THIRD YEAR SURVEY FOR PREBLE'S MEADOW JUMPING MOUSE (*Zapus hudsonius preblei*) IN COLORADO

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Introduction

Preble's meadow jumping mouse (*Zapus hudsonius preblei*) is a rare subspecies of the meadow jumping mouse (*Z. hudsonius*), and is known only from Colorado and Wyoming. Probably a Pleistocene relict, Preble's meadow jumping mouse previously may have enjoyed a wider distribution in tallgrass prairie or savanna across the eastern plains of these two states. Impoundment of wetland areas, development along riparian areas, grazing, and gravel-mining have all contributed to the decline of their populations in recent times (Fitzgerald et al. 1994). *Z. hudsonius* is broadly distributed across eastern North America above 30 degrees latitude and across western North America above 45 degrees latitude.

Two related taxa that occur in Colorado deserve mention. The western jumping mouse, *Zapus princeps*, inhabits lush riparian vegetation generally at higher elevations than *Z. h. preblei*. They are not known to be sympatric with *Z. h. preblei*; the closest known occurrence of the two species is eight miles, between Gold Hill and Boulder, Boulder County (Armstrong 1972). A third taxon of *Zapus* has just recently been discovered in Colorado: *Z.h. luteus*, previously known only from Arizona and New Mexico, has been collected in southern Las Animas County, Colorado (Jones 1996). Twenty specimens were collected from three localities, Schwacheim Creek, Chicorica Creek, and NW of Lake Dorothey on the West Fork of Schwacheim Creek, at Lake Dorothey State Wildlife Area, Las Animas County (Jones 1996). This subspecies had previously been assigned to *Z. princeps*, but has more recently been assigned to *Z. hudsonius* (Hafner et al. 1981).

Preble's meadow jumping mouse was previously known from eight counties along the South Platte River drainage (Armstrong 1972, Warren 1942). This subspecies has been found in relatively few localities in the past 20 years, and its current status in Colorado is uncertain. The U.S. Fish and Wildlife Service has published a proposal to list the subspecies as endangered pursuant to the Endangered Species Act. Notice was published March 25, 1997, and a final rule is expected in March 1998.

Sites in Colorado where Preble's meadow jumping mice have been captured in the past 20 years include the Fort St. Vrain Nuclear Generating Station near Platteville, Weld County, where three individual mice were caught, one each in 1972, 1976, and 1977 (Lehner and Wunder 1978). None were found in trapping efforts at the same site in 1992 (Compton and Hugie 1993) or 1995 (Ryon 1996). In Boulder County, on City of Boulder Open Space, Preble's meadow jumping mice have been captured in recent years at five sites along the South Boulder Creek drainage (Armstrong et al. 1996, Compton and Hugie 1993) and adjacent to Doudy Draw (C. Pague, personal communication). In Jefferson County, at Rocky Flats Environmental Technology Site (RFETS), a seemingly stable population of these mice has been documented, with captures in consecutive years from 1991 through 1997 (DOE 1996; EG&G 1992, 1993; Harrington et al. 1995, 1996; T. Ryon, personal communication). They have been seen or captured in Douglas County along both East and West Plum creeks (CDOT 1995; C. Pague, personal communication). Preble's meadow jumping mice have also been reported from El Paso County (Corn et al. 1995,1996; Meaney et al. 1996).

In 1996, we captured jumping mice in Boulder County along St. Vrain Creek, in Douglas County along Indian Creek and West Plum Creek, and in El Paso County along Smith Creek (Meaney et al. 1996). Other projects and other field workers have found jumping

mice in the Boulder area, at additional sites along East and West Plum Creek, and in the Colorado Springs area.

Throughout its range, the preferred habitat of *Z. hudsonius* is moist lowlands with dense vegetation, such as abandoned grassy fields, thick vegetation along ponds, streams, and marshes, and the rank herbaceous vegetation of wooded areas. Typical favored habitat in Colorado is riparian vegetation with adjacent grasslands near water; the riparian vegetation is dense and consists of forbs, grasses, and shrubs with an overstory of trees and shrubs at many sites (Bakeman 1997). Other vegetation communities are also used, as has been found at the U.S. Air Force Academy where they have been captured in the foothills in alder (*Alnus incana*)-willow, ponderosa pine (*Pinus ponderosa*), Ponderosa pine/alder-dogwood (*Cornus sericea*)-river birch (*Betula fontinalis*), Ponderosa pine/little bluestem (*Schizachyrium scoparium*), and Gambel oak (*Quercus gambelii*) (Corn et al. 1995). On City of Boulder Open Space, they have also been captured in cheat grass (*Anisantha (=Bromus) tectorum*) (C. Miller, personal communication).

Studies of meadow jumping mice in regions north and east of Colorado provide valuable information on their densities, which have been reported at 1.4 animals/ha up to 82.9 animals/ha (Adler et al. 1984, Boonstra and Hoyle 1986, Nichols and Conley 1982, Quimby 1951, Tester et al. 1993). Wide ranges in densities within sites suggest that populations fluctuate (Tester et al. 1993). The animals also have a tendency to wander, especially in spring (Nichols and Conley 1982). Densities, population fluctuation, and movement patterns of these mice in Colorado are not well known. At RFETS, densities reached as high as 36 animals/ha, and home ranges were documented as large as 9,625 m^2 (Harrington et al. 1996).

The project described in this report is the third year of a survey for Preble's meadow jumping mice in Colorado conducted for the Colorado Division of Wildlife. One of the goals of the project in 1995 was to survey potential distributional extremes in order to begin circumscribing the distribution of this mouse in Colorado (Meaney and Clippinger 1995). Unfortunately, jumping mice were not found at any of the seven sites surveyed in 1995. The approach in 1996 was more conservative, and involved surveying areas near known areas of occurrence, with an emphasis on occupied drainages and drainage basins (Meaney et al. 1996). Of ten sites surveyed, jumping mice were found at four. The approach in 1997 was to further survey areas near known areas of occurrence and to again attempt some outlying areas armed with a better understanding of preferred habitat than was available in 1995. As in 1996, all sites were reconnoitered on foot prior to site selection.

During the second year of the project we implemented an analysis of the vegetation parameters that provide suitable habitat for the species. We have somewhat simplified the vegetation data collection for 1997. The purpose of the vegetation sampling and analysis is to determine whether there are differences between sites where jumping mice are captured and sites where they are not found. We take this larger scale view (comparing entire sites) as the focus because jumping mice are known to wander (Nichols and Conley 1982) and therefore comparisons between transects within a site are considered too small of a scale to elucidate the question.

METHODS

This project had three components: selection of ten sites, small mammal trapping, and vegetation sampling and analysis. In the first component, we reviewed potential sites, consulted with colleagues knowledgeable about *Z. h. preblei* in Colorado, made site visits, and sought permission to trap on suitable sites on open space lands, State Parks, Division of Wildlife property, and private property. The second phase involved live-trapping small mammals at the ten selected sites. The third component consisted of vegetation sampling at all sites and subsequent analysis of the data.

Site Selection

A number of sites were suggested in discussions with Chris Pague of the Colorado Natural Heritage Program, Judy Sheppard of the Colorado Division of Wildlife, and Peter Plage of the U.S. Fish and Wildlife Service. Subsequent discussions were conducted with District Wildlife Managers and Wildlife Technicians in Larimer, Elbert, and El Paso counties.

Trapping

Five transects were established at each site, labeled and numbered from the western or southern end of the site (Transect A), to the eastern or northern end (Transect E). Transects were generally established near the river, creek, or adjacent wetlands or drainages, with much variation due to topography and legal boundaries of the site. At each site, notes were made on topography, slope, aspect, description of the riparian system, position of the site in the riparian system, vegetation (predominant trees, shrubs, forbs, and graminoids), disturbance, land use history, and threats to the habitat. Transects were marked on 7 1/2 minute U.S.G.S. topographic maps.

Trapping was conducted in accordance with U.S. Fish and Wildlife Service "Interim Survey Guidelines for Preble's Meadow Jumping Mouse", revised May 27, 1997. Protocol also followed the "Acceptable field methods in mammalogy: preliminary guidelines approved by the American Society of Mammalogists" (Journal of Mammalogy, Supplement to Volume 68, No. 4, 1987). The "Recommended Survey Field Data Compilation Form" was filled out for each successful site and submitted to the U.S. Fish and Wildlife Service.

Fifty Sherman live-traps were placed in parallel lines of 25 traps at each transect. Traps were placed 5 m apart within each line and lines were placed 10 m apart, usually on opposite sides of the river or creek. Traps were baited with a sweet feed combination (molasses in rolled oats, corn, and filler grains), and a ball of polyester fill was included for bedding. Traps were placed in a covered location under vegetation, if possible, to prevent over-cooling and over-heating of animals during the trapping period. Two hundred and fifty traps were run for three consecutive nights at each site, for a total of 750 trap nights.

Traps were set between 2:30 P.M. and sunset depending on weather conditions; they were checked and closed after sunrise the next day (to minimize trap mortality), and re-set that evening. Species, sex, and age class (adult, subadult, juvenile) were recorded for all individuals captured. All captured animals were marked with indelible ink on the tail and ventrum to indicate their recapture status if they were recaptured on subsequent mornings. All captures of *Zapus* were documented with weight, body measurements (length of head and body, length of tail, and length of hind foot) and a photographic record. Tissue samples were collected in the form of three hole punches from the animal's ears for genetic analysis. Tissue collected from the hole punches was preserved in a 95% ethanol solution. All capture data were recorded along with time, weather conditions, and approximate temperature were recorded, as well as any sign of disturbance on the trap line (raccoons, black bears).

Vegetation Sampling and Analysis

The focus of this effort was to quantitatively describe the plant community and vegetation characteristics that appear to be important habitat considerations for Preble's meadow jumping mice, using standard plant ecology techniques. Data were collected on plots along the trap line, with special focus on canopy cover, species richness, and determination of plant communities present.

Six randomly selected trap stations along each transect were sampled, resulting in a total of 30 samples, or plots, for each site. Plots were 5 m (16 ft) in radius with the trap at the center. Percent canopy cover of trees, shrubs, grasses, and forbs was noted to the nearest ten (i.e. 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100 percent cover). Cover values do not tally to 100 because they are estimated for each plant group separately regardless of multiple canopy layers. Species richness, or the number of species, was tabulated in one of three categories: 0-1, 2-3, and 4-5 species for trees and grasses; 0-2, 3-5, and 6-8 species for shrubs, and 1-3, 4-7, and greater than seven species for forbs.

Community type was selected from 35 different community types (see Appendix) found in association with Preble's meadow jumping mice in previous years. One community type was selected for each plot. Botanical nomenclature follows Weber (1990).

We tested the null hypothesis that canopy cover measures from successful (in terms of capturing jumping mice) and unsuccessful sites came from populations having the same distribution (Sokal and Rohlf 1969). A significant difference would indicate that canopy cover was statistically different between successful and unsuccessful sites. A two-tailed Mann-Whitney (Wilcoxon) test by Statgraphics+ was used to compare percent cover between successful and unsuccessful sites for trees, shrubs, grasses, and forbs.

The Chi-square test for contingency was used to compare frequencies of individual plots across species richness categories between successful and unsuccessful sites for trees, shrubs, grasses, and forbs. The null hypothesis is that the distribution across species richness categories is not independent (different) between successful and unsuccessful sites. A significant difference would indicate that successful and unsuccessful sites were independent in the frequency distribution of plots across species richness categories.

RESULTS

The following ten sites were selected for surveys for Preble's meadow jumping mouse: Weld County: Lone Tree Creek. Larimer County: Lone Pine Creek and Rabbit Creek. Boulder County: St. Vrain Creek and an unnamed drainage on the Schneider Property (City of Boulder Open Space). Elbert County: Hay Gulch, a tributary of Running Creek (= Box Elder Creek). Douglas County: Roxborough State Park, Plum Creek, and East Plum Creek. El Paso County: Beaver Creek. Site name, site directions, ownership, and locations for each site are presented in Table 1. Sites are listed north to south. The ten sites are mapped in Figure 1, and individual sites and transects are shown in Figures 2-11.. A general description of the site, its present and historic land use, the predominant vegetation, and small mammal species richness and abundance are listed below for each site.

A total of 33 individual Preble's meadow jumping mice were captured at seven of the ten sites: Lone Tree Creek, Weld County; Rabbit Creek and Lone Pine Creek, Larimer County; Hay Gulch, Elbert County; Roxborough State Park and East Plum Creek, Douglas County; and Beaver Creek, El Paso County. Five hundred and sixty-nine individuals of eleven species of small mammals (including one carnivore) were captured across all ten sites (Table 2). With 7219 trap nights and 790 total captures, the overall capture rate was 11 percent. The capture rate for jumping mice (37 captures total, including recaptures) was 0.5 percent.

In addition to jumping mice, ten other species were captured: hispid pocket mouse (*Chaetodipus hispidus*), long-tailed vole (*Microtus longicaudus*), prairie vole (*Microtus ochrogaster*), meadow vole (*Microtus pennsylvanicus*), house mouse (*Mus musculus*), Mexican woodrat (*Neotoma mexicana*), deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), masked shrew (*Sorex cinereus*), and a weasel that escaped (*Mustela* sp.).

Only deer mice were captured at all ten sites. A hispid pocket mouse was captured only at Plum Creek. Long-tailed voles and prairie voles were captured at seven sites each, and meadow voles were caught at all but one site, Rabbit Creek. One house mouse was captured at Plum Creek. A weasel was captured at Hay Gulch and two masked shrews were found at Lone Pine Creek. Mexican woodrats were captured at three sites, and western harvest mice at two sites. Preble's meadow jumping mice were captured at seven sites (Table 2). Deer mice were by far the most abundant species with 350 individuals representing 62 percent of individuals captured. The three species of voles were the next most abundant, and combined they numbered 157 individuals and represented 28 percent of individuals captured; combined with the deer mice, this accounts for 90 percent of individuals captured. Jumping mice were the fifth most abundant small mammal, with 33 individuals representing 6 percent of captures.

Site Results

Weld County: Lone Tree Creek

Lone Tree Creek crosses I-25 in extreme northwestern Weld County (Figure 2). The site is on private property north of the crossing and immediately west of the rest area called The Natural Fort, so named because of local sandstone outcrops. Lone Tree Creek appears to have headwaters in northeastern Larimer County and wend its way, mostly south and a little east, to the South Platte River; the confluence is at the Mitani-Tokuyasu State Wildlife Area, about 8-10 km (5-6 mi) east of Greeley. The land was acquired in 1985 by the present owner, who indicated that it had been intensively grazed. At present, it is lightly grazed and appears in very good condition, with a few patches of cactus (*Opuntia* sp.) belying the prior intense grazing.

Lone Tree Creek is very narrow at this site, and vegetative cover was 22 percent for trees, 36 percent for shrubs, 22 percent for forbs, and 70 percent for forbs. The tree overstory was composed of peach-leaved willow (*Salix amygdaloides*) and yellow willow (*Salix lutea*). Currant (*Ribes* sp.), coyote willow (*Salix exigua*), yellow willow, western snowberry (*Symphoricarpos occidentalis*), and wild rose (*Rosa woodsii*) comprised the shrub overstory. Forbs included yarrow (*Achillea millefolium*), western ragweed (*Ambrosia psilostachya*), burdock (*Arctium minus*), silver sage (*Artemisia frigida*), Canada thistle (*Cirsium arvensis*), hound's tongue (*Cynoglossum officinale*), daisy (*Erigeron* sp.), wild licorice (*Glycyrrhiza lepidota*), common plantain (*Plantago major*), and germander (*Teucrium canadense*). A couple of the transects run through a combination of willows and boggy wetland with some mature trees. Beyond the creek lies the rolling terrain of the shortgrass prairie, and the sandstone outcrops of the Natural Fort are nearby.

Small mammal species richness and abundance were high at this site. Six species were captured with the following number of individuals: 26 long-tailed voles, eight prairie voles, eight meadow voles, 40 deer mice, eight western harvest mice, and one Preble's meadow jumping mouse. A total of 91 individuals were captured (Table 3).

Larimer County: Rabbit Creek

The Rabbit Creek site is on the Cherokee Park Management Area, Lower Unit. It is a State Wildlife Area managed by the Colorado Division of Wildlife. This unit of about 600 hectares (1500 acres) was purchased in the 1960s and was a working cattle ranch prior to acquisition by CDOW. Controlled grazing and haying occur on this parcel, in exchange for public hunting on adjacent private lands. Rabbit Creek heads in the flanks of the Laramie Mountains and drains into the North Fork of the Cache la Poudre. The transects are located along the North Fork of Rabbit Creek (Figure 3) and also at the confluence with the Middle Fork of Rabbit Creek. The area is in hayfields, with a strip of riparian vegetation left intact. The creek is small and relatively narrow. The topography is rolling hillsides.

Graminoids and shrubs dominated this site with 72 and 30 percent cover, respectively. Tree and forb cover was 27 and 28 percent, respectively. The overstory was composed of mountain maple (*Acer glabrum*) and Rocky Mountain juniper (*Sabina scopulorum*) trees, and mountain mahogany (*Cercocarpus montanus*), chokecherry (*Padus virginiana*),

currant, wild rose, skunkbrush (*Rhus trilobata*), and coyote willow shrubs. Forbs were numerous and included water hemlock (*Cicuta douglassi*), Canada thistle, virgin's bower (*Clematis lingusticifolia*), prickly lettuce (*Lactuca serriola*), buttercup (*Ranunculus* sp.), curly dock (*Rumex crispus*), goldenrod (*Solidago* sp.), common dandelion (*Taraxacum officinale*), golden banner (*Thermopsis rhombifolia*), nettle (*Urtica gracilis*), mullein (*Verbascum thapsis*), and violet (*Viola canadense*).

Eight meadow jumping mice were captured. Small mammal species richness was low (four species), as was abundance (44 individuals) (Table 4). In addition to the jumping mice there were 14 long-tailed voles, five Mexican woodrats, and 17 deer mice.

Larimer County: Lone Pine Creek

This site is also in the Cherokee Park Management Area, in the Lone Pine Unit (Figure 4). The unit is about 1,200 hectares (3,000 acres), with Lone Pine Creek running through it. The unit was acquired in 1976 when it was a working cattle ranch. It was purchased for deer winter range and limited hunting. More recent use has included recreationists, both horseback riders and mountain bikers. Lone Pine Creek heads in the Laramie Mountains and empties into the North Fork of the Cache La Poudre River.

The riparian vegetation at this site was well-developed and dominated by trees and grasses, with canopy cover values 40 percent and 69 percent, respectively. Shrub cover was 22 percent and forb cover was 19 percent. Mountain maple, alder, narrow-leaved cottonwood (*Populus angustifolia*), plains cottonwood (*Populus deltoides*), and crack willow (*Salix fragilis*) formed the tree overstory. Numerous shrubs were present, including chokecherry, wild rose, current, red osier (*Swida sericea*), western snowberry, and lilac, an introduced cultivar. Forbs were diverse and were represented by silver sage, aster (*Aster occidentalis*), musk thistle (*Carduus nutans*), water hemlock, Canada thistle, virgins bower, hare's ear (*Conringia orientalis*), creeping jenny (*Convolvulus arvensis*), tansy mustard (*Descurainia sophia*), dragon-head (*Dracocephalum* sp.), prickly lettuce, field mint (*Mentha arvensis*), goldenrod, mullein, meadowrue (*Thalictrum fendleri*), and buttercup. Grasses included needlegrass, crested wheatgrass, western wheatgrass, smooth brome, Japanese brome (*Bromus japonicus*), Canadian wild rye, mannagrass (*Glyceria grandis*), Kentucky bluegrass, and horsetail (*Equisetum* sp.).

Eleven meadow jumping mice were captured at this site, which had the highest species richness of all ten sites (seven species), and a total of 69 individuals captured (Table 5). There were nine long-tailed voles, four prairie voles, two meadow voles, six Mexican woodrats, 35 deer mice, and two masked shrews.

Boulder County: St. Vrain Creek

This site is located across 75th Street, just east of the St. Vrain site where jumping mice were found last year. All trapping was conducted on the north side of the creek, where we obtained access (Figure 5). The creek presents a relatively flat, wide floodplain. The creek was wide and shallow with some pools and a lot of cobble stones, and shallow cut banks. A number of cobble berms were in evidence, probably from dredging. These serve

to separate the creek from some wetlands, which grade into either xeric, weedy grassland or to a stand of old cottonwoods. The cobbly berms themselves are intermittent and either barren or weedy. Cattle grazing has severely reduced much of the understory. This site is scheduled for gravel mining by Golden Excavating Company over the next 30 years, after which time it will be turned over to Boulder County Open Space.

Tree canopy cover was high (35 percent), as was graminoid cover (46 percent); shrub canopy was almost nonexistent (5 percent), and forb canopy was low (19 percent). Grazing was active at this site. The dense tree overstory was represented by peach-leaved willow, narrow-leaved and plains cottonwoods, Russian-olive (*Elaeagnus angustifolia*), mulberry (*Morus alba*), Chinese elm (*Ulmus pumila*), and black locust (*Robinia pseudoacacia*). Coyote willow, small mulberry, and wild rose were the few shrubs present. The numerous forbs included ragweed, milkweed (*Asclepias latifolia, A. speciosa*), musk thistle, tumble knapweed, golden aster (*Heterotheca villosa*), daisy, wild licorice, toadflax (*Linaria dalmatica*), bee balm (*Monarda fistulosa*), forget-me-not (*Myosotis scorpioides*), catnip (*Nepeta cataria*), plantain, curly dock, dandelion, golden banner, white Dutch clover (*Trifolium repens*), and mullein.

No jumping mice were captured at this site (Table 6). We found the lowest species richness and abundance of all sites here. There were only two species captured and a total of eight individuals, two meadow voles and six deer mice. The trapping effort was reduced from 750 to 525 trap nights because of the size limitations of the site.

Boulder County: Schneider Property

This site is along an unnamed drainage on City of Boulder Open Space (Figure 6). The drainage heads in the foothills, just northwest of Boulder, and slopes down to the plains below. It is a small ephemeral drainage that had running water during our study. Historically used for grazing, the land is now Open Space with a low visitation rate.

This site was characterized by well-developed shrubs in a narrow band along the drainage, and grasses dominating the plant canopy cover (56 percent); cover was 11 percent for trees, 32 percent for shrubs, and 24 percent for forbs. In fact, woody cover was so dense that it was difficult to place the traps near the stream, especially on the north side. The only trees were narrow-leaved cottonwoods and a few large willows. Shrubs included hawthorn (*Crataegus macrocantha*), chokecherry, wild rose, skunkbrush, coyote willow, and western snowberry. Forbs present were, milkweed, aster, Canada thistle, creeping jenny, geranium (*Geranium viscosissimum*), wild licorice, prickly lettuce, field mint, Virginia creeper (*Parthenocissus quinquefolia*), phlox (*Phlox* sp.), psoralidium (*Psoralidium tenuiflorum*), prairie coneflower (*Ratibida columnifera*), globemallow (*Sphaeralcea coccinea*), dandelion, salsify (*Tragopogon dubius*), and yucca (*Yucca glauca*).

No jumping mice were found. The species richness was intermediate (five species), and abundance was low (12 individuals). There were two long-tailed voles, three prairie voles, one meadow vole, three Mexican woodrats, and three deer mice (Table 7).

Elbert County: Hay Gulch

Hay Gulch is a narrow, 8 km (5 mi) long tributary of Running Creek. It is spring fed and is also dependent upon local rainfall for running water, as we discovered when a rainstorm caused it to flood and raised the water level 1.5 m (5 ft). It was dry but had pools every few hundred meters, when we set the traps out, as is typical for it according to the landowner. The main drainage in the area, Running Creek (called Box Elder Creek north of the county line, in Arapahoe, Adams, and Weld counties), appears to present excellent habitat for jumping mice. The property is under private ownership and is grazed from mid-January to mid-May, as has been the case for many years.

Four transects were placed along Hay Gulch, and one transect was placed along an unnamed tributary of the Gulch (Figure 7). The latter transect was placed there because an observant friend of the landowner had recalled seeing a very long-tailed mouse along that drainage, and we presumed that it could have been a jumping mouse.

Hay Gulch is narrow with water only in some places. The steep banks rise about 5 m (16 ft) above the drainage. The vegetation is well-developed along the gulch, weedy in places where the cattle congregate, and very diverse in forbs, shrubs, and grasses (both introduced and native). A mature overstory of cottonwoods is present, as well as crack willow, forming a 20 percent tree canopy cover. Shrubs provide only a low canopy cover, 17 percent, and include some coyote willow and yellow willow, and a lot of wild plum (*Prunus americana*), chokecherry, currant (*Ribes odoratum*), wild rose (*Rosa arkansana, R. woodsii*), and western snowberry. The numerous forbs provide 36 percent canopy cover and include ragweed, Indian hemp (*Apocynum cannabinum*), burdock, sage (*Artemisia ludoviciana*), aster, musk thistle, lamb's quarters (*Chenopodium pratericola, C.* sp.), Canada thistle, wild licorice, sunflower (*Helianthus annuus, H. nuttallii, H.* sp.), field mint, curly dock, groundsel (*Senecio spatioides*), goldenrod, leafy spurge (*Tithymalus uralensis*), nettle, and mullein. Wetland vegetation occurs in the bottom of the drainage by the pools, and includes cattails (*Typha latifolia*), bulrushes (*Scirpus pallidus*), rushes (*Juncus* sp.), and sedges (*Carex* sp.). Grasses had the highest canopy cover, 71 percent, and included Canada wild rye (*Elymus canadensis*), crested wheatgrass, western wheatgrass, redtop (*Agrostis stolonifera*), smooth brome, Japanese brome, spikerush (*Eleocharis acicularis*), panic grass (*Panicum capillare*), Canada bluegrass, and needlegrass (*Stipa viridula*).

A number of traps were lost due to localized flooding at this site, and resulted in a reduced trapping effort (694 trap nights). One meadow jumping mouse was captured at this site. Small mammal species richness was average at Hay Gulch, with five species: six prairie voles, 16 meadow voles, one unidentified subadult vole, one weasel (long-tailed or short-tailed, identification undetermined), 62 deer mice, and the jumping mouse. Abundance was relatively high, with a total of 87 individuals captured (Table 8).

Douglas County: Roxborough Park

Roxborough State Park is endowed with exceptional natural beauty, and is designated a Colorado Natural Area and a National Natural Landmark. This exceptional park is of geological and ecological interest. The presence of numerous geological formations, and

the location at the transition between plains and mountains, provide a substrate for ecological diversity. Acquired in 1975 after a failed attempt at development, the Park has a high diversity of plants and animals; additional land has been acquired over the years and the park is now 909 hectares (2,245 acres).

Transects A and B were placed along Willow Creek west of the Dakota Hogback (Figure 8). Transect C was placed along Willow Creek east of the hogback. Transect D was in the aspen grove along the east side of Little Willow Creek, and Transect E was located to the north of the Persse Place along Little Willow Creek.

Grasses and shrubs dominated the canopy cover at this site with 61 percent and 53 percent, respectively. Tree and forb cover were also high, with 25 percent and 28 percent, respectively. Trees present include plains cottonwood, peach-leaved willow, aspen (*Populus tremuloides*), Gambel oak (*Quercus gambelii*), and box-elder (*Negundo aceroides*), the latter three not seen at the other nine sites. Shrubs include hawthorn, wild plum, golden currant (*Ribes aureum*), currant (*Ribes cereum, R. inerme*), coyote willow, willow (*Salix irrorata*), and grape (*Vitis riparia*). The numerous forbs include alyssum (*Alyssum minus*), ragweed, burdock, aster (*Aster laevis*, *A.* sp.), water hemlock, Canada thistle, creeping Jenny, Joe Pye weed (*Eupatorium maculatum*), wild licorice, gumweed (*Grindelia squarrosa*), St. Johnswort (*Hypericum perforatum*), prickly lettuce, lupine (*Lupinus argenteus*), black medic (*Medicago lupulina*), field mint, bee balm, potentilla (*Potentilla recta*), buttercup (*Ranunculus macounii*), goldenrod, meadowrue, golden banner, tearthumb (*Truellum sagittatum*), vervain (*Verbena hastata*), and violet. Grasses included wheatgrass, smooth brome, cheatgrass, sedge, rush, timothy (*Phleum pratense*), and Kentucky bluegrass.

Two Preble's meadow jumping mice were captured at this site (Table 9). Surprisingly for a site with high ecological diversity, small mammal species richness was average (five species), and abundance was low (23 individuals captured). Other small mammals included one long-tailed vole, two prairie voles, eight meadow voles, and ten deer mice.

Douglas County: Plum Creek

This site is located along Plum Creek, above the confluence of East and West Plum Creek, and just above (north of) Indian Creek. Jumping mice have been found in all three of these drainages, and this site was selected in order to extend their known distribution to Plum Creek proper. The site is owned by the E.I. DuPont Company, which purchased it in 1906 and manufactured dynamite between 1908 and 1970. An old coal-powered plant, no longer present, has left remnant ash piles visible. There is evidence of ground disturbance from the various manufacturing activities, and there are remnant fallen trees, litter, and benches formed from the 1965 flood. The creek corridor remains, for the most part, in good condition. Transects were placed along both sides of the creek (Figure 9).

Grasses dominated this site with 45 percent cover. Trees were next with 30 percent cover. Shrubs and forbs had 24 and 18 percent cover, respectively. Plant species richness was low at this site. The tree overstory was represented by narrow-leaved and plains cottonwoods, and the shrubs by willow, wild rose, and western snowberry. Forbs included milkweed, Canada thistle, creeping Jenny, hound's tongue, wild licorice, golden

aster, water horehound (*Lycopus* sp.), Virginia creeper, goldenrod, and leafy spurge. Grasses included smooth brome, reed canarygrass (*Phalaroides arundinacea*), sedge, horsetail, rush, and cattail.

No jumping mice were captured (Table 10). Small mammal species richness and abundance were intermediate (five species and 55 individuals captured). One hispid pocket mouse, one long-tailed vole, nine meadow voles, one house mouse, and 43 deer mice were captured.

Douglas County: East Plum Creek

East Plum Creek is a relatively large drainage that parallels I-25 and a frontage road. The creek is a few hundred meters east of the road (Figure 10). Up above the banks on the west side is a second embankment above which is a railroad track. There are beaver ponds at the south end. The property is under private ownership, and in the process of being acquired by The Conservation Fund.

There is a line of cottonwoods, probably planted, at this site. Trees and grasses dominate. The vegetation is sparse in places, and overall vegetative cover is low: forbs, 22 percent; graminoids, 24 percent; shrubs, 18 percent; and trees, 24 percent. Trees include alder, Russian-olive, narrow-leaved cottonwood, and crack willow. Shrubs include alder, coyote willow, and yellow willow. Grasses include western wheatgrass, ticklegrass (*Agrostis scabra*), fringed brome (*Bromopsis canadensis*), smooth brome, sandreed, sedges, horsetail (*Equisetum* sp.), and Kentucky bluegrass. Yarrow (*Achillea lanulosa*), wintercress (*Barbarea orthoceras*), hoary alyssum (*Berteroa incana*), tumble knapweed, lettuce (*Lactuca serriola*), daisy (*Erigeron* sp.), water hemlock (*Cicuta douglasii*), white sweetclover (*Melilotus alba*), wild mint (*Mentha arvensis*), cinquefoil (*Potentilla* sp.), and curly dock are the forbs present.

Four jumping mice were captured at this site. Small mammal species richness and abundance were high. Six species and 81 individuals were captured: one long-tailed vole, seven prairie voles, three meadow voles, 65 deer mice, one western harvest mouse, and four meadow jumping mice (Table 11).

El Paso County: Beaver Creek

Beaver Creek forms a narrow drainage about 3 to 5 m (10-16 ft.) wide, with a narrow band of riparian vegetation. Water was flowing, and there are a few eroded cutbanks. The creek is located in a valley with ridges to the north and south about 75 m (250 ft) distant on each side. This site, called Forest Lakes, is planned for development. Transects were placed on both sides of the drainage (Figure 11).

Plant diversity is high right along the drainage, and very low on the adjacent hillsides where invasive knapweed dominates, along with some smooth brome and needlegrass. Vegetative cover is 21 percent for forbs, 24 percent for graminoids, 39 percent for shrubs, and 28 percent for trees. Alder and narrow-leaved cottonwoods provide the tree overstory. Chokecherry, Gambel oak, skunkbrush, coyote willow, and western snowberry comprise

the shrub component. The grasses present are western wheatgrass, smooth brome, cheat grass, sedges, horsetail, Canada bluegrass, Kentucky bluegrass, and needlegrass (*Stipa viridula*). The numerous forbs present include sage, daisy, knapweed, thistle, poison hemlock (*Conium maculatum*), sunflower (*Helianthus* sp.), toadflax, spearmint, black-eyed susan (*Rudbeckia hirta*), goldenrod, dandelion, and mullein.

Six Preble's meadow jumping mice were captured at this site. Small mammal species richness was low, with only four species, but abundance was high, with a total of 99 individuals captured (Table 12). In addition to the jumping mice there were nine prairie voles, 15 meadow voles, and 69 deer mice.

Small Mammals

Of the 33 individual jumping mice captured, 12 were female and 20 were male (one was undetermined) (Table 13). Most (27 individuals, 82 percent) were adult. The mean and range (in parentheses) of weight and body measurements for 26 adult jumping mice are: weight, 20.3 g (16-26 g); length of head and body, 73 mm (65-82 mm); length of tail, 127 mm (114-134 mm); and length of hindfoot, 30 mm (27-34 mm).

A review of species richness, individual captures, presence of Preble's meadow jumping mice, number of trap nights, and individuals captured per 100 trap nights for all sites is presented in Table 14. Species richness ranged from four to seven, and the three sites with the highest species richness, Lone Tree Creek, Lone Pine Creek, and East Plum Creek, did have jumping mice present. The number of individuals captured per 100 trap nights allows for comparisons between sites where different numbers of trap nights were employed. The four sites with greater than ten individuals captured per 100 trap nights all had jumping mice present (Lone Tree Creek, Hay Gulch, East Plum Creek, and Beaver Creek). St. Vrain Creek and the Schneider Property had the lowest number of individuals captured (two individuals per 100 trap nights) and no jumping mice. But jumping mice were caught at the site with the next lowest success, Roxborough State Park, with three individuals per 100 trap nights.

Vegetation

Frequency distributions of the percent canopy cover for trees and shrubs at successful and unsuccessful sites is presented in Figure 12. There are three tree and six shrub missing values at unsuccessful sites. Mean percent cover for successful and unsuccessful sites was 26.6 percent (n=210) and 25 percent (n=84) for trees, and 30.7 percent (n=210) and 20 percent (n=81) for shrubs, respectively. Most plots at both successful and unsuccessful sites had no tree canopy cover, and both show, generally, that as canopy cover goes up, fewer plots are represented, with the exception of a low peak in the 40 to 60 percent range for successful sites. Shrub canopy cover followed a similar pattern, except that the peak in the middle is more pronounced. The Mann-Whitney (Wilcoxon) revealed that successful sites had significantly greater shrub canopy cover than unsuccessful site ($W=6876$, $P<0.05$), but tree canopy cover was not significantly different ($W=8723$, $P>0.05$).

Figure 13 shows percent canopy cover for grasses and forbs. There are two grass and four shrub missing values at successful sites, and 11 grass and 16 forb missing values at unsuccessful sites. Most successful plots had high grass cover, in the 60 to 90 percent cover range, whereas most unsuccessful sites were in the 30 to 50 percent cover range. At the successful sites, most plots had low forb cover and as cover values increased, fewer plots were represented. At unsuccessful sites, the decline is more abrupt. Mean percent canopy cover for both grasses and forbs was significantly higher at successful versus unsuccessful sites (grasses: 56.1 percent, n=208, and 49.1 percent, n=76, respectively, $W=6753$, $P<0.05$; forbs: 25.2 percent cover, n=206, and 19.4 percent cover, n=71, respectively, $W=6841$, $P<0.05$).

Species richness for trees and shrubs is shown in Figure 14. Due to low species richness of these large plants, there were no values in the 4-5 or 6-8 species categories. Most plots had low species richness for trees (0-1 species) and shrubs (0-2 species) at both successful and unsuccessful sites. There was no significant difference between the frequency distribution across species richness categories for trees (Chi square=0, $P>0.05$) or shrubs (Chi square=0.55, $P>0.05$).

Grass species richness was highest in the 2-3 species category, but was more evenly distributed across categories at successful sites, whereas unsuccessful sites had proportionately fewer plots in the higher or lower categories (Figure 15). The majority of vegetation plots had 1-3 forb species present, with many also in the 4-7 species category. There were no forb plots with more than seven species at the unsuccessful sites, whereas 26 plots fell in this category at successful sites. There was one missing unsuccessful forb value. There was a significant difference between the frequency distributions across sites for grasses and forbs (Chi square=8.98, $P<0.05$ for grasses, and Chi square=12.78, $P<0.05$ for forbs).

The most frequently encountered community type for both successful and unsuccessful sites was "*Populus angustifolia* tree canopy with an understory of mixed shrubs and mixed herbs"; 44 successful plots and 23 unsuccessful plots were located within this community type (Table 15). Other community types that appeared relatively frequently were:

- Little or no tree canopy, dominated by mixed shrubs and mixed herbs (11 successful and 19 unsuccessful)
- Dominated by a tree canopy of *Salix* sp. with a *Salix* sp. mixed herbs and grass understory (20 successful and six unsuccessful)
- Dominated by a tree canopy of *Salix fragilis* with an understory composed of mixed herbs (17 successful, 0 unsuccessful)

The notable feature that emerges from this evaluation is the fact that jumping mice were captured at sites that contained 26 of the 35 community types.

DISCUSSION

This survey extends the known distribution of extant populations of *Z. h. preblei* to two counties of known historical occurrence, Weld and Larimer, and one county from which

there are no historical records of occurrence, Elbert County. These sites add four new drainages occupied, at least in portions, by meadow jumping mice. The Larimer and Weld county sites served to bridge the gap presented by the apparent lack of Preble's meadow jumping mice between Wyoming and the northernmost locality in Colorado, St. Vrain Creek at Hygiene, Boulder County. Hay Gulch fulfilled a desire to survey a site in Elbert County, and extended the distribution of these mice eastwards. The finding of a 10g reproductive male at this site (Table 13) is extremely puzzling. We can only surmise that some pathology may have produced a protrusion in the scrotal region, as it is doubtful that an animal that young (perhaps two weeks of age) would breed. Two additional sites in Douglas County serve to extend their distribution into two additional drainages at Roxborough State Park, and add another location along the occupied East Plum Creek. Roxborough State Park was another foothill extension, and success at this site was particularly gratifying because it is well protected. The lack of jumping mice at Plum Creek, on the DuPont property, was surprising. We expect that further trapping efforts will reveal the drainage to be occupied. In El Paso County, our finding adds another occupied tributary of Monument Creek. This site, Beaver Creek near Palmer Lake, was another foothill site that, interestingly, was extensively invaded by tumble knapweed out from the riparian corridor. Trapping the St. Vrain site was an attempt, albeit unsuccessful, to extend the distribution of these mice along that drainage. Unfortunately, the site is heavily grazed and has evidence of disturbance. The Schneider Property on City of Boulder Open Space was an attempt to secure an additional foothill site.

Three significant factors have emerged from this third year survey for Preble's meadow jumping mice. The first is that we have improved our ability to recognize suitable habitat. The first year, with a late start in the field season, we sampled seven sites and found no jumping mice. The second year we were successful in capturing jumping mice at four of the ten sites we sampled. This third year we found jumping mice at seven of the ten sites surveyed, thus going from 0, to 40, to 70 percent success rates over the three years. We have benefited by what we and others have learned in the past two seasons. We target small drainages (although not exclusively) with dense vegetation, and are willing to trap novel situations that meet these criteria.

Secondly, we broadened our understanding of where these mice may be found. They have a broader range of suitable community types than previously thought (Bakeman 1997). They were present at sites that were composed of 26 different community types (Table 15). Also, of the seven sites, four are in the transition zone of the foothills, between the plains and the mountains (Rabbit Creek, Lone Pine Creek, Roxborough State Park, and Beaver Creek). Thirdly, we have succeeded in locating populations in three counties, two of which had not revealed extant populations for a number of years (Larimer and Weld counties), and one county from which jumping mice had never been documented (Elbert County).

In regard to the Lone Pine Creek site, western jumping mice (*Zapus princeps*) were reported captured there in 1981 (Olson and Knopf 1988). Unfortunately, no specimens were collected in that study or in the present study. We do believe that the individuals captured in the present study were *Z. h. preblei*. Their weights and measurements fell within the range of the *Z.h. preblei* we have been working with for two seasons now. However, we did notice that the mid-dorsal band on the individuals from this site, and this site only, were less distinct than in mice from other Colorado sites we have trapped. We

also noted that they appeared to be less calm and jumped around more in the bags while being weighed and measured than individuals from other sites. However, neither of these characteristics would be more likely present in *Z. princeps* than in *Z. h. preblei*; in fact the reverse should be true because western jumping mice usually have a more distinct mid-dorsal band (Fitzgerald et al. 1994).

Parapatry or sympatry are an intriguing possibility for these two species. We do not know what the elevational limits are of either species. In Colorado, *Z. princeps* is known from as low as 1,830 m (6,000 ft) at Meeker, Rio Blanco County (Armstrong 1972); *Z. hudsonius* is known from as high as 2,128 m (7,000 ft) at the U.S. Air Force Academy (Dana Green, USAF Academy, personal communication). No specific zone of sympatry or parapatry has been identified. In Wyoming the distribution of the two species overlaps (Long 1965). *Z. princeps* has been found as low as 1,460 m (4,800 ft) in Johnson County, a northern county, and at 1,824 m (6,000 ft) in Natrona County, more centrally located. *Z. h. preblei* has been found at 1,915 m (6,300 ft) in Albany County (Long 1965). Thus the potential for sympatry, or at least parapatry, of these two species is present, and it will be of considerable interest to determine the ecological factors that determine their distributions on an elevational gradient along riparian corridors.

Small Mammals

Our results suggest that jumping mice are more often found at sites with high species richness and abundance of small mammals (Table 14), as was the case last year (Meaney et al. 1996), and for a colleague this year (Mark Bakeman, personal communication). In 1996, although jumping mice were found at the site with the highest richness and abundance and at the site with the lowest richness and abundance, three of the four successful sites did have high richness (Meaney et al. 1996). Preble's meadow jumping mice were found with all of the other small mammal species except hispid pocket mice and house mice. They were found in association with long-tailed voles which was not the case in 1996 (although only one site had long-tailed voles).

This small mammal trapping effort shows some range extensions for two voles, *Microtus longicaudus* and *M. ochrogaster*. The presence of long-tailed voles at Lone Tree Creek (26 individuals) extends their distribution into Weld County. And an eastward extension in Douglas County is seen in their presence at Roxborough State Park, Plum Creek, and East Plum Creek, where previously they were known only from the southwestern portion of the county. Prairie voles were found in Boulder, Douglas, Elbert and El Paso counties, which represent new counties for the species. Their occurrence in Boulder and Douglas counties was expected, as indicated by shading in Armstrong (1972), but they were not represented by museum specimens. Museum specimens will be necessary to formally document these range extensions for the two species, and are recommended for subsequent trapping efforts in these and other locales.

Vegetation

Successful vegetation plots tended to have high shrub, forb, and grass canopy cover values. Surprisingly, tree cover was extremely variable at successful sites, with the majority of plots having no tree cover. Also notable is the large number of different

community types at which jumping mice were found. This, combined with the new localities along the foothills and to the north and east in Weld and Elbert counties, and the frequent use of ditches by jumping mice, would suggest that they have a broader ecological tolerance than previously thought. Basically, jumping mice appear to favor high plant species richness with well-developed cover (Bakeman 1997, Meaney et al. 1996). This year's data lend further support to those findings, and suggest that this requirement can be met in a number of different ways

Three of the successful sites are protected and stable because they are State Parks or State Wildlife Areas: Rabbit Creek and Lone Pine Creek, Larimer County (in the Cherokee Park Management Area, CDOW), and Roxborough State Park, Douglas County. Two successful sites are under private ownership in potentially stable situations: Lone Tree Creek, Weld County, and Hay Gulch, Elbert County. Lone Tree Creek downstream of the present site, just east of I-25, is heavily grazed and does not appear to present suitable habitat for jumping mice. Thus the ability of these mice to wander and find suitable habitat in that direction may be compromised. The East Plum Creek, Douglas County, site will be protected if plans for its acquisition by The Conservation Fund are realized, as expected. However, activities along other portions of East Plum Creek pose numerous threats in terms of development and other activities. The remaining successful site, Beaver Creek, El Paso County, is scheduled for development (Bruce Watkins, District Wildlife Manager).

Recommendations

The field work outlined in this report supports earlier findings that jumping mice occur in the foothills (Corn et al. 1995) and the Colorado Piedmont, and extends their distribution on the plains. It will be important to recognize these three rather different geological elements in consideration of management, recovery, and conservation strategies. The foothills populations have now been found from Larimer to El Paso counties, leaving questions as to the possible occurrence at sites in-between. The northern Weld County finding and the eastern Elbert County finding suggest that these riparian plains grassland ecosystems merit further study. The populations in the Piedmont, where most occurrences, both recent and historic, have come from, are also of interest particularly in the extent to which jumping mice have made use of a relatively new habitat type, ditches. The type specimen (the specimen used to describe the taxon when first discovered) was collected 102 years ago along an irrigation ditch in Loveland, Larimer County (Armstrong 1972). Although ditches were not trapped in the present survey, they have become an integral component in the distribution of jumping mice in Colorado. Ditches and creeks both are the mechanism, or route, by which previously disturbed sites are recolonized from source populations after return of the vegetation.

We have a number of recommendations for future surveys.

- Lone Tree Creek at locations up and down stream. The confluence with the South Platte River, perhaps at the Mitani-Tokuyasu State Wildlife Area, merits evaluation for suitable habitat.
- Further surveys along the St. Vrain Creek and its (ditch) tributaries. In addition to last year's successful St. Vrain site at Hygiene, jumping mice were found this year along St. Vrain Creek at Lyons and five other sites along Highway 36 between Lyons and

Nelson road, Boulder County (Mark Bakeman, personal communication). Two or more of occupied sites along US 36 could be affected by proposed gravel mining.

- Additional foothills sites, perhaps in and above Eldorado Canyon State Park.
- Drainages in Elbert County, such as Bijou Creek and Kiowa Creek, are worthy of further study. Running Creek, the major drainage into which Hay Gulch empties, is also of interest. It extends north into Arapahoe, Adams, and Weld counties, where it is called Box Elder Creek.
- Re-trapping at the Plum Creek site could prove productive. The habitat was suitable, and extending the known distributions in East and West Plum creeks and Indian Creek further north into Plum Creek proper would be desirable.

The contrasting findings of the present study with those of Olson and Knopf (1988) regarding the species identification of *Zapus* at Lone Pine Creek are intriguing. We hope that the genetic tissue samples collected in the present study will determine the species identifications. If not, it will be necessary to collect specimens from this site. Because specimens were not collected in the 1988 study, it will be impossible to know which species was there at that time, because if *Z. h. preblei* are there now we cannot rule out that 16 years ago *Z. princeps* may have been present and has since been displaced. Such changes in species' presence within a taxon have been noted for other species such as woodrats (Bob Finley, personal communication). We strongly urge that specimens be collected from Lone Pine Creek, Larimer County, to confirm identification of the *Zapus* captured at that site.

The support of research on distribution of western and Preble's jumping mice along foothills creeks is much to be encouraged. Studies along an elevational gradient of a stream corridor where both species are suspected to occur could help to discern the patterns of occupation by these two species.

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Table 1. Ten sites and their locations for Preble's meadow jumping mouse survey in Colorado, Summer 1997. Successful sites in bold.

SITE NAME	SITE DIRECTIONS	OWNERSHIP	SITE LOCATION Township, range, section UTM coordinates Elevation
LONE TREE CREEK (LTC)	**Weld County Located on west side of I-25 at the Natural Fort rest area at milepost 296.**	**Private property.**	**Township 11 North, Range 67 West, Section 6 (NE NE) and Township 12 North, Range 67 West, Section 31, (SE SE); 0506330, 4533390 1,794 m (5,900 ft)**
RABBIT CREEK (RBC)	**Larimer County West on Cherokee Park Road (RD 80C) off Highway 287 about 20 miles north of Ft. Collins. Follow for about 7 miles to Cherokee Park State Wildlife Area, Lower Unit on south side.**	**Cherokee Park Management Area (SWA), Lower Unit**	**Township 10 North, Range 71 West, Section 21 (NW 1/4), Section 16 (SE 1/4), Section 15 (NW 1/4), and Section 10 (SW 1/4); 0470290, 4519260 1,915 m (6,300 ft)**
LONE PINE CREEK (LPC)	**Larimer County Eight miles west of Livermore off Highway 287 north of Ft. Collins. Cherokee Park State Wildlife Area, Lone Pine Unit. Follow road north to Lone Pine Creek.**	**Cherokee Park Management Area (SWA), Lone Pine Unit**	**Township 9 North, Range 71 West, Section 4 (SW 1/2) and Section 9 (NW NW); 0469600, 4513260 1,884m (6,200 ft)**

Table 1 (con't). Ten sites and their locations for Preble's meadow jumping mouse survey in Colorado, summer 1997. Successful sites in bold.

SITE NAME	SITE DIRECTIONS	OWNERSHIP	SITE LOCATION township, range, section UTM coordinates Elevation
ST. VRAIN CREEK (STV)	Boulder County Highway 287 north From Denver to Route 66, west about 4 miles to 75th Street, then south about 1.5 miles to where 75th Street crosses St. Vrain Creek. Trapped on east side of 75th Street north side of creek only.	Golden Excavating Company and Boulder County Open Space.	Township 3 North, Range 70 West, Section 36 (SW 1/4); 0484820, 4447220; 1,538 m (5,060 ft).
SCHNEIDER PROPERTY (SCH)	Boulder County U.S. Highway 36 north of Boulder, one mile north of intersection with Broadway. Unnamed drainage on west side of highway.	City of Boulder Open Space.	Township 1 North, Range 71 West, Section 1 (N 1/2); 0475470, 4436930; 1,733 m (5,700 ft).
HAY GULCH (HAY)	**Elbert County Southeast on Hilltop Road off Parker Road out of Parker to Singing Hills Road. Go east to end. Straight ahead and to north.**	**Private property.**	**Township 7 South, Range 64 West, Section 11 (NE NW) and Section 3 (E 1/2); 0540660, 4368070; 1,892 m (6,225 ft).**
ROXBOROUGH STATE PARK (ROX)	**Douglas County South on Wadsworth off C-470, south on Waterton Road, west on Rampart Range Road, signs to Roxborough State Park.**	**Roxborough State Park. Designated a Colorado Natural Area and National Natural Landmark.**	**Township 7 South, Range 69 West, Section 24 (N 1/2) and Section 14 (E 1/2); 0494470, 4364280; 1,839 m (6,050 ft).**

Table 1 (con't). Ten sites and their locations for Preble's meadow jumping mouse survey in Colorado, summer 1997. Successful sites in bold.

SITE NAME	SITE DIRECTIONS	OWNERSHIP	SITE LOCATION township, range, section UTM coordinates Elevation
PLUM CREEK (PLU)	Douglas County South from Denver on U.S. Highway 85 to Louviers. Right at Louviers to Plum Creek. Trapped north of road.	E.I. DuPont property.	Township 6 South, Range 68 West, Section 33 (N 1/2); 0499700, 4370880; 1,702 m (5,600 ft).
EAST PLUM CREEK (EPC)	**Douglas Road North about 1 mile from Tomah Road exit off I-25 (Exit 174) on the eastern frontage road. Trapped along creek at the blue mailbox.**	**Private property, possible acquisition by The Conservation Fund.**	**Township 9 South, Range 67 West, Section 9 (E 1/2); 0508980, 4347750; 1,976 m (6,500 ft).**
BEAVER CREEK (BVC)	**El Paso County Baptist Road exit off I-25 (South of Monument) west to end of road at Della Croce Ranch. North through gate down to creek.**	**Private property.**	**Township 11 South, Range 68 West, Section 28 (S 1/2); 0509410, 4323350; 2,128 m (7,000 ft).**

Table 2. Total number of individuals of each species and species richness at ten trapping sites in summer, 1997.

SPECIES	Lone Tree Creek	Rabbit Creek	Lone Pine Creek	St. Vrain Creek	Schneider Property	Hay Gulch	Roxborough State Park	Plum Creek	East Plum Creek	Beaver Creek	TOTAL
Chaetodipus hispidus								1			1
Microtus longicaudus	26	14	9		2		1	1	1		54
Microtus ochrogaster	8		4		3	6	2		7	9	39
Microtus pennsylvanicus	8		2	2	1	16	8	9	3	15	64
Microtus species						1					1
Mus musculus								1			1
Mustela species						1					1
Neotoma mexicana		5	6		3						14
Peromyscus maniculatus	40	17	35	6	3	62	10	43	65	69	350
Reithrodontomys megalotis	8								1		9
Sorex cinereus			2								2
Zapus hudsonius	1	8	11			1	2		4	6	33
TOTAL	**91**	**44**	**69**	**8**	**12**	**87**	**23**	**55**	**81**	**99**	**569**
Species Richness	6	4	7	2	5	5	5	5	6	4	

Table 3. Total number of individuals captured at Lone Tree Creek by species, sex, and age class. 9 - 11 September

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus longicaudus Long-tailed vole	8	12	3		1	1	1	26
Microtus ochrogaster Prairie vole	2	2	3				1	8
Microtus pennsylvanicus Meadow vole	3	5						8
Peromyscus maniculatus Deer mouse	14	12	10	1	1		2	40
Reithrodontomys megalotis Western harvest mouse	2	2	1	1			2	8
Zapus hudsonius Meadow jumping mouse	1							1
TOTAL	30	33	17	2	2	1	6	91

Note: data collected over 750 trap nights.

Table 4. Total number of individuals captured at Rabbit Creek by species, sex, and age class. 26 - 28 August

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus longicaudus Long-tailed vole	6	5	2	1				14
Neotoma mexicana Mexican woodrat	2		1				2	5
Peromyscus maniculatus Deer mouse	8	5	1	1	1		1	17
Zapus hudsonius Meadow jumping mouse	4	3	1					8
TOTAL	20	13	5	2	1		3	44

Note: data collected over 750 trap nights.

Table 5. Total number of individuals captured at Lone Pine Creek by species, sex, and age class. 20 - 22 August

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus longicaudus Long-tailed vole	5	2		1			1	9
Microtus ochrogaster Prairie vole	1	1					2	4
Microtus pennsylvanicus Meadow vole	1						1	2
Neotoma mexicana Mexican woodrat	2	3					1	6
Peromyscus maniculatus Deer mouse	9	10	9	2			5	35
Sorex cinereus Masked shrew							2	2
Zapus hudsonius Meadow jumping mouse	7	2		2				11
TOTAL	25	18	9	5			12	69

Note: data collected over 750 trap nights.

Table 6. Total number of individuals captured at St. Vrain Creek by species, sex, and age class. 22 - 24 July

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus pennsylvanicus	1		1					2
Meadow vole								
Peromyscus maniculatus	5		1					6
Deer mouse								
TOTAL	6		2					8

Note: data collected over 525 trap nights.

Table 7. Total number of individuals captured at Schneider Property by species, sex, and age class. 24 - 24 June

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus longicaudus Long-tailed vole		1		1				2
Microtus ochrogaster Prairie vole			2	1				3
Microtus pennsylvanicus Meadow vole							1	1
Neotoma mexicana Mexican woodrat				1			2	3
Peromyscus maniculatus Deer mouse		1		1			1	3
TOTAL		2	2	4			4	12

Note: data collected over 750 trap nights.

Table 8. Total number of individuals captured at Hay Gulch by species, sex, and age class. 3 - 5 September

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus ochrogaster Prairie vole	2	3		1				6
Microtus pennsylvanicus Meadow vole	9	4					3	16
Microtus species Vole species			1					1
Mustela species Weasel species							1	1
Peromyscus maniculatus Deer mouse	23	17	8	7			7	62
Zapus hudsonius Meadow jumping mouse			1					1
TOTAL	34	24	10	8			11	87

Note: data collected over 694 trap nights.

Table 9. Total number of individuals captured at Roxborough State Park by species, sex, and age class. 29 - 31 July

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus longicaudus Long-tailed vole	1							1
Microtus ochrogaster Prairie vole	1	1						2
Microtus pennsylvanicus Meadow vole	4	3					1	8
Peromyscus maniculatus Deer mouse	4	3	1				2	10
Zapus hudsonius Meadow jumping mouse			1	1				2
TOTAL	10	7	2	1			3	23

Note: data collected over 750 trap nights.

Table 10. Total number of individuals captured at Plum Creek by species, sex, and age class. 17 - 19 June

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Chaetodipus hispidus Hispid pocket mouse		1						1
Microtus longicaudus Long-tailed vole	1							1
Microtus pennsylvanicus Meadow vole	3	3	1		1		1	9
Mus musculus House mouse							1	1
Peromyscus maniculatus Deer mouse	12	13	4	5	2	2	5	43
TOTAL	16	17	5	5	3	2	7	55

Note: data collected over 750 trap nights.

Table 11. Total number of individuals captured at East Plum Creek by species, sex, and age class. 8 - 10 July

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus longicaudus Long-tailed vole	1							1
Microtus ochrogaster Prairie vole	4	1	1	1				7
Microtus pennsylvanicus Meadow vole		2	1					3
Peromyscus maniculatus Deer mouse	15	10	16	6	9	8	1	65
Reithrodontomys megalotis Western Harvest Mouse		1						1
Zapus hudsonius Meadow jumping mouse	2	2						4
TOTAL	22	16	18	7	9	8	1	81

Note: data collected over 750 trap nights.

Table 12. Total number of individuals captured at Beaver Creek by species, sex, and age class. 22 - 24 July

Species	Adult		Subadult		Juvenile		Unknown	Total
	Male	Female	Male	Female	Male	Female	(sex or age)	
Microtus ochrogaster Prairie vole	4	4				1		9
Microtus pennsylvanicus Meadow vole	5	7			2		1	15
Peromyscus maniculatus Deer mouse	14	25	14	11	3	2		69
Zapus hudsonius Meadow jumping mouse	3	2					1	6
TOTAL	26	38	14	11	5	3	2	99

Note: data collected over 750 trap nights.

Table 13. Preble's meadow jumping mice captured and genetic samples collected from each individual.

SITE	DATE	TRANSECT	TRAP	AGE	SEX	REPRODUCTIVE CONDITION	WEIGHT (g)	HEAD BODY (mm)	TAIL (mm)	HINDFOOT (mm)	GENETIC SAMPLES
Beaver Creek	22-Jul-97	C	15L	A	M	Y	17	72	123	29	Ear plugs, hair.
Beaver Creek	23-Jul-97	A	12R	A	M	N	17	75	126	27	None
Beaver Creek	23-Jul-97	E	20R	A	U	U					None
Beaver Creek	24-Jul-97	C	11R	A	M	N	16	74	122	30	Ear plugs, hair.
Beaver Creek	24-Jul-97	C	22L	A	F	N	20	78	114	31	Ear plugs, hair.
Beaver Creek	24-Jul-97	C	17L	A	F	Y	21	72	128	29	Ear plugs, hair.
East Plum Creek	08-Jul-97	A	9L	A	F	Y	26	79	126	30	None
East Plum Creek	09-Jul-97	A	2R	A	M	Y	22	80	128	32	Ear plugs, hair.
East Plum Creek	09-Jul-97	A	11R	A	M	N	18.5	76	130	31	Ear plugs, hair.
East Plum Creek	10-Jul-97	A	1R	A	F	Y	20.5	76	128	29	Ear plugs, no hair.
Roxborough State Park	29-Jul-97	B	15L	S	F	N	13	73	124	25	Ear plugs, no hair.
Roxborough State Park	31-Jul-97	D	26	S	M	Y	13.5	69	129	30	Ear plugs, hair.
Lone Pine Creek	20-Aug-97	A	12R	A	M	Y	21.5	70	131	31	Ear plugs, hair.
Lone Pine Creek	21-Aug-97	A	13L	A	M	Y	22.5	76	119	27	Ear plugs, hair.
Lone Pine Creek	21-Aug-97	D	5R	A	M	Y	21.5	66	132	29	Ear plugs, hair.
Lone Pine Creek	21-Aug-97	E	17R	S	F	N	16.5	65	130	30	Ear plugs, hair.
Lone Pine Creek	22-Aug-97	B	2L	A	F	N	19.5	68	130	29	Ear plugs, hair.
Lone Pine Creek	22-Aug-97	E	10R	A	M	Y	18	68	125	35	Ear plugs, hair.
Lone Pine Creek	22-Aug-97	E	8R	S	F	N	18.5	70	132	30	Ear plugs, hair.
Lone Pine Creek	22-Aug-97	E	6R	A	F	Y	21.5	64	129	30	Ear plugs, hair.
Lone Pine Creek	22-Aug-97	D	6L	A	M	Y	19.5	80	131	31	Ear plugs, hair.
Lone Pine Creek	22-Aug-97	D	7R	A	M	Y	17	65	120	34	Ear plugs, hair.
Lone Pine Creek	22-Aug-97	D	3R	A	M	Y	17	73	134	31	None

Table 13 (cont.). Preble's meadow jumping mice captured and genetic samples collected from each individual.

SITE	DATE	TRANSECT	TRAP	AGE	SEX	REPRODUCTIVE CONDITION	WEIGHT (g)	HEAD BODY (mm)	TAIL (mm)	HINDFOOT (mm)	GENETIC SAMPLES
Rabbit Creek	27-Aug-97	E	15L	S	M	Y	12.5	56	112	27	Ear plugs, hair.
Rabbit Creek	27-Aug-97	D	9L	A	M	Y	20	79	126	30	Ear plugs, no hair.
Rabbit Creek	27-Aug-97	D	2L	A	M	Y	22.5	75	122	30	Ear plugs, hair.
Rabbit Creek	27-Aug-97	C	16L	A	F	Y	19	69	130	29	Ear plugs, hair.
Rabbit Creek	28-Aug-97	E	23R	A	M	Y	21	75	132	30	Ear plugs, hair.
Rabbit Creek	28-Aug-97	D	13R	A	F	N	24	82	124	30	Ear plugs, hair.
Rabbit Creek	28-Aug-97	E	1R	A	M	N	25.5	76	129	29	Ear plugs, hair.
Rabbit Creek	28-Aug-97	C	7L	A	F	N	21	71	121	31	Ear plugs, hair.
Hay Gulch	04-Sep-97	E	16R	S	M	Y	11.5	56	108	26	None
Lone Tree Creek	10-Sep-97	C	12R	A	M	Y	19.5	72	134	29	Ear plugs, hair.

Table 14: Site, species richness, individual captures, presence of Preble's meadow jumping mice, trap nights, and individual captures per 100 trap-nights.

Site	Species Richness	Individual Captures	Presence of Preble's Meadow Jumping Mice	Trap Nights	Individuals captured per 100 trap-nights
Lone Tree Creek	6	91	X	750	12
Rabbit Creek	4	44	X	750	6
Lone Pine Creek	7	69	X	750	9
St. Vrain Creek	2	8		525	2
Schneider Property	5	12		750	2
Hay Gulch	5	87	X	694	13
Roxborough State Park	5	23	X	750	3
Plum Creek	5	55		750	7
East Plum Creek	6	81	X	750	11
Beaver Creek	4	99	X	750	13

Table 15. Community types and their occurrences at trap stations at successful and unsuccessful sites.

Community Type	Number of Occurrences Successful Sites	Number of Occurrences Unsuccessful Sites
1: Little or no tree or shrub canopy. Dominated by *Bromopsis inermis* sometimes with other grasses or sedges.	14 (HAY, LPC, RBC)	0
2: Little or no tree or shrub canopy. Dominated by *Typha latifolia*, sometimes with other grasses or sedges.	0	1 (PLU)
3: Little or no tree or shrub canopy. Dominated by wetland mixed herbs such as *Carex* spp., *Juncus* spp., *Poa* spp., *Equisetum* spp., *Mentha arvensis*, etc.	13 (EPC, HAY, LTC, RBC)	5 (PLU, STV)
4: Little or no tree or shrub canopy. Dominated by mesic mixed herbs such as *Cirsium arvensis*, *Lepidium* spp., etc.	12 (BVC, HAY, LPC, LTC)	1 (STV)
5: Little or no tree or shrub canopy. Dominated by litter and mixed herbs.	1 (EPC)	1 (STV)
6: Little or no tree or shrub canopy. Dominated by bare ground and mixed herbs.	5 (EPC)	6 (STV)
8: Dominated by *Symphoricarpos occidentalis* with little or no tree canopy and often with high litter and some grasses and/or herbs.	9 (BVC, LPC, LTC)	1 (STV)
9: Dominated by mixed shrubs with little or no tree canopy and graminoids such as *Scirpus* spp., *Juncus* spp., and *Poa* spp.	5 (BVC, HAY, LTC, ROX)	0
10: Little or no tree canopy. Dominated by mixed shrubs and mixed herbs.	11 (BVC, EPC, HAY, ROX)	19 (SCH, STV)
11: Little or no tree canopy. Dominated by *Padus virginiana*, *Symphoricarpos occidentalis*, and *Poa* spp.	5 (LPC, RBC)	1 (PLU)
13: Tree canopy of *Salix fragilis* dominates with an understory of soil or litter.	1 (EPC)	0
16: Dominated by a tree canopy of *Salix* sp. with a mixed shrub and mixed wetland herb understory.	3 (LTC, RBC)	1 (PLU)
17: Dominated by a tree canopy of *Salix* sp. with a *Salix* sp. and litter or soil understory.	2 (EPC)	0

Table 15a (con't). Community types and their occurrences at trap stations at successful and unsuccessful sites.

Community Type	Number of Occurrences Successful Sites	Number of Occurrences Unsuccessful Sites
18: Dominated by a tree canopy of *Salix* sp. with a *Salix* sp. and *Carex* spp. understory.	0	1 (PLU)
19: Dominated by a tree canopy of *Salix* sp. with a *Salix* sp. mixed herb and grass understory.	20 (EPC, HAY, LTC, RBC, ROX)	6 (PLU, STV)
20: Dominated by a tree canopy of *Salix fragilis* with an understory composed of mixed herbs.	17 (EPC, HAY, LPC, LTC, RBC)	0
21: Dominated by *Salix exigua* in both the tree and shrub canopies with a litter understory.	1 (BVC)	0
22: Dominated by a *Salix exigua* tree canopy with a mixed shrub and mixed herb understory.	12 (BVC, EPC, HAY, RBC)	1 (PLU)
23: Dominated by *Salix exigua* with an understory of wetland graminoids such as *Carex* spp., *Juncus* spp., *Scirpus* spp., and *Poa* spp.	5 (HAY, LTC)	0
24: Dominated by a tree canopy of *Alnus incana* with mixed shrubs and mixed herbs in the understory.	13 (BVC, EPC)	0
25: Dominated by *Populus deltoides* and *P. angustifolia* in the tree canopy with mixed shrubs and graminoids in the understory.	0	3 (PLU)
26: Dominated by a *Populus deltoides* tree canopy with an understory of graminoids and litter.	1 (HAY)	1 (PLU)
27: Dominated by a *Populus deltoides* tree canopy with an understory of mixed shrubs and mixed herbs.	6 (HAY, LPC, ROX)	7 (PLU, SCH)
29: Dominated by a *Populus angustifolia* tree canopy with an understory of mixed shrubs and mixed herbs.	44 (BVC, HAY, LPC, LTC, RBC, ROX)	23 (PLU, SCH, STV)
30: Tree canopy dominated by *Quercus gambelii* with a *Symphoricarpos occidentalis* and litter understory.	1 (ROX)	0
33: Overstory dominated by *Alnus incana* with a mixed herb understory.	5 (EPC, LPC)	0

Table 15a (con't). Community types and their occurrences at trap stations at successful and unsuccessful sites.

Community Type	Number of Occurrences Successful Sites	Number of Occurrences Unsuccessful Sites
34: Overstory dominated by *Populus deltoides* with a mixed herb understory.	1 (EPC)	3 (PLU, STV)
35: Overstory dominated by *Elaeagnus angustifolia* with a mixed herb understory.	0	4 (PLU, STV)
36: Tree canopy dominated by *Salix* spp. with an understory of *Crataegus* spp. and mixed herbs and grasses.	2 (BVC, ROX)	3 (SCH)
38: Tree canopy dominated by *Acer glabrum* with an understory of mixed shrubs and mixed herbs and grasses.	1 (RBC)	0

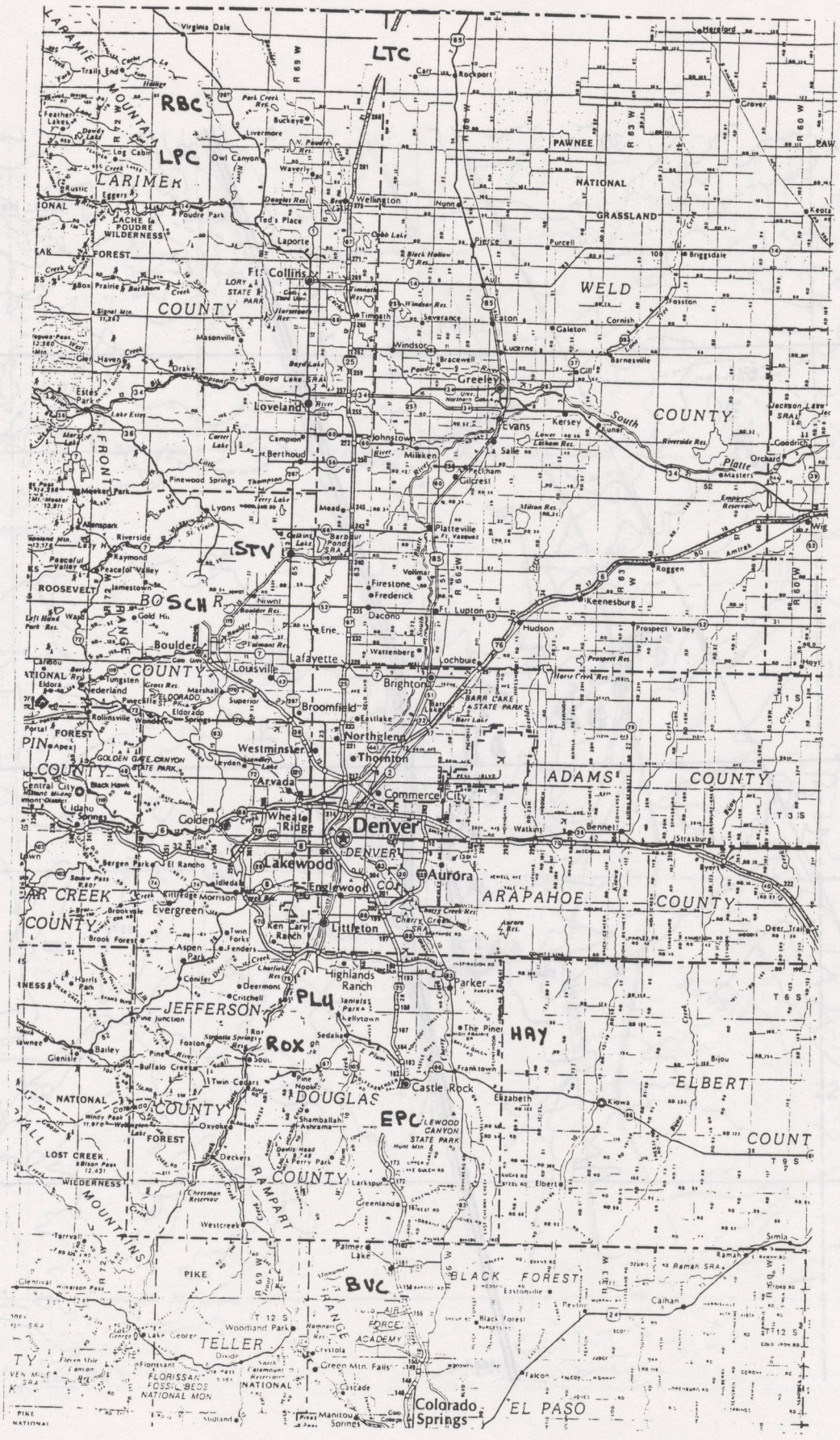

Figure 1. Location of the ten sites surveyed in 1997. LTC=Lone Tree Creek; RBC=Rabbit Creek; LPC=Lone Pine Creek; STV=St. Vrain Creek; SCH=Schneider property; HAY=Hay Gulch; ROX=Roxborough State Park; PLU=Plum Creek; EPC=East Plum Creek; BVC=Beaver Creek.

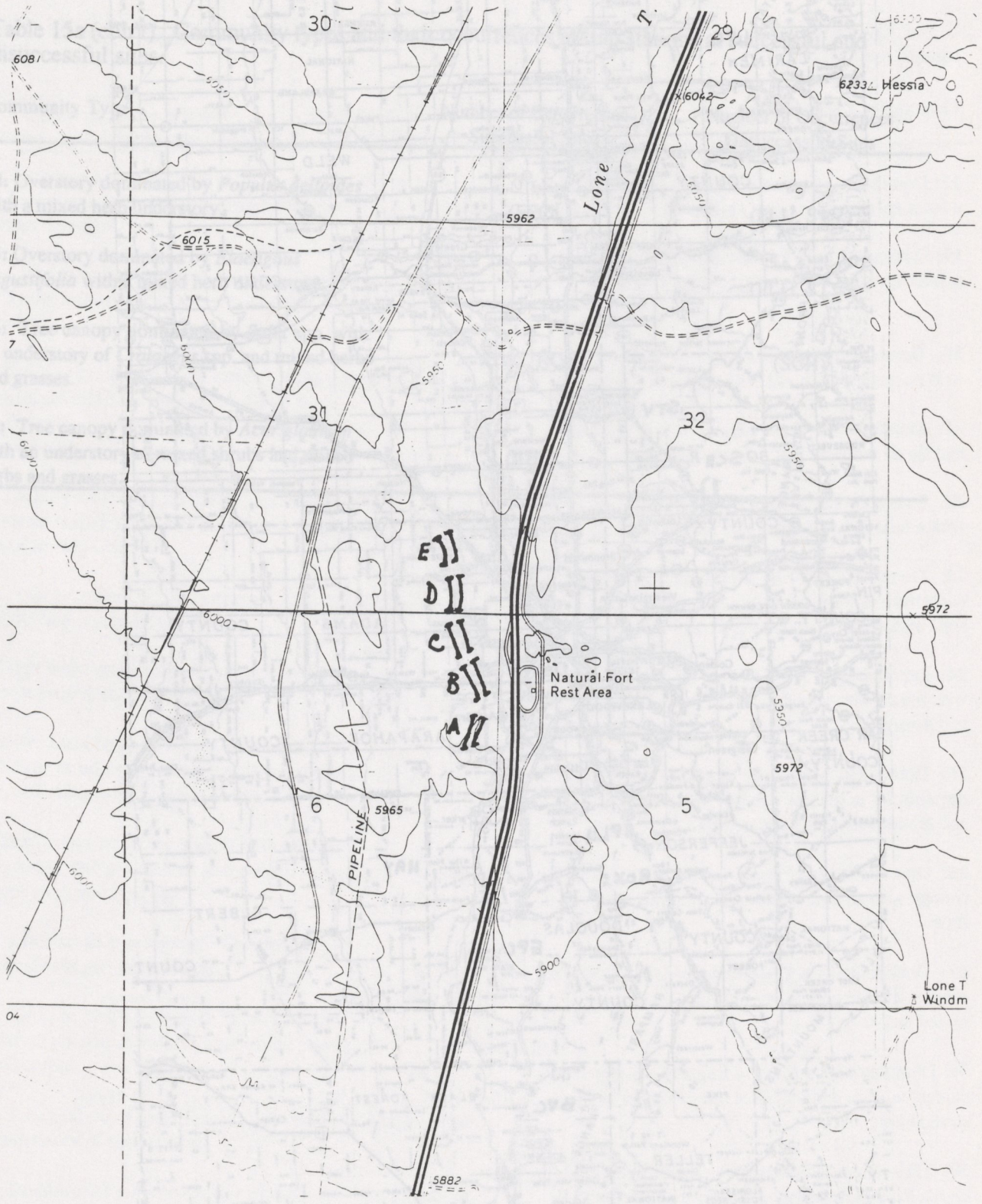

Figure 2. Location of transects at Lone Tree Creek, Weld County.

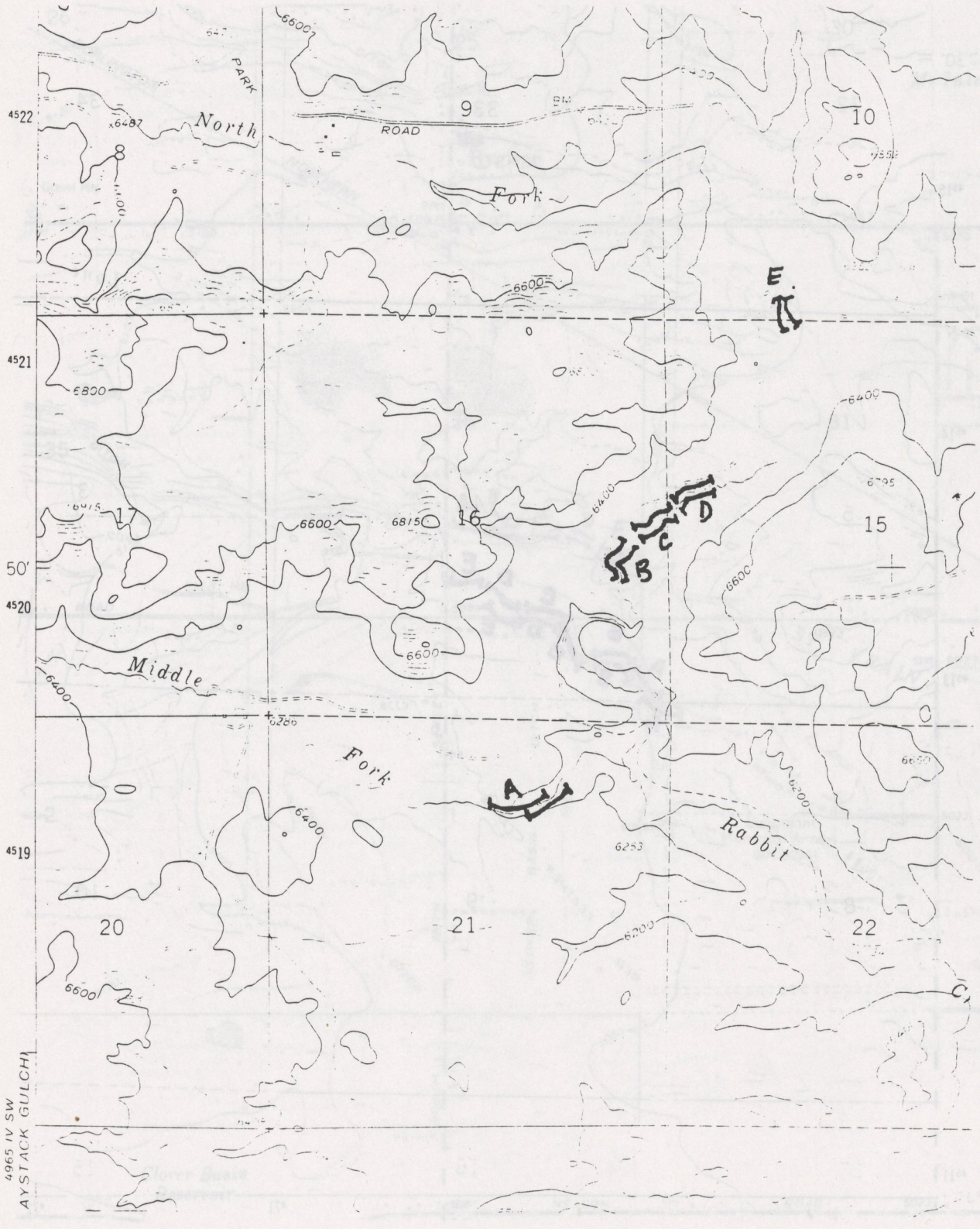

Figure 3. Location of transects at Rabbit Creek, Larimer County.

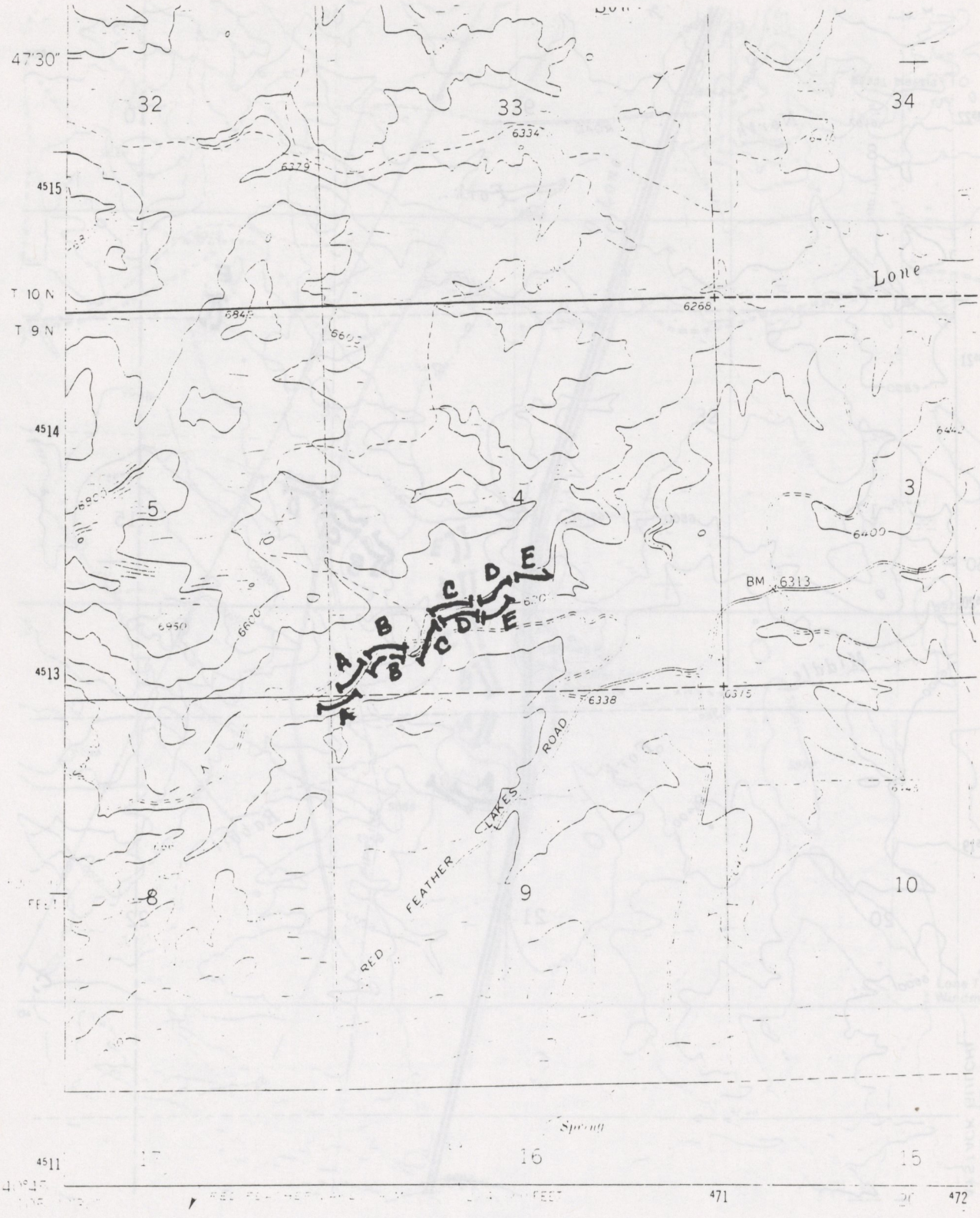

Figure 4. Location of transects at Lone Pine Creek, Larimer County.

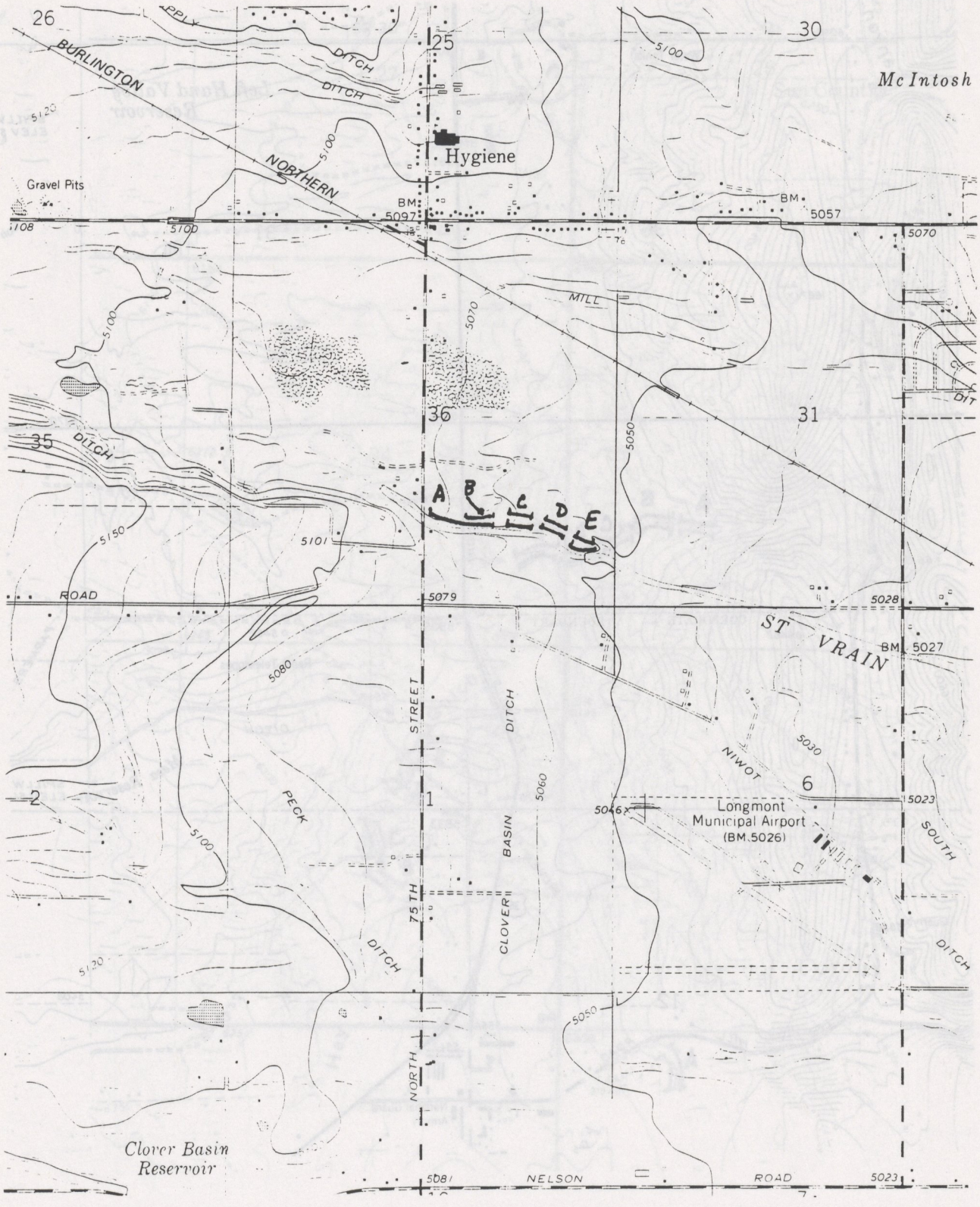

Figure 5. Location of transects at St. Vrain Creek, Boulder County.

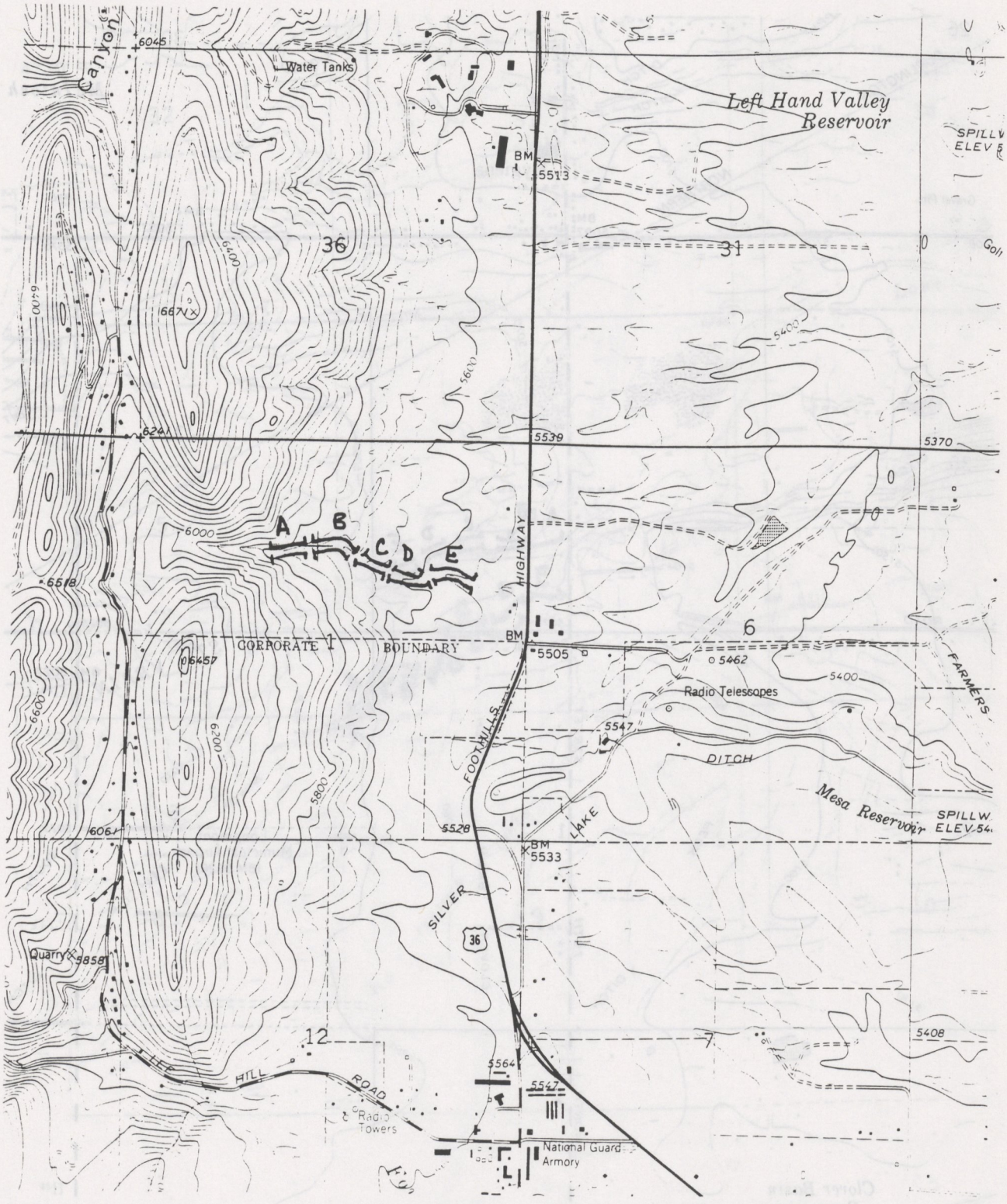

Figure 6. Location of transects at the Schneider property, Boulder County.

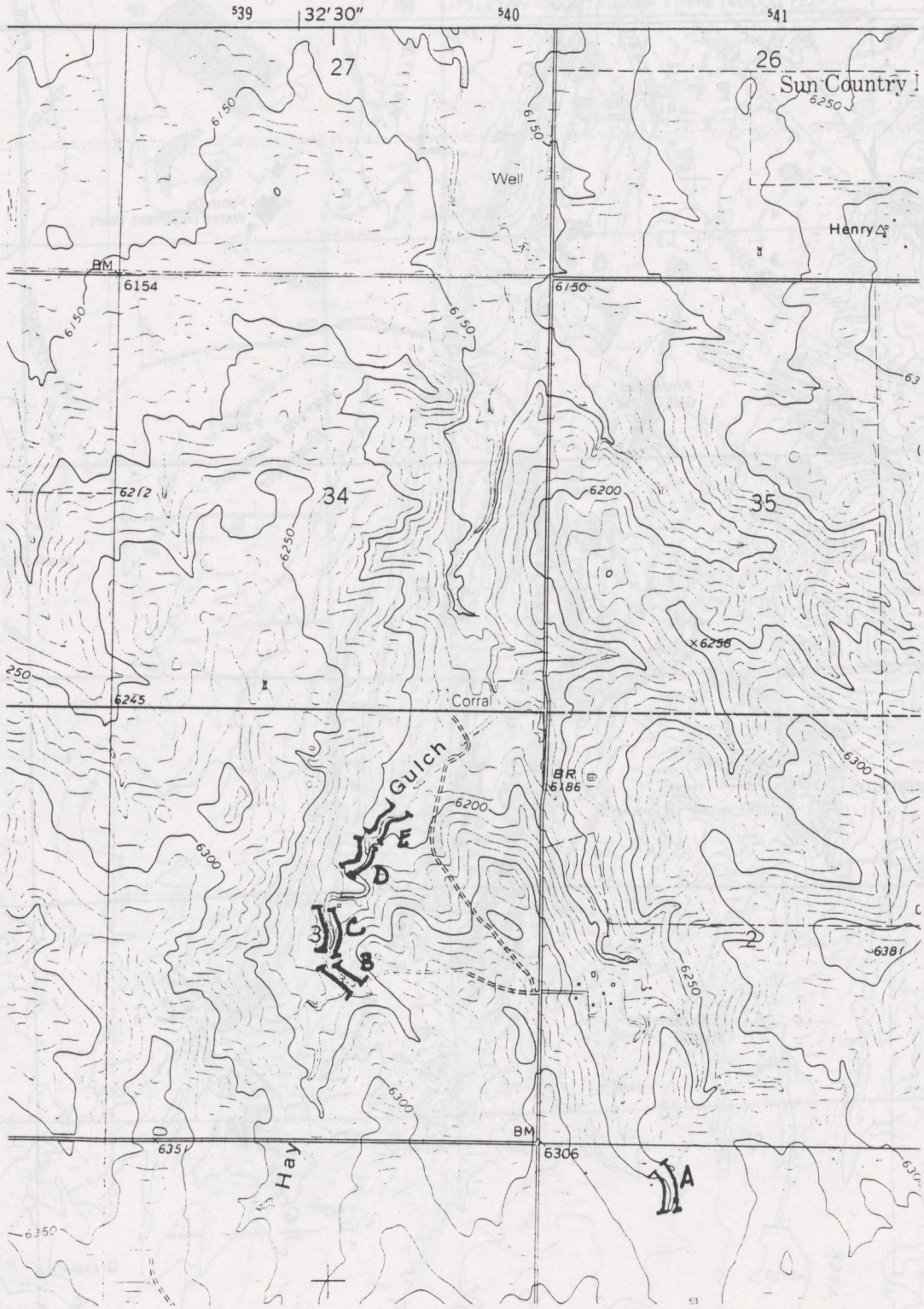

Figure 7. Location of transects at Hay Gulch, Elbert County.

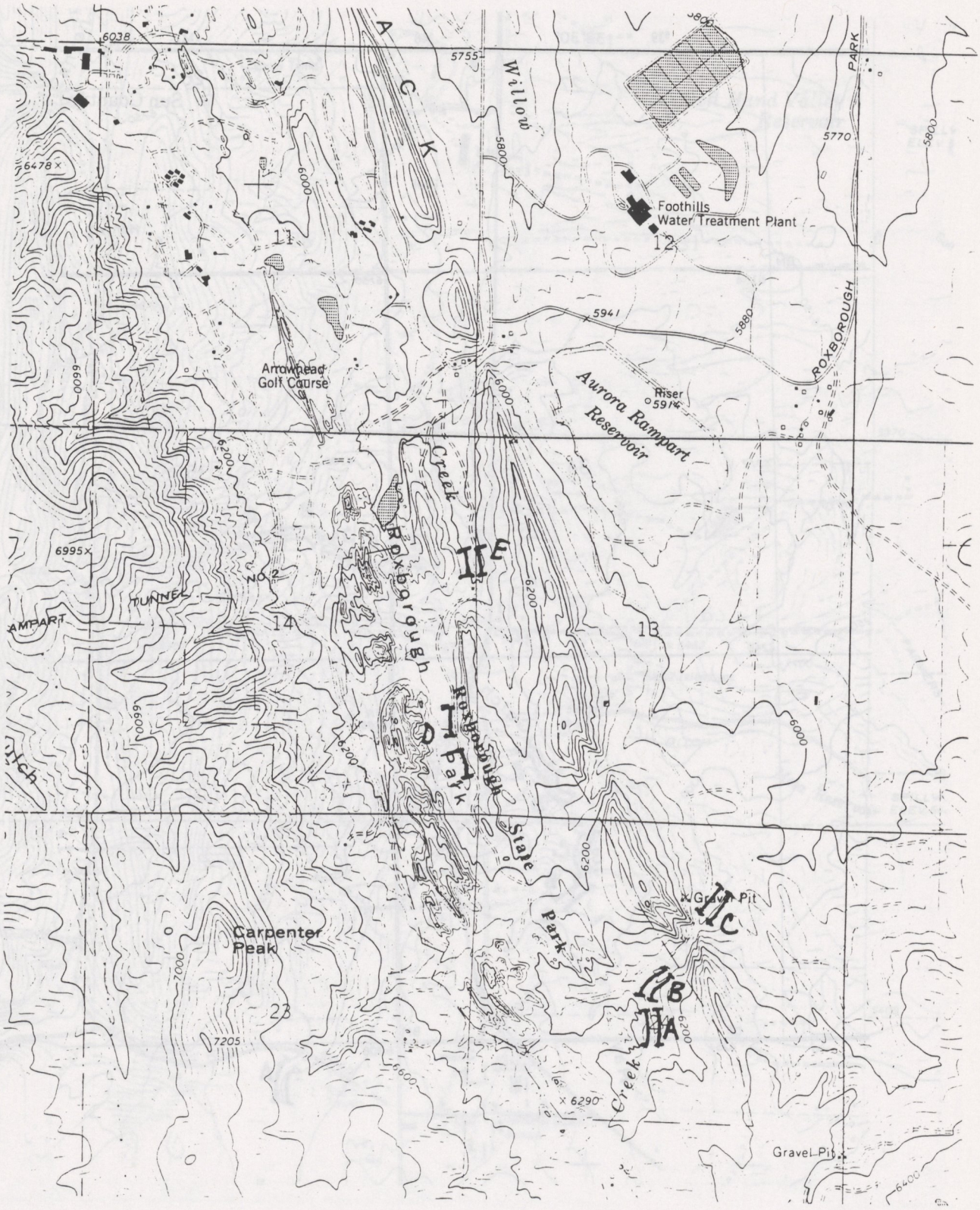

Figure 8. Location of transects at Roxborough State Park, Douglas County.

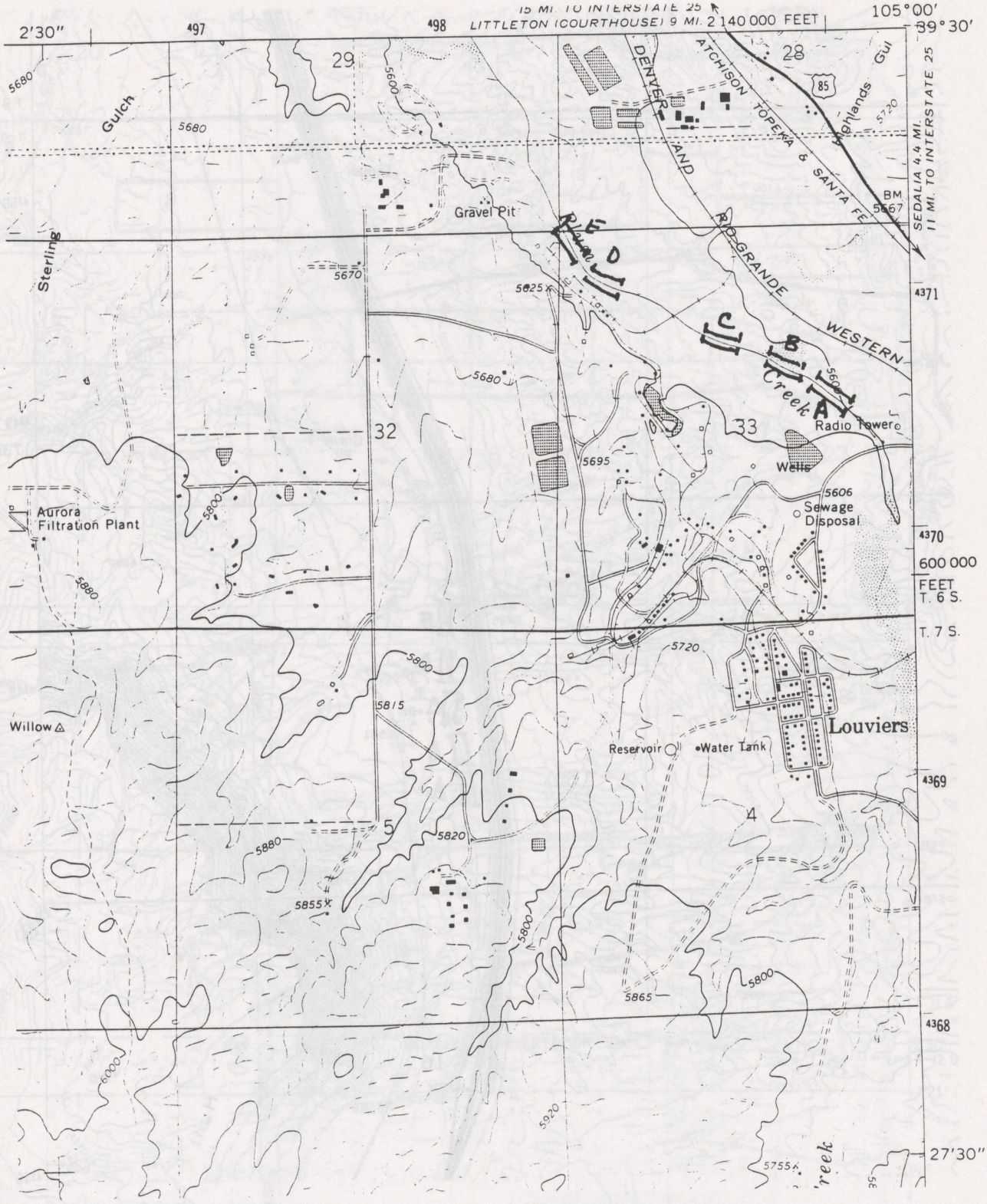

Figure 9. Location of transects at Plum Creek, Douglas County.

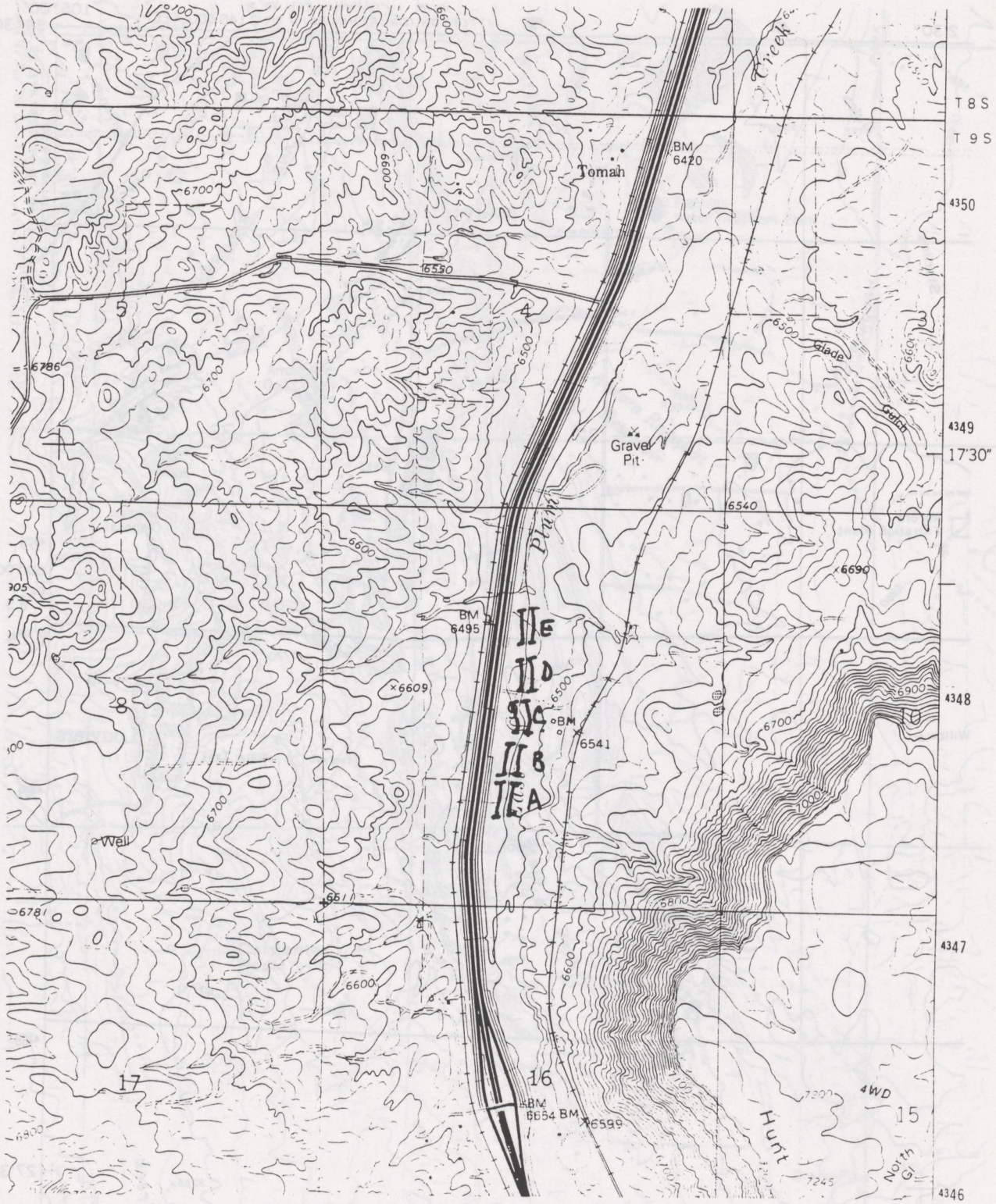

Figure 10. Location of transects at East Plum Creek, Douglas County.

Figure 11. Location of transects at Beaver Creek, El Paso County.

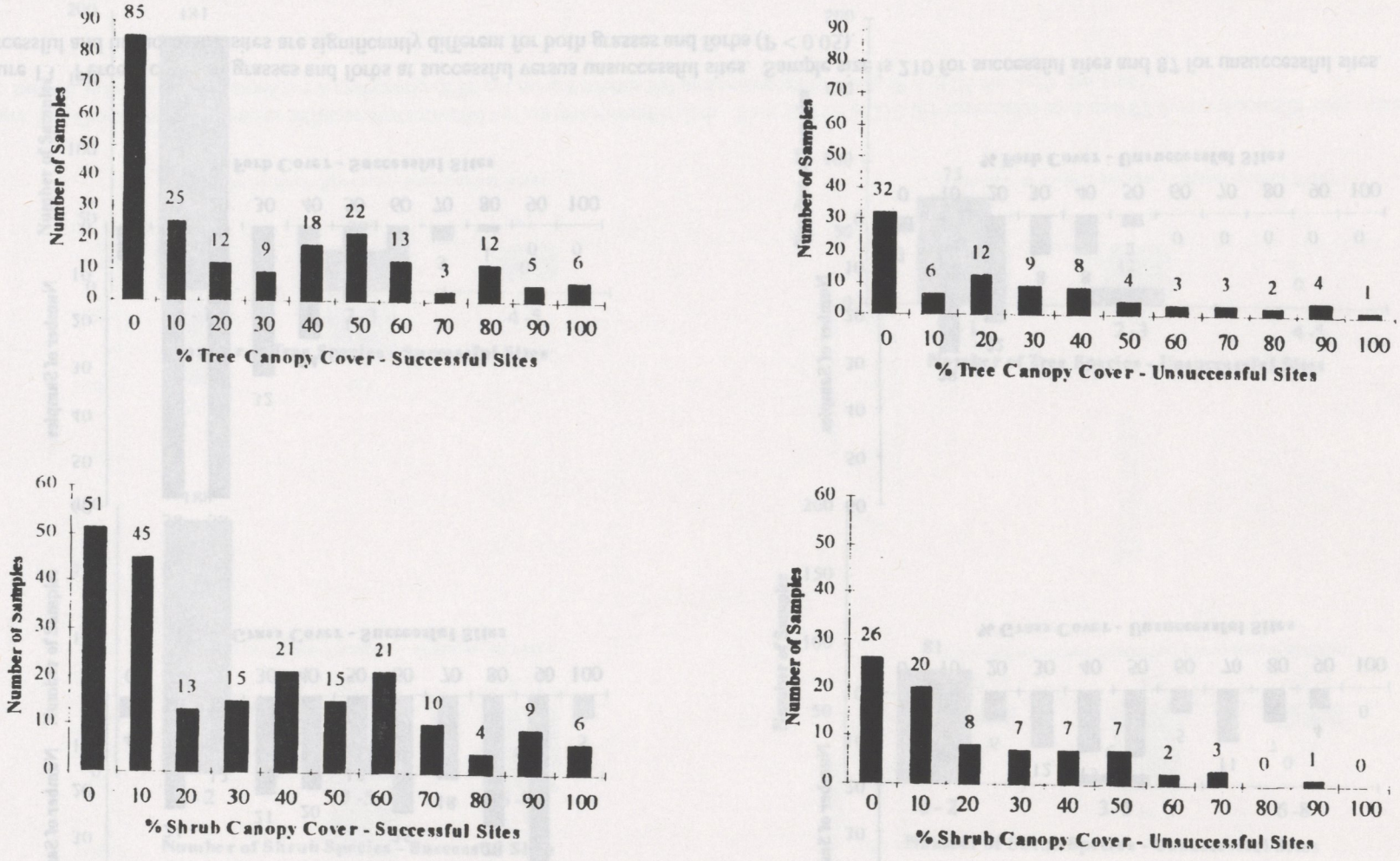

Figure 12. Percent cover of trees and shrubs at successful versus unsuccessful sites. Sample size is 210 for successful sites and 87 for unsuccessful sites. Tree cover is not significantly different between successful and unsuccessful sites. Shrub cover is different ($P < 0.05$) between sites (see text).

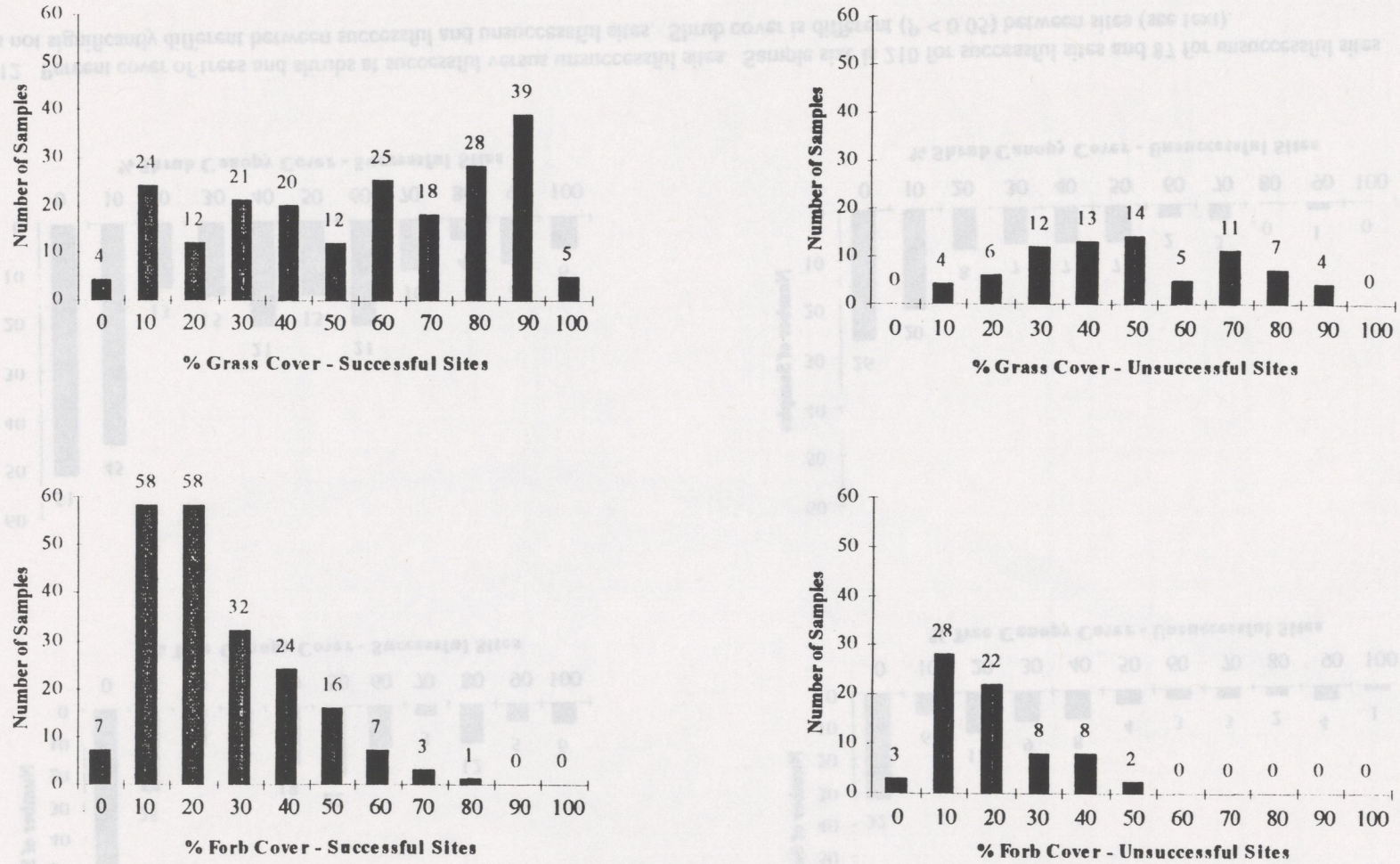

Figure 13. Percent cover of grasses and forbs at successful versus unsuccessful sites. Sample size is 210 for successful sites and 87 for unsuccessful sites. Successful and unsuccessful sites are significantly different for both grasses and forbs ($P < 0.05$).

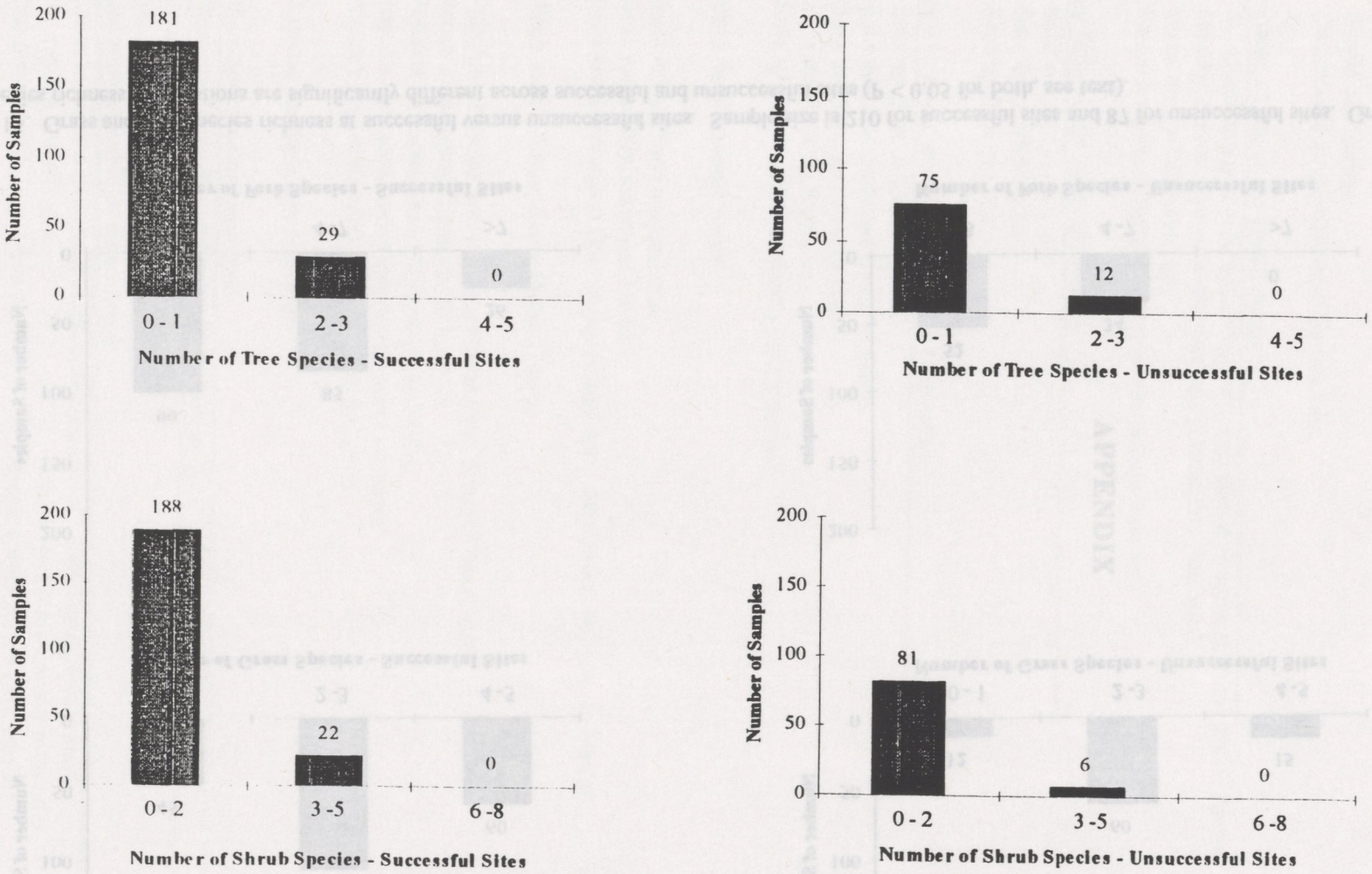

Figure 14. Tree and shrub species richness at successful versus unsuccessful sites. Sample size is 210 for successful sites and 87 for unsuccessful sites. Tree and shrub species richness distributions are not significantly different at successful and unsuccessful sites ($P < 0.05$).

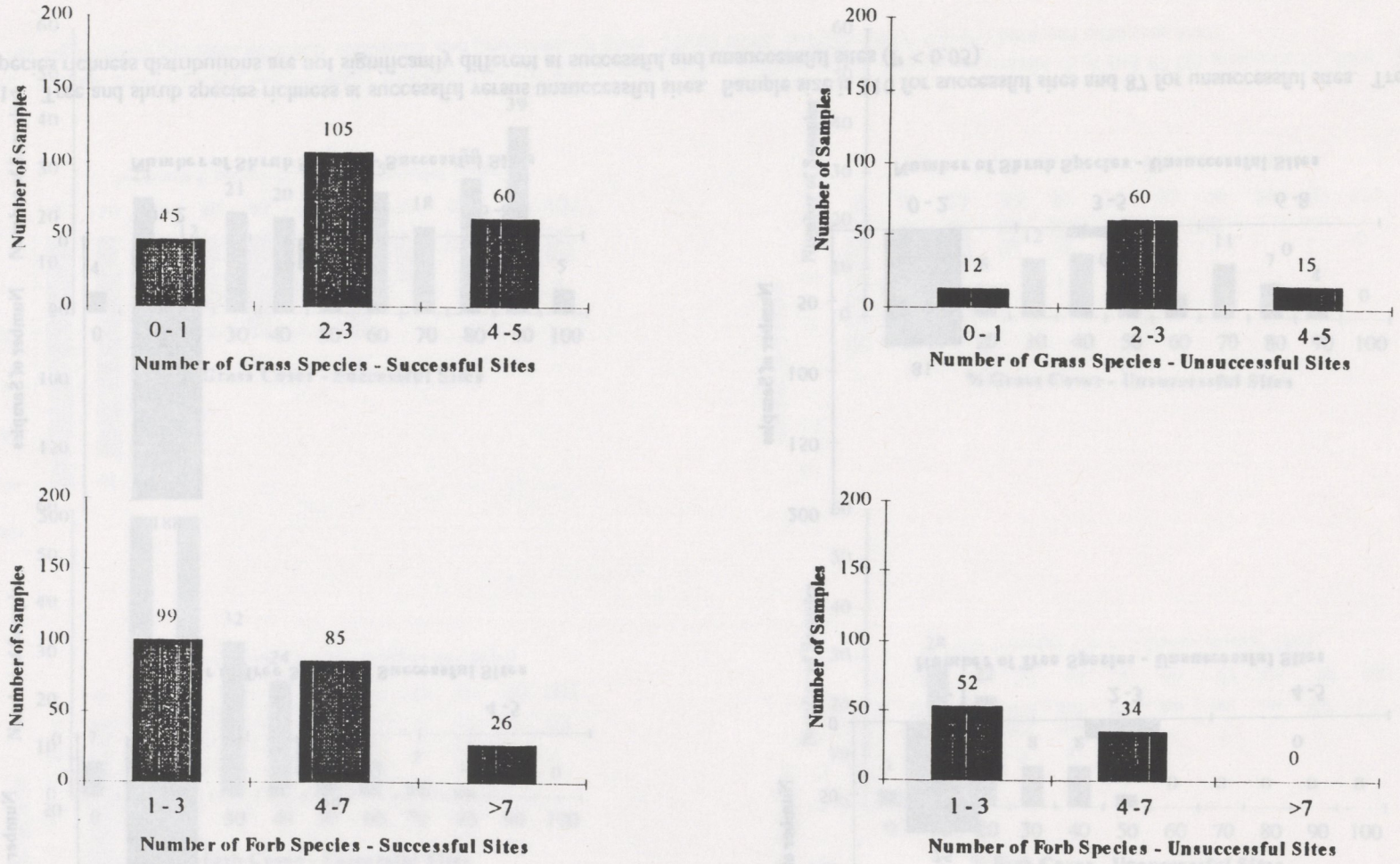

Figure 15. Grass and forb species richness at successful versus unsuccessful sites. Sample size is 210 for successful sites and 87 for unsuccessful sites. Grass and forb species richness distributions are significantly different across successful and unsuccessful sites ($P < 0.05$ for both, see text).

APPENDIX

Little or No Tree or Shrub Canopy — Plant Community Types - 1997

1 Bromus inermis/ sometimes with other grasses or sedges
2 Typha latifolia/ sometimes with grasses or sedges
3 Mixed Herbs: wetland type (Carex sp., Juncus sp., Poa spp., Equisetum arvense, Mentha arvense, etc)
4 Mixed Herbs: mesic type (Cirsium sp., Lepidium sp., Bromus inermis, Poa spp.)
5 Litter/Mixed Herbs
6 Soil/Mixed Herbs
7 Calamovilfa longifolia/Mixed Herbs/Litter

Shrub Dominated - Little or No Tree Canopy

8 Symphoricarpos occidentalis/often with high litter and some grasses and/or herbs
9 Mixed shrubs/Graminoids (Scirpus sp., Juncus sp., Poa spp.)
10 Mixed shrubs/Mixed Herbs
11 Padus americana/Symphoricarpos occidentalis/Poa spp.

Tree Canopy Only - Little or No Understory

12 Salix exigua/Soil or Litter
13 Salix fragilis/Soil or Litter
14 Salix sp./Soil or Litter

Tree Canopy with Shrub and/or Herbaceous Understory

15 Salix sp./Shrubs/Litter
16 Salix sp./ Shrubs/Mixed Wetland Herbs
17 Salix sp./Salix sp./Litter or Soil
18 Salix sp./Salix sp./Carex sp.
19 Salix sp./Salix sp./Mixed Herbs (with grasses)

20 Salix fragilis/Mixed Herbs

21 Salix exigua/Salix exigua/Litter
22 Salix exigua/Shrubs/Mixed Herbs
23 Salix exigua/Wetland Graminoids (Carex spp., Juncus sp., Scirpus sp, Poa sp.)

24 Alnus incana/Mixed Shrubs/Mixed Herbs

25 Populus deltoides and P. angustifolia/Mixed Shrubs/Graminoids
26 Populus deltoides/Graminoids/Litter
27 Populus deltoides/Mixed Shrubs/Mixed Herbs
28 Populus deltoides/Padus virginiana/Bromus inermis
29 Populus angustifolia/Mixed Shrubs/Mixed Herbs

30 Quercus gambelii/Symocc/Litter

31 Pinus ponderosa/Graminoids
32 Pinus ponderosa/Mixed Shrubs/Mixed Herbs
33 Alnus incana/mixed herbs
34 Populus deltoides/mixed herbs
35 Eleagnus angustifolia/mixed herbs

Notes: Communities are described in the following format: Tree/Shrub/Herbaceous

Shrubs usually include one or more:
Symphoricarpos occidentalis
Rosa sp.
Padus americana
Prunus americana
Ribes sp.
Amorpha fruticosa
Salix exigua
Rhus trilobata

Mixed Herbs are usually wetland or mesic combinations (see above) these include forbs and graminoids

Graminoids include one or more:
Bromus inermis, Poa spp., Dactylis glomerata, Calamovilfa longifolia, Bromopsis pumpelliana