thesis, University of Utah, Salt Lake City. 112 pp.
- FLINDERS, J.T., AND R.M. HANSEN. 1972. Diets and habitats of jackrabbits in northeastern Colorado. Colorado State University, Range Science Department, Science Series 12:1-29.
- FOREYT, W.J. 1990. Pneumonia in bighorn sheep: effects of *Pasteurella haemolytica* from domestic sheep and effects on survival and long-term reproduction. Biennial Symposium on North American Wild Sheep and Goat Council Volume 7.
- FRASE, B., AND R.S. HOFFMANN. 1980. Mammalian species: *Marmota flaviventris*. American Society of Mammalogists 135:1-8.
- FRITZELL, E.K., AND K.J. HAROLDSON. 1982. Mammalian species: *Urocyon cinereoargenteus*. American Society of Mammalogists 189:1-8.
- GARCIA-PEREA, R. 1992. New data on the systematics of lynxes. *Cat News* 16:15-16.
- GARRISON, T.E., AND T.L. BEST. 1990. Mammalian species: *Dipodomys ordii*. American Society of Mammalogists 353:1-10.
- GEIST, V. 1971. Mountain sheep—a study in behavior and evolution. University of Chicago Press. 383 pp.
- . 1996. Buffalo nation: history and legend of the North American bison. Voyageur Press, Stillwater, MN.
- GOEROLD, W.T. 1990. The energy and mineral industry in Utah. Pages 11-15 in *Wilderness at the edge*. Foundation for the Utah Wilderness Coalition, Salt Lake City, UT.
- GREEN, J.S., AND J.T. FLINDERS. 1980. Mammalian species: *Brachylagus idahoensis*. American Society of Mammalogists 125:1-4.
- GREENE, R.A., AND G.H. MURPHY. 1932. The influence of two burrowing rodents, *Dipodomys spectabilis spectabilis* (kangaroo rat) and *Neotoma albigula albigula* (pack rat), on desert soils in Arizona. II. Physical effects. *Ecology* 13:359-363.
- GREENE, R.A., AND C. RAYNARD. 1932. The influence of two burrowing rodents, *Dipodomys spectabilis spectabilis* (kangaroo rat) and *Neotoma albigula albigula* (pack rat), on desert soils in Arizona. *Ecology* 13: 73-80.
- GREGORY, H.E., AND R.C. MOORE. 1931. The Kaiparowits region. Government Printing Office, Washington, DC. 161 pp.
- HAFNER, M.S., J.C. HAFNER, J.L. PATTON, AND M.F. SMITH. 1987. Macrogeographic patterns of genetic differentiation in the pocket gopher *Thomomys umbrinus*. *Systematic Zoology* 36:5-11.
- HALL, E.R. 1981. The mammals of North America. John Wiley and Sons, New York. 2 volumes. 1181 pp.
- HANSEN, R.M., AND J.T. FLINDERS. 1969. Food habits of North American hares. Colorado State University, Range Science Department, Science Series 1:1-18.
- HART, B.E. 1992. Mammalian species: *Tamias dorsalis*. American Society of Mammalogists 399:1-6.
- HASENYAGER, R.N. 1980. Bats of Utah. Publication 80-15, Utah State Division of Wildlife Resources. 109 pp.
- HAYSSEN, V. 1991. Mammalian species: *Dipodomys microps*. American Society of Mammalogists 389:1-9.
- HAYWARD, C.L., D. BECK, AND W.W. TANNER. 1958. Zoology of the upper Colorado River Basin. Brigham Young University Science Bulletin, Biological Series 1(3):1-74.
- HAYWARD, C., M. KILPACK, H. COFFERY, AND C. PRITCHETT. 1958-1960. Unpublished data on small mammalian population records. Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT.
- HEMMER, H. 1978. The evolutionary systematics of living Felidae: present status and current problems. *Carnivore* 1(1):71-79.
- HERDER, M., J. JACKSON, AND H. BARBER. 1997. Science symposium: status of bats in the Grand Staircase-Escalante National Monument. Bureau of Land Management, Grand Staircase-Escalante National Monument. [http://www.ut.blm.gov/monument/Education\\_and\\_Research/science\\_symposium.html](http://www.ut.blm.gov/monument/Education_and_Research/science_symposium.html). July 1998.
- HERMANSON, J.W., AND T.J. O'SHEA. 1983. Mammalian species: *Antrozous pallidus*. American Society of Mammalogists 213:1-8.
- HILLMAN, C.N., AND T.W. CLARK. 1980. Mammalian species: *Mustela nigripes*. American Society of Mammalogists 126:1-3.
- HOFFMEISTER, D.F. 1981. Mammalian species: *Peromyscus truei*. American Society of Mammalogists 161:1-5.
- . 1986. Mammals of Arizona. University of Arizona Press and Arizona Game and Fish Department. 602 pp.
- HONACKI, J.H., K.E. KINMAN, AND J.W. KOEPL. 1982. Mammal species of the world: a taxonomic and geographic reference. Association of Systematics Collections, Lawrence, KS. 694 pp.
- JACQUART, H.C. 1986. Prescriptive transplanting and monitoring of Utah prairie dog (*Cynomys parvidens*) populations. Master's thesis, Brigham Young University, Provo, UT. 59 pp.
- JAMESON, E.W., JR., AND H.J. PEETERS. 1988. California mammals. University of California Press, Berkeley. 403 pp.
- JENKINS, S., AND P.E. BUSHER. 1979. Mammalian species: *Castor canadensis*. American Society of Mammalogists 120:1-8.
- JESSUP, D.A. 1981. Pneumonia in bighorn sheep: effects on populations. *Cal-Neva Wildlife Society Transactions*. Pages 72-78.
- JOHNSON, D.W., AND D.M. ARMSTRONG. 1987. Mammalian species: *Peromyscus crinitus*. American Society of Mammalogists 287:1-8.
- JONES, F.L., G. FLITNER, AND R. GARD. 1957. Report on a survey of bighorn sheep in the Santa Rosa Mountains, Riverside Co. California Fish and Game 43:179-191.
- JORGENSEN, P. 1974. Vehicle use at a desert bighorn watering area. *Desert Bighorn Council Transactions* 18:18-24.
- JOSEPHY, A.M., JR. 1994. Five hundred nations: an illustrated history of North American Indians. Pathways Productions, New York. 468 pp.
- JUNG, J.A., AND R.S. HOFFMANN. 1981. An annotated key to the long-tailed shrews (genus *Sorex*) of the U.S. and Canada, with notes on the Middle American *Sorex*. *Occasional Papers of the Museum of Natural History, University of Kansas* 94:1-48.
- KARPOWITZ, J.F. 1981. Home ranges and movements of Utah bobcats with reference to habitat selection and prey base. Master's thesis, Brigham Young University, Provo, UT. 58 pp.
- KIMBALL, J.F. 1997. Utah sensitive species list. Policy No. W2Q-4, State of Utah, Department of Natural Resources, Utah Division of Wildlife.
- KING, C.M. 1983. Mammalian species: *Mustela erminea*. American Society of Mammalogists 195:1-8.

- KINLAW, A. 1995. Mammalian species: *Spilogale putorius*. American Society of Mammalogists 511:1-7.
- KNOWLTON, F.F. 1972. Preliminary interpretations of coyote population mechanics with some management implications. *Journal Wildlife Management* 36: 369-382.
- KOOP, B.F., R.J. BAKER, AND J.T. MASCARELLO. 1985. Cladistical analysis of chromosomal evolution within the genus *Neotoma*. Occasional Papers of the Museum of Texas Tech University 96:1-9.
- KRATOCHVIL, J. 1982. Karyotype and systematics of the family Felidae. *Folia Zoologica* 29:289-304.
- KUNZ, T.H. 1982. Mammalian species: *Lastonycteris noctivagans*. American Society of Mammalogists 172:1-5.
- KURTA, A., AND R.H. BAKER. 1990. Mammalian species: *Eptesicus fuscus*. American Society of Mammalogists 356:1-10.
- KURTÉN, B., AND E. ANDERSON. 1980. Pleistocene mammals of North America. Columbia University, New York. 442 pp.
- LARIVIERE, S., AND L.R. WALTON. 1998. Mammalian species: *Lontra canadensis*. American Society of Mammalogists 587:1-8.
- LARRISON, E.J., AND D.R. JOHNSON. 1981. Mammals of Idaho. University of Idaho, Moscow. 166 pp.
- LEGATE, L. 1990. Minerals proposed in wilderness areas. Pages 15-29 in *Wilderness at the edge*. Foundation for the Utah Wilderness Coalition, Salt Lake City, UT.
- LEOPOLD, A.S. 1950. Deer in relation to plant succession. Pages 571-580 in 13th Transactions of the North American Wildlife Conference.
- LIM, B.K. 1987. Mammalian species: *Lepus townsendii*. American Society of Mammalogists 288:1-6.
- LONG, C.A. 1973. Mammalian species: *Taxidea taxus*. American Society of Mammalogists 26:1-4.
- LOTZE, J.-H., AND S. ANDERSON. 1979. Mammalian species: *Procyon lotor*. American Society of Mammalogists 119:1-8.
- LUDWIG, D.R. 1984. Mammalian species: *Microtus richardsoni*. American Society of Mammalogists 223:1-6.
- MADER, H.J. 1984. Animal habitat isolation by roads and agricultural fields. *Biological Conservation* 29:81-96.
- MANNING, R.W., AND J.K. JONES, JR. 1989. Mammalian species: *Myotis evotis*. American Society of Mammalogists 329:1-5.
- MASCARELLO, J.T. 1978. Chromosomal, biochemical, mensural, penile, and cranial variation in desert woodrats (*Neotoma lepida*). *Journal of Mammalogy* 59:477-495.
- MASCARELLO, J.T., AND T.C. HSU. 1976. Chromosome evolution in woodrats, genus *Neotoma* (Rodentia: Critidae). *Evolution* 30:152-169.
- MATYUSHKIN, E.N. 1979. Lynx of the Holarctic. In: O.L. Rossolimo, editor, *Mammals: investigations on the fauna of the Soviet Union*. Sbornik Trudov Zoologicheskovo Muzeya MGU 13:1-279.
- MCALLISTER, J.A., AND R.S. HOFFMANN. 1988. Mammalian species: *Phenacomys intermedius*. American Society of Mammalogists 305:1-8.
- MCALLISTER, K.R. 1995. Washington State recovery plan for the pygmy rabbit. *Wildlife Management Program*, Washington Department of Fish and Wildlife, Olympia. 73 pp.
- MCCARTY, R. 1975. Mammalian species: *Onychomys torridus*. American Society of Mammalogists 59:1-5.
- \_\_\_\_\_. 1978. Mammalian species: *Onychomys leucogaster*. American Society of Mammalogists 87:1-6.
- McFADDEN, D.A. 1996. Virgin Anasazi settlement and adaptation on the Grand Staircase. *Utah Archaeology* 9(1):1-34.
- \_\_\_\_\_. 1997. Formative settlement on the Grand Staircase/Escalante National Monument: a tale of two adaptations. Pages 51-62 in *Learning from the Land Symposium*. BLM and the State of Utah, Cedar City, UT.
- McGREW, J.C. 1979. Mammalian species: *Vulpes macrotis*. American Society of Mammalogists 123:1-6.
- MEAD, R.A. 1968a. Reproduction in eastern forms of the spotted skunk (genus *Spilogale*). *Journal of Zoology* 156:119-136.
- \_\_\_\_\_. 1968b. Reproduction in western forms of the spotted skunk (genus *Spilogale*). *Journal of Mammalogy* 49:373-390.
- \_\_\_\_\_. 1989. The physiology and evolution of delayed implantation in carnivores. Pages 437-464 in J.L. Gittleman, editor, *Carnivore behavior, ecology, and evolution*. Cornell University Press, Ithaca, NY. 620 pp.
- MEAGHER, M. 1986. Mammalian species: *Bison bison*. American Society of Mammalogists 266:1-8.
- MECH, L.D. 1974. Mammalian species: *Canis lupus*. American Society of Mammalogists 37:1-6.
- MEINZER, W.P., D.N. UECKERT, AND J.T. FLINDERS. 1975. Food niche of coyotes in the rolling plains of Texas. *Journal of Range Management* 28:22-27.
- MERRIAM, C.H. 1905. Two new chipmunks from Colorado and Arizona. *Proceedings of the Biological Society of Washington* 18:163-166.
- MITCHELL, G.J. 1980. The pronghorn antelope in Alberta. Alberta Department of Energy and Natural Resources, Fish and Wildlife Division, Canada. 165 pp.
- MOLLHAGEN, T.R., AND M.A. BOGAN. 1997. Bats of the Henry Mountain region of southeast Utah. Occasional Papers of Texas Tech University. Tech University (Lubbock) 170:1-13.
- MONSON, G., AND L. SUMNER, EDITORS. 1980. The desert bighorn: its life history, ecology, and management. University Arizona Press, Tucson. 370 pp.
- MURDOCK, J.R., S.L. WELSH, AND B.W. WOOD. 1974. Small mammals assessment on Fourmile Bench and Ahlstrom Road of the Kaiparowits Basin, Kane Co., Utah. Pages 719-727 in *Navajo-Kaiparowits environmental baseline studies*. Center for Health and Environmental Studies, Brigham Young University, Provo, UT.
- NEWMARK, W.D. 1985. Legal boundaries of western North American national parks: a problem of congruence. *Biological Conservation* 33:197-208.
- \_\_\_\_\_. 1995. Extinction of mammal populations in western North American national parks. *Conservation Biology* 9:512-526.
- NOSS, R.F. 1995. Maintaining ecological integrity in representative reserve networks. *World Wildlife Fund Canada and World Wildlife Fund U.S.*, Toronto and Washington, DC.
- NOSS, R.F., H.B. QUIGLEY, M.G. HORNOCKER, T. MERRILL, AND P.C. PAQUET. 1996. Conservation biology and carnivore conservation in the Rocky Mountains. *Conservation Biology* 10:949-963.
- NOWAK, R.M. 1991. Walker's mammals of the world. 5th edition. Volume II. John Hopkins University, Baltimore, MD. 1628 pp.
- OAKS, E.C., P.J. YOUNG, G.L. KIRKLAND, JR., AND D.F. SCHMIDT. 1987. Mammalian species: *Spermophilus*

- variegatus*. American Society of Mammalogists 272: 1-8.
- O'FARRELL, M.J., AND E.H. STUDIER. 1980. Mammalian species: *Myotis thysanodes*. American Society of Mammalogists 137:1-5.
- O'GARA, B.W. 1978. Mammalian species: *Antilocapra americana*. American Society of Mammalogists 90:1-7.
- ONDERKA, D.K., S.A. RAWLEK, AND W.D. WISHART. 1988. Susceptibility of Rocky Mountain bighorn sheep and domestic livestock strains of *Pasteurella haemolytica*. Canadian Journal of Veterinarian Research 52: 439-444.
- O'NEAL, G.T., J.T. FLINDERS, AND W.P. CLARY. 1987. Behavior ecology of the Nevada kit fox (*Vulpes macrotis nevadensis*) on a managed desert rangeland. In: H.H. Genoways, editor, Current mammalogy. Volume I. Plenum Publishers Corporation, New York.
- PASITSCHNIK-ARTS, M. 1993. Mammalian species: *Ursus arctos*. American Society of Mammalogists 439:1-10.
- PASITSCHNIK-ARTS, M., AND S. LARIVIERE. 1995. Mammalian species: *Gulo gulo*. American Society of Mammalogists 499:1-10.
- PATTERSON, B.D. 1984. Geographic variation and taxonomy of Colorado and Hopi chipmunks (genus *Eutamias*). Journal of Mammalogy 65:442-456.
- PICKETT, S.T.A., R.S. OSTFELD, M. SHACHAK, G.E. LIKENS, EDITORS. 1997. The ecological basis of conservation: heterogeneity, ecosystems, and biodiversity. Chapman and Hall, New York.
- PIZZIMENTI, J.J., AND G.D. COLLIER. 1975. Mammalian species: *Cynomys parvidens*. American Society of Mammalogists 52:1-3.
- POCOCK, R.I. 1917. The classification of the existing Felidae. Annals and Magazine of Natural History, Serial 8, 20:329-350.
- PRESIDENTIAL PROCLAMATION 6920. 1996. Establishment of the Grand Staircase-Escalante National Monument. Bureau of Land Management, Grand Staircase-Escalante National Monument. <http://www.ut.blm.gov/monument/proclamation.html>. July 1998.
- PRESNALL, C.C. 1938. Mammals of Zion-Bryce and Cedar Breaks. Zion-Bryce Museum Bulletin 2. 20 pp.
- PRITCHETT, C.L. Key to animals of the Intermountain West. Unpublished manuscript, Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT.
- \_\_\_\_\_. 1962. Vertebrate distribution in relation to certain habitats in central Kane County, Utah. Master's thesis, Brigham Young University, Provo, UT. 83 pp.
- RAINES, J.A. 1976. Modeling studies of small mammal trapping phenology, and plant succession in the Kaiparowits region, Kane County, Utah. Master's thesis, Botany and Range Science Department, Brigham Young University, Provo, UT. 118 pp.
- RAWLEY, E. 1986. Early records of wildlife in Utah. Publication 86-2, Division of Wildlife Resources, Utah Department of Natural Resources.
- REBAR, C., AND W. CONELY. 1983. Interactions in microhabitat between *Dipodomys ordii* and *Onychomys leucogaster*. Ecology 64:984-988.
- RICKART, E.A. 1987. Mammalian species: *Spermophilus townsendii*. American Society of Mammalogists 268: 1-6.
- RUSSELL, O. 1955. Journal of a trapper. Oregon Historical Society, Portland. 179 pp.
- SANDERSON, R.H. 1959. Relationships between jackrabbit use and availability of forage on native sandhills range. Master's thesis, Colorado State University, Fort Collins. 85 pp.
- SCHAFFER, T.S. 1991. Mammals of the Abajo Mountains, an isolated mountain range in San Juan County, southeastern Utah. Occasional Papers of Texas Tech University (Lubbock) 137:1-15.
- SCHALLER, G.B., T. QITAO, K.G. JOHNSON, W. YIAOMING, S. HEMING, AND H. JINCHU. 1989. Feeding ecology of giant pandas and Asiatic black bears in the Tangiache Reserve, China. Pages 212-239 in J.L. Gittleman editor, Carnivore behavior, ecology, and evolution. Cornell, Ithaca, NY. 620 pp.
- SCHMIDL, D.J. 1991. Bats of Texas. Texas A&M University, College Station. 188 pp.
- SHACKLETON, D.M. 1985. Mammalian species: *Ovis canadensis*. American Society of Mammalogists 230:1-9.
- SHAW, J.H., AND M. MEAGHER. 2000. Pages 447-466 in S. Demarias and P.R. Krausman, editors, Ecology and management of large mammals in North America. Prentice Hall, Upper Saddle River, NJ.
- SHEFFIELD, S.R., AND H.H. THOMAS. 1997. Mammalian species: *Mustela frenata*. American Society of Mammalogists 570:1-9.
- SHUMP, K.A., AND A.U. SHUMP. 1982a. Mammalian species: *Lasiurus borealis*. American Society of Mammalogists 183:1-6.
- \_\_\_\_\_. 1982b. Mammalian species: *Lasiurus cinereus*. American Society of Mammalogists 185:1-5.
- SIMPSON, M.R. 1993. Mammalian species: *Myotis californicus*. American Society of Mammalogists 429:1-4.
- SMITH, A.T., AND M.L. WESTON. 1990. Mammalian species: *Ochotona princeps*. American Society of Mammalogists 352:1-8.
- SMITH, F.A. 1997. Mammalian species: *Neotoma cinerea*. American Society of Mammalogists 564:1-8.
- SMITH, J.G. 1952. Food habits of mule deer in Utah. Journal of Wildlife Management 16:148-155.
- SMITH, T.S., AND J.T. FLINDERS. 1991. The bighorn sheep of Bear Mountain: ecological investigations and management recommendations. Research final report to Utah Division of Wildlife Resources, Salt Lake City. 394 pp.
- \_\_\_\_\_. 1992. Evaluation of mountain sheep habitat in Zion National Park, Utah. Desert Bighorn Council Transaction 36:4-9.
- SMOLEN, M.J., AND B.L. KELLER. 1987. Mammalian species: *Microtus longicaudus*. American Society of Mammalogists 271:1-7.
- SPARKS, E.A. 1974. Checklist of Utah wild mammals. State of Utah Department of Natural Resources, Division of Wildlife Resources. 33 pp.
- STEGNER, W. 1990. Introduction. In: Wilderness at the edge. Foundation for the Utah Wilderness Coalition, Salt Lake City. 400 pp.
- STEIGERS, W.D. 1978. Mortality of mule deer fawns in south-central Washington. Master's thesis, Brigham Young University, Provo, UT. 33 pp.
- \_\_\_\_\_. 1981. Habitat use and mortality of mule deer fawns in western South Dakota. Doctoral dissertation, Brigham Young University, Provo, UT. 192 pp.
- STRICKLAN, D., J.T. FLINDERS, AND R.G. CATES. 1995. Factors affecting selection of winter food and roosting resources by porcupines in Utah. Great Basin Naturalist 55:29-36.
- STRUEBEL, D. 1989. Small mammals of the Yellowstone ecosystem. Roberts Rhineharts, Boulder, CO. 152 pp.



- STRUEBEL, D.P., AND J.P. FITZGERALD. 1978. Mammalian species: *Spermophilus spilosoma*. American Society of Mammalogists 101:1-4.
- TANNER, V.M. 1940. A biotic study of the Kaiparowits region of Utah. Great Basin Naturalist 1:97-127.
- TAYLOR, W.P. 1935. Some animal relations to soils. Ecology 16:127-136.
- THOMAS, D.H., J. MILLER, R. WHITE, P. NOBOKOV, P.J. DELORIA. 1993. The Native Americans. Turner Publishing, Atlanta, GA. 479 pp.
- TOMASI, T.E., AND R.S. HOFFMANN. 1984. *Sorex preblei* in Utah and Wyoming. Journal of Mammalogy 65:708.
- TUMLISON, R. 1987. Mammalian species: *Felis lynx*. American Society of Mammalogists 269:1-8.
- TUMLISON, R., AND M.E. DOUGLAS. 1992. Parsimony analysis and the phylogeny of the Pleistocene bats (Chiroptera: Vespertilionidae). Journal of Mammalogy 73: 276-285.
- UTAH FURBEARER HARVEST REPORT. 1997. Utah Department of Natural Resources, Division of Wildlife Resources. 28 pp.
- VANDYKE, W.A., A. SANDS, J. YOAKUM, A. POLENTZ, AND J. BLAISDELL. 1983. Wildlife habitat in managed rangelands—the Great Basin of SE Oregon: bighorn sheep. General Technical Report PNW-159, USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. 37 pp.
- VAN GELDER, R.G. 1959. A taxonomic revision of the spotted skunks (genus *Spilogale*). Bulletin of the American Museum of Natural History 117:229-392.
- VAN ZYLL DE JONG, C.G. 1984. Taxonomic relationships of Nearctic small-footed bats of the *Myotis leibii* group (Chiroptera: Vespertilionidae). Canadian Journal of Zoology 62:2519-2526.
- \_\_\_\_\_. 1987. A phylogenetic study of the Lutrinae (Carnivora; Mustelidae) using morphological data. Canadian Journal of Zoology 65:2536-2544.
- VAN ZYLL DE JONG, C.G., AND S.A. WRIGHT. 1991. An evaluation of the usefulness of mammalian keratin in systematic analyses. Canadian Journal of Zoology 69: 847-852.
- VERTS, B.J., AND G.L. KIRKLAND, JR. 1988. Mammalian species: *Perognathus parvus*. American Society of Mammalogists 318:1-8.
- VISITOR INFORMATION. 1998. Bureau of Land Management—Grand Staircase—Escalante National Monument. [http://www.ut.blm.gov/monument/visitor\\_information.html](http://www.ut.blm.gov/monument/visitor_information.html). July 1998.
- VOICHT, D.R. 1987. Red fox. Pages 378-392 in Wild fur-bearer management and conservation in North America. Ontario Trappers Association, Ontario, Canada.
- VORHIES, C.T., AND W.P. TAYLOR. 1933. The life histories and ecology of jack rabbits, *Lepus alleni* and *Lepus californicus* sp. Arizona Agricultural Experiment Station, Technical Bulletin 49:471-587.
- WADE-SMITH, J., AND B.J. VERTS. 1982. Mammalian species: *Mephitis mephitis*. American Society of Mammalogists 173:1-7.
- WAGNER, F.H. 1972. Coyotes and sheep: some thoughts on ecology, economics, and ethics. Forty-fourth Honor Lecture, Utah State University, Logan. 59 pp.
- WAGNER, F.H., AND L.C. STODDART. 1972. Influence of coyote predation on black-tailed jackrabbit populations in Utah. Journal of Wildlife Management 36: 329-342.
- WALDMAN, C. 1985. Atlas of the North American Indian. Facts on File Publications, New York. 276 pp.
- WARNER, R.M., AND N.J. CZAPLEWSKI. 1984. Mammalian species: *Myotis volans*. American Society of Mammalogists 224:1-4.
- WASSNIK, J.L. 1993. Mammals of the Central Rockies. Mountain Press Publishing, Missoula, MT. 161 pp.
- WATKINS, L.C. 1977. Mammalian species: *Euderma maculatum*. American Society of Mammalogists 77:1-4.
- WEBSTER, W.D., AND J.K. JONES, JR. 1982. Mammalian species: *Reithrodontomys megalotis*. American Society of Mammalogists 167:1-5.
- WEIGEL, I. 1961. Das Fellmuster der wildleben Katzenarten und der Hauttze in Vergleichender und Stammesgeschichtlicher Hinsicht. Säugetierkundliche Mitteilungen 9:1-120.
- WELLES, R.E., AND F.B. WELLES. 1961. The bighorns of Death Valley. Fauna Service No. 6. U.S. Government Printing Office, Washington, DC. 242 pp.
- WELSH, S.L., D. ATWOOD, L.C. HIGGINS, AND S. GOODRICH. 1987. A Utah flora. Great Basin Naturalist Memoirs 9: 1-894. Brigham Young University, Provo, UT.
- WELSH, S.L., B.W. WOOD, AND J.A. RAINES. 1974. Small mammal assessments on Fourmile Bench and Ahlstrom Road of the Kaiparowits Basin, Kane Co., Utah. Pages 719-727 in Navajo-Kaiparowits environmental baseline studies. Center for Health and Environmental Studies and Botany and Range Science Department, Brigham Young University, Provo, UT.
- WELLS-GOSLING, N., AND L. HEANEY. 1984. Mammalian species: *Glaucomyx sabrinus*. American Society of Mammalogists 229:1-8.
- WERDELIN, L. 1981. The evolution of lynxes. Annales Zoologici Fennici. 18:37-71.
- WHITE, C.G. 1997. Ecological aspects and dietary habits of gray fox in eastern Utah. Master's thesis, Brigham Young University, Provo, UT. 72 pp.
- WILDERNESS ACT 1964. 1978. In: J.C. Hendee, G.H. Stankey, and R.C. Lucas, Wilderness management. USDA Forest Service Publication 1365.
- WILKINS, K.T. 1989. Mammalian species: *Tadarida brasiliensis*. American Society of Mammalogists 331:1-10.
- WILLNER, G.R., G.A. FELDHAMER, E.E. ZUCKER, AND J.A. CHAPMAN. 1980. Mammalian species: *Ondatra zibethicus*. American Society of Mammalogists 141:1-8.
- WILSON, E.O. 1992. The diversity of life. Harvard University Press, Cambridge, MA.
- WILSON, D.E., AND D.M. REEDER. 1993. Mammal species of the world: a taxonomic and geographic reference. 2nd edition. Smithsonian Institution, Washington, DC, and London, in association with American Society of Mammalogists. 1206 pp.
- WOODS, C.A. 1973. Mammalian species: *Erethizon dorsatum*. American Society of Mammalogists 29:1-6.
- ZEVELOFF, S.I. 1988. Mammals of the Intermountain West. University of Utah Press, Salt Lake City. 365 pp.

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