

Status Report on *Zapus hudsonius pret*
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Stephen A. Compton and Roy D. Hu

**Status Report on *Zapus hudsonius preblei*, a
Candidate Endangered Subspecies**

Stephen Compton & Roy Hugie

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Stephen A. Compton and Roy D. Hugie, PhD²

Scientific name of taxon: *Zapus hudsonius preblei* Krutzsch

Common name of taxon: Preble's Meadow Jumping Mouse

Family: Zapodidae

State(s) where taxon occurs: Colorado and Wyoming, U.S.A.

Current Federal Status: Candidate Endangered Subspecies

Recommended Federal Status: Threatened

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I. Subspecies Information

1. Classification and nomenclature

- A. Order- Rodentia
- B. Superfamily- Dipodoidea
- C. Family- Zapodidae
- D. Subfamily- Zapodinae
- E. Genus

- 1. Name of genus- *Zapus* Coues, 1876:253.
- 2. Size of genus- There are three living species in the genus *Zapus*, all of which occur exclusively in North America (Kruttsch 1954, Whitaker 1972). The species are *Z. trinotatus*, *Z. princeps*, and *Z. hudsonius*, in order from least to most anatomically progressive (Kruttsch 1954).

F. Species

- 1. Species scientific name- *Zapus hudsonius* Zimmerman, 1780:358.
- 2. Species synonyms
 - a. *Dipus hudsonius* Zimmerman, 1780:358. Type locality Hudson Bay, Canada; restricted to Fort Severn, Ontario.
 - b. *Dipus labradorius* Kerr, 1792:276. Type locality Preble (1899) states that the type specimen came from Hudson Bay.
 - c. *Dipus canadensis* Davies, 1798:157. Type locality near Quebec City, Province of Quebec, Canada.
 - d. *Dipus americanus* Barton, 1799:115. Type locality near Philadelphia, Pennsylvania.
 - e. *Meriones microcephalus* Harlan, 1839:1. Type locality Becks Farm, a few miles NE Philadelphia, Pennsylvania.
 - f. *Meriones acadicus* Dawson, 1856:2. Type locality Nova Scotia, Canada.
 - g. *Zapus tenellus* Merriam, 1897:103. Type locality Kamloops, British Columbia, Canada.
- 3. Size of species- There are eleven subspecies of the species *Zapus hudsonius* (Kruttsch 1954, Whitaker 1972). They are, in alphabetical order, *Z. h. acadicus* Dawson; *Z. h. alascensis* Merriam; *Z. h. americanus* Barton; *Z. h. campestris* Preble; *Z. h. canadensis* Davies; *Z. h. hudsonius* Zimmerman; *Z. h. intermedius* Kruttsch; *Z. h. ladas* Bangs; *Z. h. pallidus* Cockrum and Baker; *Z. h. preblei* Kruttsch; and *Z. h. tenellus* Merriam.

G. Subspecies scientific name

- 1. Trinomial- *Zapus hudsonius preblei* Kruttsch, 1954:452.
- 2. Full bibliographic citation- Kruttsch, Philip H. 1954. North American Jumping Mice (Genus *Zapus*). University of Kansas Publications, Museum of Natural History. Volume 7, No. 4, pp. 349-472.
- 3. Type specimen- Male, adult, No. 73085, U. S. Nat. Mus., Biol. Surv. Coll.; Loveland, Larimer County, Colorado; obtained on July 23, 1895, by E. A. Preble, original No. 435.

H. Subspecies synonyms- None.

I. Common name of subspecies- Preble's meadow jumping mouse.

2. Present legal or other formal status

A. National

1. United States

- a. Present designated or proposed legal protection or regulation- There is currently no designated or proposed federal legal protection for this subspecies.
- b. Other current formal status recommendations- Preble's meadow jumping mouse (*Zapus hudsonius preblei*) is currently a Category 2 candidate subspecies. Thus, the United States Fish and Wildlife Service (USFWS) will consider the information in this report to decide whether to upgrade this mammal's classification to a Category 1. Upgrading may initiate consideration for listing this subspecies as threatened or endangered.
- c. Review of past status- Preble's meadow jumping mouse has had no formal legal protection or special status in the past. Recently, concern has arisen pertaining to the status of Preble's meadow jumping mouse. The USFWS has initiated this Status Survey in order to determine whether the subspecies should be listed as threatened or endangered.

B. State

1. Colorado

- a. Present designated or proposed legal protection or regulation- Preble's meadow jumping mouse has been classified by the State of Colorado Division of Wildlife (CDOW) as a "nongame" subspecies. This classification provides legal protection of the subspecies from being taken (Judy Sheppard pers. comm.).
- b. Other current formal status recommendations- In May 1990, the CDOW classified the Preble's subspecies a "species of special concern." This is an administrative classification, and not a legal one. The Preble's subspecies is currently the only mammal classified as a "species of special concern" in the state (Judy Sheppard pers. comm.).
- c. Review of past status- Historically, Preble's meadow jumping mouse has been legally protected as a "nongame" subspecies.

2. Wyoming

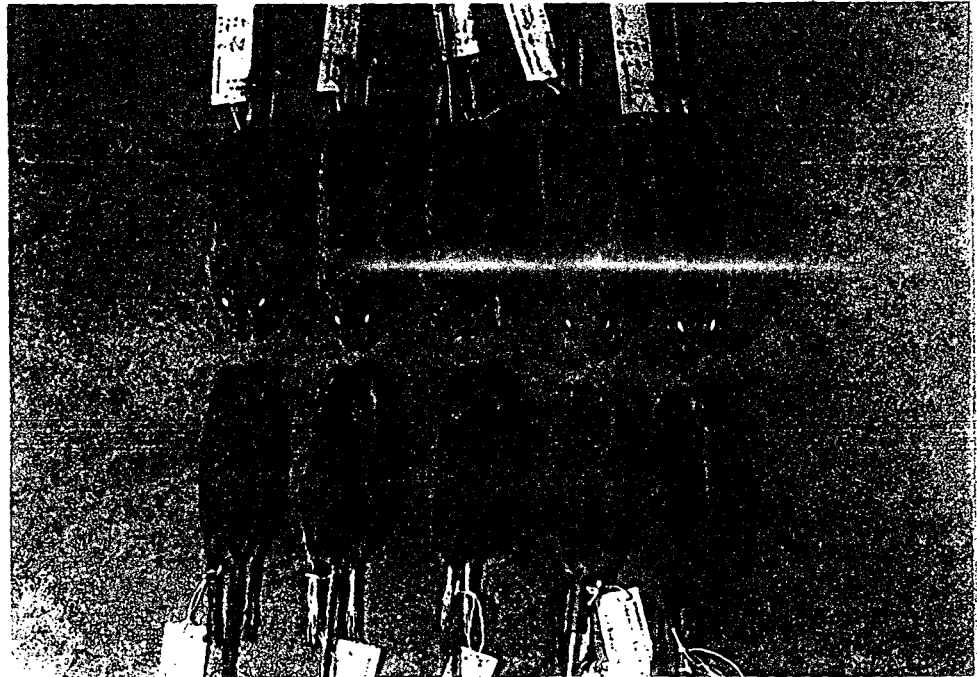
- a. Present designated or proposed legal protection or regulation- On March 8, 1993, the State of Wyoming Game & Fish Department (WGFD) enacted a nongame wildlife protection regulation under Wyoming Game and Fish Commission Chapter LII: Nongame Wildlife (Bob Luce pers. comm.). This is a Commission regulation, and is not a state statute. The regulation provides legal protection for nongame mammals. In particular, Preble's meadow jumping mouse was provided with the highest level of protection under Section 11 of the regulation, which prohibits intentional take of the subspecies, but does not prosecute incidental take and allows taking for reasons of public health (Bob Luce pers. comm.).

- b. **Other current formal status recommendations-** The WGFD has designated *Zapus hudsonius* as a Priority II nongame species, meaning it is a priority species in need of special management in Wyoming (WGFD 1991). This designation is administrative, not legal (Bob Luce pers. comm.). Two subspecies occur in Wyoming, namely *Z. h. campestris* and *Z. h. preblei*. The WGFD does not currently recognize any additional special status for the Preble's subspecies. The WGFD is currently updating their lists of species of special concern, which may affect the designation of the Preble's subspecies.
- c. **Review of past status-** Historically, Preble's meadow jumping mouse has had no legal protective status.

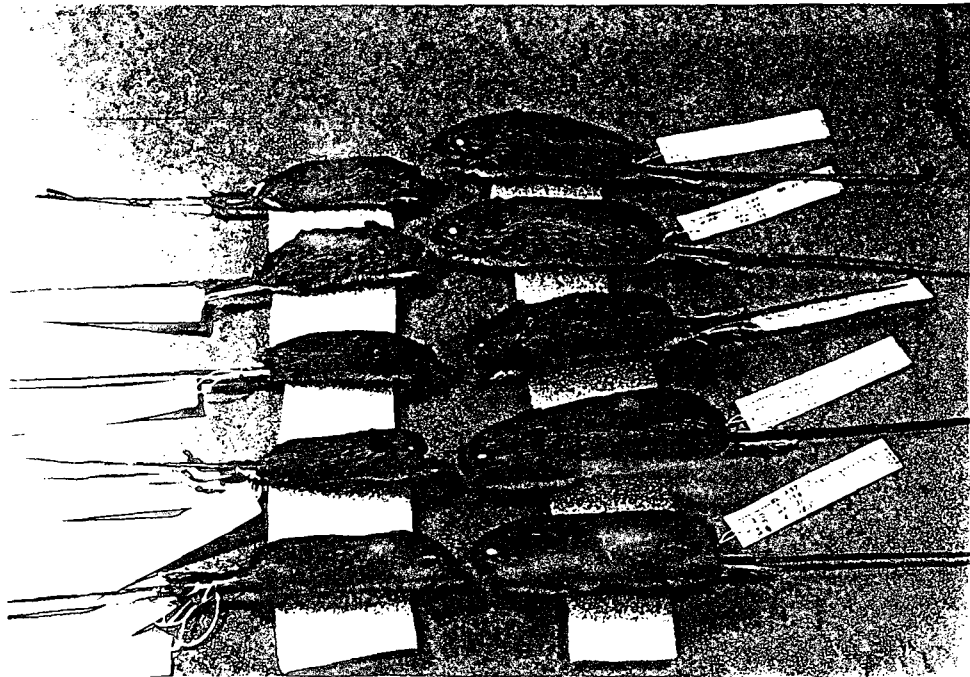
3. Description

- A. **General nontechnical description-** Whitaker (1972) described the general characteristics common to the genus *Zapus* as being long-tailed, yellowish mice with hind legs much longer than forelegs; tail attenuate, subcylindrical and longer than body; eyes small and midway between nose and ear; upper lip with median groove; vibrissae conspicuous; general pelage coarse. Krutzsch (1954) describes the coloration of the pelage of *Z. h. preblei* as, "color dull, back from near Clay Color to near Tawny-Olive with admixture of black hair forming poorly defined dorsal band; sides lighter than back from near Clay Color to near Cinnamon-Buff; lateral line distinct and clear Ochraceous-Buff; belly white, sometimes faint wash of clear Ochraceous-Buff; tail bicolored, brownish to light brownish-black above, grayish-white to yellowish-white below." Capitalized color terms refer to a standard, while color terms in lower case do not (Krutzsch 1954). Krutzsch (1954) described the general configuration of the skull as, "incisive foramina relatively narrow and elongate; auditory bullae moderately inflated; pterygoid fossae relatively broad; postpalatal notch broadly rounded; interorbital region relatively narrow; zygomatic arch not widely bowed; frontal region well inflated; distance from incisors to postpalatal notch relatively short."
- B. **Technical description-** *Zapus* may be distinguished from *Napaeozapus* in not having a white-tipped tail, and in having four upper molariform teeth (*Napaeozapus* has three upper molariform teeth). *Zapus* may be distinguished from *Eozapus* in having no white-tipped tail, and no dark longitudinal stripe down the abdomen. *Z. hudsonius* has the first molariform tooth small, measuring 0.30 mm long by 0.35 mm wide, and is distinguishable from *Z. trinotatus* (0.70 by 0.75) and *Z. princeps* (0.55 by 0.50) based on this characteristic (Krutzsch 1954). The dentition is i 1/1, c 0/0, p 1/0, m 3/3 (Whitaker 1972). *Z. hudsonius* has incisive foramina shorter than 4.6 mm (*Z. princeps* longer than 4.6 mm); palatal breadth at last molariform (M3) tooth less than 4.2 mm (*Z. princeps* more than 4.4 mm); condylobasal length usually less than 20.3 mm (*Z. princeps* usually 20.3 or more); maxillary toothrow usually 3.7 or less (*Z. princeps* usually greater than 3.7) (Whitaker 1972). Baculum with tip lanceolate (not spade-shaped) and tip less than 0.43 mm wide, and less than 5.1 mm in total length (length of chord from base to tip, not actual length of bone); underfur with medullary pattern rectangular, cuticular scales large; guard hair averaging 115 micra in diameter (Krutzsch 1954).

- C. **Local subspecies pelage comparisons-** Among subspecies of *Z. hudsonius*, *Z. h. preblei* most closely resembles its nearest geographical neighbor *Z. h. campestris* (Kruttsch 1954). Kruttsch (1954) described how *Z. h. preblei* differs from topotypes of *Z. h. campestris*, "Upper parts generally dull, averaging lighter, less black-tipped hair; dorsal band less distinct; sides duller." Kruttsch (1954) also described how *Z. h. preblei* differs from *Z. h. pallidus*, its next nearest geographical neighbor, "Upper parts generally duller (less ochraceous); dorsal band less distinct; sides paler (not bright Ochraceous-Buff)."
- D. **Local subspecies cranial comparisons-** Kruttsch (1954) described how the skull of *Z. h. preblei* differs qualitatively from that of *Z. h. campestris*, "averag(es) smaller in most cranial measurements taken; least interorbital constriction narrower; auditory bullae smaller, less well inflated; incisive foramina narrower, not truncate posteriorly; frontal region usually more inflated." Similarly, Kruttsch (1954) stated how the skull of *Z. h. preblei* was different from that of *Z. h. pallidus*; "zygomatic arch less widely bowed; least interorbital constriction narrower; occipitonasal length averaging greater; distance from incisors to postpalatal notch averaging less; incisive foramina longer, proportionally less widely bowed; auditory bullae longer; pterygoid fossae averaging broader."
- E. **Photographs and/or line drawings**
1. Photograph comparing dorsal view of study skins of *Zapus hudsonius preblei* (facing up) and *Zapus princeps princeps* (facing down).



2. Photograph comparing lateral view of study skins of *Zapus hudsonius preblei* (facing right) and *Zapus princeps princeps* (facing left).



4. **Significance**

- A. **Natural-** *Z. h. preblei* is the only species of jumping mouse (including *Eozapus*, *Zapus* and *Napaeozapus*) that occurs in its range (east of the Rocky Mountains in the plateau of northern Colorado and southern Wyoming).
- B. **Human-** There is no recorded historical, commercial, recreational, or other practical human use of this subspecies.

5. **Geographical Distribution**

- A. **Geographical range-** *Z. h. preblei* is known to occur only in the states of Colorado and Wyoming (Kruttsch 1954, Long 1965, Armstrong 1972). In Colorado, Preble's meadow jumping mouse is known only from the western edge of the Colorado Piedmont, in the South Platte drainage southward to the vicinity of Denver (Armstrong 1972). The range of Preble's meadow jumping mouse may overlap the range of the Western jumping mouse (*Z. princeps princeps*) near the foothills of the Rocky Mountains (Armstrong 1972, James Fitzgerald, pers. comm.). However, Armstrong (1972) states that the "nearest documented approach of the two species is about eight miles, between Gold Hill and Boulder." More recent data from the Rocky Flats Plant indicates that the ranges nearly overlap in this vicinity (Ebasco Services Inc. pers. comm.). In Wyoming, Preble's is noted as being rare, known only from the southeastern portion of the state and from the mountains of south-central Wyoming (Long 1965). Armstrong (1972) states that the ranges of Preble's and Western jumping mice may overlap in northern Albany County, Wyoming, similar to the approach of the two ranges in Colorado.
- B. **Precise occurrences-** Precise study skin information for skins examined includes date, county, specific location available on tag, number of skins examined, and museum code for museum in which the specimen is housed. Information for

additional study skins include county, location, museum code, and reference. Information for additional records of capture include county, location, year (if available), number of captures, and reference. Museum codes are as follows: DMNH= Denver Museum of Natural History; UCM= University of Colorado Museum; USNM= United States National Museum; CSU= Colorado State University; KU= University of Kansas, Museum of Natural History; FMNH= Field Museum of Natural History.

1. Colorado

a. Study skin location data

1. 08/04/51 Boulder County, 8.5 mi. N and 3.25 mi. E Boulder, 1 (UCM).
2. 09/03/35 Boulder County, 3 mi. NW Niwot, 1 (DMNH).
3. Boulder County, 3 mi. E Boulder, 1 (UCM).
4. 05/06/12 Boulder County, 5 mi. E Boulder, 1 (UCM).
5. 10/17/09 Jefferson County, 1.25 mi. W Semper, 5500 ft., 1 (DMNH).

b. Study skins having ambiguous or incomplete locality information

1. 08/25/36 Adams County, Croak's Lake, 1 (DMNH).
2. 01/07/30 Boulder County, Niwot, 1 (DMNH).

c. Additional study skins

1. Larimer County, Loveland, 2 (USNM) (Krutzsich 1954, Armstrong 1972).
2. Larimer County, 2.5 mi SE Fort Collins, 1 (CSU) (Armstrong 1972).
3. Weld County, Greely, 1 (UCM) (Armstrong 1972).
4. Weld County, 6 mi. E Hudson, 5000 ft., 1 (CSU) (Armstrong 1972).
5. Boulder County, south of Boulder, 1 (UCM) (Krutzsich 1954).
6. Boulder County, Boulder, 24 (3,USNM;21,FMNH) (Armstrong 1972).
7. Jefferson County, Semper, 1 (KU) (Armstrong 1972).

d. Additional records of capture

1. Denver County, Denver, 1 (Armstrong 1972).
2. Arapahoe County, no precise locality, 1 (Armstrong 1972).
3. El Paso County, Woodburn, 1972, 4 (Jones and Jones 1985).
4. Weld County, Fort St. Vrain, 1972, 1 (Bruce Wunder pers. comm.).
5. Weld County, Fort St. Vrain, 1976, 1 (Bruce Wunder pers. comm.).
6. Weld County, Fort St. Vrain, 1977, 1 (Bruce Wunder pers. comm.).
7. Boulder County, Rocky Flats Plant, 1991, 1 (Ebasco Services Inc. pers. comm.).

8. Boulder County, Tracy Collins parcel, Coal Creek, City of Boulder Open Space Department, 1989, 3 (Dawson 1989).
9. Boulder County, VanVleet parcel, City of Boulder Open Space Department, 1992, 1, captured during live-trapping as part of Status Survey, identified by Stephen A. Compton and Dr. David M. Armstrong, director of the University of Colorado Museum.

2. Wyoming

a. Study skin location data

1. Albany County, Springhill, 12 mi. N Laramie Peak, 6300 ft., 5 (USNM) (Long 1965, Krutzsch 1954).

b. Study skins having ambiguous or incomplete locality information

1. Laramie County, Cheyenne, 1 (USNM) (Long 1965, Krutzsch 1954).

c. Additional records

1. Platte County, Chugwater, 1 (Krutzsch 1954).

C. Biogeographical and phylogenetic history- Krutzsch (1954) provides an excellent description of the paleontology and biogeographical history of the species *Z. hudsonius*. In summary, the fossil record of the genus *Zapus* is scanty. Krutzsch (1954) considered the extinct genus *Pliozapus* of the Mid Pliocene a direct ancestor to the genera *Eozapus*, *Zapus*, and *Napaeozapus*, with all four genera belonging to the subfamily Zapodinae. Krutzsch (1954) considered that the Asiatic Recent Genus *Eozapus* has not progressed much beyond the Pliocene stage in zapidine evolution (i.e., *Pliozapus*), while the North American Recent Genus *Zapus* essentially achieved its present form by early Pleistocene times, and the Recent Genus *Napaeozapus* achieved its more progressive structure by mid-Pleistocene times. There are two reports of lower jaws of *Zapus* from the Pleistocene. The jaws were found in the Port Kennedy Cave fauna of Pennsylvania, and the Cumberland Cave of Maryland. Two extinct species have been described that resemble *Z. hudsonius*. The extinct species are *Z. burti* Hibbard of the mid-Pleistocene of Kansas, and *Z. rinkerii* Hibbard of the Blancan Age of Kansas. The three species *Z. rinkerii*, *Z. burti*, and *Z. hudsonius* represent a structurally and geographically progressive series, and show a trend in dentition from broad, brachydont cheek-teeth to narrow, semi-hypsodont cheek-teeth.

6. Habitat

A. Concise statement of general environment and habitat- Throughout its range, *Z. hudsonius* may occur in low undergrowth consisting of grasses or forbs or both, in open coniferous forests, deciduous hardwood groves, or in stands of tall shrubs and low trees, but most frequently in open, moist areas (Krutzsch 1954). *Z. hudsonius* prefers moist lowland habitats to drier upland habitats (Quimby 1951, Armstrong 1972).

B. Physical characteristics

1. Moisture requirements- *Z. hudsonius* prefers moist habitats to drier upland habitats (Quimby 1951, Armstrong 1972), but it is not known what level of moisture may be required by the species. Soil moisture seems to have little or no direct effect on populations of *Zapus*, except

as it influences other factors, and distance to major bodies of water is of little importance (Whitaker 1972). However, another author concluded that there is a definite relationship between *Z. hudsonius* and moisture, but that the species avoids sparse vegetation (Whitaker 1972). One author found that the activity of zapodids increases with rainfall (Whitaker 1972).

2. Other physical features of environment and habitat- *Z. hudsonius* requires dense ground cover. The species does not move across roads, heavily grazed areas, or cultivated fields (Quimby 1951). No other physical feature of the environment has been specified as influencing populations of *Zapus*.

C. Biological characteristics

1. Vegetation physiognomy and community structure- As noted above, *Z. hudsonius* prefers moist, lowland habitats consisting of low undergrowth. Reports from several authors, concerning widely different parts of North America, indicate that *Z. hudsonius* selects habitats in vegetation of like form, even though different assemblages of plant species may be involved (Kruttsch 1954). Adequate herbaceous ground cover is necessary for maintenance of populations of *Zapus* (Whitaker 1972). Populations of *Zapus* favor grassy vegetation, but the species of plant present (including food plants) are of little importance (Whitaker 1972).
2. Associated species- Quimby (1951) reported other mammals caught in the area of his Minnesota study. The species included three shrew species (*Sorex cinereus cinereus*, *Sorex arcticus laricorum*, and *Blarina brevicauda brevicauda*), Short-tailed weasel (*Mustela erminea bangsi*), Striped Ground Squirrel (*Citellus tridecemlineatus tridecemlineatus*), Gray Chipmunk (*Tamias striatus griseus*), Mississippi Valley Pocket Gopher (*Geomys bursarias bursarias*), Prairie White-footed Mouse (*Peromyscus maniculatus bairdii*), Wood Mouse (*Peromyscus leucopus noreboracensis*), Pennsylvania Meadow Mouse (*Microtus pennsylvanicus pennsylvanicus*), and House Mouse (*Mus musculus*). The Raccoon (*Procyon lotor hirtus*) and Striped Skunk (*Mephitis mephitis*) also occurred in the area. Live-trapping conducted by Pioneer Environmental Consulting Services, Inc. at the VanVleet parcel, City of Boulder Open Space Department, revealed that *Peromyscus maniculatus*, *Microtus pennsylvanicus*, and *Mus musculus* were present in the study area where *Z. h. preblei* was captured. The meadow jumping mouse and meadow vole have nearly identical distributions over North America, and both live in moist meadow habitats (Boonstra and Hoyle 1986).
3. Dominance and frequency- Armstrong (1972) states that *Z. hudsonius* (*preblei*) is poorly known in Colorado, and apparently is nowhere abundant. Records in the state are marginal for the species and apparently the population there is relict. Long (1965) states that *Z. h. preblei* is rare, and is known only from southeastern Wyoming and mountains of south-central Wyoming.

7. Demography

1. **Known populations-** The status of extant populations of *Z. h. preblei* is poorly known in Colorado, and unknown in Wyoming. A live-trapping effort was conducted in areas of suitable habitat in Colorado, and in areas of most recent known locations of subspecies capture. Areas of most recent capture were trapped in an effort to confirm the presence of extant populations. No *Z. h. preblei* were captured in these locations. A single individual was captured in a new location south of Boulder, Colorado. All known captures and observations of the subspecies since 1972 are listed below in chronological order.
2. **Demographic details (Number and geographic spacing of known populations)**
 - a. **Particular Population:**
 1. **Area of the population-** Three individuals captured, one each in 1972, 1976 and 1977, at the Fort St. Vrain Nuclear Generating Station by Dr. Bruce Wunder, University of Colorado, as a subcontractor to Fred Glover at Thorne Ecological Institute in Boulder for a study entitled Ecological Monitoring-Fort St. Vrain Generating Station from 1972-79. To date, we have not obtained this report. However, Bruce Wunder (pers. comm.) stated that all captures were located northeast of the Nuclear Generating Station along an irrigation canal which flowed to the S. Platte River.
 2. **Number, and age (or size) classes of individuals-** Specific details may be available in the above report.
 3. **Density (number of individuals per unit area)-** It is doubtful that a population estimate during the 1970s would be available in the above report; with only one capture in any year, any population density estimate would be very low.
 4. **Presence-** Pioneer Environmental Consulting Services, Inc. conducted live-trapping at four different locations (Sections 27 and 34, T 4N, R 67 W) at Fort St. Vrain from August 5-9, 1992, including heaviest trapping at the location of the three captures in the 1970s. Over 920 trap-nights, no *Z. h. preblei* were captured.
 5. **Evidence of reproduction-** The population was evidently viable during the mid-1970s, given the chronological spacing of the captures. However, there is no evidence of current reproduction.
 6. **Evidence of expansion/contraction-** The presence of any population at Fort St. Vrain is highly questionable given the results of the recent live-trapping survey. The live-trapping results may indicate a contraction or extirpation of the population.

b. **Particular Population:**

1. **Area of the population-** Gwilym S. Jones and Diana B. Jones observed several, and snap-trapped four *Z. hudsonius* on June 21, 1972 near Woodburn, El Paso County, Colorado (Jones and Jones 1985). Even though the captures were well south of any other known capture of this subspecies, it is most likely that the individuals were *Z. h. preblei*.
2. **Number, and age (or size) classes of individuals-** No information was provided in the above-referenced article, with the exception that four individuals were captured and several individuals were observed simultaneously.
3. **Density (number of individuals per unit area)-** No population estimate was provided in the above-referenced article.
4. **Presence-** No recent live-trapping effort was conducted in this area.
5. **Evidence of reproduction-** No information was provided in the above-referenced article.
6. **Evidence of expansion/contraction-** No time-series capture or observational data is available.

c. **Particular Population:**

1. **Area of the population-** Kristina Williams and Roy E. Dawson, working as seasonal park rangers for the City of Boulder Open Space Department, live-trapped three *Z. hudsonius* at the Tracy Collins parcel in May, 1989 (Dawson 1989). Specifically, the individuals were captured at the base of a small basin, adjacent to Coal Creek, between Colorado State Highways 93 and 128, 3 miles south of Boulder, Colorado (central portion of Section 33, T 1S, R 70W). Given the location of the captures, it is assumed that the individuals were *Z. h. preblei*.
2. **Number, and age (or size) classes of individuals-** Three male *Z. hudsonius*, two adult and one with no age specified, were captured, one each on May 23, 25 and 31, 1989, weighing 17, 21 and 22 grams, respectively.
3. **Density (number of individuals per unit area)-** There was no population estimate.
4. **Presence-** Live-trapping was conducted at the Tracy Collins parcel, Coal Creek location from August 12-15, 1992 by Pioneer Environmental Consulting Services, Inc. Over 300 trap-nights, no *Z. hudsonius* were captured.
5. **Evidence of reproduction-** There was no evidence of juveniles or pregnant or lactating females at Coal Creek in 1989, and no captures in 1992.
6. **Evidence of expansion/contraction-** There is not enough long-term capture data to make this determination.

d. **Particular Population:**

1. **Area of the population-** Biologists for Ebasco Services Inc. live-trapped a single *Z. h. preblei* near Woman Creek, part of the U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado on May 24, 1991 (Ebasco Services Inc. pers. comm.). The habitat consisted of a smooth brome (*Bromus inermis*) reclaimed grassland site adjacent to a Woman Creek riparian area.
2. **Number, and age (or size) classes of individuals-** The individual was an adult male, weighing 17.0 grams, and having a body length of 79 mm, tail length of 102 mm, hind foot length of 27 mm, and ear length of 7 mm.
3. **Density (number of individuals per unit area)-** No population estimate was given.
4. **Presence-** No live-trapping was conducted in 1992.
5. **Evidence of reproduction-** There was no evidence of juveniles or pregnant or lactating females at Rocky Flats in 1991.
6. **Evidence of expansion/contraction-** There is no long-term capture data available to make this determination.

e. **Particular Population:**

1. **Area of the population-** A single *Z. h. preblei* was captured at the VanVleet parcel (Section 10, T 1S, R 70W), City of Boulder Open Space Department, just south of Highway 36, on August 14, 1992 by Stephen A. Compton, Pioneer Environmental Consulting Services, Inc. The habitat consisted of moist, lowland topography, with a vegetation of dense, tall grasses with some forbs.
 2. **Number, and age (or size) classes of individuals-** The individual was an adult female, weighed 25.5 grams, and had a body length of 85 mm and a tail length of 134 mm.
 3. **Density (number of individuals per unit area)-** No population estimate was possible based on the single capture.
 4. **Presence-** Over 300 trap-nights at the VanVleet parcel, there was only a single capture of *Z. h. preblei*. This capture represents the presence of the subspecies at the VanVleet parcel, but the status of any population in the area is unknown.
 5. **Evidence of reproduction-** The adult female showed no evidence of pregnancy or lactation.
 6. **Evidence of expansion/contraction-** The capture represents the first capture in this location, and therefore there is not enough long-term capture data to make this determination.
3. **Other demographic information-** In addition to live-trapping surveys conducted at Fort St. Vrain Generating Station, and the Tracy Collins and VanVleet parcels, Pioneer Environmental Consulting Services, Inc.

conducted additional live-trapping near the VanVleet parcel on City of Boulder Open Space Department lands. Live-trapping was conducted on appropriate moist, lowland habitats at Burke I (Section 3, T 1S, R 70W), south of Baseline Road, and Burke II (Section 34, T 1N, R 70 W), north of Baseline Road, just east of Boulder, Colorado from August 12-15, 1992. Over a total of 300 trap-nights on each parcel, no *Z. h. preblei* were captured. No other live-trapping surveys were conducted to determine the status of the subspecies in Colorado or Wyoming.

8. General ecology- The general ecology of *Z. hudsonius* is summarized by Quimby (1951), Krutzsch (1954) and Whitaker (1972). Specific studies concerning *Z. h. preblei* in Wyoming and Colorado, are very scarce. Observations of intraspecific behavior of *Z. hudsonius* (Jones and Jones 1985) represent the only specific information available for the subspecies of concern. As a result, species information is presented in lieu of subspecies information.

A. Food and feeding behavior- Quimby (1951) studied food preferences by presenting to caged *Z. hudsonius* the plants and invertebrate animals normally available to these mice in nature. He indicated that, in general, the starchy fruits of the Gramineae and the more or less fleshy fruits of various groups of plants (*Ribes*, *Fragaria*, *Rubus*, *Cornus*, *Vaccinium*, and *Vicia*) are more heavily utilized than other plant materials. The fruits of 15 plants, including *Typha*, *Cyperus*, *Scripus*, *Salix*, *Corylus*, *Alnus*, *Chenopodium*, *Trifolium*, *Rhus*, *Cicuta*, *Asclepias*, *Phlox*, *Plantago*, and *Rudbeckia*, were not eaten. The starchy roots of *Typha* and leaves of *Setaria* were slightly utilized. *Z. hudsonius* is also highly insectivorous; of 28 insects species, 2 Gastropods, 1 Arachnid, and 1 Diplopod provided, all but adult silphid and coccinellid beetles and larval papilionid caterpillars, and the highly chitinous parts of insects were consumed. *Z. hudsonius* is known to consume many insects under natural conditions.

Whitaker (1972) examined the stomach contents of 796 *Z. hudsonius*, and found that when this species emerges from hibernation in late April and May it feeds on a variety of foods. Animal material is about half the food and seeds are about 20%. As the season progresses, more seeds and less animal materials are consumed, and the fungus *Endogone* becomes important and is actively sought by the animals. Seeds, particularly grass seeds, are the basic food in general. The different grasses are used in sequence as they progressively ripen and disappear in the field. Some of the more important seeds eaten were those of *Phleum*, *Anthoxanthum*, *Poa*, *Cerastium*, *Rumex acetosello*, *Dactylus*, *Potentilla*, *Oxalis*, *Echinochloa*, *Ulmus*, and *Asclepias*. The most important of the animal foods were lepidopterous larvae and beetles of the families Carabidae and Curculionidae.

Quimby (1951) described a caged mouse feeding on grass seeds. It sat on its haunches and fed by means of the front feet. First the fruiting head of the grass was cut off, then all parts were stripped beginning at one end. Only the seeds were eaten, but many of these dropped to the ground, and no effort was made to retrieve them. Whitaker (1972) made similar observations. *Zapus* reach as high as they can on grass stems, or climb stems to bite through the stem to cut off the seed head for consumption (Whitaker 1972). These mice apparently forage on the surface and in the herbaceous vegetation above the ground, but the fungal foods extensively eaten are probably obtained by scratching the ground (Whitaker

1972). Mice in captivity regularly drink water, but it is not known whether *Zapus* in the field drink or get their water from green vegetation or from dew, or both (Quimby 1951).

- B. **Home range-** Quimby (1951) found that the home range of female *Z. hudsonius* varied from 0.19 to 0.87 acres, with a mean of 0.38 acres, while male home ranges varied from 0.14 to 1.10 acres, with a mean of 0.43 acres, in one area in Minnesota. In another area of Minnesota, he found that nine males had significantly larger home ranges (2.70 acres) than did 17 females (average 1.57 ± 0.22 acres). Calculated home ranges in Michigan were 0.89 ± 0.11 for 26 males, and 0.92 ± 0.11 for 24 females, the differences being not significant (Whitaker 1972). Quimby (1951) theorized that environment plays a major role in determining the size, and that the shape of home ranges is determined by terrain, density and type of cover, and land use in the immediate area. Home ranges shift; in one case an adult moved more than half a mile. Authors have reported the tendency for *Z. hudsonius* to wander, possibly to seek moist locations during the dry part of summer (Whitaker 1972). Quimby (1951) found them to have essentially no homing tendencies on the basis of releases of 13 individuals 0.2 to 0.5 miles from their original home ranges. Only two returned by chance wandering.
- C. **Population Density-** Quimby (1951) estimated that there were 11.91 mice per acre in one Minnesota study area, and gave monthly averages ranging from 1.81 to 3.57 mice per acre for a second area. Authors agree that the population density of jumping mice may vary considerably from year to year (Whitaker 1972). An inverse relationship may exist between *Z. hudsonius* and meadow vole (*Microtus pennsylvanicus*) densities because both species have nearly identical distributions over North America and both live in moist meadow habitats (Boonstra and Hoyle 1986).
- D. **Population Structure-** Quimby (1951) recognized three age classes, namely adults, subadults (with adult pelage but of small size), and juveniles (very small size and juvenile pelage), in a Minnesota *Z. hudsonius* population. No young of the year appeared in the catch until July when 25% were either juveniles or subadults. Fifty percent of those caught in August were young of the year. The figures for September were more difficult to determine since the young from early litters have all the appearances of adults at this time; but 61% were definitely young of the year, 8% were definitely adults, the remaining 30% were classified as adults, but some or all were young of the year. These data indicate that the over-wintering adults are gradually replaced by the young of the year as the summer progresses. Factors doubtless include mortality from predation, old age, and other natural causes. Kruttsch (1954) concluded that sexes in *Z. hudsonius* vary only slightly from a one to one ratio.
- E. **Predators-** *Zapus* have been reported to be preyed upon by barn owls, mink, and rattlesnake (Quimby 1951, Kruttsch 1954, Whitaker 1972). *Z. hudsonius* have been reported to be preyed upon by barn and long-eared owls, red tailed hawks, northern pike, weasel, and a green frog (Quimby 1951, Kruttsch 1954, Whitaker 1972). It seems safe to assume that jumping mice are preyed upon by representatives of all major vertebrate groups (Quimby 1951).
- F. **Parasites-** Whitaker (1972) provides an excellent summary of the parasites, or associates, of *Z. hudsonius*. The species harbors few parasites in comparison to many other species of small mammals of comparable size. Among bacteria,

Escherichia coli, *Bacillus mycoides*, *Klebsiella* sp., and *Bacteriodes* sp. have been reported from the cecum. The general occurrence of trematodes, cestodes and nematodes in a population tends to be very low. The trematodes *Notocotylus hassali*, *Plagiorchis proximus*, *Plagiorchis* sp., *Quinqueserialis quinqueserialis*, *Quinqueserialis* sp., *Schistosomatiuim douthitti*, and *Echinostoma* sp. have been reported. Cestodes reported include *Mesocestoides* sp., larval *Taenia mustelae*, *Choanotaenia* sp., and *Hymenolepis* sp. Reported nematodes are *Subulura ungulatus*, *Spirocerca zapi*, *Mastophorus muris*, *Citellinoides zapodis*, *Rictularia* sp., and *Longistriata dalrymplei*. The ticks *Dermacentor variabilis* and *Ixodes muris* have been found on *Z. hudsonius*, with the latter found on 36 of 864 mice examined in New York. The chigger mites *Trombicula microti*, *T. subsignata*, *Euschongastia diversa acuta*, *Androlaelaps fahrenheitsi* and *Haemogamasus hirsutus* have been reported. The most abundant external parasite of *Z. hudsonius* in New York and Indiana is the hypopus (transport form) of *Dermacarus hypudaei*, which does not feed on the mouse, and is not found in adult form on the mouse. No other mites have been reported with any regularity, but the chiggers *Neotrombicula subsignata*, *Eutrombicula alfreddugesi*, and *Neoschongastia* sp., and mites *Eularlaps stabularis*, *Laelaps kochi*, *Haemogamasus alaskensis*, and a few free-living mites considered accidentals have been reported. Flea occurrence is also low in a population, and species reports include *Orchopeas leucopus*, *Megabothris asio*, *M. wagneri*, *M. quirini*, *Stenopomia americana*, *Corrodopsylla curvata*, and *Ctenophthalmus pseudagyrates*. Larval botflies, *Cuterebra*, often have been found on *Z. hudsonius*. Only one louse, probably *Neohaematopinus* sp., was found on 864 *Z. hudsonius* examined in New York.

9. Reproduction

- A. **Breeding Season-** The breeding season begins shortly after *Z. hudsonius* emerge from hibernation in the spring, and reproduction continues until a few weeks before the species hibernates in autumn (Krutzsch 1954). Quimby (1951) stated that date of emergence from hibernation varies from year to year, and hence the beginning of the breeding season also varies. Quimby (1951) presented data from a Minnesota population where the dates of birth of *Z. hudsonius* ranged from June 15 to August 23. Information from North Carolina and Georgia indicate a longer breeding season into late September (Krutzsch 1954). The breeding season, therefore, probably varies geographically. The breeding season varies seasonally in that a Michigan population showed two peaks of breeding activity in spring and another in late summer, with little activity during the intervening summer. Quimby (1951) ascertained that three peaks occur in Minnesota, occurring in late June, mid- and late July, and mid-August. Many *Z. hudsonius* in New York have two litters per year since 67% of the adult females taken in the first major breeding period (May 21 to June 20) were pregnant, or had given birth recently, and 84% of the adult females taken from July 21 to August 20 were pregnant or had recently given birth (Whitaker 1972).
- B. **Gestation Period-** The gestation period of nonlactating, caged *Z. hudsonius* was approximately 18 days, with gestation being prolonged in lactating females (Quimby 1951).
- C. **Nesting-** Preble (1899) stated that during the latter part of the summer *Zapus* makes a globular nest of grass about 4 inches in diameter, with a small entrance

at the side. Quimby (1951) observed captive *Z. hudsonius* construct characteristic oval grass nests of various sizes, either on the surface or underground. Nests may have a soft lining in the middle of the chamber or be made of leaves, and tend to be well concealed under grass and other vegetation, or under a rotten log (Quimby 1951). Preble (1899) stated that hibernating *Zapus* are generally found in underground nest holes varying in depth from a few inches to 2 or 3 feet, while others have located nests in sandy slopes (Quimby 1951).

- D. **Litters-** Quimby (1951) found an average of 5.7 young per litter in Minnesota (17 litters, range 4 to 7), and a mean in New York was 4.5 (17 litters range 3 to 7) (Whitaker 1972). Kruttsch (1954) determined a mean of 4.5 by averaging embryo counts from 62 individual museum labels. Seventy-eight snap-trapped females from New York had a mean number of embryos of 5.5 (range 2 to 9) (Whitaker 1972).
- E. **Ontogeny-** Newborn young (neonates) of *Z. hudsonius*, based on 19 individuals, had a mean total length of 34.4, range 30 to 39 mm; mean tail length of 9.3, range 7 to 11 mm; mean hind foot length of 4.7, range 3 to 6 (Whitaker 1972). The average weight of 14 neonates from three litters was 0.8 g, with a range of 0.7 to 1.0 g (Whitaker 1972). Quimby (1951) presented extensive information concerning the growth and development of *Z. hudsonius*, which was summarized by Whitaker (1972). Neonates had minute vibrissae, but otherwise were naked and pink, with closed eyes that appeared as dark spots. The ear pinnae were folded over the external ear openings. During the first week, the vibrissae became visible to the naked eye, the tail became bicolored, and pinnae of the ears unfolded and were tipped with black, and the claws appeared. Yellowish hairs appeared about the ninth day dorsally, and spread to include the sides about day 13. By then the vibrissae had become prominent and were about 8 mm long. The eyes were still closed, but a crack down the center was visible by about day 13, when white incisors erupted. Sparse, pale-colored hairs were visible on the belly, back of the feet and on the outer surfaces of the legs. During the third week the hair covering was completed and the external auditory meatus began to open. By this time the young were readily identifiable as jumping mice. During the fourth week the adult pelage replaced the juvenile pelage and the eyes opened. The incisors changed from white to the yellowish orange of the adult, and by day 23 all but the third molars had erupted. After the fourth week, growth of the young mice slowed considerably. By this time they were 4.6 times their length at birth, whereas at the end of the 13th week their length had increased to only 5.8 times their length at birth. Tail length had increased 10 times in the first four weeks and 12 times in the first 13 weeks. At four weeks the hind foot was 5.6 times longer than at birth and at 13 weeks it was 5.9 times longer. The young weighed about 2 to 4 g at day 10, about 4 to 8 g at day 20, about 8 to 11 g at day 30, reached a minimum adult weight of about 14 to 15 g at about day 60, and weighed about 20 g by about day 90.
- F. **Age at first parturition-** Quimby (1951) presented evidence from live-trapped and snap-trapped individuals that young of early litters breed during their first summer, at an age of approximately 2 months.
- G. **Longevity-** Quimby (1951) provided definite evidence from a recapture study in Minnesota that *Z. hudsonius* may live to 2 or more years of age. He theorized that the proportion of a population that reaches advanced age is very small, as evidenced by the high turnover rate and instability of natural populations.

10. Behavior

A. Individual

1. Locomotion

- a. **Jumping-** The saltatorial powers of *Z. hudsonius* are well described, and are believed to occur primarily when an animal is frightened. Quimby (1951) noted that the species may jump as far as three feet, while other authors claim to have observed jumps up to 10 feet (Krutzsch 1954), but these observations are in doubt (Quimby 1951). Quimby (1951) found the greatest jumps to occur initially and normally cover a distance of two to three feet; subsequent jumps were shorter but more rapid. A jumping mouse in full retreat progressed by jumps of about one foot. As a means of protection, the animal may move by several long bounds and then stop or remain motionless. When not frightened, animals may progress by a series of short hops of one to six inches (Whitaker 1972). It is believed the tail acts as a balancing organ during jumping (Krutzsch 1954).
- b. **Walking/Crawling-** Whitaker (1972) states that the common name of this species is a misnomer. Mice of the species do not normally progress by jumping, but more often move slowly through the grass, and frequently crawl through the grass or under the grass, sometimes flattening their bodies to the ground and proceeding on all fours.
- c. **Swimming-** Whitaker (1972) reported that several authors have found *Z. hudsonius* to be a good swimmer both on the surface and underwater. Quimby (1951) observed an individual swim rapidly by lunges produced by sweeping strokes of the hind limbs employed simultaneously, and swim more steadily and slowly by using all four limbs one at a time, with the anterior part of the body being held high in the water. The tail is not used for swimming, either for propulsion or as a rudder.
- d. **Climbing-** *Z. hudsonius* has been observed to climb over brush, and to climb up grass stems during feeding (Whitaker 1972).
- e. **Digging-** Quimby (1951) described how caged *Z. hudsonius* construct underground burrows: "After selecting a spot, usually a depression, the animal began to excavate the soil by means of the front feet, throwing it out behind. This process continued until the hole was deep enough to enclose the anterior half of the mouse, at which time the hind feet were also brought into action to throw the loose dirt out of the burrow."
- f. **Washing-** *Zapus* have been observed to wash their feet, faces, and especially their long tails; "The tail was grasped in the forepaws, and passed completely through the mouth, whereas the hands and feet were washed by means of the forepaws" (Whitaker 1972).

2. **Voice and Noises-** Quimby (1951) found that the young *Z. hudsonius* at birth are naked and helpless, but emit a high-pitched squeaking sound, audible for several feet. A "suckling note" is made during the first week. Adults are usually silent, but a few sounds have been recorded, such as

a series of short chirps, a sound similar to a cloth being rubbed across damp glass, and a clucking noise when individuals were excited (Whitaker 1972). Several *Z. hudsonius (preblei)* were observed to make highly agitated squeaks in close proximity to one another (Jones and Jones 1985). A drumming noise was observed when one animal vibrated its tail rapidly against a surface (Whitaker 1972).

3. **Activity period-** Quimby (1951) determined that all records including trapping, field observations and observations of captives indicate that *Z. hudsonius* are mostly nocturnal. Almost all daylight activity of captives occurred on cloudy, damp days and consisted of feeding and moving about. Similarly, nocturnal activity seemed to be greater on cloudy, damp nights. Ordinarily they remained in their quarters during the day, seldom venturing out until after dark.
4. **Hibernation-** The hibernating ability of *Z. hudsonius* is well summarized by Whitaker (1972). *Z. hudsonius* is one of the most profound hibernators, and remains in hibernation as long or longer than most other mammals. The hibernation period probably varies geographically. In Minnesota, 8 of 19 mice entered hibernation between September 17 and October 1, whereas the remainder had shown no sign of hibernating by this date. All of the early hibernators were adults. Seven that had shown no tendency for hibernation by October 1 had entered hibernation by October 16. In both groups the greatest weight gains were during the two weeks just prior to hibernation. About 67% of a New York population studied disappeared during the winter, and began hibernation by about October 20. Fat production begins in central New York around September 1, and continues until all animals have disappeared. The animals that reach adult size and have time to accumulate fat are the animals that survive hibernation. *Z. hudsonius* apparently emerges from hibernation in the last week of April or the first week in May in New York and Minnesota. Males generally precede females. The species usually hibernates in solitary, underground nests, but has been observed in pairs.

- B. **Intraspecific-** Quimby (1951) noted that *Z. hudsonius* is most likely solitary, as evidenced by only one instance of capturing two individuals in one live-trap, and 431 single catches. Caged individuals, regardless of sex, age class, or number in the cage, did not act antagonistically with one another. In most instances all residents occupied the same retreat and new additions were accepted. One exception occurred, however, when two recently captured adult males were placed in the same cage during May soon after emergence. One was definitely hostile towards the other, and would bite or attempt to bite the other on the rump. It is suspected that the one bit off about one inch from the other's tail. The only other evidence of antagonistic intraspecific behavior was observed by Jones and Jones (1985). They observed several *Z. hudsonius (preblei)* jumping into the air and squeaking, in close proximity to one another (i.e., less than one foot). This activity was centered around a solitary, low shrub on the edge of a wet depression. The bounds of the mice were reportedly about 60 cm long and 45 cm above the ground. The mice disappeared upon close approach of the observers.

- C. **Interspecific-** *Z. hudsonius* are docile creatures, but there is some evidence that they will defend themselves when attacked (Quimby 1951). A subadult imprisoned with an adult meadow mouse, *Microtus pennsylvanicus*, was killed and badly mutilated during a struggle. The much larger meadow mouse, although not mortally wounded, suffered a severe gash in the upper lip, evidently inflicted by the incisors of the jumping mouse. Whitaker (1972) reported that in habitats where there appeared to be sufficient food, other species of mammals, if they did compete, did not limit the distribution or abundance of *Zapus*. As mentioned above under *Jumping*, when frightened *Z. hudsonius* escapes by means of long bounds, and then stops, may progress by crawling low to the ground, and may remain motionless, at times with its white ventral region pressed close to the ground, using its coloration as camouflage (Quimby 1951).

11. **Physiology**

- A. **Thermoregulation-** The average body temperature of *Z. hudsonius* was calculated to be 37.27°C (range 35.1 to 40.1°C), but expresses a rhythmic daily cycle, being highest at night (mean of 38.0°C) and lowest during the day (mean of 36.9°C) (Whitaker 1972). This daily fluctuation reflects the nocturnal behavior pattern of this species. During exposure to temperatures of 0 to 10°C, the body temperature of a *Z. hudsonius* was unstable. In response to ambient night temperatures less than zero, the body temperature increased to a normal nighttime active temperature of about 38°C, and was apparently the result of increased metabolic activity. This activity was interpreted to be beneficial in keeping the animal from freezing, and was similar to activity found in other hibernating mammals (Whitaker 1972). During dormancy, rectal temperatures were found to be at least 3°C higher than ambient temperatures above 0°C. In response to ambient temperature below 0°C, skin temperature rose from 3 to 10°C. The body temperature of one animal during emergence from hibernation rose from 2 to 25°C in 30 minutes, fluctuated between 25 and 33°C for about an hour, and leveled off at 33°C thereafter (Whitaker 1972).
- B. **Oxygen consumption-** Whitaker (1972) presented information on oxygen consumption of a *Z. hudsonius* as it entered hibernation. At an ambient temperature of 29°C, oxygen consumption was about 2000 mm³/hr/g of body weight. At 10°C, oxygen consumption rose to between 5000 and 6000 mm³. Metabolic response dropped slightly in the first hour, dropped to 200 mm³ the next half hour, and reached a minimum of 40 mm³ in another 4 hours. After waking spontaneously, the animal utilized 5000 mm³ necessary for maintenance at 10°C within an hour of emergence.
- C. **Weight fluctuation-** *Z. hudsonius* puts on fat, deposited in a thin layer over the inside of the skin, over the back, and in body cavities, in the autumn in preparation for hibernation (Krutzschn 1954). Weight gain can be rapid and extensive. One individual fattened from 19 to 37 g, with average daily increases of 1.9 to 2.0 g per day. A 6 to 8% increase in body weight per day was observed in some individuals over three days. The rate was found to be lower over longer periods, with periods of increase interspersed with periods of non-increase. Increase in weight is not synchronized among individuals. Jumping mice that fatten on short days before hibernation hibernated for longer periods than mice that fattened on long days (Whitaker 1972).

12. **Current land ownership and management responsibility necessary**
- A. **General nature of ownership(s)-** The Colorado locations of most recent capture of *Z. h. preblei*, being possible locations of extant populations, include the U.S. Department of Energy's Rocky Flats Plant, the Fort St. Vrain Nuclear Generating Station, and City of Boulder Open Space Department lands (i.e., Tracy Collins and VanVleet parcels). These properties have several features in common; they are relatively large units of land, portions of which generally consist of homogenous, contiguous critical vegetational habitat, that have been and are in some way protected from development and high human usage. Other lands consisting of potential critical habitat in Colorado and Wyoming may be federally-, state-, county-, city-, or privately owned.
- B. **Specific landowner(s), if known; give name(s) and address(es) if available and not publicity-sensitive-**
1. **Rocky Flats Plant-** The Rocky Flats Plant is federally owned by the U.S. Department of Energy. General information about the plant may be obtained by calling (303) 966-7000, or Melany Zgabay, Communications Department, at (303) 966-4001. To obtain information concerning environmental restoration, contact Bruce Bevirt at EG&G Rocky Flats, Inc., Rocky Flats Plant, P.O. Box 464, Golden, Colorado, 80402-0464, or by phone at (303) 966-8514.
 2. **Fort St. Vrain Nuclear Generating Station-** The Fort St. Vrain Nuclear Generating Station is owned and operated by the Public Service Company of Colorado. The Nuclear Training Manager for Nuclear Operations (station manager) is Ted Borst, who may be contacted at the plant location at 16805 WCR 191/2, Platteville, CO 80651, or by phone at (303) 620-1000 or by pager at (303) 556-0380.
 3. **City of Boulder Open Space: Tracy Collins parcel-** The Tracy Collins parcel is under the jurisdiction of the City of Boulder Open Space Department, P.O. Box 791, Boulder, CO 80306. Mark D. Gershman is the Wetlands-Wildlife Coordinator for the Open Space Department, and may be contacted at (303) 441-3440.
 4. **City of Boulder Open Space: VanVleet parcel-** Same as for the Tracy Collins parcel.
- C. **Management responsibility-** Currently, the above-mentioned lands are administered by their respective owners. The current management of the above areas of potentially critical habitat is not necessarily proactive toward preserving critical habitat. However, the inherent low level of human activity at the two power plants, for reasons of security, safety, and location, and at the City of Boulder Open Space lands, for reasons of preserving the aesthetic and recreational values of the landscape, has acted to preserve these lands as potentially viable habitat for *Z. h. preblei*.
- D. **Easements, conservation restrictions, rights-of-way, special designations, etc.-**
1. **Rocky Flats Plant-** A power company currently has an easement to access and maintain transmission lines that traverse the plant. In addition, Western Aggregate and Charles McKay Aggregate have mineral rights to mine materials for concrete production. There are currently no areas of special environmental designation; however, there is discussion concerning designating the Rock Creek area, located at the north end of

the buffer zone, as an area of special environmental concern (Melany Zgabay pers. comm.).

2. **Fort St. Vrain Nuclear Generating Station-** The Public Service Company of Colorado has leased the majority of its land associated with the Fort St. Vrain Nuclear Generating Station to ranchers to graze and water livestock, and for minimal agricultural activities, since the mid-1970s or earlier (Ted Borst pers. comm.). Part of this grazing activity is directly adjacent to the irrigation canal where captures of *Z. h. preblei* were made in the 1970s. The grazing may have had an adverse impact on the dense, tall vegetation along the canal which is considered critical habitat structure. There has also been periodic exploration for natural gas involving the drilling of wells (Ted Borst pers. comm.). No other known leases, easements, or special designations are known for this station.
3. **City of Boulder Open Space: Tracy Collins parcel-** The Tracy Collins parcel is leased for livestock grazing in the spirit of preserving agricultural heritage and promoting ecologically sound agriculture. Grazing has been allowed on the parcel since its inclusion as City of Boulder Open Space land in 1984 (Mark Gershman pers. comm.).
4. **City of Boulder Open Space: VanVleet parcel-** The VanVleet parcel is leased for agricultural purposes, and is utilized as a hayfield and winter pasture for livestock. The land is leased in the spirit of preserving agricultural heritage and promoting ecologically sound agriculture. The land has been leased for agricultural purposes since its inclusion as City of Boulder Open Space land in 1978 (Mark Gershman pers. comm.).

13. Management practices and experience

A. Review of past management and land-use experiences

1. **Rocky Flats Plant-** The U.S. Department of Atomic Energy established the Rocky Flats Plant in 1952 (Melany Zgabay pers. comm.). The plant is currently administered by the U.S. Department of Energy. The plant was established to produce plutonium for nuclear weaponry. Land associated with the plant consists of 6440 total acres, approximately 6000 acres of which consists of a buffer zone around the main facility. The buffer zone has been effectively protected from human activities and development since establishment of the plant. In essence, the area has served as a nature preserve, and is surrounded by a security fence. No proactive wildlife or habitat management has occurred on the site, with the exception of the maintenance of traditional ungulate migration routes. Small-mammal surveys were conducted during the summer of 1991 by Ebasco Services Inc.
2. **Fort St. Vrain Nuclear Generating Station-** The Public Service Company established the Fort St. Vrain Nuclear Generating Station in about 1965 (Ted Borst pers. comm.). Land associated with the station consists of approximately 2300 acres that has received a very low level of human activity and development since station establishment. Public use is low because there are no important fisheries in the nearby water resources (i.e., St. Vrain Creek and S. Platte River), and no important aesthetic resources in the area. Occasionally, company personnel hunt near a pond at the north end of the buffer zone. Leasing of lands for

livestock grazing has occurred since the mid-1970s on the majority of the buffer area around the station. Some of this land is potential *Z. h. preblei* habitat. Dr. Bruce Wunder, University of Colorado, conducted live-trapping during the 1970s on station land as part of an Ecological Monitoring study of the location, and captured three individuals over an eight-year period. No proactive management has occurred on the site to monitor or preserve habitat for this subspecies.

3. **City of Boulder Open Space: Tracy Collins parcel-** The Tracy Collins parcel, which contains part of the Coal Creek riparian area, has been administered by the City of Boulder Open Space Department since 1984 (Mark Gershman pers. comm.). The area consists of 146 acres that are leased for livestock grazing. Public access is also allowed on the area for recreational purposes, but no trails occur in the specific area of capture, and recreational use is very low. The specific area is bordered by Colorado State Highways 93 and 128 to the west, north and east, and by other Open Space lands to the south. The area is surrounded by Open Space lands for a distance ranging from 1.5 to 4.5 miles.

4. **City of Boulder Open Space: VanVleet parcel-** The VanVleet parcel has been administered by the City of Boulder Open Space Department since 1978 (Mark Gershman pers. comm.). The parcel consists of 771 acres, and is bordered to the north by the Burke parcels and to the south by other Open Space lands. The specific location of capture is bounded by Open Space lands for close to 1.0 mile in any direction. The parcel is leased for agricultural and grazing purposes. Public access is also allowed for recreational activities, although dogs are prohibited on the VanVleet parcel itself. A heavily utilized walking/hiking trail exists through the VanVleet parcel, very close to the location of capture.

B. **Performance under changed conditions-** There is a paucity of information available concerning the status of populations of *Z. h. preblei* over time or under changing conditions. One example, however, may include the history of capture data from Fort St. Vrain. Summer grazing began at Fort St. Vrain sometime in the mid-1970s, at the latest. There were single captures in 1972, 1976 and 1977, the first capture being prior to, and the latter two captures during heavy grazing. However, there was no capture in 1992, which may indicate the negative effect of long-term, heavy grazing of livestock on the vegetational habitat of *Z. h. preblei*. Winter grazing has been allowed on the VanVleet parcel (location of most recent capture) since 1978. Winter grazing would not be expected to directly impact hibernating jumping mice, but might impact habitat structure. Armstrong (1972) indicated that due to the dependence of this subspecies on dense vegetation in moist lowlands, irrigation should have an influence, both historically and currently, on the locations of occurrence of this subspecies.

C. **Current management policies and actions**

1. **Rocky Flats Plant-** Currently, the Rocky Flats Plant maintains its security fence, as the plant is currently conducting environmental restoration and waste management. The plant is planning to be fully decommissioned and decontaminated sometime in the future. Land management of the buffer zone is not a proactive process. However, there is discussion concerning designating the Rock Creek area, located

in the northern part of the buffer zone, as an area of special environmental concern (Melany Zgabay pers. comm.).

2. **Fort St. Vrain Nuclear Generating Station-** The current management policy allows for continued leasing of the 2300-acre buffer zone around the station for grazing and agricultural activities. Natural gas exploration, hunting, and recreational activities are not prohibited, but these activities have occurred at only low levels historically (Ted Borst pers. comm.).
3. **City of Boulder Open Space: Tracy Collins parcel-** The Tracy Collins parcel is leased and managed for summer grazing in the spirit of preserving agricultural heritage and promoting ecologically sound agriculture (Mark Gershman pers. comm.).
4. **City of Boulder Open Space: VanVleet parcel-** The VanVleet parcel is leased for agricultural purposes, namely as a hayfield and winter pasture, in the same spirit as above (Mark Gershman pers. comm.).

D. **Future land use**

1. **Rocky Flats Plant-** The future state of the Rocky Flats plant is unknown, as planning appears to be in a perpetual state of flux. The U.S. Department of Energy is planning on having the plant fully decommissioned and decontaminated sometime in the future. There is discussion of opening the land to economic development (Melany Zgabay pers. comm.).
2. **Fort St. Vrain Nuclear Generating Station-** In the next ten years or so, the Public Service Co. is planning to convert its plant from nuclear generation to a natural gas fired plant. They plan to continue operations and current land management policies, during the conversion process (Ted Borst pers. comm.).
3. **City of Boulder Open Space: Tracy Collins parcel-** The City of Boulder Open Space Department is planning on maintaining its current land management policy on the Tracy Collins parcel, unless other Open Space goals become more important (Mark Gershman pers. comm.).
4. **City of Boulder Open Space: VanVleet parcel-** Same as above, but for the VanVleet parcel (Mark Gershman pers. comm.).

14. **Evidence of threats to survival**

A. **Present or threatened destruction, modification, or curtailment of habitat or range**

1. **Past threats-** Assuming the affinity of *Z. h. preblei* for moist lowland habitat consisting of dense, grassy vegetation, it is reasonable to assume that much of the landscape of the western Colorado Piedmont, well northward into Wyoming, consisted of such habitat before the turn of the century. The advent of agriculture, with the conversion of moist grasslands into commercial, monocultural farmlands, probably eliminated a fair amount of viable habitat for this subspecies. The summer grazing of livestock in moist meadow and riparian habitats has probably played a significant role in reducing the amount of viable habitat for this subspecies. The development of irrigation systems to shunt water to farmlands, and away from other lands, may have left certain pockets of lands in a drier, unsuitable condition. Alternatively, irrigation may have also produced viable habitat where dikes and/or canals were constructed through dry, upland areas. It is more likely, however, that the inadvertent

construction of narrow, linear habitat has not compensated for the losses of habitat converted to agricultural use. Residential and commercial development throughout the known historical range of *Z. h. preblei* has doubtlessly fragmented this subspecies' critical habitat. The management of water resources for associated domestic and commercial water usage has had a tendency to channelize and isolate water resources and fragment, realign, and reduce riparian habitat.

2. **Existing threats-** The continued residential and commercial development, or "urban sprawl" of the Colorado Piedmont area includes the cities of Denver, Boulder, Fort Collins, and Greeley, Colorado, and to a lesser extent Laramie and Cheyenne, Wyoming. This conversion from natural conditions and habitats to those of human use (i.e., structures, parking lots, paved and unpaved roadways, walkways, trails, airports) continues to fragment and extirpate potential critical habitat for this subspecies. Agricultural uses and developments on critical meadow and riparian habitats, such as construction and maintenance of irrigation canals, permanent and temporary roadways, storage facilities, croplands, and the grazing of livestock, will continue to remove or effectively destroy viable habitat for this subspecies.
3. **Potential threats-** Future residential, commercial, municipal and agricultural developments could threaten the remaining critical habitat of *Z. h. preblei*.

- B. **Overutilization for commercial, sporting, scientific, or educational use-** There is no historical or current information that would indicate the this subspecies has ever been exploited for commercial, sporting, scientific, or educational purposes. In fact, the total number of study skins collected and maintained for this subspecies is relatively low.
- C. **Disease, predation, or grazing-** The number of parasites known to effect the species *Z. hudsonius* is relatively low compared to other small mammal species. The severity of parasitic inflictions are mild and have not been recorded to have caused mortality in this species. Although the species is known to be preyed upon by representatives of every major vertebrate group, and the species' primary defense mechanism may seem potentially ineffective (remaining motionless and camouflaged), there is no evidence that overutilization by predators has caused a decline in the local subspecies. However, the subspecies may utilize habitat associated with irrigation canals and associated riparian habitats. These narrow habitat strips may be heavily frequented by avian and mammalian predators because such habitats would be relatively more diverse and productive than the surrounding drier upland habitat. The effect of grazing would be to reduce the density and height of moist, lowland grasslands. Habitats supporting this critical vegetation type would be likely candidates for conversion, both in the past and in current times, into quality grazing and agricultural lands. There is some evidence from live-trapping at Fort St. Vrain that the primary area of capture in the 1970s has been converted to grazing land, and that the subspecies has been adversely affected by grazing.
- D. **Inadequacy of existing regulatory mechanisms**
 1. **Past threats-** The establishment of agricultural lands and construction of irrigation facilities was relatively unfettered during the period of expansion toward the western United States. The development of

transport ways and commercial and residential structures during early expansion was also relatively unregulated compared to modern standards. These developments were also relatively small-scale and somewhat reversible compared to modern developments.

2. **Existing threats-** The location of residential and commercial development and construction are under the jurisdiction of local city and town zoning ordinances. The City of Denver, located in what was once prime habitat for *Z. h. preblei*, is primarily zoned for commercial and residential development. Similarly, much of the Cities of Boulder, Fort Collins, and Greely are commercially and residentially zoned. Fortunately, the City of Boulder has exercised great foresight through the purchase of extensive parcels of land, placed under the jurisdiction of the Open Space Department, to be used primarily as natural, recreational parks or for ecologically sound agricultural purposes. No such effort has been made to date by the Cities of Fort Collins and Greely. Much of the intervening lands between these major cities is zoned as residential and agricultural. However, the towns of Loveland and Longmont, and dozens of other smaller towns, fragment much of the intervening landscape with both small commercial and generally expanding residential zones. In addition, there are currently no effective zoning ordinances that provide for a buffer zone, or in any other way protect critical meadow and riparian areas from grazing. Without the active participation and commitment of town and city planning committees to establish local zoning ordinances that preserve locations of contiguous, natural habitat, the remaining critical habitat of *Z. h. preblei* will surely eventually perish.
3. **Potential threats-** Continued residential, commercial, municipal and agricultural developments could potentially threaten the remaining critical habitat of *Z. h. preblei*.

III. Assessment and Recommendations

1. **General assessment of vigor, trends, and status-** The assessment of historical trends concerning the vigor and status of *Z. h. preblei* is a difficult task, due to both the historical and current paucity of demographic data. Historical data in the form of study skins outlines the historical range of the species (see *Geographical range*). However, the status of the species within its historical range is not well known, as few study skins have been collected (a total of 38, with 14 other records in Colorado, and a total of 6, with 1 additional record in Wyoming). Armstrong (1972) stated that this subspecies, "is poorly known in Colorado, an apparently is nowhere abundant." Long (1965) echoed this idea for Wyoming in stating that this subspecies was rare. These assessments may provide an accurate portrait of the general vigor of this subspecies. It may be that *Z. h. preblei* has historically maintained a low population density in Colorado and Wyoming, or has at least been isolated in its distribution to refuges of critical moist, lowland habitat. Since there is evidence that this subspecies still exists in locations with appropriate habitat (i.e., Coal Creek in 1989, Rocky Flats in 1991, and VanVleet in 1992), the extinction of the species may not be imminent. However, given the number of reports of this subspecies in recent history (12 individuals in the last 20 years), and the nature of the reports (found in isolated refuges of critical habitat), the current status of the species may be declining, and the preservation of refuges of critical habitat may be essential to maintain this subspecies.

2. **Priority of listing or status change**
- A. **Recommendation to U.S. Fish and Wildlife Service-** It is recommended that *Z. h. preblei* be listed as threatened in Colorado and Wyoming. However, further study on the location and status of specific populations of this subspecies should be conducted to establish the current vigor of the subspecies, and to identify additional locations of critical habitat.
 - B. **Recommendations to other U.S. Federal Agencies-** The U.S. Department of Energy, which has jurisdiction and management responsibility for the Rocky Flats Plant, should be informed of the importance of its buffer zone land as critical habitat for *Z. h. preblei*. It is recommended that a formal management policy be formulated to ensure the maintenance and protection of critical habitat.
 - C. **Other status recommendations**
 - 1. **Counties and local areas**
 - a. **City of Boulder Open Space Department-** The Open Space Department, which has jurisdiction and management responsibility for the Tracy Collins and VanVleet parcels, should be informed of the importance of its land as critical habitat for *Z. h. preblei*. It is recommended that a formal management policy be formulated to ensure the maintenance and protection of critical habitat for this subspecies.
 - b. **Public Service Company of Colorado-** The Public Service Co., which has jurisdiction and management responsibility for the Fort St. Vrain Nuclear Generating Station, should also be informed of the potential importance of its buffer zone land as critical habitat for *Z. h. preblei*. It is recommended that a formal management policy be formulated to ensure the maintenance and protection of critical habitat for this subspecies.
 - 2. **State**
 - a. **Colorado-** The Colorado Division of Wildlife (CDOW) should be contacted regarding the recommended federal listing of *Z. h. preblei* as a threatened subspecies. Currently, this subspecies is a "species of special concern" for the CDOW, and is also legally protected from being taken intentionally as a nongame species. However, no formal proactive management policy has been established. The CDOW should act under the federal regulations stated in the Endangered Species Act (1969, as amended) to preserve and protect this subspecies and its critical habitat.
 - b. **Wyoming-** The Wyoming Game and Fish Department (WGFD) should be contacted regarding the recommended federal listing of *Z. h. preblei* as a threatened species. Currently, this subspecies is legally protected by Wyoming Game and Fish Commission regulations from being taken intentionally. However, no formal proactive management policy has been established. The WGFD should act under the federal regulations stated in the Endangered Species Act (1969, as amended 1973) to preserve and protect this subspecies and its critical habitat.
 - 3. **International-** International trade or exploitation of this subspecies should be prohibited.

3. Recommended critical habitat

- A. **Concise statement (Based on the information reviewed in this statement and the field studies of the author, the following area is recommended for designation as the Critical Habitat of *Zapus hudsonius preblei* under the provisions of the Endangered Species Act of 1973):** It is recommended that the locations of most recent known capture be designated as critical habitat for this subspecies. This would include locations, specified below under *Township and range*, in the Rocky Flats Plant, Fort St. Vrain Nuclear Generating Station, Coal Creek of the City of Boulder Open Space Department's Tracy Collins parcel, as well as the Open Space Department's VanVleet parcel and adjacent parcels. Any new discoveries of this subspecies should be included as critical habitat if the subspecies is listed.
- B. **Legal description of boundaries-** The primary historical range of *Z. h. preblei* in Colorado extends southward from eastern Larimer County to eastern Boulder County, southwestern Weld County, and western Denver and Arapahoe Counties, and terminates in eastern Jefferson and northern Douglas County (Armstrong 1972). In addition, the subspecies appears to have been captured near Woodburn, El Paso County. Hence, the historical range should be extended southward, east of the Front Range, to this location. In Wyoming, based on six study skins and one additional record of *Z. h. preblei*, the historical range occurs in the southeastern portion of the state, in the majority of Albany, Laramie and Platte Counties, and in the southern portion of Converse County, all south of the North Platte River (Long 1965). Known locations of critical habitat within these historical ranges include portions of the Rocky Flats Plant, near Golden, Colorado, Fort St. Vrain Nuclear Generating Station, near Longmont, Colorado, and the Tracy Collins and VanVleet parcels of the City of Boulder Open Space Department, south and east of Boulder, Colorado. Other critical habitat may exist within the subspecies' historical range.
- C. **Township and range-** Rocky Flats Plant is located in southern half of Sections 2 and 3, all of Sections 10 and 11, and the northern half of Sections 14 and 15, T 2S, R 70W. The location of critical habitat is the Woman Creek drainage, which traverses the southern portion of Section 11. Critical habitat at the Fort St. Vrain Nuclear Generating Station is located in Sections 27 and 34, T 4N, R 67W. Coal Creek, of the Tracy Collins parcel, traverses the southeast portion of Section 32, cuts diagonally (northeast) across Section 33, and traverses the southern portion of Section 27, T 1S, R 70W. The VanVleet parcel and adjacent Open Space land is located in the majority of Section 15, the eastern portions of Sections 9 and 16, the northwest portion of Section 14, the southwest portion of Section 11, and most of Section 10, and traverses the central portion of Section 3, T 1S, R 70W, and extends to the south-central portion of Section 34, T 1N, R 70W.
- D. **Publicity/sensitivity of critical habitat areas**
1. **Rocky Flats Plant-** The Rocky Flats Plant, a former nuclear weapons plant, is being phased out of commission. The future of the plant and associated buffer zone land is unknown, and a matter of public concern.
 2. **Fort St. Vrain Nuclear Generating Station-** The Public Service Company of Colorado is in the process of converting the station to a natural gas fired plant. The re-operation of this plant could positively

- influence the economies of local municipalities. However, the past status of the land as a nuclear plant buffer zone may be of some public concern.
3. City of Boulder Open Space: Tracy Collins parcel- The Tracy Collins parcel may be of particular public concern. The City of Boulder Open Space Department leases this land to private citizens for agricultural purposes (i.e., summer grazing). These purposes may not be compatible with preserving critical habitat of *Z. h. preblei*, and some discussion about this issue may ensue. Overall, the public supports the efforts of the Open Space Department, so preservation of subspecies habitat may be viewed as a positive goal by the majority of citizens.
 4. City of Boulder Open Space: VanVleet parcel- Similarly, the VanVleet parcel is leased for agricultural purposes (hayfield and winter pasture). These purposes may or may not be compatible with preserving critical habitat of *Z. h. preblei*, and some discussion about this issue may ensue. Overall, the public supports the efforts of the Open Space Department, so preservation of subspecies habitat may be viewed as a positive goal by the majority of citizens.

4. Conservation/recovery recommendations

A. General conservation recommendations

1. Recommendations regarding present or anticipated activities

- a. Rocky Flats Plant- The maintenance of current conditions, which effectively protect the local *Z. h. preblei* from disturbances such as development and high human usage, is perceived to be adequate protection. If the U.S. Department of Energy is planning on selling the buffer zone land to commercial developers, it is recommended that the portion of land consisting of critical habitat be protected or preserved in some way, such as transferring the land to the U.S. Fish and Wildlife Service, or other appropriate federal or state agency. This coupled with the immediate formulation of a formal land management plan that specifically cites moist, lowland habitat (i.e., Woman Creek) as critical habitat would effectively protect the subspecies and its habitat.
- b. Fort St. Vrain Nuclear Generating Station- The conversion of the Fort St. Vrain plant to a natural gas fired plant should not adversely impact the subspecies in any way. However, the continuation of heavy grazing activity along moist, lowland habitats (i.e., irrigation canal flowing from pond at north end of the buffer zone land, or other irrigation canals) may adversely impact *Z. h. preblei*, if a population still exists there. It is recommended that further live-trapping studies occur on station lands to determine the existence of subspecies populations. If such populations are found, it is recommended that a buffer strip, for instance 400 feet wide, be centered along neighboring irrigation canals to prevent grazing and livestock access. This action would allow the growth and maintenance of dense, tall, grassy vegetation during the annual activity period of this subspecies.

- c. **City of Boulder Open Space: Tracy Collins parcel-** It is recommended that further live-trapping studies occur along Coal Creek, possibly extending outside the Tracy Collins parcel, to identify the locations of any populations of *Z. h. preblei*. If such populations are found, it is recommended that the area of critical habitat be identified, and a formal policy be formulated by the City of Boulder Open Space Department to preserve and protect both the critical habitat and this subspecies.
 - d. **City of Boulder Open Space: VanVleet parcel-** Similarly, it is recommended that an extensive live-trapping study be performed on the VanVleet parcel and adjacent parcels of Open Space land (i.e., Burke I, Burke II, and parcels to the south) to determine the precise locations of subspecies populations and associated areas of critical habitat. If populations are found, it is recommended that a formal policy be formulated by the City of Boulder Open Space Department to preserve and protect both the critical habitat and populations of this subspecies.
 - e. **Other-** In general, the municipalities of Denver, Boulder, Fort Collins, Greeley, and intervening townships in Colorado, and Laramie and Cheyenne in Wyoming should be cognizant of areas of potential critical habitat for this subspecies, and should endeavor to preserve and protect these habitats from extirpation as a result of residential, commercial, municipal, and agricultural developments.
2. **Areas recommended for protection**
- a. **Rocky Flats Plant-** The areas recommended for protection are the areas of moist, lowland habitat associated with Woman Creek.
 - b. **Fort St. Vrain Nuclear Generating Station-** The irrigation canal that flows from the pond at the northern end of the Fort St. Vrain Nuclear Generating Station buffer zone, and associated moist, lowland habitat.
 - c. **City of Boulder Open Space: Tracy Collins parcel-** The drainage associated with Coal Creek, which traverses Tracy Collins and adjacent parcels.
 - d. **City of Boulder Open Space: VanVleet parcel-** The area south of Highway 36 within the VanVleet and adjacent parcels for a distance of at least 0.5 miles.
 - e. **Other-** Any and all other moist, lowland habitats of 5.0 or more contiguous acres consisting of dense, tall, grassy vegetation within the historical range of the subspecies are potential areas of critical habitat for *Z. h. preblei*. These areas should be thoroughly investigated for subspecies presence, and should be duly protected until thoroughly investigated.
3. **Habitat management recommendations**
- a. **Rocky Flats Plant-** Management of the Woman Creek habitat should consist primarily of minimizing human disturbance and development of the area, and maintaining or protecting the natural water flow through the creek.

- b. **Fort St. Vrain Nuclear Generating Station-** As a precaution, management of the irrigation canal should involve minimizing human disturbance and livestock grazing in a buffer zone of at least 400 feet either side of the canal midline. This buffer zone should effectively allow the growth and maintenance of dense, tall, grassy vegetation required by this subspecies. Buffer strips could be managed along other canals and waterways within the buffer zone of the station. However, it should be noted that a low level of grazing may not adversely impact this subspecies.
- c. **City of Boulder Open Space: Tracy Collins parcel-** As a precaution, management of the Coal Creek drainage should involve minimizing human disturbance and livestock grazing in a buffer zone of at least 400 feet either side of the creek midline. This buffer zone should effectively allow the growth and maintenance of native vegetational structure required by this subspecies. However, it should be noted that a low level of grazing may not adversely impact this subspecies.
- d. **City of Boulder Open Space: VanVleet parcel-** The current agricultural activities performed on the VanVleet parcel include the harvesting of hay in the autumn, and use of the parcel as winter pasture for livestock. These activities do not necessarily threaten critical habitat for *Z. h. preblei*. Harvesting of hay should take place after the presumed period of hibernation of this subspecies (i.e., after mid-October). The use of the land as winter pasture should not impact this subspecies, as it is believed to remain in hibernation, usually well underground, until early April.

- 4. **Publicity/sensitivity-** Same as for 3.D. above.
- 5. **Other recommendations-** None

B. Monitoring activities and further studies recommended

- 1. **Rocky Flats Plant-** It is recommended that live-trapping studies continue at the Plant to determine the status of the population inhabiting the Woman Creek drainage.
- 2. **Fort St. Vrain Nuclear Generating Station-** As above, it is recommended that further live-trapping studies occur on station lands to determine the existence and location of subspecies populations.
- 3. **City of Boulder Open Space: Tracy Collins parcel-** As above, it is recommended that further live-trapping studies occur along Coal Creek, possibly extending outside the Tracy Collins parcel, to identify the locations of any populations of *Z. h. preblei*.
- 4. **City of Boulder Open Space: VanVleet parcel-** As above, it is recommended that an extensive live-trapping study be performed on the VanVleet parcel and adjacent parcels of Open Space land (i.e., Burke I, Burke II, and parcels to the south) to determine the precise locations of subspecies populations and associated areas of critical habitat.
- 5. **Other-** A thorough survey should be conducted throughout the historical range of this subspecies to identify potential critical habitat areas (5 contiguous acres or more). Once identified, a thorough live-trapping study should be conducted in each area of potential critical habitat to

positively identify all extant populations of *Z. h. preblei*. Such a survey should also include live-trapping efforts in the southernmost location of capture near Woodburn, El Paso County, Colorado.

5. Interested parties

- A. U.S. Department of Interior, Fish and Wildlife Service, Colorado State Office.
- B. U.S. Department of Interior, Fish and Wildlife Service, Wyoming State Office.
- C. Colorado Division of Wildlife, Central Region Office.
- D. Colorado Division of Wildlife, NE Regional Office.
- E. Wyoming Game and Fish Department, Game Division.
- F. U.S. Department of Energy, Rocky Flats Plant.
- G. EG&G Rocky Flats, Inc.
- H. Public Service Company of Colorado, Fort St. Vrain Nuclear Generating Station.
- I. City of Boulder Open Space Department.

III. Information Sources

1. Sources of information

- A. Publications
 - 1. References cited in report- See *Literature Cited*.
 - 2. Other technical publications- None
- B. Museum collections consulted- Pioneer Environmental Consulting Services, Inc., contacted nine museums to determine the location of study skins and to obtain capture location information. The museums consulted included:
 - 1. Denver Museum of Natural History, Denver, CO. (5 specimens)
 - 2. The Academy of Natural Sciences, Philadelphia, PA. (no specimens)
 - 3. National Museum of Natural History, Washington, DC. (10 specimens)
 - 4. The University of Kansas Museum of Natural History, Lawrence, KS. (1 specimen)
 - 5. The Cleveland Museum of Natural History, Cleveland, OH. (no specimens)
 - 6. Field Museum of Natural History, Chicago, IL. (21 specimens)
 - 7. University of Colorado Museum, Boulder, CO. (5 specimens)
 - 8. Colorado State University, Fort Collins, CO (2 specimens)
 - 9. National Ecology Research Center, Fort Collins, CO. (no specimens)
- C. Fieldwork
 - 1. Live-trapping surveys were performed by Pioneer Environmental Consulting Services, Inc. in the following locations:
 - a. Fort St. Vrain Nuclear Generating Station, buffer zone, Sections 27 and 34, T 4N, R 67W; August 5-9, 1992.
 - b. City of Boulder Open Space Department land, Tracy Collins parcel, Section 33, T 1S, R 70W; August 12-15, 1992.
 - c. City of Boulder Open Space Department land, VanVleet parcel, Section 10, T 1S, R 70W; August 12-15, 1992.
 - d. City of Boulder Open Space Department land, Burke I parcel, Section 3, T 1S, R 70W; August 15-18, 1992.

- e. City of Boulder Open Space Department land, Burke II parcel, Section 34, T 1N, R 70W; August 15-18, 1992.
2. A Live-trapping survey was performed by Ebasco Services Inc. at the U.S. Department of Energy's Rocky Flats Plant, during the summer and fall of 1991.
3. An extensive live-trapping survey was performed by Thorne Ecological Institute in the buffer zone of the Fort St. Vrain Nuclear Generating Station, during the summers of 1972-79.

D. Knowledgeable individuals

1. Dr. David M. Armstrong, University of Colorado.
2. Dr. James Fitzgerald, University of Northern Colorado.
3. Dr. Bruce Wunder, Colorado State University.

E. Other information sources

1. Computer printouts from the WILDATA database (Latilong) and Colorado Wildlife Species Database (CWSD) from the Colorado Division of Wildlife.
2. Computer printout from the Wyoming Natural Diversity Data Base from The Nature Conservancy.

2. Summary of materials on file- All references cited in this report, as well as current phone numbers and/or addresses of knowledgeable individuals are filed with Pioneer Environmental Consulting Services, Inc., 980 West 1800 South, Logan, Utah, 84321.

IV. Authorship

1. Initial authorship- Stephen A. Compton and Roy D. Hugie, PhD, Pioneer Environmental Consulting Services, Inc., 980 West 1800 South, Logan, Utah, 84321.
2. Maintenance of status report- Addendums to this report will be produced by the initial authors. Maintenance and distribution of this report will be the responsibility of the Contracting Officer's Technical Representative, Lee Carlson, U.S. Fish and Wildlife Service, Colorado Field Office, 730 Simms Street, Golden, Colorado, 80401.

V. New Information

1. Record of revisions to this status report- None

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