ECOLOGICAL SURVEY OF THE CITY OF BOULDER, COLORADO MOUNTAIN PARKS

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David J. Cooper, Editor

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INTRODUCTION

David J. Cooper

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The mountains, foothills and plains surrounding the city of Boulder, Colorado are spectacularly scenic, ecologically diverse and esthetically vital to the people of the region. A large portion of this land is owned and managed by the city of Boulder as mountain parks which truly are a public treasure. The parks provide a broad expanse of landscape at the foot of the Rocky Mountains in which city dwellers can find the freedom and subject for spiritual, recreational and educational pursuits. There is room to wander. Hiking trails, bicycle paths and roadways provide access to natural systems as diverse as grasslands, forests, mountain and plains streams and ponds, talus slopes, rock slabs, cliffs, boulders, and mountain summits. Even though a major metropolitan area borders and surrounds much of the mountain parks many areas are undisturbed and represent some of the best remaining examples of pre-settlement ecosystems to be found along the entire Colorado Front Range. The juxtaposition of the parks and growing cities makes the parks even more important and potentially endangered by overuse and improper management.

Several topographical factors interact to make the ecology of the Boulder area unique and diverse. The Rocky Mountains are at their most easterly point along the Colorado Front Range, and at Boulder the Rockies have their most abrupt rise from the

plains. Both Green Mountain and Bear Peak rise about 3,000 vertical ft. from the plains. Boulder Creek and South Boulder Creek exit from the mountains on the edges of these peaks and provide wet stream courses adjacent to the high peaks. The Fountain formation is competent in this area and forms the "flatirons" which have weathered into talus, the major source of rock for debris flows onto the basal plains. Rocky terrain at the foot of the mountains in the form of pediments, present day floodplains, and bedrock hogbacks is abundant. Deep and steep walled north-facing canyons occur in many areas at low elevation adjacent to the plains. Also importantly the Front Range is an arc opening toward the plains with Boulder at the western-most edge. Upslope storms that encounter the Front Range are funnelled into the Boulder area and precipitation is significantly greater than areas to the north, south and east. A cloud veil frequently forms on Green Mountain and Bear Peak creating locally humid environments.

Many eastern species have used the streams and rivers which cross the arid Great Plains to reach the Rocky Mountains during the wetter and cooler Pleistocene. These species formed ecosystems in the Colorado foothills and plains closely related to those of the eastern forests and plains. After the Pleistocene ended the climate dried up and the connection with the east was severed. However many species and ecosystems persist as relicts here because the moisture situation of floodplains, cool canyons and rocky slopes are so favorable. These ecosystems occur as islands separated from their principal present day range

farther east and north. True tall grass prairie in both its upland and lowland aspects occurs in several locations along floodplains and rocky areas of mesa rims. Species of the eastern deciduous forest and other mesic biomes occur in the cool north-facing canyons. Many species of orchids and ferns are of primary concern. The Dakota and other hogbacks provide continuous and xeric habitats in a north-south orientation along the base of the mountains. Chihuauan species have used this habitat as their path for migration north into the Boulder area from regions far to the south. The result of all these processes and interactions is a tremendously complex and remarkable mosaic of ecosystems with species of eastern, northern, southern and Rocky Mountain affinities occurring adjacent to or mixed with each other. It is an area truly worth knowing and preserving.

The purpose of the present inventory was to begin to assemble existing information and to collect new information where none previosuly existed on the flora, fauna and ecosystems of the region. Included in this study is land under the management of the city of Boulder Parks and Recreation Department. The effort was divided into three groups, botanists, mammalogists, and ornithologists. Since there was no funding for the project all efforts were by individuals interested in using their expertise to help identify and preserve the ecological diversity of the area. The botany portion of this report includes a discussion of the areas vegetation and a list of and notes on the taxa known to occur in the area. The vegetation units are not the product of rigorous quantitative analysis.

They are subjective and broad, meant primarily to give a framework from which future more detailed studies could radiate and into which information on bird and mammal distribution could be integrated. The list of plants was assembled from records of species documented by collections in the herbarium of the University of Colorado. In addition to this notes on other species which are known to occur but are not documented by collections are given. The study of mammals was conducted by a class in mammalogy at the University of Colorado. All their data was collected during the course of the present study. The data on birds is presented from records of birds kept by local ornithologists in their studies of the area. Their data is thus a summary of many years' observations.

It should be kept in mind that this survey is only a first step toward the goal of more completely documenting the ecosystems and biota of this region. Because the Mountain Parks do contain many ecosystems which are truly unique this survey should continue in years to come, and information be added to the body of information and the synthesis presented here. The wise management of any resource first requires an adequate inventory of the resource. It is toward the fulfillment of that requirement that the present inventory was initiated.

VEGETATION OF THE MOUNTAIN PARKS

David J. Cooper

Ten general categories of vegetation were established primarily to provide a framework for mammalogists and ornithologists to use in their work. Each category is described here and the diversity of vegetation types to be found in each is expanded upon.

1.PONDS AND REEDS. This category includes lakes and ponds found on the plains, most of which are reclaimed gravel mining pits. Sawhill ponds is the largest of the pond areas. Vegetation is controlled by high water table which remains high all summer. The primary plants are emergent species including cattails, arrowhead, and submerged species of algae. This type of habitat is vital for all waterfowl and shorebirds. While these habitats are heavily used for recreation, much of the area surrounding these ponds was disturbed by the mining operations and still remains in a weedy state.

2.GRASSLANDS. This is a very broad category and includes a wide variety of vegetation types. True lowland prairie dominated by big bluestem (Andropogon gerardii), indian grass (Sorgastrum avenaceum), and switchgrass (Panicum virgatum) occurs in the lowlands of the Boulder area, especially in the South Boulder Creek drainage. This vegetation type most probably represents the type of grassland which was common here during the Pleistocene, but has become restricted in Colorado to the moist mountainfront area of Boulder and a few areas on the plains such as at Bonny Reservoir in the Republican River drainage. This

type is scattered in small patches in the Mountain Parks. Another lowland tallgrass type is dominated by prairie cordgrass (Spartina pectinata). This type is found occasionally in wet sloughs and river bank situations, and was surely common everywhere in the Boulder area. It currently occurs in the Mountain Parks at Sawhill Ponds.

Rocky uplands on the mesas between Boulder Creek and South Boulder Creek may have vegetation similar to the upland aspect of the tallgrass or true prairie. Little bluestem (Schizicharium scoparium), prairie dropseed (Sporobolos heterolepis), and porcupine grass (Stipa spartea) may be abundant and dominant. The latter two mentioned species are quite rare in Colorado and are known to occur primarily from the Boulder area and from the highlands of the Black Forest near Franktown. This type is very well developed at Shannahan Ridge park, and on the many mesas that border Chautauqua meadow and other mesas farther south. Suprisingly this type has not been described from the Boulder area before. It is also a Pleistocene relict found in the most moist upland in the area. Uplands of this nature are quite rare in Colorado. In the Boulder area Rocky Mountain species such as mountain muhly (Muhlenbergia montana) are found with the prairie species already mentioned, and provide wonderful examples of the mixing of these floristic elements.

The slopes of the mesas and the bottomslands in many areas are composed of shale bedrock. Western wheat grass (Agropyron smithii), bluegrass (Poa aggasizensis), canada bluegrass (Poa compressa), and green needle grass (Stipa viridula) are usually

dominant in these situations. This is one of the most abundant grass-dominated types in the area. Typical short-grass prairie is not abundant in the mountain parks although most of the species typically associated with this prairie such as blue grama grass (Bouteloua gracilis) and buffalo grass (Buchloe dactyloides) can be abundant. Along the xeric hogbacks north of town and in the NCAR area indian rice grass (Oryzopsis hymenoides) and New Mexican feather grass (Stipa neomexicana) may be abundant. The latter grass is a Chihuauan species which is common in the American Southwest and reaches far to the north along the Colorado Front Range. The distribution of many Chihuauan species which occur in this area may be relicts of the Hypsithermal.

3.PLAINS RIPARIAN. This type occurs along the streams and rivers in the Boulder area. Plains cottonwood (Populus sargentii) and peach-leaved willow (Salix amygdaloides) are the dominant overstory. According to turn of the century reports shrubby understory may be dense in undisturbed stands, but no undisturbed stands occur in the Boulder region. The most important shrubs are alder (Alnus tenuifolia), river birch (Betula occidentalis) and sandbar willow (Salix exigua).

4.FOOTHILLS RIPARIAN. This type is similar to the last but is found in cool canyons at the mountain front. In addition to the tree species already mentioned box-elder (Acer negundo), and green ash (Fraxinus pennsylvanica) also occur. The latter species is native to deciduous forests of the eastern U.S. and extends west into western Nebraska and far eastern Colorado but

does not appear to have been in the Boulder area before the original settlement. A Shrub understory is very well-developed in this type. Shrubs found here include chokecherry (Prunus virginiana), wild plum (Prunus americana), pin cherry (Prunus pensylvanica), hawthorn (Crategus erythropoda and C. succulenta), and others.

5.MOUNTAIN RIPARIAN. This type is represented only on the north side of Green Mountain. It is probably the most unique area in the foothills of the entire Colorado Front Range. Here occurs the most southerly stand of paper birch (Betula papyrifera) in the western U.S. and the only stand south of the Black Hills of South Dakota. This birch surely is a Pleistocene relict and probably reflects the southern extention of boreal vegetation into this region during the ice ages. Other trees found include the narrowleaf cottonwood (Populus angustifolia) and aspen (Populus tremuloides). The most important shrub in this type is beaked hazelnut (Corylus cornuta) which is common in the eastern deciduous forest but in Colorado is abundant only in cool canyons along the east slope of the Front Range. A rather large number of regionally rare and disjunct species occur in permanently wet seeps and along streams in this area. Found here are wood lily (Lilium philadelphicum), white adders-mouth (Malaxis monophylla ssp. brachypoda), alaskan orchis (Piperia unalaschensis), common rattlesnake-plantain (Goodyera oblongifolia), broad-lipped twayblade (Listera convallarioides), rattlesnake fern (Botrychium virginianum), dwarf raspberry (Rubus pubescens), white-veined wintergreen (Pyrola picta), wild

sasparilla (Aralia nudicaulis) and others. These species are rare in the southern Rocky Mountains but can be quite locally abundant in this habitat type while others occur in populations of only a few dozen plants. This habitat type must be considered very threatened and no disturbance whatsoever must ever occur. This should eliminate additional trail construction, wood-cutting, nature class field trips, camping etc.

6.GRASSLAND-FOREST ECOTONE. Lower treeline in the Boulder area usually occurs on the mesas and hogbacks with Ponderosa pine (Pinus ponderosa) being the primary coniferous tree. Old photographs of this area indicate that treeline has advanced from the foothills well out onto the mesas and plains during this century, probably as a result of wildfire suppression, and the disturbance of soils due to cattle grazing. This ecotone can occur in a variety of habitat types and may form dense stands or be open and parklike with broad grassy areas between trees. The shrubs wax current (Ribes cereum), skunkbush (Rhus trilobata), and mountain mahogany (Cercocarpus montanus) may occur with the pine. Presently numerous pine seedlings occur in the grassy parks between trees, and proper management is needed to prevent the loss of grasslands especially on the mesas where relict tallgrass stands occur. It is presumed that much of this upland grassland has already been lost due to the spread of the pine and its development of very dense stands which produced low light quality and heavy needle fall to the forest floor. At the lower limit of the ponderosa pine zone in Colorado a submontane zone dominated by shrubs usually occurs. Farther south in the Front

Range scrub oak (Quercus gambelii) usually dominates this zone, but this species reaches its northern limit in the Front Range near Morrison. South of Boulder near Golden and north of Boulder near Lyons submontane shrub stands dominated by mountain mahogony are well-developed and indicate that the better moisture situation in the Boulder area has allowed the pine to occur at lower elevations than other areas of the Front Range, and it occupies and dominates almost all sites suitable for the shrubs right down to the plains. Thus the submontane zone is absent in the Boulder area.

7.PONDEROSA PINE FOREST. This is the dominant forest type over the mesa tops, and the drier portions of the mountains. Because the stands have had a very complicated history little can be said here of their native composition. The stands have obviously spread and become more densly populated in the past 100 years. Fire has been totally supressed during this time and the trees have recently been subject to parasitism by mistletoe (Arcuethobium vaginatum) and by very high populations of pine bark beetle, which has caused the demise of many, many trees. Project Greenslope thinned many stands during the years 1981-1982. In many stands which were very dense shade-tolerant douglas-fir (Pseudotsuga menzeisii) have become established. Where stands have been thinned and heavy equipment has disturbed soils a tremendous number of pine seedlings occur, and it is obvious that ponderosa pine is a pioneer on disturbed soil in this area. In areas which have not been disturbed by the processes mentioned spike fescue (Leucopoa kingii) occurs and may

be the dominant grass. THe ponderosa pine-spike fescue stand type appears to be limited to the Boulder area in Colorado, but most of its former range has surely been disturbed. It is probable that mountain muhly (Muhlenbergia montana) was once common in dry open areas in forests, but is uncommon at present. In disturbed forest areas poverty oat-grass (Danthonia spicata) occurs in abundance.

8.MIXED PONDEROSA PINE-DOUGLAS-FIR FOREST. This type includes much of the steep east and west faces of Flagstaff Mountain, Green Mountain, and Bear Peak where the two species occur together. This type may be intermediate between the Ponderosa pine and douglas-fir types.

9.DOUGLAS-FIR FOREST. This forest type is dominated almost exclusively by douglas-fir (Pseudotsuga menzesii). It occurs on steep north-facing slopes at lower elevations and on all slope aspects at higher elevations. It is the dominant vegetation type on the upper portions of Green Mountain and Bear Peak. It may occur on deep soils or on talus. An understory of shrubs such as wax flower (Jamesia americana) and wild raspberry (Rubus idaeus ssp.melanolasius), along with herbs, sedges such as elk sedge (Carex geyeri), and numerous cryptogams may be common.

10.ROCK FACES AND ROCK CANYONS. This type occurs on the steeper faces of the foothill canyons and on the flatirons and talus slopes associated with the flatirons. Trees are generally absent but shrubs such wax flower (Jamesia americana) and pericome (Pericome caudata) may be abundant. Several species of ferns such as fendlers lip fern (Cheilanthes fendleri), grass

fern (*Asplenium septentrionales*), and american rock-brake (*Cryptogamma crispa* ssp. *acrostichoides*) are limited to this type. While this type is not rich in species (except cryptogams) it is essential for nesting raptors and also for recreational rock climbing and thus an important management problem exists.

*nomenclature according to W.A.Weber. 1976. Rocky Mountain Flora. University of Colorado Associated Press. 479pp.

FLORA OF THE MOUNTAIN PARKS

INTRODUCTION

David J. Cooper

The primary floristic list and notes presented here has been compiled by W.A. Weber from specimens in the University of Colorado herbarium. In most instances there specimens were collected before 1950. Little collecting has occurred in the years since. Additions to this list and notes are by R. Wittmann and D. Cooper who have collected or made observations in the area. These lists show that even though the Mountain Parks occur adjacent to a large metropolitan area in which a major university and numerous scientific laboratories and firms are based the area is far from well-known, and much information is still needed. In my searches for the rare species small-leaved false indigo (Amorpha nana), porcupine grass (Stipa spartea), prairie dropseed (Sporobolus heterolepis) and others I found them in numerous previously unknown locations in which they were quite plentiful and much more abundant than the location or locations where they had been known to occur. The problem is that so few people know the critical plant taxa for this area, and thus knowledge is slow to accumulate. The present report should be updated at frequent intervals when new information on the status of critical species is collected.

CATALOG OF THE VASCULAR PLANTS OF THE BOULDER MOUNTAIN PARKS (ENCHANTED MESA, GREEN MOUNTAIN, FLAGSTAFF)

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This catalog has been abstracted from an unpublished work, Flora of Boulder County, Colorado, and is based on specimens in the herbarium of the University of Colorado Museum. For detailed citations of the records, users are referred to the master copy in the Museum. Keys to recognition of the species, and general statements as to their habitats may be sought in Weber, W. A. Rocky Mountain Flora. Name changes may be traced in Weber & Johnston, Natural History Inventory of Colorado. I. Vascular Plants, Mosses, and Lichens. Only those species which are of special interest for conservation reasons are listed with notes and comments. The full Boulder County flora catalog is in preparation.

PTERIDOPHYTA

ASPIDIACEAE--SHIELDFERN FAMILY

DRYOPTERIS FILIX-MAS (L.) SCHOTT. Male Fern. A rare and handsome fern once almost exterminated by pharmaceutical collectors, but persisting in the narrow ravines between the Flatirons.

ASPLENIACEAE--SPLEENWORT FAMILY

ASPLENIUM SEPTENTRIONALE (L.) HOFFM. Grass Fern. Confined to crevices in the rock walls of the Flatirons.

ASPLENIUM TRICHOMANES L. Maidenhair Spleenwort. Once there was a small clump of this species in a large boulder by the spring at the base of the Mesa trail where the road to Chautauqua reservoir crosses the gulch, but this seems to have been grubbed out. It is not known from any other site in the parks.

ATHYRIACEAE--LADY FERN FAMILY

ATHYRIUM FILIX-FEMINA (L.) ROTH EX MERT. Lady Fern. Frequent in the more moist cool gulches of Green Mountain.

CYSTOPTERIS FRAGILIS (L.) BERNH.

EQUISETACEAE--HORSETAIL FAMILY

EQUISETUM ARVENSE L.
HIPPOCHAETE HYEMALIS (L.) BRUHIN
HIPPOCHAETE LAEVIGATA (A. BR.) FARWELL

HYPOLEPIDACEAE--BRACKEN FAMILY

PTERIDIUM AQUILINUM (L.) KUHN SSP. LANUGINOSUM (BONG.) HULTEN

OPHIOGLOSSACEAE--ADDER'S TONGUE FAMILY

BOTRYPUS VIRGINIANUS (L.) HOLUB. Rattlesnake Fern. Extremely rare, known only from a small portion of a gulch on the middle slopes of Green Mountain

POLYPODIACEAE--POLYPODY FAMILY

POLYPODIUM HESPERIUM MAXON. Rare, on fixed outcrops on Green Mountain.

SELAGINELLACEAE--LITTLE CLUBMOSS FAMILY

SELAGINELLA DENSA RYDB.
SELAGINELLA UNDERWOODII HIERON.
SELAGINELLA WEATHERBIANA TRYON

SINOPTERIDACEAE--LIP FERN FAMILY

CHEILANTHES FENDLERI HOOK. Found only along horizontal joint planes above the road on the upper slopes of Flagstaff Mt.

WOODSIACEAE--WOODSIA FAMILY

WOODSIA MEXICANA FEE
WOODSIA SCOPULINA D. C. EAT.

GYMNOSPERMS

CUPRESSACEAE--CYPRESS FAMILY

JUNIPERUS COMMUNIS L. SSP. ALPINA (NEILR.) CELAK.
JUNIPERUS SCOPULORUM SARG.

PINACEAE--PINE FAMILY

PICEA PUNGENS ENGELM. Known from South Boulder Canyon at 6,800 ft.
PINUS FLEXILIS JAMES
PINUS PONDEROSA DOUGL. EX P. & C. LAWS. SSP. SCOPULORUM (S. WATS.) W. A. WEBER
PSEUDOTSUGA MENZIESII (MIRB.) FRANCO

ANGIOSPERMS--DICOTS

ACERACEAE--MAPLE FAMILY

ACER GLABRUM TORR. VAR. GLABRUM
NEGUNDO ACEROIDES (L.) MOENCH SSP. INTERIUS (BRITT. & SHAFER) W. A. WEBER
NEGUNDO ACEROIDES (L.) MOENCH SSP. VIOLACEUM (KIRCHN. IN PETZ & KIRCHN.) W. A. WEBER INED.

AMARANTHACEAE--AMARANTH FAMILY

AMARANTHUS RETROFLEXUS L.

ANACARDIACEAE--SUMAC FAMILY

RHUS AROMATICA AIT. SSP. TRILOBATA (NUTT. EX T. & G.) W. A. WEBER

RHUS GLABRA L.

TOXICODENDRON RYDBERGII (SMALL EX RYDB.) GREENE. Poison Ivy. In 1946 this species was found only along the trail at the base of Gregory Gulch, but with increased use of the parks it has spread to picnic areas along the base of the Flatirons and along trails. Disturbance and soil compaction aid its spread.

APOCYNACEAE--DOGBANE FAMILY

APOCYNUM ANDROSAEMIFOLIUM L.
APOCYNUM CANNABINUM L.

ARALIACEAE--GINSENG FAMILY

ARALIA NUDICAULIS L. Wild Sarsaparilla. Frequent in the bottoms of cool north-facing gulches such as Long Canyon and South Boulder Creek tributaries. A rare or infrequent relict of the eastern and midwestern prairie woodlands.

ASCLEPIADACEAE--MILKWEED FAMILY

ASCLEPIAS PUMILA (A. GRAY) VAIL
ASCLEPIAS SPECIOSA TORR.
ASCLEPIAS STENOPHYLLA A. GRAY
ASCLEPIAS VIRIDIFLORA RAF.

BERBERIDACEAE--BARBERRY FAMILY

BERBERIS VULGARIS L. Common Barberry. This is an introduced species known only in Colorado only from a few shrubs in Bluebell Gulch. Most of this species has been eliminated from the United States because it carries the alternate host of Wheat Stem Rust.

MAHONIA REPENS (LINDL.) G. DON

BETULACEAE--BIRCH FAMILY

ALNUS INCANA (L.) MOENCH SSP. TENUIFOLIA (NUTT.) BREIT.

BETULA FONTINALIS SARG.

BETULA PAPYRIFERA MARSH. The small colony of this species in Long Canyon represents the only occurrence of this species in Colorado and the southernmost stand in western North America. It has hybridized extensively in Long Canyon with B. fontinalis and only one or two trees seem to be relatively pure B. papyrifera. This stand was researched and discussed by S. G. Froiland in the journal, Evolution. It is one of the most important species in the park deserving protection.

CORYLUS CORNUTA MARSH. Western Hazelnut. Common in the moist foothill gulches, but elsewhere in Colorado this is quite rare.

BORAGINACEAE--BORAGE FAMILY

CYNOGLOSSUM OFFICINALE L.
LAPPULA REDOWSKII (HORNEM.) GREENE
LITHOSPERMUM ARVENSE L.
LITHOSPERMUM INCISUM LEHM.
LITHOSPERMUM MULTIFLORUM TORR. EX A. GRAY
MERTENSIA LANCEOLATA (PURSH) A. DC.
ONOSMODIUM MOLLE MICHX. SSP. OCCIDENTALE (MACK.) COCHRANE
OREOCARYA VIRGATA (A. GRAY) GREENE

CACTACEAE--CACTUS FAMILY

OPUNTIA COMPRESSA (SALISB.) MACBR.
OPUNTIA FRAGILIS (NUTT.) HAW. VAR. FRAGILIS

CAMPANULACEAE

CAMPANULA ROTUNDIFOLIA L.
TRIODANIS PERFOLIATA (L.) NIEUWL.

CAPRIFOLIACEAE

LONICERA INVOLUCRATA BANKS EX SPRENG.
SYMPHORICARPOS ALBUS (L.) BLAKE
SYMPHORICARPOS OCCIDENTALIS HOOK.

VIBURNUM LENTAGO L. An old introduction in Bluebell Canyon still persists as a few plants.

VIBURNUM LANTANA L. Also introduced, probably by birds, from cultivated plants in town.

CARYOPHYLLACEAE--PINK FAMILY

ALSINE MEDIA L.
CERASTIUM ARVENSE L.
CERASTIUM FONTANUM BAUMG.
CERASTIUM NUTANS RAF. VAR. BRACHYPODUM ENGELM. EX A. GRAY
PARONYCHIA JAMESII T. & G.
PSEUDOSTELLARIA JAMESIANA (TORR.) W. A. WEBER & R. HARTMAN
SAPONARIA OFFICINALIS L.

CHENOPODIACEAE--GOOSEFOOT FAMILY

ATRIPLEX HORTENSIS L.
CHENOPODIUM BERLANDIERI MOQUIN
CHENOPODIUM BOTRYS L.
CHENOPODIUM FREMONTII S. WATS.
CHENOPODIUM HYBRIDUM L.
KOCHIA SIEVERSIANA (PALL.) C. A. MEY.
SALSOLA COLLINA PALL.

SALSOLA IBERICA SENNEN & PAU

COMPOSITAE--SUNFLOWER FAMILY

ACHILLEA LANULOSA NUTT. SSP. LANULOSA
AMBROSIA ARTEMISIIFOLIA (L.) DESCOURT.
AMBROSIA PSILOSTACHYA DC. VAR. CORONOPIFOLIA (T. & G.) FARWELL
AMBROSIA TRIFIDA L.
ANAPHALIS MARGARITACEA (L.) BENTH. & HOOK.
ANTENNARIA NEGLECTA GREENE
ANTENNARIA PARVIFOLIA NUTT.
ANTENNARIA ROSEA GREENE
ARNICA CORDIFOLIA HOOK.
ARNICA FULGENS PURSH
ARTEMISIA BIENNIS WILLD.
ARTEMISIA CAMPESTRIS L. SSP. CAUDATA (MICHX.) HALL & CLEMENTS
ARTEMISIA DRACUNCULUS L. SSP. GLAUCA (PALL.) HALL & CLEMENTS
ARTEMISIA FRIGIDA WILLD.
ARTEMISIA LUDOVICIANA NUTT.
ASTER LAEVIS L. VAR. GEYERI A. GRAY
ASTER PORTERI A. GRAY
BAHIA DISSECTA (A. GRAY) BRITT.
BIDENS CERNUA L.
BIDENS VULGATA GREENE
BRICKELLIA CALIFORNICA (T. & G.) A. GRAY
BRICKELLIA GRANDIFLORA (HOOK.) NUTT.
CARDUUS NUTANS L. SSP. MACROLEPIS (PETERMAN) KAZMI
CHLOROCREPIS ALBIFLORA (HOOK.) W. A. WEBER
CIRSIUM CENTAUREAE (RYDB.) K. SCHUM.
CIRSIUM UNDULATUM (NUTT.) SPRENG.
CIRSIUM VULGARE (SAVI) TENORE
CREPIS ATRIBARBA HELLER
CREPIS OCCIDENTALIS NUTT.

DYSSODIA PAPPOSA (VENT.) HITCHC.
ERIGERON COMPOSITUS PURSH VAR. GLABRATUS MACOUN
ERIGERON DIVERGENS T. & G. VAR. DIVERGENS
ERIGERON FLAGELLARIS A. GRAY VAR. FLAGELLARIS
ERIGERON SPECIOSUS (LINDL.) DC. VAR. MACRANTHUS (NUTT.) CRONQ.
GAILLARDIA ARISTATA PURSH
GRINDELIA SQUARROSA (PURSH) DUNAL
GRINDELIA SUBALPINA GREENE
HELIANTHUS ANNUUS L.
HELIANTHUS PUMILUS NUTT.
HELIANTHUS RIGIDUS (CASS.) DESF. SSP. SUBRHOMBOIDEUS (RYDB.) HEISER
HELIOMERIS MULTIFLORA NUTT.
HETEROTHECA VILLOSA (PURSH) SHINNERS
KUHNIA ROSMARINIFOLIA VENT. VAR. CHLOROLEPIS (WOOT. & STANDL.) BLAKE
LACTUCA BIENNIS (MOENCH) FERN.
LACTUCA CANADENSIS L.
LACTUCA SERRIOLA L.
LIATRIS LIGULISTYLIS (A. NELS.) K. SCHUM.
LIATRIS PUNCTATA HOOK.
NOTHOCALAIS CUSPIDATA (PURSH) GREENE
OLIGONEURON RIGIDUM (L.) SMALL

PACKERA FENDLERI (A. GRAY) WEBER & LOVE
PACKERA PLATTENSIS (NUTT.) WEBER & LOVE
PACKERA PSEUDAUREA (RYDB.) WEBER & LOVE
PACKERA TRIDENTICULATA (RYDB.) WEBER & LOVE
PERICOME CAUDATA A. GRAY VAR. CAUDATA
RATIBIDA COLUMNIFERA (NUTT.) WOOT. & STANDL.
RUDBECKIA HIRTA L.
RUDBECKIA AMPLA A. NELS.
SENECIO INTEGERRIMUS NUTT. VAR. INTEGERRIMUS
SENECIO RAPIFOLIUS NUTT.
SENECIO SPARTIOIDES T. & G.
SOLIDAGO CANADENSIS L.
SOLIDAGO GIGANTEA AIT.
SOLIDAGO MISSOURIENSIS NUTT.
SOLIDAGO NANA NUTT.
SOLIDAGO SPECIOSA NUTT. VAR. PALLIDA PORTER
TARAXACUM LAEVIGATUM (WILLD.) DC.
TARAXACUM OFFICINALE WEB. IN WIGG.
TETRANEURIS ACAULIS (NUTT.) GREENE SSP. ACAULIS
TOWNSENDIA EXSCAPA (RICH.) PORTER
TOWNSENDIA GRANDIFLORA NUTT.
TRAGOPOGON DUBIUS SCOP. SSP. MAJOR (JACQ.) VOLLM.
TRAGOPOGON PORRIFOLIUS L.
TRAGOPOGON PRATENSIS L.
VIRGULUS FALCATUS)LINDL.) REV. & KEENER

CONVOLVULACEAE--MORNING-GLORY FAMILY

CONVOLVULUS ARVENSIS L.
CUSCUTA APPROXIMATA BAB. VAR. URCEOLATA (KTZE.) YUNCKER
EVOLVULUS NUTTALLIANUS SCHULTES

CORNACEAE--DOGWOOD FAMILY

SWIDA SERICEA (L.) HOLUB

CRASSULACEAE--STONECROP FAMILY

SEDUM LANCEOLATUM TORR.

CRUCIFERAE--MUSTARD FAMILY

ALYSSUM ALYSSOIDES L.
BOECHERA FENDLERI (S. WATS.) WEBER
BRASSICA HIRSUTA (L.) SCOP.
CAMELINA MICROCARPA ANDRZ. EX DC.
CAPSELLA BURSA-PASTORIS (L.) MEDIC.
DRABA NEMOROSA L.
DRABA REPTANS (LAM.) FERN.
ERYSIMUM CAPITATUM (DOUGL.) GREENE
LEPIDIUM VIRGINICUM L.
LESQUERELLA MONTANA (A. GRAY) S. WATS.
NOCCAEA MONTANA (L.) F. K. MEY.
PHYSARIA VITULIFERA RYDB.
SISYMBRIUM ALTISSIMUM L.

THLASPI ARVENSE L.
TURRITIS GLABRA L.

ELAEAGNACEAE--ELAEAGNUS FAMILY

ELAEAGNUS ANGUSTIFOLIA L.
SHEPHERDIA CANADENSIS (L.) NUTT.

ERICACEAE--HEATH FAMILY

ARCTOSTAPHYLOS UVA-URSI (L.) SPRENG. SSP. ADENOTRICHA (FERN. & MACBR.) CALD. & TAYL.

EUPHORBIACEAE--SPURGE FAMILY

AGALOMA MARGINATA (PURSH) LOVE & LOVE
CHAMAESYCE GLYPTOSPERMA (ENGELM.) SMALL
CHAMAESYCE STICTOSPORA (ENGELM.) SMALL
EUPHORBIA ROBUSTA (ENGELM.) SMALL
EUPHORBIA SPATHULATA LAM.
TRAGIA RAMOSA TORR.

FAGACEAE--OAK FAMILY

QUERCUS GAMBELII NUTT. This species is not native here but Mr. Greenman planted acorns along trails many years ago and here and there the oaks have survived.

FUMARIACEAE-FUMITORY FAMILY

CORYDALIS AUREA WILLD. SSP. AUREA

GENTIANACEAE--GENTIAN FAMILY

FRASERA SPECIOSA DOUGL. EX GRISEB.
GENTIANELLA AMARELLA (L.) BOERN. SSP. ACUTA (MICHX.) J. M. GILLETT
PNEUMONANTHE AFFINIS (GRISEB.) GREENE

GERANIACEAE--GERANIUM FAMILY

ERODIUM CICUTARIUM (L.) L'HER. EX AIT.
GERANIUM CAESPITOSUM JAMES EX TORR. VAR. CAESPITOSUM
GERANIUM CAESPITOSUM JAMES EX TORR. VAR. PARRYI (ENGELM. IN GRAY) WEBER INED.

GROSSULARIACEAE--GOOSEBERRY FAMILY

RIBES AUREUM PURSH
RIBES CEREUM DOUGL.
RIBES INERME RYDB.

HYDRANGEACEAE--HYDRANGEA FAMILY

JAMESIA AMERICANA T. & G.

HYDROPHYLLACEAE--WATERLEAF FAMILY

HYDROPHYLLUM FENDLERI (A. GRAY) HELLER
PHACELIA HETEROPHYLLA PURSH

HYPERICACEAE--ST. JOHNSWORT FAMILY

HYPERICUM PERFORATUM L. St. Johnswort. This has not been found on Mountain Park property yet, but it is excessively abundant on the mesas south of it and should be watched for. It is a European weed introduction now spreading rapidly throughout Colorado after being known for a long time only from the Rocky Flats area.

LABIATAE--MINT FAMILY

HEDEOMA HISPIDUM PURSH
LYCOPUS AMERICANUS MUEHL. EX BART.
MENTHA ARVENSIS L.
MOLDAVICA PARVIFLORA (NUTT.) BRITT.
MONARDA FISTULOSA L. VAR. MENTHAEFOLIA (GRAH.) FERN.
NEPETA CATARIA L.
PRUNELLA VULGARIS L.
SCUTELLARIA BRITTONII PORTER

LEGUMINOSAE--PEA FAMILY

AMORPHA NANA NUTT.
ASTRAGALUS ADSURGENS PALL. VAR. ROBUSTIOR HOOK.
ASTRAGALUS AGRESTIS DOUGL. EX G. DON
ASTRAGALUS CANADENSIS L. VAR. CANADENSIS
ASTRAGALUS DRUMMONDII DOUGL. EX HOOK.
ASTRAGALUS PARRYI A. GRAY
ASTRAGALUS SHORTIANUS NUTT. IN T. & G.
DALEA CANDIDA WILLD. VAR. OLIGOPHYLLA (TORR.) SHINNERS
DALEA PURPUREA VENT.
LATHYRUS LEUCANTHUS RYDB.
LUPINUS ARGENTEUS PURSH
MELILOTUS ALBA MEDIC.
MELILOTUS OFFICINALIS (L.) LAM.
OXYTROPIS LAMBERTII PURSH VAR. BIGELOVII A. GRAY
OXYTROPIS MULTICEPS NUTT.

PSORALEA ARGOPHYLLA PURSH. The Mesa trail area is the only place within a hundred miles of Boulder where this species occurs. It is a plant of undisturbed prairies.

PSORALEA TENUIFLORA PURSH VAR. TENUIFLORA
THERMOPSIS DIVARICARPA A. NELS.
TRIFOLIUM HYBRIDUM L.
TRIFOLIUM PRATENSE L.
TRIFOLIUM REPENS L.
VICIA AMERICANA MUEHL. EX. WILLD.

LINACEAE--FLAX FAMILY

LINUM LEWISII PURSH

LOASACEAE--LOASA FAMILY

MENTZELIA ALBICAULIS (HOOK.) DOUGL. EX T. & G.
MENTZELIA NUDA (PURSH) T. & G. VAR. NUDA
MENTZELIA SINUATA (RYDB.) HILL

LYTHRACEAE--LOOSESTRIFE FAMILY

LYTHRUM ALATUM PURSH

MALVACEAE--MALLOW FAMILY

MALVA NEGLECTA WALLR.

MONOTROPACEAE--INDIANPIPE FAMILY

PTEROSPORA ANDROMEDEA NUTT.

MORACEAE--MULBERRY FAMILY

HUMULUS LUPULUS L. VAR. NEOMEXICANUS A. NELS. & CKLL.

NYCTAGINACEAE--FOUR-O'CLOCK FAMILY

OXYBAPHUS LINEARIS (PURSH) B. L. ROB. VAR. LINEARIS

OLEACEAE--OLIVE FAMILY

FRAXINUS PENNSYLVANICA MARSH. VAR. LANCEOLATA (BORKH.) SARG.

ONAGRACEAE--EVENING-PRIMROSE FAMILY

CALYLOPHUS SERRULATUS (NUTT.) RAVEN
CHAMERION ANGUSTIFOLIUM (L.) HOLUB
CIRCAEA ALPINA L. SSP. PACIFICA (ASCHERS. & MAGN.) RAVEN
EPILOBIUM ADENOCAULON HAUSSKN. VAR ADENOCAULON
EPILOBIUM PANICULATUM NUTT. EX T. & G.
GAURA COCCINEA NUTT. EX PURSH
GAURA PARVIFLORA DOUGL. EX LEHM. VAR. PARVIFLORA
GAYOPHYTUM DIFFUSUM T. & G. SSP. PARVIFLORUM LEWIS & SZWEYK.
OENOTHERA CAESPITOSA NUTT. EX FRASER
OENOTHERA VILLOSA THUNB. SSP. STRIGOSA (RYDB.) DIETR. & RAVEN

OROBANCHACEAE--BROOM-RAPE FAMILY

OROBANCHE FASCICULATA NUTT.

OXALIDACEAE--WOOD SORREL FAMILY

OXALIS STRICTA L.

PAPAVERACEAE--POPPY FAMILY

ARGEMONE POLYANTHEMOS (FEDDE) G. B. OWNBEY

PLANTAGINACEAE--PLANTAIN FAMILY

PLANTAGO LANCEOLATA L.
PLANTAGO PATAGONICA JACQ. VAR. SPINULOSA (DCNE.) A. GRAY

POLEMONIACEAE--PHLOX FAMILY

GILIA PINNATIFIDA NUTT.
GILIA SINUATA DOUGL. EX. BENTH.
IPOMOPSIS CANDIDA (RYDB.) WHERRY
IPOMOPSIS SPICATA (NUTT.) V. GRANT SSP. SPICATA
MICROSTERIS GRACILIS (DOUGL. EX HOOK.) GREENE SSP. HUMILIS (GREENE) V. GRANT
NAVARRETIA MINIMA NUTT.
PHLOX MULTIFLORA A. NELS. SSP. MULTIFLORA

POLYGONACEAE--KNOTWEED FAMILY

ACETOSELLA VULGARIS (KOCH) FOURR.
ERIOGONUM ALATUM TORR. VAR. ALATUM
ERIOGONUM JAMESII BENTH. VAR. FLAVESCENS S. WATS.
ERIOGONUM UMBELLATUM TORR.
FALLOPIA CONVOLVULUS (L.) A. LOVE
POLYGONUM DOUGLASII GREENE
POLYGONUM RURIVAGUM JORD.
RUMEX CRISPUS L.
RUMEX SALICIFOLIUS WEINM. SSP. TRIANGULIVALVIS DANSER VAR. MONTIGENITUS JEPS.

PORTULACACEAE--PURSLANE FAMILY

CLAYTONIA ROSEA RYDB.
CRUNOCALLIS CHAMISSOI (LEDEB. EX SPRENG.) RYDB.
TALINUM PARVIFLORUM NUTT. EX T. & G.

PRIMULACEAE--PRIMROSE FAMILY

ANDROSACE OCCIDENTALIS PURSH
ANDROSACE SEPTENTRIONALIS L.
DODECATHEON PULCHELLUM (RAF.) MERR.
LYSIMACHIA CILIATA L.

PYROLACEAE--PYROLA FAMILY

CHIMAPHILA UMBELLATA (L.) BART. SSP. OCCIDENTALIS (RYDB.) HULTEN
PYROLA PICTA SMITH

RANUNCULACEAE--BUTTERCUP FAMILY

ACTAEA RUBRA (AIT.) WILLD. SSP. ARGUTA (NUTT. IN T. & G.) HULTEN
ANEMONE CANADENSIS L.
ANEMONE CYLINDRICA A. GRAY
ATRAGENE OCCIDENTALIS HORNEM.
CLEMATIS LIGUSTICIFOLIA NUTT. EX T. & G.
CORIFLORA HIRSUTISSIMA (PURSH) W. A. WEBER
CYRTORHYNCHA RANUNCULINA NUTT. EX T. & G.
DELPHINIUM CAROLINIANUM WALT. SSP. PENARDII (HUTH) WARNOCK INED.
DELPHINIUM NUTTALLIANUM PRITZEL EX WALP.
PULSATILLA PATENS (L.) MILL. SSP. MULTIFIDA (PRITZEL) ZAMELS
RANUNCULUS ABORTIVUS L. SSP. ACROLASIUS (FERN.) KAPOOR & LOVE
RANUNCULUS GLABERRIMUS HOOK. VAR. ELLIPTICUS GREENE
RANUNCULUS MACOUNII BRITT.

RHAMNACEAE--BUCKTHORN FAMILY

CEANOTHUS FENDLERI A. GRAY
CEANOTHUS VELUTINUS DOUGL.

ROSACEAE--ROSE FAMILY

AGRIMONIA STRIATA MICHX.
AMELANCHIER ALNIFOLIA NUTT.
CERASUS PENSYLVANICA (L. f.) LOISEL.
CERASUS PUMILA (L.) MICHX. SSP. BESSEYI (L. H. BAILEY) W. A. WEBER INED.
CERCOCARPUS MONTANUS RAF. VAR. MONTANUS
CRATAEGUS CHRYSOCARPA ASHE
CRATAEGUS DOUGLASII LINDL.
CRATAEGUS MACRACANTHA LODD. VAR. OCCIDENTALIS (BRITT.) EGGLEST.
DRYMOCALLIS FISSA (NUTT.) RYDB.
FRAGARIA VESCA L. VAR. BRACTEATA (HELLER) R. J. DAVIS
FRAGARIA VIRGINIANA DUCHESNE VAR. GLAUCA ROTHR.
GEUM ALEPPICUM JACQ. SSP. STRICTUM (AIT.) R. T. CLAUSEN
HOLODISCUS DUMOSUS (NUTT.) HELLER VAR. DUMOSUS
MALUS DOMESTICA BORKH.
PADUS VIRGINIANA (L.) MILL.
PENTAPHYLLOIDES FLORIBUNDA (PURSH) A. LOVE
PHYSOCARPUS MONOGYNUS (TORR.) COULT.
PHYSOCARPUS OPULIFOLIUS (L.) MAXIM. VAR. INTERMEDIUS (RYDB.) B. L. ROB.
POTENTILLA HIPPIANA LEHM.
POTENTILLA PENSYLVANICA L.
PRUNUS AMERICANA MARSH.
ROSA ACICULARIS LINDL. SSP. SAYI (SCHWEIN.) W. H. LEWIS
ROSA GLAUCA POURRET. Cultivated in Boulder, and spread by jays into lower Gregory Canyon where it seems to be thriving.
ROSA WOODSII LINDL.
RUBUS DELICIOSUS TORR.
RUBUS IDAEUS L. SSP. SACHALINESIS (LEVIER) FOCKE
RUBUS LACINIATUS WILLD.
RUBUS PUBESCENS RAF.
SORBUS SCOPULINA GREENE

RUBIACEAE--MADDER FAMILY

GALIUM SEPTENTRIONALE R. & S.
GALIUM SPURIUM L. F. VAILLANTII (DC.) R. K. MOORE
GALIUM TRIFLORUM MICHX.

SALICACEAE--WILLOW FAMILY

POPULUS X ACUMINATA RYDB.
POPULUS ANGUSTIFOLIA JAMES
POPULUS DELTOIDES MARSH. SSP. MONILIFERA (AIT.) ECKENW.
POPULUS TREMULOIDES MICHX.
SALIX AMYGDALOIDES ANDERSS.
SALIX BEBBIANA SARG. VAR. PERROSTRATA (RYDB.) SCHNEID.
SALIX EXIGUA NUTT. VAR. EXIGUA
SALIX FRAGILIS L.
SALIX IRRORATA ANDERSS.
SALIX LASIANDRA BENTH. VAR CAUDATA (NUTT.) SUDW.

SANTALACEAE--SANDALWOOD FAMILY

COMANDRA UMBELLATA (L.) NUTT. SSP. PALLIDA (A. DC.) PIEHL

SAXIFRAGACEAE--SAXIFRAGE FAMILY

HEUCHERA BRACTEATA (TORR.) SER.
HEUCHERA PARVIFOLIA NUTTALL EX T. & G. VAR. PARVIFOLIA
MICRANTHES RHOMBOIDEA (GREENE) SMALL

SCROPHULARIACEAE--FIGWORT FAMILY

BESSEYA PLANTAGINEA (BENTH. IN DC.) RYDB.
CASTILLEJA SESSILIFLORA PURSH
COLLINSIA PARVIFLORA DOUGL. EX LINDL.
DIGITALIS PURPUREA L. Naturalized in the canyon of South Boulder Creek.
GRATIOLA NEGLECTA TORR.

LINARIA DALMATICA (L.) MILL. VAR. MACEDONICA FENZL. This is a very aggressive perennial weed that recently appeared on the Chautauqua meadow and should be eliminated whenever seen.

MIMULUS FLORIBUNDUS LINDL.
MIMULUS GUTTATUS DC.
ORTHOCARPUS LUTEUS NUTT.
PENSTEMON GRACILIS NUTT.
PENSTEMON SECUNDIFLORUS BENTH. IN DC.
PENSTEMON VIRENS PENNELL EX RYDB.
PENSTEMON VIRGATUS A. GRAY SSP. ASA-GRAYI CROSSWHITE
SCROPHULARIA LANCEOLATA PURSH
VERBASCUM THAPSUS L.
VERONICA AMERICANA SCHWEIN. EX BENTH.
VERONICA BILOBA L.

SIMAROUBACEAE--TREE-OF-HEAVEN FAMILY

AILANTHUS ALTISSIMA (MILL.) SWINGLE. Tree-of-Heaven. Naturalized in the Chautauqua Park area.

SOLANACEAE--NIGHTSHADE FAMILY

PHYSALIS HETEROPHYLLA NEES
PHYSALIS VIRGINIANA MILL.
SOLANUM TRIFLORUM NUTT.

ULMACEAE--ELM FAMILY

CELTIS OCCIDENTALIS L.
ULMUS PUMILA L.

UMBELLIFERAE--PARSLEY FAMILY

ALETES ACAULIS (TORR.) C. & R.
CONIUM MACULATUM L.
HARBOURIA TRACHYPLEURA (A. GRAY) C. & R.
HERACLEUM SPHONDYLIUM L. SSP. MONTANUM (SCHLEICH. EX GAUD.) BRIQ. IN SCHINZ & KELL.
LIGUSTICUM PORTERI C. & R.
LOMATIUM ORIENTALE C. & R.
OSMORHIZA CHILENSIS H. & A.
OSMORHIZA DEPAUPERATA PHIL.
OSMORHIZA LONGISTYLIS (TORR.) DC.
SANICULA MARILANDICA L.

URTICACEAE--NETTLE FAMILY

PARIETARIA PENSYLVANICA MUEHL. EX. WILLD.
URTICA DIOICA L. SSP. GRACILIS (AIT.) SELAND.

VERBENACEAE--VERVAIN FAMILY

VERBENA BRACTEATA LAG. & RODR.

VIOLACEAE--VIOLET FAMILY

VIOLA CANADENSIS L. VAR. SCOPULORUM A. GRAY
VIOLA NUTTALLII PURSH VAR. NUTTALLII
VIOLA PEDATIFIDA DON
VIOLA RUGULOSA GREENE

VISCACEAE--MISTLETOE FAMILY

ARCEUTHOBIUM VAGINATUM (WILLD.) PRESL

VITACEAE--GRAPE FAMILY

PARTHENOCISSUS INSERTA (KERNER) K. FRITSCH
VITIS RIPARIA MICHX.

PHANEROGAMS--MONOCOTS

AGAVACEAE--AGAVE FAMILY

YUCCA GLAUCA NUTT.

ALLIACEAE--ONION FAMILY

ALLIUM CERNUUM ROTH
ALLIUM TEXTILE NELS. & MACBR.

COMMELINACEAE--DAYFLOWER FAMILY

TRADESCANTIA OCCIDENTALIS (BRITT.) SMYTH VAR. SCOPULORUM (ROSE) AND. & WOODS.

CYPERACEAE--SEDGE FAMILY

CAREX DEWEYANA SCHWEIN.
CAREX DOUGLASII F. BOOTT IN HOOK.
CAREX GEOPHILA MACK.
CAREX GEYERI F. BOOTT
CAREX NEBRASCENSIS DEWEY
CAREX PENSYLVANICA LAM. SSP. HELIOPHILA (MACK.) W. A. WEBER
CAREX PETASATA DEWEY
CAREX PRAEGRACILIS W. BOOTT
CAREX SPRENGELII DEWEY EX SPRENG.
CAREX STENOPHYLLA WAHLENB. SSP. ELEOCHARIS (L. H. BAILEY) HULTEN

CAREX TORREYI TUCK. The only Colorado locality now know for the species is the base of the trail to the first Flatiron just above Gregory Creek. It grows right along the trail and only there, for a few feet.

ELEOCHARIS MACROSTACHYA BRITTON
SCHOENOPLECTUS PUNGENS (VAHL) PALLA
SCIRPUS PALLIDUS (BRITT.) FERN.

GRAMINEAE--GRASS FAMILY

ANDROPOGON GERARDII VITM.
ANISANTHA TECTORUM (L.) NEVSKI
ARISTIDA LONGISETA STEUD.
BOUTELOUA CURTIPENDULA (MICHX.) TORR. VAR. CAESPITOSA GOULD & KAPADIA
BOUTELOUA GRACILIS (H.B.K.) LAG. EX GRIFF.
BOUTELOUA HIRSUTA LAG.
BROMOPSIS CANADENSIS (L.) HOLUB
BROMOPSIS INERMIS (LEYSS) HOLUB SSP. INERMIS
BROMUS BRIZAEFORMIS FISCH. & MEY.
BROMUS JAPONICUS THUNB.
BUCHLOE DACTYLOIDES (NUTT.) ENGELM.
CERATOCHLOA MARGINATA (NEES EX STEUD.) W. A. WEBER
CRITESION JUBATUM (L.) NEVSKI
DACTYLIS GLOMERATA L.

DANTHONIA SPICATA (L.) P. BEAUV. EX R. & S. VAR. PINETORUM PIPER
DICHANTHELIUM OLIGOSANTHES (SCHULTES) GOULD VAR. SCRIBNERIANUM (NASH) GOULD
ELYMUS ALBICANS (SCRIBN. & SMITH) LOVE
ELYMUS CANADENSIS L. VAR. ROBUSTUS (SCRIBN. & SMITH) MACK. & BUSH
ELYMUS LONGIFOLIUS (J. G. SM.) GOULD
ELYTRIGIA REPENS (L.) NEVSKI
FESTUCA PRATENSIS HUDS.
KOELERIA MACRANTHA (LEDEB.) SCHULT.
LEUCOPOA KINGII (S. WATS.) W. A. WEBER
LEYMUS INNOVATUS (BEAL) PILGER SSP. AMBIGUUS (VASEY & SCRIBN.) LOVE
LYCURUS PHLEOIDES H.B.K.
MUHLENBERGIA MONTANA (NUTT.) HITCHC.
MUHLENBERGIA RACEMOSA (MICHX.) B.S.P.
MUHLENBERGIA WRIGHTII VASEY EX COULT.
ORYZOPSIS ASPERIFOLIA MICHX.
ORYZOPSIS MICRANTHA (TRIN. & RUPR.) THURB.
PANICUM VIRGATUM L.
PASCOPYRUM SMITHII (RYDB.) LOVE
PHLEUM PRATENSE L.
POA AGASSIZENSIS BOIV. & D. LOVE
POA COMPRESSA L.
POA FENDLERIANA (STEUD.) VASEY
POA PALUSTRIS L.
SCHEDONNARDUS PANICULATUS (NUTT.) TREL.
SCHIZACHNE PURPURASCENS (TORR.) SWALLEN
SCHIZACHYRIUM SCOPARIUM (MICHX.) NASH
SETARIA GLAUCA (L.) P. BEAUV.
SETARIA VIRIDIS (L.) P. BEAUV.
SPHENOPHOLIS OBTUSATA (MICHX.) SCRIBN.
SPOROBOLUS CRYPTANDRUS (TORR.) A. GRAY

SPOROBOLUS HETEROLEPIS (A. GRAY) A. GRAY. A rare mid-grass prairie species that is abundant locally on the mesas west of NCAR in the vicinity of Echo Rock along the Mesa Trail.

STIPA COMATA TRIN. & RUPR. VAR. COMATA
STIPA NEOMEXICANA (THURB. EX COULT.) SCRIBN.

STIPA SPARTEA TRIN. A very rare grass that occurs sparingly along the mesas just south of Eldorado Spring also is found at White Rocks.

STIPA VIRIDULA TRIN.
TRISETUM SPICATUM (L.) RICHT. SSP. MAJUS HULTEN
VULPIA OCTOFLORA (WALT.) RYDB.

IRIDACEAE--IRIS FAMILY

IRIS MISSOURIENSIS NUTT.
SISYRINCHIUM MONTANUM GREENE

JUNCACEAE--RUSH FAMILY

JUNCUS ARCTICUS WILLD. SSP. ATER (RYDB.) HULTEN
JUNCUS BUFONIUS L.
JUNCUS DUDLEYI WIEG.
JUNCUS INTERIOR WIEG.
JUNCUS SAXIMONTANUS A. NELS.

LILIACEAE--LILY FAMILY

ANTICLEA ELEGANS (PURSH) RYDB.
CALOCHORTUS GUNNISONII S. WATS.
DISPORUM TRACHYCARPUM (S. WATS.) BENTH. & HOOK.
LEUCOCRINUM MONTANUM NUTT. EX A. GRAY
LILIUM PHILADELPHICUM L.
SMILACINA AMPLEXICAULIS NUTT.
SMILACINA STELLATA (L.) DESF.
TOXICOSCORDION VENENOSUM (S. WATS.) RYDB.

ORCHIDACEAE--ORCHID FAMILY

CORALLORRHIZA MACULATA RAF.
CORALLORRHIZA WISTERIANA CONRAD
GOODYERA OBLONGIFOLIA RAF.
LIMNORCHIS SACCATA (GREENE) LOVE & SIMON
LISTERA CONVALLARIOIDES TORR.
LYSIELLA OBTUSATA (BANKS EX PURSH) BRITT. & RYDB.

MALAXIS MONOPHYLLA (L.) SW. SSP. BRACHYPODA (A. GRAY) LOVE & LOVE. Very rare, in a side canyon off Long Canyon on Green Mt. Evidently appears only in extremely favorable seasons.

PIPERIA UNALASCENSIS (SPRENG.) RYDB. Extremely rare, at one point along the Mesa Trail, also appearing only in exceptional seasons.

ADDITIONS TO THE FLORA OF BOULDER MOUNTAIN PARKS

Ron Wittmann

*nomenclature according to Weber, W.A. 1976. Rocky Mountain Flora. University of Colorado Associated Press. 479pp.

Most collecting in the area of Mt. Sanitas, Sunshine Canyon, Enchanted Mesa, National Bureau of Standards area, NCAR area, Skunk Creek, Flagstaff Mountain and Bear Creek valley.

Aegilops cylindrica

Agoseris glauca

Agrostis gigantea

Agrostis scabra

Alyssum minus

Anisantha sterilis

Ameranthus blitoides

Antennaria pulcherrima

Aquilegia caerulea

Arrhenatherum elatior

Asparagus officionalis

Astragalus tridactylicus

Astragalus crassicarpus

Aster hesperius

Avena fatua

Barbarea orthoceras

Berteroa incana

Cardaria chalapensis

Carex aurea

Carex brevior

Carex emoryi

Carex microptera

Carex pityophila

Carex rossii

Carex scoparia

Carex stipata

Carex vulpinoidea

Castilleja integra

Castilleja linareaefolia

Castilleja miniata

Ceanothus herbaceous

Chamaesyce fendleri

Chorispora tenella

Chrysothamnus nauseosus

Cichorium intybus

Cirscium arvense

Collomia linearis

Colutea arborescens

Conyza canadensis
Corallorhiza striata
Coryphantha missouriensis
Daucua carrota
Descurainia pinnata
Descurainia richarsonii
Descurainia sophia
Dichanthelium perlongum
Digitaria sanguinalis
Dipsacus sylvestris
Echinochloa crus-galli
Echinocereus viridiflora
Eleocharis elliptica
Eleocharis quinqueflora
Ellisia nyctaginea
Eragrostis cilianensis
Eragrostis diffusa
Eragrostis trichodes
Eremogene fendleri
Erigeron formosissimus
Erigeron pumilus
Erigeron strigosus
Erigeron vetensis
Eriogonum effusum
Festuca saximontana
Froelichia gracilis
Glyceria striata
Gnaphallium canescens
Gypsophila paniculata
Chlorocrepis gracilis
Helianthus deltoidea
Hybanthis verticillatus
Hymenopappus filifolia
Hypericum perforatum
Juncus longistylus
Lathyrus eucosmus
Lathyrus latifolius
Leersia oryzoides
Linaria vulgaris
Linaria texana
Linnaea borealis
Lolium perenne
Lygodesmia juncea
Machaeranthera pattersonii
Mertensia ciliata
Marrubium vulgare
Monarda pectinata
Musineon divaricatum
Oenothera albicaulis
Oenothera coronopifolia
Oenothera nuttallii
Opuntia polyacantha
Oreochrysum parryi
Oryzopsis hymenoides

Oxybaphus nyctaginea
Pediocactus simpsonii
Phalaris arundinacea
Plantago major
Poa secunda
Pointsettia dentata
Populus alba
Pyrola asarifolia
Ranunculus acriformis
Ranunculus repens
Rosa multiflora
Salvia azurea
Scirpus microcarpus
Scrophularia lanceolata
Silene antirrhina
Smilax lasioneuron
Sporobolus asper
Stephanomeria pauciflora
Thelesperma megapotamicum
Tribulus terrestris
Verbena hastata
Veronica peregrinus
Viola odorata

Panicum capillare
Penstemon angustifolia
Picea engelmannii
Poa bulbosa
Podospermum laciniatum
Polygonum engelmannii
Populus tremuloides
Ramischia secunda
Ranunculus inamoemus
Rorippa palustris
Salvia reflexa
Saxifraga bronchialis
Scirpus lacustris
Secale cereale
Sysimbrium officionale
Sorghastrum avenaceum
Sporobolus heterolepis
Stipa scribneri
Townsendia hookeri
Triticum aestivum
Verbena stricta
Viola kitaibeliana
Cheilanthes fendleri

ADDITIONS TO MOUNTAIN PARKS FLORA LIST

David J. Cooper

*nomenclature follows W.A. Weber. 1976. Rocky Mountain Flora.

University of Colorado Associated Press.

Cryptogamma crispa ssp. acrostichoides Crevices in flatirons, Skunk Creek canyon

Opuntia phaecantha

Opuntia polyacantha

Coryphantha vivipara

Arenaria fendleri

Silene scouleri

Glycyrrhiza lepidota

Hedysarum boreale

Rubus parviflorus

Carex disperma

Carex occidentalis

Carex brevior

Muhlenbergia asperifolia

Sporobolus heterolepis This species is common on rocky soil of the mesas and mesa rims.

Stipa spartea This species is common on rocky soils usually on the mesas and mesa rims, and is usually found with Sporobolus heterolepis. Stands of this grass up to several hundred square meters in extent occur on the mesas south of Chautauqua meadow, and from there south to Eldorado Springs.

Vahlodea atropurpurea

Limnorchis dilatata

MAMMALS OF THE BOULDER MOUNTAIN PARKS

David M. Armstrong[1] and Jerry Freeman[2], Editors

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CITY OF BOULDER--DEPARTMENT OF PARKS AND RECREATION

INTRODUCTION

The Boulder Mountain Parks are a magnificent and enduring legacy. For three-quarters of a century they have helped to preserve a mountain vista unscarred by development. They provide recreational opportunities and they provide opportunities for quiet solitude. Beyond all that, they provide habitat for abundant wildlife.

The wildlife resource is an intrinsic part of the Mountain Parks. It obviously contributes to their esthetic and recreational value. In addition, however, wildlife can serve as an indicator of environmental quality. A fauna that is an intact, functioning, symbiotic whole attests to the quality and care of maintenance and management. The fauna can serve as a comprehensively sensitive monitor of environmental change.

To fulfill that potential, of course, research of two kinds is needed. First, a sort of general baseline must be described. Then detailed studies must be undertaken to determine the effects on wildlife of a variety of impacts, human and otherwise.

The present study addresses primarily the need for a descriptive baseline. It does so for a part of the wildlife resource--the native mammals. The study is necessarily limited in scope and duration, but it is a start, a foundation upon which future research can build. We hope that further research will, in fact, be done. It is important to both management and interpretation.

The quantity of mammalogical research that has been done in the Boulder Mountain Parks is remarkably small, especially if one considers the proximity of the Parks to a major research university with a history of excellence in field biology.

In the 1870s, pioneer naturalist Mrs. M. A. Maxwell made a collection of mammals around Boulder that was exhibited at the Philadelphia Exposition of 1876. Probably some of those specimens (see Coues, 1879) were obtained on what is now the Boulder Mountain Parks. Beyond some student projects, however, and the extensive work on Abert's squirrel by Dr. Robert Farentinos (e. g., Farentinos, 1974), little more has been done.

There is, of course, an abundance of literature on comparable areas along the Front Range, so we are not wholly ignorant of the mammalian fauna of the region, but local studies are to be encouraged. Cary (1911) made observations around Boulder as part of his biological survey of Colorado; indeed, he outfitted at Boulder for his travels westward into more remote parts of the state. Collectors in the Boulder area sent specimens to the Smithsonian Institution for study by such distinguished mammalogists as C. Hart Merriam. Gold Hill is the type locality for two

subspecies of mammals (Eutamias minimus operarius Merriam, 1905, and Neotoma mexicana fallax Merriam, 1894), Ward for two (Clethrionomys gapperi galei Merriam, 1890, and Eutamias umbrinus montanus White, 1953), and Boulder for another (Eptesicus fuscus pallidus Young, 1908). The pioneering mammalogical work of E. R. Warren (1910, 1942) in the vicinity of Colorado Springs applies to the situation about Boulder with little qualification. Quick (1964) and Mutel (1976) reviewed some aspects of mammalian ecology in Boulder County generally, and Lanham (1974) commented briefly on mammals of the Enchanted Mesa. Armstrong (1972) summarized the distribution of mammals in Boulder County as part of a statewide study, based on examination of museum specimens, and later (1975) he reviewed the biology of many local species in a semi-technical treatment of mammals of Rocky Mountain National Park.

METHODS

The present study is based on field reconnaissance, live-trapping, and review of the literature. It was done as a term project by students in Mammalogy (EPO Biology 476/576) during the Fall Semester 1982. Students involved all were advanced undergraduates (mostly majors in Biology or Environmental Conservation) or graduate students (in EPO Biology or Museology).

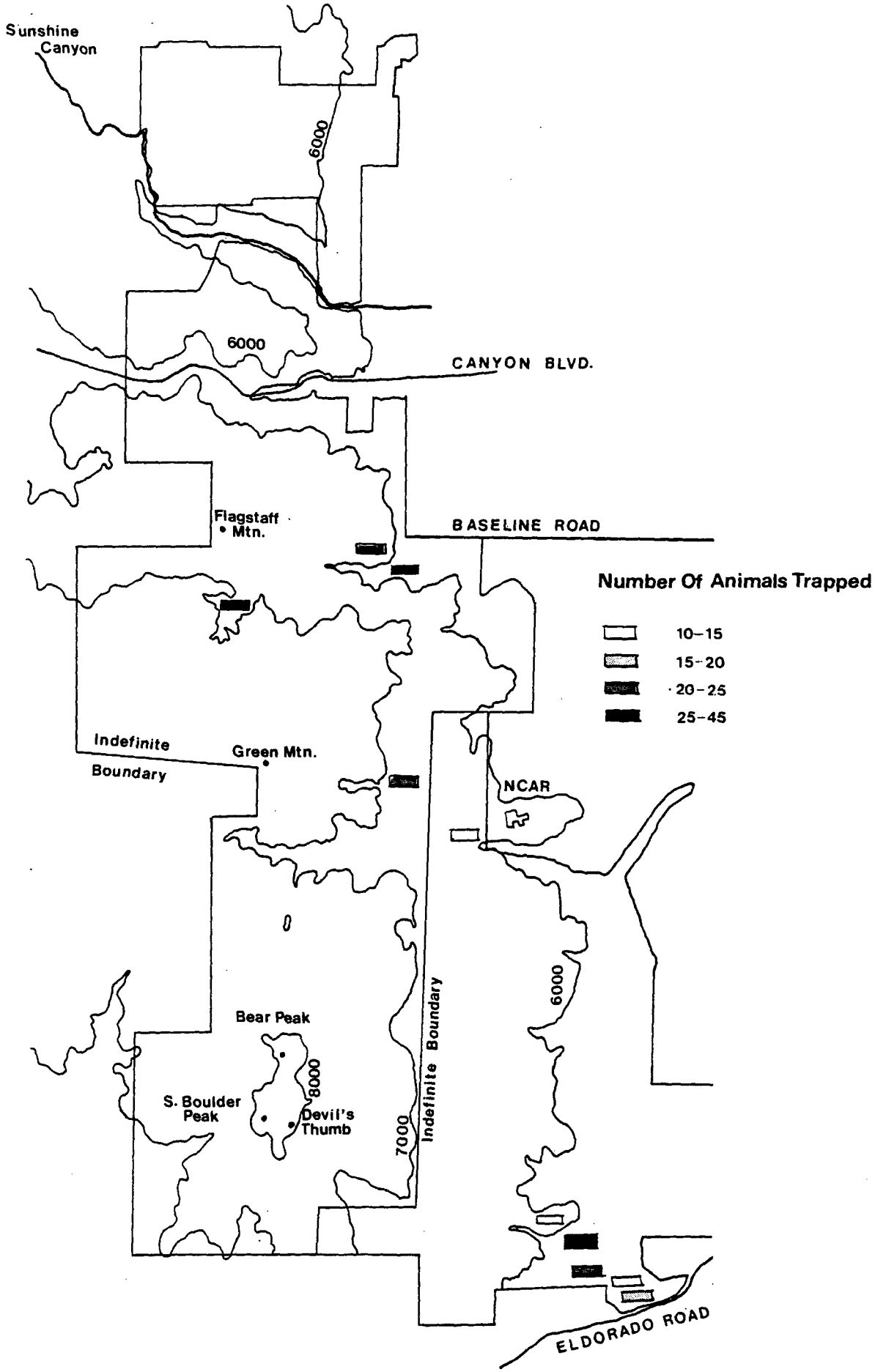
Field study was under the immediate supervision of the graduate students in the course. Each graduate student was responsible for a field trip to a different ecosystem-type. A field trip consisted of two parts: (1) daylight reconnaissance (searching for mammals and their sign--tracks, burrows, scat, etc.) and (2) a live-trapping session. Graduate students were assisted in their efforts by other members of the class.

Live-trapping was done according to a scheme used by Armstrong (1977). At each study site (see Fig. 1) four double transects were set, consisting of 50 Sherman livetraps set in two parallel lines of 25 traps each, the traps placed at 5-m. intervals and the lines set 10 m. apart. Such an array effectively samples an area of 130 x 20 m., or roughly one-fourth hectare. Traps were baited with oats and peanut butter and furnished with shredded cotton for bedding. They were set at dusk and retrieved at dawn. Every effort was made to keep the survey work inconspicuous to Park visitors. Table 1 indicates some details of field trips. All work was carried out under permits from the Colorado Division of Wildlife and the City of Boulder Department of Parks and Recreation.

In addition to field study, students conducted species-specific reviews of the zoological literature. Their first assignment was to locate as much relevant literature on individual species as possible. The goal was to locate all literature on the species in Boulder County, all relevant Coloradan literature, with coverage attenuating beyond that, emphasizing the most thorough and/or recent studies. This primary bibliography, on index cards, is on file with the senior editor and is available on request.

Next, each student surveyed the literature in an effort to locate, insofar as possible, the information outlined on the Summary Data Sheet (see

Figure 1. Location of trap-lines, Boulder Mountain Parks, EPOB 476/576 term project, Fall 1982. (Drafted by Katherine M. Kilbane.)


Sunshine Canyon
6000
6000
CANYON BLVD.
Flagstaff Mtn.
BASELINE ROAD
Number Of Animals Trapped
10–15
15–20
20–25
25–45
Indefinite Boundary
Green Mtn.
NCAR
6000
Bear Peak
8000
S. Boulder Peak
Devil's Thumb
7000
Indefinite Boundary
ELDORADO ROAD

KMK

TABLE 1. Field trip leaders, localities, and dates (1982)

Ecological Community-Type	Locality	Leader	Dates
Plains Grassland	S end Mesa Trail	D. Armstrong	10-11 Sept.
	S end Mesa Trail	J. Ortega	29-30 Oct.
Ponderosa Pine Woodland	S end Mesa Trail	B. Bennett	25-26 Sept.
Woodland/Grassland Ecotone	above NCAR	J. Kaplan	24-25 Sept.
Mixed Coniferous Forest	nr. S end Mesa Trail	S. Stein	25-26 Sept.
Aspen Woodland/ Montane Riparian	Long Canyon, 7100 ft.	M. Millett	1-2 Oct.
Montane Riparian	Gregory Canyon, 6200 ft.	A. Armstrong	15-16 Oct.
Foothills Scrub	Gregory Canyon	R. Johnson	15-16 Oct.
Plains Riparian Woodland	S Boulder Creek, 5600 ft.	D. Abbate	16-17 Oct.
Talus	Base of Third Flatiron	O. Pollak	22-23 Oct.

Appendix I). Completed sheets also are on file with the senior editor.

From summaries of data, brief accounts of species were prepared, including information under the following headings: distribution, description, natural history, and selected references. Undergraduates each prepared at least two accounts and graduate students prepared three. These accounts form the bulk of this report.

For consistency, all measurements are in millimeters and all weights are in grams unless otherwise noted. Order of treatment and vernacular and technical nomenclature follow Jones et al. (1982). Authorship of individual accounts is indicated by initials at the end of each account.

Acknowledgments.--For their assistance and encouragement we thank D. Michael Segrest, Director; Ron Donahue, Supervisor; Dick Lyman, Ranger; and especially Ranger Brian Peck. Dr. David Cooper of the Parks and Recreation Advisory Board encouraged the project and Katherine Welch first suggested the need for it. Gary Berlin of the Colorado Division of Wildlife assisted in compliance with the Scientific Collecting Permit.

RESULTS AND DISCUSSION

General.--The mammalian fauna of the Boulder Mountain Parks is listed in Table 2. The list includes (1) those species known to occur in the Parks (at least occasionally) based on field observations and/or published records; (2) species expected to occur on the basis of known ecological distribution in areas nearby, but not yet documented; and (3) species known or expected to have occurred since permanent settlement in the Boulder Valley, but now extirpated. That list includes 88 species. Of the total, 49 species are documented or observed, 21 are expected, and eight have been extirpated within historic times.

Few areas of comparable size in temperate North America could claim so great a faunal list. The richness of our mammalian fauna is due to topographic and consequent ecological diversity. Boulder's mountain backdrop is not just dramatic scenery; it is rich ecological opportunity because of the plethora of different habitats.

Live-trapping.--Table 3 presents data derived from live-trapping grids. Field effort totaled 1850 trap-nights over ten field trips to nine ecosystem-types. This preliminary effort was too limited and too diffuse to be definitive, but the results are of some interest. A total of 215 individuals of eight species was captured. The deer mouse (Peromyscus maniculatus) was by far the most frequently captured species; it was captured in all habitats, and in two of the ecosystem-types it was the only species captured.

The number of species captured in a particular ecosystem-type varied from one (ponderosa pine woodland, mixed coniferous forest) to four (plains grassland, foothills scrub). Field studies were not designed to determine population sizes. However, percent trap success (Table 3) gives some rough idea of relative density across the nine community-types. Greatest trapping success was in foothills scrub and montane riparian ecosystems (Gregory Canyon) and in aspen woodland (also montane riparian, in this instance, as represented in Long Canyon).

Ecological Distribution.--Ecological distribution of species is indicated in Table 2 across nine ecosystem-types, as documented by field observation and review of the literature. At the foot of the Table, the total number of species in particular ecosystem-types is indicated. Note that the ecosystem-types with the largest numbers of species are the pinderosa pine woodland and the woodland/grassland ecotone. Note also, however, that even those communities provide habitat for only a little more than half the mammalian fauna.

The message is clear. The rich mammalian fauna of the Parks is not dependent upon one or a few particularly rich community-types. Rather, it is due to a diverse mosaic of different communities.

Table 4 indicates similarity among the nine ecosystem-types. Above the diagonal is indicated the number of species in common. Below the diagonal is an index of faunal similarity, $2C / (N_1 + N_2)$, where C is the number of species in common between two community-types and N_1 and N_2 are the respective numbers of species in each community-type.

TABLE 2. Potential natural mammalian fauna of Boulder Mountain Parks. (LEGEND: Basis for record--D = documented by specimen or certain observation; H = hypothetical but strongly expected; E = extirpated within historic times; Faunal Element--A = autochthonous Coloradan; B = Boreo-cordilleran; C = Cordilleran; Ch = Chihuahuan; E = eastern; G = Great Basin; N = neotropical; P = plains, campestrian; W = widespread. After Armstrong (1972) and more recent sources, including present survey.)

SPECIES	Basis for Record (B)	Faunal Element (F)	Plains Grassland (1)	Plains Riparian (2)	Foothills Scrub (3)	Woodland/Grassland Ecotone (4)	Ponderosa Pine (5)	Mixed Coniferous Forest (6)	Montane Riparian (7)	Aspen Woodland (8)	Talus (9)
Order Marsupicarnivora--Marsupials											
Didelphis marsupialis--Virginia Opossum	D	N		X							
Order Insectivora--Insectivores											
Sorex cinereus--Masked Shrew	D	B		X		X	X	X	X	X	X
Sorex monticolus--Montane Shrew	D	C				X	X	X	X	X	X
Sorex nanus--Dwarf Shrew	H	C			X	X	X	X	X	X	X
Sorex palustris--Water Shrew	D	B						X	X	X	
Sorex merriami--Merriam's Shrew	D	G			X	X	X				
Cryptotis parva--Least Shrew	D	E	X	X							

TABLE 2, continued.

SPECIES	B	F	1	2	3	4	5	6	7	8	9
Order Chiroptera--Bats											
Myotis lucifugus--Little Brown Bat	D	W		X	X	X	X	X	X	X	
Myotis evotis--Long-eared Myotis	D	G				X	X				
Myotis thysanodes--Fringed Myotis	H	Ch				X	X				
Myotis volans--Long-legged Myotis	D	G		X		X	X		X	X	
Myotis leibii--Small-footed Myotis	D	W	X	X	X						
Lasionycteris noctivagans--Silver-haired Bat	D	W		X		X	X	X		X	
Eptesicus fuscus--Big Brown Bat	D	W		X	X	X	X	X		X	
Lasiurus cinereus--Hoary Bat	D	W		X		X	X			X	
Plecotus townsendii--Townsend's Big-eared Bat	D	Ch			X	X	X				
Order Lagomorpha--Rabbits and Allies											
Sylvilagus floridanus--Eastern Cottontail	H	E		X							
Sylvilagus nuttallii--Nuttall's Cottontail	D	G			X	X	X	X	X	X	
Sylvilagus audubonii--Desert Cottontail	D	Ch	X								
Lepus americanus--Snowshoe Hare	H	B						X	X	X	
Lepus townsendii--White-tailed Jackrabbit	D	G	X			X	X	X		X	X
Lepus californicus--Black-tailed Jackrabbit	H	Ch	X		X	X					
Order Rodentia--Rodents											
Eutamias minimus--Least Chipmunk	D	B			X	X	X	X	X	X	X
Eutamias quadrivittatus--Colorado Chipmunk	D	A			X	X	X				X
Eutamias umbrinus--Uinta Chipmunk	D	C						X		X	X
Marmota flaviventris--Yellow-bellied Marmot	D	C			X	X	X	X	X	X	X
Spermophilus elegans--Wyoming Ground Squirrel	H	C				X	X				
Spermophilus tridecemlineatus--13-lined Ground Squirrel	D	P	X								
Spermophilus spilosoma--Spotted Ground Squirrel	D	P	X								
Spermophilus variegatus--Rock Squirrel	D	Ch			X	X	X				
Spermophilus lateralis--Golden-mantled Ground Squirrel	D	C			X	X	X	X		X	X

TABLE 2, continued.

SPECIES	B	F	1	2	3	4	5	6	7	8	9
Cynomys ludovicianus--Black-tailed Prairie Dog	D	P	X			X					
Sciurus niger--Fox Squirrel	D	E		X							
Sciurus aberti--Abert's Squirrel	D	A				X	X				
Tamiasciurus hudsonicus--Chickaree, or Pine Squirrel	D	B					X	X			
Thomomys talpoides--Northern Pocket Gopher	D	C	X		X	X	X	X		X	X
Geomys bursarius--Plains Pocket Gopher	H	P	X								
Perognathus fasciatus--Olive-backed Pocket Mouse	H	P	X			X					
Perognathus flavescens--Plains Pocket Mouse	H	P	X								
Perognathus flavus--Silky Pocket Mouse	H	Ch	X								
Perognathus hispidus--Hispid Pocket Mouse	D	P	X								
Dipodomys ordii--Ord's Kangaroo Rat	H	Ch	X								
Castor canadensis--Beaver	D	W		X					X		
Reithrodontomys montanus--Plains Harvest Mouse	H	P	X								
Reithrodontomys megalotis--Western Harvest Mouse	D	Ch	X								
Peromyscus maniculatus--Deer Mouse	D	W	X	X	X	X	X	X	X	X	X
Peromyscus difficilis--Rock Mouse	D	Ch			X	X	X				
Onychomys leucogaster--Northern Grasshopper Mouse	H	Ch	X								
Neotoma mexicana--Mexican Woodrat	D	Ch			X	X	X				X
Neotoma cinerea--Bushy-tailed Woodrat	D	C			X	X	X	X			X
Clethrionomys gapperi--Northern Red-backed Vole	D	B						X	X	X	
Phenacomys intermedius--Heather Vole	H	B						X	X	X	
Microtus pennsylvanicus--Meadow Vole	D	B		X					X	X	
Microtus montanus--Montane Vole	D	C					X	X	X	X	X
Microtus longicaudus--Long-tailed Vole	D	C					X	X	X	X	X
Microtus ochrogaster--Prairie Vole	D	P	X	X		X					

TABLE 2, continued.

SPECIES	B	F	1	2	3	4	5	6	7	8	9
Ondatra zibethicus--Muskrat	D	W		X					X		
Zapus hudsonius--Meadow Jumping Mouse	H	E		X							
Zapus princeps--Western Jumping Mouse	H	C							X	X	
Erethizon dorsatum--Porcupine	D	W		X	X	X	X	X	X	X	
Order Carnivora--Carnivores											
Canis latrans--Coyote	D	W	X	X	X	X	X	X	X	X	X
Canis lupus--Gray Wolf	E	W	X	X	X	X	X	X	X	X	X
Vulpes vulpes--Red Fox	D	W		X	X	X	X	X	X	X	
Vulpes velox--Swift Fox	H	P	X								
Urocyon cinereoargenteus--Gray Fox	H	Ch			X	X	X				X
Ursus americanus--Black Bear	D	W		X	X	X	X	X	X	X	
Ursus arctos--Grizzly Bear	E	W	X	X	X	X	X	X	X	X	X
Procyon lotor--Raccoon	D	W		X		X	X				
Bassariscus astutus--Ringtail	H	Ch			X						X
Martes americana--Pine Marten	H	B						X			
Mustela erminea--Short-tailed Weasel, or Ermine	D	B				X	X	X	X	X	X
Mustela frenata--Long-tailed Weasel	D	W	X	X	X	X	X	X	X	X	X
Mustela nigripes--Black-Footed Ferret	E	P	X								
Mustela vison--Mink	D	W		X					X		
Gulo gulo--Wolverine	E	B						X			
Taxidea taxus--Badger	D	P	X		X	X	X				X
Spilogale gracilis--Western Spotted Skunk	D	Ch			X	X	X				X
Mephitis mephitis--Striped Skunk	D	W	X	X	X	X	X	X	X	X	X
Lutra canadensis--River Otter	E	W		X					X		
Felis concolor--Mountain Lion	D	W		X	X	X	X				X
Felis canadensis--Lynx	E	B						X			
Felis rufus--Bobcat	D	W		X	X	X	X	X			X

TABLE 2, continued.

SPECIES	B	F	1	2	3	4	5	6	7	8	9
Order Artiodactyla--Even-toed Ungulates											
Cervus elaphus--Wapiti, or Elk	D	W	X				X	X		X	
Odocoileus hemionus--Mule Deer	D	W		X	X	X	X	X	X	X	X
Odocoileus virginianus--White-tailed Deer	H	W		X							
Antilocapra americana--Pronghorn	E	P	X								
Bison bison--Bison	E	P	X			X					
Ovis canadensis--Bighorn Sheep	D	C			X	X	X				X
TOTAL--88 species			31	37	34	48	47	37	31	35	29

TABLE 3. Results of live-trapping for small mammals on Boulder Mountain Parks.

Ecosystem-type	Date	*Perognathus hispidus*	*Peromyscus maniculatus*	*Peromyscus difficilis*	*Neotoma mexicana*	*Clethrionomys gapperi*	*Microtus pennsylvanicus*	*Microtus longicaudus*	*Microtus ochrogaster*	TOTAL	Numbers/100 trapnights
Plains Grassland	9/10/82	1	21	--	--	--	--	--	3	24	12
	30/10/82	--	15	2	--	--	--	--	1	18	9
Ponderosa Pine Woodland	9/26/82	--	10	--	--	--	--	--	--	10	5
Woodland/Grassland Ecotone	9/25/82	--	15	--	2	--	--	--	2	19	9.5
Mixed Coniferous Forest	9/26/82	--	9	--	--	--	--	--	--	9	4.5
Aspen Woodland	10/1/82	--	29	--	--	1	1	--	--	31	20.7
Montane Riparian	10/15/82	--	32	10	--	--	--	--	1	43	21.5
Foothills Scrub	10/15/82	--	17	2	1	--	--	--	2	22	22
Plains Riparian	10/16/82	--	5	11	--	--	1	--	--	17	8.5
Talus	10/23/82	--	12	5	4	--	--	--	--	21	10.5
TOTALS		1	165	30	7	1	2	1	8	214	11.6

TABLE 4. Similarity matrix of nine ecosystem-types of Boulder Mountain Parks. (For explanation of index, see text.)

	GRASSLAND	PLAINS RIPARIAN WOODLAND	FOOTHILLS SCRUB	WOODLAND/GRASSLAND ECOTONE	PONDEROSA PINE	MIXED CONIFEROUS FOREST	MONTANE RIPARIAN	ASPEN WOODLAND	TALUS
GRASSLAND	XXXXX	9	9	14	10	99	6	8	9
PLAINS RIPARIAN	0.265	XXXXX	16	20	19	14	20	16	10
FOOTHILLS SCRUB	0.277	0.451	XXXXX	32	31	20	15	18	21
WOODLAND/GRASSLAND ECOTONE	0.354	0.471	0.780	XXXXX	43	25	19	25	24
PONDEROSA PINE	0.256	0.452	0.765	0.905	XXXXX	29	20	28	26
MIXED CONIFEROUS FOREST	0.265	0.378	0.563	0.588	0.690	XXXXX	24	30	21
MONTANE RIPARIAN	0.194	0.588	0.461	0.481	0.513	0.706	XXXXX	27	15
ASPEN WOODLAND	0.242	0.444	0.522	0.602	0.683	0.833	0.818	XXXXX	19
TALUS	0.305	0.308	0.677	0.632	0.693	0.646	0.508	0.603	XXXXX

The table indicates that tracts of plains grassland have the most distinctive mammalian fauna of the nine ecosystem types. Mean resemblance with the other eight is only 0.270. Strongest faunal resemblance, as would be expected, is with the grassland/woodland ecotone, but even that index is only about 35 percent. This points out the importance of those small tracts of natural grassland preserved in the Mountain Parks and adjacent Open Space. It is gratifying to learn that species that usually are less abundant and susceptible to disturbance, such as the hispid pocket mouse (Perognathus hispidus), are present on these grasslands, and also to note that the grasslands are not degraded by the presence of adventive species like house mice (Mus musculus).

Plains riparian woodland (as represented along South Boulder Creek east of Eldorado Springs) shows strongest resemblance with montane riparian systems. Undeveloped floodplains are critical to faunal contact among tracts of riparian habitat through Boulder and into the foothills. Strong cooperation in planning and management among the various city and county agencies responsible for parks and open space is indicated.

Open talus, as sampled in the boulder fields beneath the Third Flatiron, has a fairly small fauna, but a rather complicated one. Hence, its mean resemblance with other ecosystem types is fairly consistent and fairly low. Only species that can use rocks for cover find such situations habitable.

The strongest faunal resemblance in Table 4 is between ponderosa pine woodland and woodland/grassland ecotone. That is not surprising. Foothills shrublands also are strongly related here as are, in fact, other upland ecosystem-types. These relationships are summarized in Figure 2, which is a cluster diagram of the similarity values shown in Table 4. Diagrams of this sort are explained in detail in Armstrong (1972, 1977).

The strong similarity among those ecosystems should not be allowed to obscure their distinctiveness. Mammalian species--especially small, terrestrial mammals--tend to have fairly specific habitat requirements although they may range through several ecosystem-types. They tend to depend upon a fairly narrow suite of habitat attributes for cover. For example, the rock mouse (Peromyscus difficilis) was found along the riparian corridor in Gregory Canyon, taken in traps at the water's edge. Appropriate breeding and feeding habitat for that species is rocky, brush-covered slopes.

Faunal Development.--The present-day fauna of the Boulder Mountain Parks has come to occur in the region over thousands to millions of years, through a process of faunal evolution. In the last two decades, the least shrew, Cryptotis parva, joined the fauna. In the 1940s and 1950s, fox squirrels moved into the area naturally (to join populations that had been introduced artificially a half-century earlier). Raccoons entered the area with increasing agricultural activity, Wyoming ground squirrels came

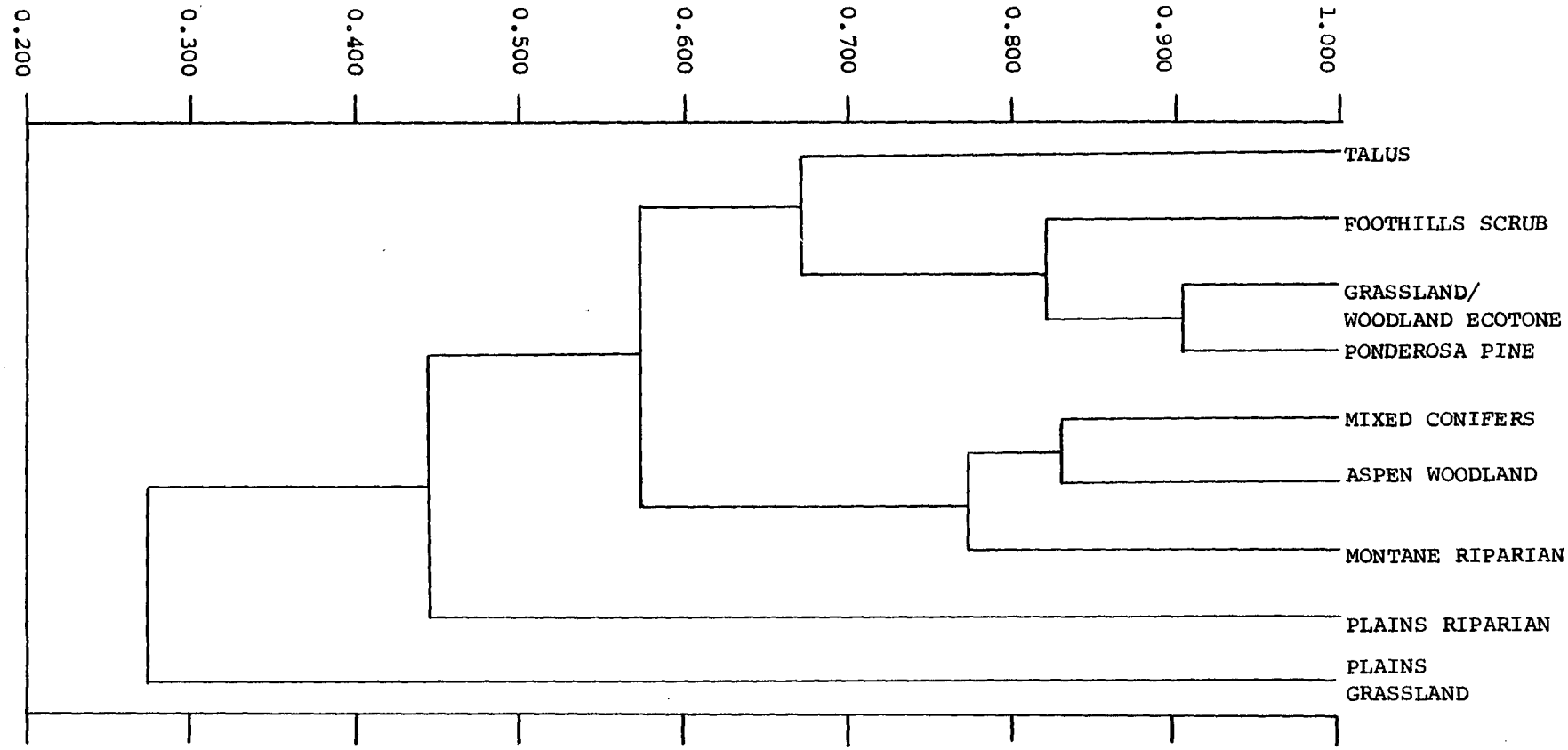


FIGURE 2. Mean faunal similarity of nine ecosystem types on Boulder Mountain Parks. (For explanation, see text.)

with forest clearance, and black-tailed jackrabbits moved in with reduction in range of the white-tailed jackrabbit. The white-tailed jackrabbit declined in response to overgrazing and perhaps climatic change. The whole story of these or most other distributional patterns will never be known. Obviously we have little direct evidence about faunal evolution prior to the advent of permanent settlement in the Boulder Valley. The fossil record of mammals in the Boulder Valley over the past several million years is negligible because the area along the mountain front has been an area of erosion, not deposition.

However, we can look at the ranges of species to get some idea of the geographical relationships of the species of our fauna. That turns out to be of some interest. Some species have affinities with the eastern United States and some with the South. Armstrong discussed this matter in terms of "faunal elements." Faunal elements are groups of species with similar geographic ranges and a center of common distribution. The faunal affinities of the mammals of the Mountain Parks are shown in Table 2. Nine geographic patterns are represented.

Widespread species (25 species, 28 percent of the fauna) are not identifiable with any particular geographic region. The remainder of the fauna, however, shows strong geographic affinities. Four species (5 percent) are of eastern affinities, and share a center of distribution in eastern North America. Five species (6 percent) have distributions centered on the Great Basin. Two species have distributions centered on the Colorado Plateau. The fauna of the Great Plains, the Campestrian Faunal Element, contributes 15 species (17 percent). A single species, the Virginia opossum, represents the Neotropical Faunal Element. Fourteen percent of the fauna (12 species) represents the Boreo-cordilleran Faunal Element, a group of species with distributions centered in the boreal forests of Canada and the Upper Midwest, and extending southward along the Sierra Nevada, the Rockies, and the Appalachians. Another 11 species (12 percent of the fauna) are of the Cordilleran Faunal Element, centered on the Rocky Mountains. Finally, 13 species show affinities with the Mexican Plateau and are termed the Chihuahuan Faunal Element.

This wide array of species has come to occur in the region at different times, responding to different opportunities. Eastern and neotropical species are concentrated in the plains riparian ecosystem. They tend to be recent arrivals in our area. Cordilleran and Boreo-cordilleran species are concentrated in forested ecosystems of the higher foothills and mountains. Some of them are "left-overs" from Ice Age patterns of distribution. Campestrian species occur mostly on plains grasslands and in the grassland/woodland ecotone. Chihuahuan species, by contrast, tend to be concentrated in the foothills scrub ecosystem. Their distribution may be relict also, a remainder from a warmer, and perhaps drier, time, the Hypsithermal Interval, some 5000 years ago.

This look at faunal affinities is necessarily hasty and speculative, but it ought to re-emphasize the fact that the mammalian fauna of the Boulder Mountain Parks is a complex whole. It has come to occur in the diverse ecosystems of the foothills of the Front Range over untold millenia in

response to changing ecological opportunity. It remains because opportunity remains. Increasingly, however, its survival is in the hands of human institutions.

CONCLUSIONS

The mammalian fauna of the Boulder Mountain Parks is rich and diverse. That diversity is due to several ecological and historical factors. The habitat is diverse because of topographic complexity. Ecologic change within the Parks is rapid over short distances because gradients are steep. The Continental Divide stands farther east in Boulder County than anywhere else in North America, and the mountains rise abruptly from the plains. Mammalian species with a wide range of faunal affinities have responded to the opportunity provided by the habitat, exhibiting a rich mixture of adaptive strategies.

The Parks encompass excellent representative tracts of some of the least abundant ecosystem-types, in particular, foothills scrub communities. That ecosystem is the principle habitat of most of the Chihuahuan species indicated in Table 2. These are species of narrowly restricted distribution. They are species near the northern limits of their distributional ranges.

Species occur where they do because (1) they could get there and (2) they could prevail. Over much of the Earth, a third factor has come to be of co-equal importance with those ecological factors. That is a social factor. Species occur where they do because humans tolerate them and protect their habitat (or at least they do not actively destroy it).

This human social factor is of great importance to the mammalian fauna of the Boulder Mountain Parks. Boulder is unique among Front Range cities in the extent to which the richest of its natural ecosystems--the mosaic of ecosystems that form the foothills backdrop--have been preserved. That preservation took foresight that was lacking elsewhere. The uniqueness of the Boulder Mountain Parks makes their stewardship an even greater responsibility. Our Mountain Parks are more than just a local resource; they are a national treasure.

RECOMMENDATIONS

1. Interpretive and educational efforts using the Mountain Parks resource should be continued and strengthened.

2. Careful management that recognizes the importance of ecological diversity and the uniqueness of the Mountain Parks should be continued.

3. Interpretation, management, and research should be coordinated carefully with City and County Open Space programs so that continuity of habitats (especially riparian corridors) can be maintained.

4. Interpretation and management should be based on an on-going program of research. Both broad baseline research and detailed community- or species-specific studies are needed. Both basic and applied research will meet interpretive and mangerial needs.

   A. Some research (such as a management plan for mule deer) will need to be done on contract.

   B. Other research can be accomplished by encouragement of work by students (either as course projects or as individual projects by qualified graduate or undergraduate students) or by interested community organizations.

   C. The Mountain Parks are particularly suited to non-manipulative, observational research in ecology and behavior.

   D. Because of the complex ecology of the Mountain Parks, species often are closely "packed" in biotic communities. Hence, this is a particularly good place to study competitive interactions and niche structure. Suggested subjects for such studies would include:

      1. Six species of shrews.
      2. Five species of Myotis, or the bat fauna as a whole.
      3. Three species of Sylvilagus.
      4. Three species of chipmunks (plus the golden-mantled ground squirrel).
      5. Three species of tree squirrels.
      6. Two species of Peromyscus, one a specialist, the other a generalist.
      7. Two species of Neotoma.
      8. Four species of Microtus (and up to six kinds of voles).

E. Because of the excellent preservation in the Mountain Parks of habitat for Chihuahuan species, and because the Parks are near the northern distributional limits of those species, autecological studies of those mammals should be encouraged: rock squirrel, rock mouse, Mexican woodrat, and also two Coloradan autochthonous species, the Colorado chipmunk and Abert's squirrel.

VIRGINIA OPPOSSUM

Didelphis virginiana

Distribution.-- The Virginia opossum ranges from Ontario southward through Florida and westward to Nebraska, Colorado, and Texas. The species first appeared in the southeastern corner of Colorado in 1903; its present habitat is riparian communities along the Arkansas and South Platte rivers in the eastern two-fifths of the state. The single record from Boulder County is a specimen taken at Green Mountain Cemetery in 1919; it may have escaped captivity.

Description.-- The opossum is the size of a house cat. The long, coarse, sparse pelage is grayish. The ears are naked, nose pad pink, and the big toe clawless and opposable. As a marsupial, the female has a ventral pouch in which the young are carried.

External measurements of a female from Yuma County, Colorado: total length, 574; tail, 259; hindfoot, 44; ear, 31. Weight ranges from 2.5 to 3.5 kg, with males being heavier. Greatest length of skull ranges from 98.3 to 119.9 and zygomatic breadth from 48.3 to 67.8.

Natural History.-- Opossums are mostly found in flat lowland areas, along streams. They spend a considerable amount of time in cottonwoods and brush. They den in burrows made by other animals, or under rocks, brush, or in hollow trees. They are nocturnal and do not hibernate. The animals are solitary; male encounters are highly antagonistic. An opossum will bite if provoked but most often will "play dead".

The diet is omnivorous, emphasizing insects. Corn and earthworms are eaten during the winter, and fruits, berries, and seeds are eaten during the growing season; carrion and birds' eggs are supplementary.

Females bear two litters per season, each with 5 and 25 young (the mean being 7 to 8) but there are only 13 teats, so the excess perish. The breeding season begins in January with a second in April. Estrus occurs at 28 day intervals, if pregnancy does not occur; gestation lasts 12 to 13 days. New borns are highly altricial. They make their way from the vagina to the pouch where they remain and suckle for 90 to 100 days. Both males and females are sexually mature at eight months. Average longevity is about 16 months and rarely exceeds two years.

Predators (man, raptors, and many carnivorous mammals) are insignificant compared to the parasites which afflict the opossum. Highway casualties are responsible for many deaths. Average longevity is about 16 months and rarely exceeds two years. Legally, the opossum is a furbearer, although the pelt is of low quality and worth only about two dollars.

Selected References.-- Jones et al. (in press); Keefe (1967); McManus (1974).

M.A.M.

MASKED SHREW

Sorex cinereus

Distribution.--The masked shrew is found from the Arctic Slope of Alaska and Canada, southward to the north central United States and in mountainous regions to southern Utah, central New Mexico, North Carolina, and Tennessee. In Colorado this species occupies a variety of habitats, including streamside woodland, brush and meadows in the mountains and wetlands on the adjacent plains. It occurs throughout Boulder County.

Description.--This is a medium-sized shrew with the familiar shrew-like characteristics including a sharp-pointed muzzle, small eyes, ears hidden by fur, and a slender body. The fur is soft, short, and quite dense. The upper parts are sepia brown and the under parts are ashy gray. The tail is bicolored. This species is often confused with the montane shrew, which is a bit larger and darker in color.

External measurements of two masked shrews from Colorado are total length, 90, 105; tail, 37, 54. Greatest length of skull of a female was 16.6; zygomatic breadth ranges from 7.1 to 7.9.

Natural History.--The masked shrew is most often found in meadows and damp places in the grass and quite often among fallen and rotting logs. Masked shrews are extremely active animals with very high metabolic rates. Their pulse ranges from 588 to 1320 beats per minute, with a respiration rate almost as high. During most of the year these animals are quite active, however they have been found to go into periods of deep slumber, slowing the metabolic processes.

Masked shrews eat mostly insects, yet they have been found to eat worms, molluscs, vegetables, and occasionally small mice. Each day these animals consume more than their own weight in food.

Females bear three litters per year, giving birth to four to nine young per litter. Breeding season is between the months of March and October. The gestation period is 21 days. Nests are made of dry grass or leaves, in holes in tree stumps or under rocks. Very few masked shrews live to be more than one year old.

Selected References.-- Armstrong (1975); Forsyth (1976); Wrigley (1979).

E.M.M.

MONTANE, or DUSKY SHREW

Sorex monticolus

Distribution.--The dusky shrew is a species of western North America, ranging from British Columbia southward through mountainous parts of the West to central Mexico. In Colorado, the species occurs at mid- to high elevations in the western two-thirds of the state. The animals occur in the western part of Boulder County. Localities of record on the Boulder Mountain Parks include the mouth of Gregory Canyon and the eastern slope of Mount Sanitas. This species formerly was known as Sorex vagrans, the wandering shrew. However, it has now been discovered that Sorex vagrans is a separate species, sympatric with S. monticolus in parts of the Pacific Northwest. In older literature on Coloradan mammals, look for information on this species under the name S. vagrans, or under the name of the local subspecies, S. obscurus.

Description.--This is a rather nondescript shrew, grayish brown above and paler below. It is slightly larger than Sorex cinereus and the tail is more distinctly bicolored, and it is slightly smaller than S. merriami and less grayish in color. Mostly, however, shrews cannot be identified without recourse to the teeth. In S. monticolus, the third unicuspid tooth is decidedly smaller than the fourth, whereas in S. cinereus and S. merriami the unicuspids all are about the same size.

Mean (and extreme) external measurements of six females from Boulder and Larimer counties are: total length, 103.5 (95-116); length of tail, 45.8 (43-49); length of hind foot, 12.8 (12-13); length of ear, 7.7 (7-8) Condylobasal length of those animals was 17.27 (16.7-17.5); cranial breadth, 8.84 (8.5-9.1). These shrews weigh 5 to 7 gr.

Natural History.--Typical habitat of the wandering shrews is moist streamside vegetation, either willow thickets or marshes. They often are associated with microtine rodents, especially montane voles. Sometimes, however, they are taken with other shrews.

Cover probably is a less important habitat requirement than is food. Dusky shrews forage beneath the litter for a wide variety of prey, mostly of invertebrates. Adult and larval beetles, caterpillars, pupae, centipedes, pillbugs, and carrion are eaten. The animals sometimes capture and kill young mice twice their size. They are active throughout the year, foraging beneath the snow for dormant prey.

Shrews are rather unsociable animals. As adults they are spread rather evenly across available habitat by mutual avoidance and nest defense. The home range is some 4000 square feet, or about 1/10 acre.

Mating occurs in spring and summer and females probably are polyestrous. although that is not certain. Gestation takes about 20 days. The young are blind and naked at birth, but they grow rapidly. Litter size ranges from two to nine, with an average about six. The young stay with the mother until six or seven weeks of age and then disperse.

Selected References.--Brown (1967b); Spencer and Pettus (1966).

D.M.A.

DWARF SHREW

Sorex nanus

Distribution.--The dwarf shrew occurs mainly in and near the Central and Southern Rocky Mountains. Specimens have also been found eastward to western South Dakota. The species is as yet unreported from Boulder County, but records elsewhere along the Front Range indicate the strong possibility of its occurrence in the Boulder Mountain Parks. The type locality of S. nanus is Estes Park.

Description.--S. nanus is an extremely small mammal, among the smallest of the shrews. Summer pelage is hair brown to olive brown, smoke gray to buffy ventrally. In the winter it is paler and grayer. The tail is bi-colored. The skull is small, slender and very flat.

External measurements of three males from Larimer County were: total length, 105, 89, 97; tail, 42, 40, 39; hindfoot, 10, 11, 10. Weight varies from 1.8-3.2 gr. Condylobasal length ranges from 13.8-14.8; cranial breadth from 5.2 to 5.5.

Natural History.--The dwarf shrew seems to have a preference for drier montane environments. In Colorado they inhabit forests, open woodlands, rocky, shrubby foothills slopes, and alpine and subalpine rockslides. Altitudinal range is from 5500 to over 10,000 ft. In a study made in Larimer County dwarf shrews were found in highest frequency in forests. Sedge marsh and dry brushy slopes also contribute to the fairly wide array of habitats and conditions this species is accustomed to. S. cinerus, S. monticolus, S. merriami are known to occur in Colorado with S. nanus. There seems to be little evidence of competition among shrews.

Captive dwarf shrews have been observed feeding on the carcasses of several types of terrestrial vertebrates. They do not eat slugs but prefer soft-bodied spiders and insects. They will cache excess foodstuffs such as mealworms.

Breeding season in the alpine zone is from late June to early July. First litters usually appear in late July to early August. In some cases there are two litters per season with the second litter being born in late August to early September. Usually four to six young are born. Little else is known about the development and behavior of this species.

The only evidence of predation on S. nanus was a mandible found in a barn owl pellet. This species is as poorly known as any small mammal. More studies need to be done in regard to ecology, growth and development, behavior, and physiological constraints on one of Earth's smallest warm-blooded animals.

Selected References.--Armstrong et al. (1973); Spencer and Pettus (1966); Hoffmann and Owen (1980).

F.M.B

WATER SHREW

Sorex palustris

Distribution.--The water shrew is distributed over the north-central, and northeastern U.S., and mountainous regions of the West. In Colorado, this shrew is found near water at elevations of 6000 to 10,000 ft. *Sorex palustris* is not documented from the Boulder Mountain Parks, but may be expected in Long Canyon.

Description.--This shrew is readily recognized by its large size and bicolored fur, blackish gray above and silvery below. The tail is about the same length as head and body. The feet are lined with stiff hairs. Measurements of two males and a female from Grand Mesa are: total length, 161, 166, 166; tail, 78, 79, 80; hindfoot, 21, 20, 20. Weights range from 12 to 18 gm. Measurements of the skull include greatest length of skull, 20.8, 21.0, 20.7; interorbital constriction, 7.3, 7.1, 7.1.

Habitat.--Water shrews are closely associated with water and are found along the banks of rivers, streams, lakes, and particularly, beaver ponds. Extensive tunnels are constructed among boulders, rocky banks, crevices, ledges, and tree roots. Nests average 10 cm. in diameter and are made of sticks and leaves.

The diet is largely insectivorous, including stoneflies, mayflies, and caddisflies; other invertebrates and even small fish may be taken. The water shrew does not hibernate, and although mainly nocturnal, may forage at any time during day or night. Shrews have justifiably earned a reputation as voracious eaters. Their small size resulting in a large surface:volume ratio requires large amounts of food, as much or more than the body weight daily, to fuel the high metabolic rate.

S. palustris is reproductively active from January to August with two or more litters born after a gestation of 2 to 3 weeks. Litter size averages six(four to eight). Females born early in spring may breed the first season, but most breed at one year of age. The animals are short-lived; few live beyond the second winter.

The water shrew's excellent swimming ability has amazed or startled fishermen who may see them scamper across the water or swim below the surface surrounded by a silvery layer of air. The fur resists wetting and is groomed often with the fringed feet. Sight is poorly developed, but smell, hearing, and the tactile senses are acute. These shrews probably avoid each other, but noisy and vigorous fighting may occur when they do encounter each other. Populations are regulated by predators such as hawks, owls, weasels, minks, and snakes. The shrew also harbors mites, fleas, ticks, and other parasites.

Selected References.--Conaway (1952); Jones *et al.* (in press); Sorenson (1962).

A.B.A.

MERRIAM'S SHREW

Sorex merriami

Distribution.--Merriam's shrew is apparently a rare shrew, and thus the capture of a single specimen can markedly change the pattern of their known distribution. Presently, it is believed that this species ranges from east-central Washington down into northeastern California, south to central Arizona, northeast to western Nebraska, and into eastern Wyoming and Montana. In Colorado, the local subspecies is found principally in the northeastern and northwestern parts of the state. One captured in Gregory Canyon is preserved in the University of Colorado Museum.

Description.--This is a small grayish animal with whitish underparts, distinguished from other shrews on the basis of characteristics of its skull. Also, during breeding season, the males have greatly enlarged flank glands that generally exceed the size of those of any other shrew. It molts twice a year, from March through June, and again from September through November. The winter pelage is generally brighter, drab above, and paler below.

Measurements of a specimen from Gregory Canyon are: total length, 90; length of tail, 35; length of hindfoot, 12; greatest length of skull, 16.1;cranial breadth, 7.9.

Natural History.--The majority of the data on Merriam's shrew have been collected in eastern Washington, where a large proportion of the specimens have been captured; there are few data specific to Colorado. Coloradan specimens all were found in or adjacent to dry areas, variously covered with sage, juniper, short-grass prairie, and mountain mahogany, and some of them were caught by traps laid in the runways of meadow mice or other voles. This seems to be a fairly strong association, and the shrews are probably using these cleared stretches for foraging purposes.

Merriam's shrews are insectivorous, apparently preferring caterpillars, at least in the warmer months, but they also feed on spiders, beetles, and crickets. Owls are the only documented predators, but these shrews doubtless fall prey to most carnivorous vertebrates.

Pregnant females have been captured from mid-March through early July, whereas males with enlarged testes have been captured from March to early June. For three pregnant females captured in Washington State, the embryo count was five, six, and seven. Males have relatively large flank glands; possibly the strong odors sometimes emitted by these creatures may be associated with their breeding season. Very little is known about these rare animals, particularly with respect to population structure and dynamics.

Selected References.--Armstrong and Jones (1971); Diersing and Hoffmeister (1977).

J.M. McC.

LEAST SHREW

Cryptotis parva

Distribution.--The least shrew generally occurs in the eastern half of the United States and is common in Mexico and Central America. In Colorado, the species is found in the drainages of the South Platte and and Republican rivers. There is evidence that the habitat created by extensive irrigation has allowed the animal to extend its range westward in the last two decades. In Boulder County the species occurs in wetlands to the base of the foothills; it was first traced here in 1966, near Boulder Reservoir.

Description.--The least shrew is small, with inconspicuous ears, minute black eyes, and a long pointed snout. Brownish gray in color, the pelage is fine, dense, short and almost velvety. Its extremely short tail is less than one-third the total body length, and that distinguishes it from other shrews.

Measurements of a male and a female from Yuma County were: total length, 81, 85; tail, 18, 18; hindfoot, 11, 11; weight 5.2, 4.7 gr; condylobasal length, 15.5, 15.2; cranial breadth, 7.7, 7.9.

Natural History.--In the northern part of its range, the least shrew inhabits grassy, weedy and brushy fields. It is often associated with dense herbaceous cover. Burrows may be of several forms but are generally simple, small, and terminate in a nest. Nests are also found on the surface under logs or human artifacts. Approximately 100 cm. in diameter, the nests are usually constructed of dried grasses and/or leaves. The species may be colonial or at least social. This is unusual behavior for a shrew. Large numbers of the animal often are found together in the same nest. The species is active at all hours of the day but is most active at night. The least shrew is active throughout the year.

Food consists almost entirely of insects, earthworms, and spiders. Food habits in Colorado have not been studied, but in Indiana, the larva of moth beetles, earthworms, spiders and the internal organs of crickets and grasshoppers made up the bulk of the animal's diet.

Females give birth to litters of three to seven young from March to November in the northern part of the range. The young are altricial but development is fairly rapid. Adult weight is reached in about 30 days.

Owls are known to prey heavily on the least shrew. Other predators include hawks, skunks and falcons. Very little is actually known about this species. Thorough studies of the animal's population ecology, genetics, and social behavior remain to be done.

Selected References.--Whitaker (1974); Williams and McArthur (1972).

S.M.A.

LITTLE BROWN BAT

Myotis Lucifugus

Distribution.--The little brown bat is widely distributed occupying most of North America, from southern Alaska to Newfoundland, south to Chihuahua. M. lucifugus is found throughout Colorado. Specimens are available from Boulder and Jamestown, and the species was observed along South Boulder Creek in September 1982.

Description.--This species is recognized by its dark metallic color and its flight, erratic for a bat its size. The pelage is long and silky with hairs burnished at the tips. The tragus is medium long and blunt.

Mean (and extreme) external measurements of 14 females from Lake County are: total length, 94.9 (89-102); tail, 40.5 (37-44); hindfoot, 10.6 (10-11); ear, 14.7 (14-16), forearm, 38.13 (36.9-40.3). Females usually weigh more than males, ranging from 6 to 8 gr. Greatest length of skull ranges from 13.8-15.2 (mean 14.53), and zygomatic breadth ranges from 8.5-9.5 (mean, 9.04).

Natural History.--In Colorado, M. lucifugus is common in forested areas and woodlands. It is found at elevations of up to 11,000 ft. Nursery colonies roost in buildings and warm attics; single males are found almost anywhere. They are highly gregarious; large aggregations may facilitate thermoregulation. The species lowers its thermostat to approximate the temperature of the hibernaculum. M. lucifugus hibernates from five to six months a year.

The diet consists mainly of flying insects 3 to 10 mm. in length, such as midges, mosquitos, and beetles. They have been observed to reject some kinds of insects. They use echolocation while foraging.

Females give birth to a single young in early summer. No more than one litter per year has been documented. Most female and some male yearlings are fertile. The young are dependent on their mothers for about three weeks after birth. Females usually live longer than males; ages greater than 31 years have been reported.

Small carnivores, birds, mice, and snakes prey upon the little brown bat. This bat hosts many parasites but the incidence of rabies appears to be low, 1 % or less. Populations of the little brown bat may be seriously declining. Preserving roost sites could increase populations. Conversely, destroying roost sites, disturbance during hibernation, use of heavy pesticides, and "progressive" architecture all detract from increasing populations.

Selected References.--Fenton and Barclay (1980); Humphrey and Cope (1976).

F. M. B.

LONG-EARED MYOTIS

Myotis evotis

Distribution.--The long-eared myotis is a widely distributed bat of the coniferous forests of western North America. It occurs from Baja California north to British Columbia, and eastward to extreme western North Dakota, South Dakota, and Nebraska. In Colorado, the species occurs during the breeding months in foothills, plateaus, and lower mountains on both sides of the Continental Divide. It most likely occurs in the mountainous portions of the Boulder Mountain Parks, but because of its nocturnal habits, observation is difficult. Two specimens have been reported from Boulder.

Description.--Myotis evotis is a small bat with the largest ears of any North American Myotis; when laid forward they extend 5 to 7 mm. beyond the tip of the muzzle. The pelage of the body is a light to medium brown; immatures are grayer. The ears are conspicuously darker, approaching black, and contrast strongly with the color of the body. The tail membrane is edged with a sparse and inconspicuous fringe of thin hairs. The similar fringed myotis has shorter ears, a longer forearm, and conspicuous hairs on the tail membrane. Male and female are simil in size and color. Measurements of three males are: total length, 94, 89, 91; tail, 46, 44, 42; hindfoot, 10, 8, 1; ear, 23, 22, 23; weights range from 5 to 7 gr; greatest length of skull, 15.5, 15.5, 15.7; zygomatic breadth, 9.2, --, 9.4; forearm, 38.2, 37.8, 37.6.

Natural History.--The long-eared myotis is a bat of evergreen forests at middle elevations, about 1800 to 2600. It also occurs in semiarid shrubland. It is primarily a tree-roosting species, but also utilizes sheds, cabins, and caves as well as abandoned mines and buildings. They tend to use trees as diurnal roosts and caves or mine shafts as nocturnal roosts. This is not a colony-forming species, although small maternity colonies are formed during the breeding season.

The long-eared myotis feeds over ponds and between, within, and below the canopy of the forest. It is also known to feed in clearings and around campfires and outdoor lights. It is entirely insectivorous, catching insects in flight or gleaning them from foliage or the ground. It is a slow-flying, highly maneuverable bat. When in competition with other species, the long-eared myotis feeds almost entirely on beetles; in addition, the sexes may undergo resource partitioning in the absence of another competitor, with the male eating more moths and the female more beetles. One young is born between May and July. The winter range is not known.

Selected References.--Black (1974); Husar (1976); Jones (1965); Jones et al. (in press).

H. E. B., Jr.

FRINGED BAT

Myotis thysanodes

Distribution.--The fringed bat is a species of desert, grassland and woodland habitats, ranging from British Columbia to Veracruz and Chiapas with a disjunct population in the Black Hills of Wyoming and South Dakota. In Colorado, the species occurs in scattered localities at moderate elevations near the mountains on both sides of the Continental Divide. The species has yet to be documented in Boulder County, but its occurence is strongly suspected on geographic and ecological grounds.

Description.-- A fringe of pale hairs along the trailing edge of the uropatagium distinguishes this species from M. evotis, with which it is sympatric. Moderate in size, the dorsal fur is reddish buff and the venter is pale buffy to grayish white. Color varies geographically with a tendency toward darker colors in northern populations.

External measurements of a male and two females from Canyonlands National Park, Utah, were: total length, 90, 97, 95; length of tail, 40, 43, 45; length of hindfoot, 11, 11, 10; length of ear, 19, 18, 19; weight, 5.4, 5.7, 6.3; forearm, 41.8, 42.8, 43.6; greatest length of skull, 16.6, 16.1, 16.5; zygomatic breadth, 9.7, 9.3, 9.8.

Natural History.--The fringed bat seems to prefer coniferous woodlands and desert scrub situations where they are found roosting in crevices, caves, mice, mine shafts, and buildings. Food consists mostly of beetles although moths are also eaten. The diet in Colorado has not been detailed, but in Soccoro County, New Mexico, beetles were found to be prominent in the diet (73 percent). The remainder was determined to be moths.

Females give birth to a single young per year. Copulation is not achieved until after leaving the maternity roost in the fall. Evidently there is little variation in the timing of reproduction throughout the range of species. The gestation period is from fifty to sixty days in length.

Young are precocial; at parturition they average 54 percent of total adult length, and 22 percent of adult weight. Weaning takes place at about 20 days. In Arizona, the age structure (based on tooth wear) was skewed strongly toward young animals and showed a sex ratio of 50:50.

This bat is known to migrate, although little is known about the direction or magnitude of movements. Spring migration to the maternity roost is known to be rapid. Colonies seem to be easily disturbed bu humans. No studies have been done in Colorado on the population dynamics and the general knowledge of this species here is poor.

Selected References.--Armstrong (1982); O'Farrell and Studier (1980).

R. A. A.

LONG-LEGGED BAT

Myotis volans

Distribution.--The long-legged bat is a species of western north America, reaching the limits of its range in Colorado, Nebraska, and South Dakota. In Colorado, the species occurs throughout the wooded areas of the western three-fifths of the state. The species prefers to live in open mountain woodland and coniferous forests, and has been documented from Boulder.

Description.--The species is a medium-sized member of the genus myotis with low, rounded ears, and a distinctly keeled calcar. The keeled calcar and the low, rounded ears distinguish it from M. lucifigus, a species with which it is sympatric. The long-legged bat is the only brown bat in which the belly fur extends onto the wing to a line joining the elbow and knee. The species is smoke brown to chocolate brown above, yellow brown below. Dorsal hairs have burnished tips.

Mean (and extreme) external measurements of six males, followed by nine females from Park County, were: total length,97.3 mm (96-99), 102.0 (99-106); tail, 41.6 (40-43), 41.6 (38-46); hindfoot, 9.0 (9-9), 8.9 (8-9); ear, 12.7 (12-13) 12.3 (11-11), weight, 8.72 gm. (8.0-9.2), 11.18 (9.5-12.1); forearm, 37.75 (36.9-39.1), 38.19 (37.2-38.8). Greatest length of skull ranges from 14.3 to 14.7 mm. in males, and 14.6-15.0 in females; zygomatic breadth is 8.3 to 9.1 in males, and 8.4-9.1 in females.

Natural History.--The species inhabits open forests and woodlands from 4000 to 9000 ft. in elevation. It is somewhat common in deciduous lowlands, and will tolerate desert badlands. Nursery colonies form in buildings, rock crevices, and trees during the summer. Trees are probably the most common sites for roosting. The bats roost during the day, and emerge just after sunset to feed. They feed at to 3 m. above water and forest openings. The species probably migrates, although it is not known where.

Breeding occurs from mid June to early July and the young are born in spring, wherein the female gives birth to one individual per litter per year. Reproduction and development have largely not been studied. Longevity is unknown.

Population ecology studies for this species are lacking. Most of the species ecology is unknown.

Selected References.--Black (1973); Barbour and Davis (1969), Freeman (1980); O'Farrell and Bradley (1969).

B.I.L.

SMALL-FOOTED MYOTIS

Myotis leibii

Distribution.--The small-footed myotis is an uncommon bat which occurs widely in temperate North America from California to the Atlantic Coast, and from southern Canada to northern Mexico. In Colorado, this bat is found statewide in suitable habitat. Locally, it is most common in the foothills. This species has not been documented for the Boulder Mountain Parks but has been found in Boulder Canyon at 6200 ft. and therefore should be expected.

Description.--Small size and, in particular, small feet (7 to 8 mm.) characterize this bat. The fur is yellowish brown, contrasted by dark, almost black, ears and membranes. The calcar is keeled. Myotis leibii is distinguished from the similar Myotis californicus by the burnished tips of the dorsal hairs and a more flattened skull. Another small bat, the western pipistrelle, is pale in color and relatively smaller, neither of the latter species occurs in the Boulder area.

External measurements of a male and mean (and extreme) females from Larimer, El Paso, and Boulder counties were: total length, 85, 79.7 (76-86); tail, 38, 36.3 (35-39); hindfoot, 8, 7.3 (7-8); ear 14, 13.5 (12-15); forearm, 32.1, 32.6 (30.9-33.9); weight, 4.8, 4.5 gm. Greatest length of skull of a female from Larimer County, 14.4, zygomatic breadth, 8.6.

Natural History.--Rocky, broken shrubland of the plains and foothills up to 8000 ft. is the preferred habitat of the small-footed myotis. This bat is typically asocial and roosts singly or in small numbers. Summer roosts are located under bark, rocks, or in pockets of sandstone. The winter hibernaculum is unusual for such a small bat. Surprisingly, the bat stays active until November and then hibernates in rather exposed areas near the entrances of mines, tunnels, or caves, rock crevices, and possibly in barns and houses. They have been found overwintering under rocks in the floors of caves. It is unusual for a bat with such a high surface:volume ratio to hibernate in such cold places. Larger bats often are found much deeper in caves where temperatures are more moderate. Myotis leibii is the only bat of the genus Myotis known to hibernate in Colorado.

The diet is insectivorous, mostly composed of beetles, flies, true bugs, and ants. Foraging occurs early in the evening with a slow, fluttering flight.

After a gestation period of about two months, a single young is born in June or July. Females with young may form small nursery colonies.

The small-footed myotis is preyed on occasionally by owls, falcons, or hoary bats, but cold temperature is the limiting factor. Longevity is uncertain, but one banded individual was recovered after nine years.

Selected References.--Armstrong (1982); Barbour and Davis (1969); Jones et al. (in press); Robbins et al. (1977).

A.B.A.

SILVER-HAIRED BAT

Lasionycteris noctivagans

Distribution.--The silver-haired bat occurs from southern Canada to Mexico and from coast to coast in the United States. In Colorado, they occur statewide, but because they show a strong preference for forested areas, they are more common in mountainous parts of the state than on the eastern plains. The species is documented from Boulder and doubtless occurs throughout the Boulder Mountain Parks. Probably they do not overwinter in Colorado, but their winter haunts are unknown.

Description.--This is an unmistakable species. The fur is black, with a liberal sprinkling of white hairs giving the back silvery appearance. They are slow fliers.

Mean (and extreme) external measurements of 15 males from Park County were: total length, 101.1 (95-105); length of tail, 38.1 (36-40); length of hindfoot, 8.8 (8-9); length of ear, 15.1 (14-16); length of forearm, 40.53 (39.0-42.4); weight, 10.85 (9.9-13.2) gr. Greatest length of skull, averaged 16.37 (15.9-16.7), zygomatic breadth, 9.92 (9.5-10.2).

This species can be confused with no other in North America. It is roughly the size of the larger Myotis species, but its coloration is very characteristic. The only other bat with whitish hairs on the back is the hoary bat, Lasiurus cinereus, which is much larger in size, has a heavily furred interfemoral membrane, and has low rounded ears.

Natural History.--Silver-haired bats roost in trees, beneath loose bark, in snags, or in tree holes. Migrants sometimes roost in houses or outbuildings. Migration occurs in spring and fall. Boulder County is along the broad migratory route. Males stop in Colorado to summer but females move farther north, to insect-rich Canadian forests, to rear the young.

Foraging begins in early evening. The foraging route is a leisurely circular path, fairly close to the ground, and may have specific hunting routes. Specific food habits are poorly known in Colorado. Elsewhere the silver-haired bat is opportunistic feeding principally on moths, beetles, bugs, flies, and caddisflies.

In Boulder Mountain Parks, L. noctivagans probably forages with the hoary bat, big brown bat, little brown bat, long-eared myotis, long-legged myotis, fringed myotis, and small-footed myotis. Predators include snakes, owls, and hoary bats.

Unlike most other bats, which tend toward single births, silver-haired bats give birth to twins on the northern summer range in June or July. The breeding habits of this species are poorly known. However, copulation seems to occur in fall, prior to hibernation. Sperm are stored by the female through the winter and fertilization takes place in spring. Gestation takes about 50 to 60 days, and young are born in June or early July. Young are weaned by five weeks of age.

Selected References.--Kunz (1982).

D. M. A.

BIG BROWN BAT

Eptesicus fuscus

Distribution.--The big brown bat occurs from coast to coast in North America and from central Canada southward to Panama. Over that range it is one of the more common--or at least one of the more obvious--bats, because it frequently roosts in houses. The animals occur statewide in Colorado, throughout Boulder County. The type locality of the local subspecies, E. f. pallidus, is Boulder. The species was observed in late September 1982 along South Boulder Creek.

Description.--Among local bats, this species is large and heavy-bodied. Only the little brown bat has a generally similar appearance, but Myotis lucifugus is smaller (forearm about 40 mm., rather than 45 or more) and the tips of the hairs are shiny.

Mean (and extreme) external measurements of 10 females from the vicinity of Fort Collins are: total length, 115.0 (108-123); length of tail, 48.7 (45-52); length of hindfoot, 11.4 (11-13); length of ear, 16.9 (15-18); length of forearm, 47.5 (45-50); weight, 17.25 (13.9-19.7); greatest length of skull, 18.54 (18.3-19.7); zygomatic breadth, 12.34 (11.4-12.6). As the common name suggests, these bats are brownish in color; the membranes are black.

Natural History.--This is one of the more common bats in the area, and apparently they live here year round. They live in lofts, attics, hollow trees, caves, mines, beneath bridges, and in storm sewers.

Food consists of beetles, flying ants, flies, and occasional moths. An experienced hunter can fill its stomach in about an hour, but that sort of efficiency takes practice. Feeding begins about dusk. Often the animals fly a repeated circuit. The animals may hang up to rest between foraging bouts on a porch, under an eaves, or in a tree.

Mating takes place in the winter roost, in late autumn or winter. Spermatozoa are stored by the female until ovulation occurs in April. Gestation takes about 60 days, and the young are born in late June. Within a month the young can fly and begin to forage for themselves. In our subspecies, single births are the rule (but eastern mothers typically give birth to twins).

Like other bats, big brown bats are sometimes preyed upon by owls, raccoons, and other nocturnal predators. However, their most serious enemy is mankind, who tends to have an exaggerated fear of bats and hence subjects them to over-zealous control, as well as to wanton destruction. If left unmolested to live out a normal lifespan, these bats may live 15 to 20 years.

Selected References.--Barbour and Davis (1969); Phillips (1966); Constantine (1980), Kunz (1974).

D.M.A.

HOARY BAT

Lasiurus cinereus

Distribution.--The hoary bat is widespread throughout the contiguous United States. The species is usually found in wooded habitats of lower and middle elevations in Colorado. There are records from Boulder, and the species doubtless occurs throughout the Boulder Mountain Parks.

Description.--The hoary bat can be distinguished from other Coloradan bats by its 1/1 insicors, large size, and brown dorsal hairs with white tips, which gives it a hoary or frosted appearance. The skull is large and robust, ears are small and rimmed with black, and the wings are relatively long and narrow.

Mean (and extreme) measurements of 28 specimens from Colorado were: total length, 133.1 (125-140); tail length, 53.4 (50-60); hindfoot, 11.1 (9-12); length of ear, 16.5 (13-18); length of forearm, 52.33 (50-56); weight, 27.41 (24.3-32.1); greatest length of skull, 17.36 (16.8-18.0); zygomatic breadth, 12.18 (11.4-12.6).

Natural History.--The hoary bat, although generally not common occurs over a wide range of habitats. Individuals and family groups are seen by day in the foliage of trees, 10 to 15 feet above the ground. Foraging for flying insects (and sometimes for smaller species of bats) begins just after the sunset, when aerial insect densities are highest. They feed extensively on moths and can consume up to 25 percent of prefeeding body weight. Being strong, open-air foragers, they can cover large areas. Little is known directly about their migrations, but it appears that the sexes are segregated during the summer, with males restricted to western United States, and females moving farther north to give birth to the twin young. Females give birth while hanging and the uropatagium and umbilicus prevents the offspring from falling. The young cling to the mother on foraging flights until one week old.

These bats are aggressive and when disturbed will display a threat posture with mouth and wings wide open with a clicking-hissing vocalization. Predators known to take hoary bats include snakes, skunks, owls, hawks, and blue jays. The species has been implicated in the transmission of rabies to skunks which are an important vector of the disease to dogs and ultimately to man. Voracious consumption of insects makes it valuable in terms of ecosystem stability and may make it a candidate for future biological control programs. Unfortunately, because of its long migrations and nocturnal habit, very little is known about the biology of this species.

Selected References.--Shump and Shump (1982).

O.D.P.

TOWNSEND'S BIG-EARED BAT

Plecotus townsendii

Distribution.--Townsend's big-eared bat ranges primarily from southern British Columbia south to the interior of Mexico and from northeastern Montana, Wyoming, and just east of the Rockies to the Pacific Coast. Additionally, a narrow part of its range extends eastward through Oklahoma, southern Kansas, Missouri, northeastern Arkansas, Kentucky, and eastward to the Virginias. The species is absent from the plains of northeastern Colorado, but records exist of its presence in Boulder County, where it occurs in foothills canyon

Description.--Townsend's big-eared bat is of moderate size. Mean (and extreme) measurements of five males and of six females, all from Larimer County, are: total length, 91.8 (82-100), 96.3 (87-102); length of tail, 43.1 (35-38) 45.0 (38-57); hindfoot, 10.2 (9-12), 11.0 (10-12); ear, 33.6 (30-37), 35.8 (34-38); forearm, 42.83 (39.0-44.5), 43.58 (42.4-44.7); weight, 10.50 (9.0-11.5), 14.38 (10.0-14.0); condylobasal length, 15.28 (15.0-15.6), 15.37 (15.2-15.7); zygomatic breadth, 9.10 (9.0-9.2), 8.92 (8.8-9.0).

Pelage of this species is generally brown, but individual coloration may range from nearly black to light brown or gray. With its huge ears, this species can be confused with no other local bat.

Natural History.--Townsend's big-eared bat tends to occur in deciduous or coniferous forests, and at elevations to 2920 m (9500 ft) in Colorado. It may use man-made structures for roosts and hibernacula. The species is insectivorous, but detail of its diet are essentially unknown. Its hibernation is on its summer range from late November to March. However, it may awaken sporadically during the warmer periods of winter. P. townsendii may be expected to be found in hibernating within the Boulder Mountain Parks.

The testes start to develop during summer and sperm production is greatest in September. Males store their sperm because females do not come into estrus until autumn. Copulation peaks from November to February. The gestation period is from 56 to 100 days. Males are absent from nursery roosts. Females are monoestrous and usually one young is born. Births occur from mid-April to mid-July, with a peak in late May or early June. Newborn young weigh 2.1 to 2.7 gr. They can fly by 2½ to 3 weeks of age and are weaned at 6 weeks.

For its size, this species is long-lived, with individuals known to survive more than 16 years in the wild. The animals occur in low density, non-migratory populations throughout their range; therefore, populations must not be harassed. Nursey colonies are quite susceptible to human disturbance.

Selected References.--Humphrey and Kunz (1976); Kunz and Martin (1982).

J. C. O.

EASTERN COTTONTAIL

Sylvilagus floridanus

Distribution.--The eastern cottontail is a species of the Great Plains and eastward, and has a wider distribution than other species of cottontails. It has a range from southern Canada to Venezuela and from the eastern seaboard of the United States to the base of the Rocky Mountains. In Colorado, the species occurs in the northeastern corner of the state. It has yet to be documented in Boulder County but doubtless occurs here.

Description.--In Colorado, S. floridanus may be distinguished by much darker pelage and larger size from S. audubonii, with which it is sympatric. The animals are brownish to grayish on the upper parts and white on the underside of the body and tail. There is no real pattern except a distinct rusty patch on the nap of the neck.

External measurements of ten animals from Cherry County, Nebraska were: total length, 420.3 (400-452); tail, 50.5 (41-71); hindfoot, 97.5 (83-104); ear, 55.9 (52-61); weight, 2 to 3 lbs. Greatest length of skull, averages 72.6 (70.8-75.3); zygomatic breadth is 36.0 (35.6-36).

Natural History.--Eastern cottontails prefer riparian communities along major streams of the eastern plains or adjacent agricultural situations where dense plant growth provides good cover. This species feeds upon a wide variety of plant species. In summer the diet is chiefly herbaceous plants with a preference for legumes and grasses. They also utilize stems and shoots of shrubs and woody vegetation, especially in winter when preferred foods are dormant.

Females bear two to six litters per season with a litter size of four to seven. Breeding periods are of one week duration separated by intervals of about two weeks. Gestation last twenty six to twenty seven days and in Missouri post-partum breeding was measured at almost one hundred percent. As time of parturition approaches, the female digs an elliptical nest lined with vegetation and wads of soft fur pulled from her shoulders, flanks, and legs. The young are nursed at dawn and dusk by the female who also defends the nest from intruders. The young are altricial but show rapid growth in the first two weeks then leveling off. Mortality rate is extremely high with seventy percent of the individuals dying before the age of five months.

Coyotes, foxes, weasels, hawks, owls, rattlesnakes, and numerous other carnivores prey on these cottontails. Home ranges have been estimated in Colorado to be from one to five acres for females although it may be as large as fifteen. Adult males may range as far as one hundred acres.

Eastern Cottontails are important game animals and it is not uncommon for the kill in the U. S. to exceed one million animals. However, general knowledge of the biology of this species in Colorado is poor.

Selected References.--Chapman et al. (1980); Jones et al. (in press).

R. A. A.

NUTTALL'S COTTONTAIL

Sylvilagus nuttallii

Distribution.--The range of Nuttall's cottontail extends from the Canadian border south to Arizona and New Mexico, and from the eastern slopes of the Rocky Mountains west to the eastern slopes of the Cascade-Sierra Nevada Range. It is found in suitable habitat throughout most of the mountainous areas of Colorado from foothills to medium elevations. Individuals have been documented throughout higher parts of Boulder County.

Description.--Sylvilagus nuttallii is relatively large for a cottontail with long hind legs, comparatively short, round-tipped ears, a long rostrum, and a large tail. It is dark pinkish and buffy above, with a grayer, paler pelage on the sides and white underparts. Nuttall's cottontail is sympatric with S. audubonii and is distinguished by its darker colored pelage with more dorsal black hairs; smaller ears with a thin black line on the margin; a bright rusty nape; smaller hind feet, and long dense hair covering the hind feet. Locally, S. nuttallii may also be found in close proximity to S. floridanus and is separated (with difficulty) by slightly paler dorsal pelage, duller brownish throat patch, and more densely furred ears.

External measurements of four females from Garfield County were: total length, 377 (367-397); tail, 40.2 (36-42); hindfoot, 97.2 (90-104); ear, 64.0 (60-68). Greatest length of skull is around 70; zygomatic breadth about 35. Average weight of six males from South Dakota was 809.5 g.

Natural History.--The species occurs at the edge of coniferous forests and in dense stands of sagebrush or other brushy areas. It ranges in elevation from 6000 feet (1800 m.) to 11,500 ft. (3500 m.) in the Pikes Peak region. Forms are used for cover. These are cup-like cavities lined and covered with fur, grass, and small sticks. The cottontail is known to inhabit the abandoned burrows of other animals, but burrowing behavior has not been well documented.

Foraging activity usually occurs in early morning, late afternoon and evening, though this species may be active any time of the day or night. Diet consists of sagebrush, juniper, and other shrubs. Grasses are a preferred food in spring and summer.

Reproduction has not been detailed in Colorado, but in Oregon, the breeding season was reported from late February to late July. Gestation is 28 to 30 days and females bear four or five litters per season. Litter size may vary from one to eight.

Cottontails are poorly known in Colorado, despite their abundance. Perhaps this is partly because the species are so difficult to identify. Nonetheless the Boulder Mountain Parks and adjacent greenbelt lands would be an excellent place to study habitat relationships among these three closely related species.

Selected References.--Chapman et al. (1980); Jones et al. (in press).

D. J. A.

DESERT COTTONTAIL

Sylvilagus audubonii

Distribution.--The desert cottontail occurs throughout the west from the Canadian border to central Mexico and from central Nebraska to the Pacific Coast. Locally, the species ranges through the plains of eastern Colorado, including eastern Boulder County. The cottontail may be found in the foothills or on arid mesas and creekbeds.

Description.--The coat of the desert cottontail is short with sparsely furred ears and slender hindfeet. The color is a pale grayish wash which gets paler on the sides to a whitish belly. They also have an orangish-brown throat and chest patch. S. floridanus and S. nuttallii are both close relatives, both are darker dorsally.

External measurements of two males and mean (and extreme) of nine females from Larimer County are: total length, 431, 448, 410.5 (392-438); length of tail, 44, 46, 46.8 (35-56); hindfoot, 86, 98, 89.9 (83-100); ear, 65, 75, 69.7 (59-88); weight, 1125, 985, 952.0 gr. (609-1139); greatest length of skull, 72.3, 68.6, 69.66 (67.9-74.1); zygomatic breadth, 34.8, 34.6, 35.23 (33.3-36.5).

Natural History.--The habitat of desert cottontails is low elevation deserts and semiarid grasslands. They prefer heavy brush and weedy field margins. These cottontails do not normally burrow as they prefer protection of thickets and rest in small, shallow, pear-shaped "forms". The animals avoid the hot sun and feed in early morning and evening. The species is active throughout the year and is generally solitary.

Grasses, forbs, and shrubs especially succulent terminal shoots, comrpise the diet of desert cottontails.

Breeding patterns vary greatly depending on the warmth of the climate. In Colorado, breeding can start as late as April and extend through August. Females may have between one and five litters per year with an average of three. Litter size is generally three to four; embryos are reabsorbed if the mother is frightened or if there are food shortages. The gestation period is 28 days. The young are very altricial and about 90 mm long at birth. Growth and development are very rapid, however, and the animals are able to reproduce at about 90 days of age. Cottontails in the wild usually live to be only about a year old.

Cottontails are common prey for many aerial and terestrial predators, such as hawks, large owls, coyotes, fox, badger, bobcats, large snakes, dogs, and cats. They also carry many parasites and are prone to rabies and tularemia. They are also hunted extensively by man. In Colorado, about 250,000 cottontails are harvested annually, of which some 2000 are taken in Boulder County.

Selected References.--Chapman and Willner (1978); Jones et al. (in press).

K. M. K.

SNOWSHOE HARE

Lepus americanus

Distribution.--The snowshoe hare is a species of boreal forests in the northern United States and Canada. In Colorado, the species lives throughout the Rockies in densely forested areas. It may occur in the highest parts of the Mountain Parks.

Description.--The snowshoe hare is between the cottontails and the jackrabbits in size. It has a dense pelage that is brownish in the summer and white in the winter, being various shades in between during the spring and fall. The complete color change of the snowshoe hare from summer to winter has puzzled many people. The fur begins changing in September and is completely white by December. This color change is stimulated by a decrease in daylength. It takes the molt 70-90 days, beginning with the ears, wrists, and feet, and then the lower legs, rump, and tail, and lastly the midline, shoulders, and crown, to change from brown to white.

Measurements for three males and two females from Grand County were: total length, 395, 464, 412, 425, 426; tail, 25.52, 41, 31.59; hindfoot, 140, 152, 138, 153, 150; ear, 67, 70, 65, 71, 65. The greatest length of skull is 70-80 mm.; the zygomatic breadth is 36 mm. (36-39 mm). There is no anterior projection on the supraorbital process of the snowshoe hare.

Natural History.--Snowshoe hares inhabit coniferous and deciduous forests. They are restricted in altitude only by tree line. They neither have burrows nor formal nests, but rest in forms on forest floor, cushioned by grass, leaves, and dust. The animals are nocturnal and feed upon woody plants, twigs, willows and aspen. Red fox, coyote, lynx, hawks, and great horned owls are common predators of the snowshoe hare. The snowshoe is not a territorial animal but does resist crowding, usually occupying 3 to 4 acres each. Populations fluctuates radically. Snowshoe hare populations tend to decrease and increase on a ten-year cycle, although that is not documented in Colorado.

Females usually bear two litters a year between the months of March and August. They birth an average of five young at a time and lactate between 8 and 30 days. The young are precocial, and there is little parental care. Survival of the young is 45 percent and their longevity is about 2 years.

Snowshoe hares are hunted for food and fur. Often, these hares girdle young trees while feeding and thus kill them, destroying young forests, and being a nuisance to humans. About 600 of the 13,400 snowshoe hares taken in Colorado in 1980 were killed in Boulder County.

Selected References.--Adams (1959) Bider (1961); Dolbeer and Clark (1975); Smith (1980).

A.E.D.

BLACK-TAILED JACKRABBIT

Lepus californicus

Distribution.--The black-tailed jackrabbit is a species of the Southwest and Mexico. In the past century it has expanded its range both northward and eastward in response to environmental change on the central Great Plains, occupying habitats once used by white-tailed jackrabbits. L. californicus occurs at elevations to about 7000 ft., including eastern Boulder County. The animals should be expected in grassy and brushy areas at lowest elevations on the Boulder Mountain Parks.

Description.--Large size, especially large feet and ears, distinguish this from local mammals other than the white-tailed jackrabbit, the tail of which has a grayish median stripe rather than a dense black dorsal patch. Upper parts are dappled brown. Hairs have gray bases and black tipes. The belly is gray. The huge ears have a buffy fringe and black tips. The pelage is similar winter and summer.

Two males and two females from Larimer County had the following measurements: total length, 490, 570, 459, 580; tail, 89, 79, 72, 65; hindfoot, 137, 123, 137, 130; ear, 119, 125, 110, 119; weight, --, 3445, 4996, 2395; greatest length of skull, 97.4, 97.7, --, 90.9; zygomatic breadth, 43.2, 43.3, 43.6, 43.7.

Natural History.--Black-tailed jackrabbits are animals of open country, grasslands, and shrublands. The animals do not burrow. By day they rest in a hollow "form" in the shade of a shrub. The ears act as radiators to dissipate excess heat. For defense, jackrabbits rely on their cryptic coloration and their great speed. In the open, they attain speeds in excess of 34 miles per hour, with single leaps longer than 3 m.

Diet varies with season. During the warmer months they eat tender grasses and forbs, including hay. During winter, the animals browse on shrubs. Often black-tailed jackrabbits are accused of degrading rangeland. It is true that the species often is found on poor ranges, but seldom are they the cause. It takes 60 to 100 jackrabbits to equal the grazing pressure of one steer. Jack rabbits do spread prickly-pear, by breaking up the pads and strewing them about, thus propagating them.

Breeding occurs throughout the warmer months, from late winter to early fall. Females are polyestrous and they are induced ovulators. The gestation period is six weeks. Typically a female bears one to four litters of one to eight young during a season. Jackrabbits are hares; hence, the young are precocial. They are born fully haired and open-eyed, eat solid food at 10 days of age, and reach 90 percent of adult size by ten weeks.

Jackrabbits are preyed upon by coyotes, owls, foxes, large snakes, and bobcats. They are susceptible to tick fever and tulariemia. In 1980, 121, 765 jackrabbits (of both species) were killed in Colorado as "varmints", of which 715 were taken in Boulder County.

Selected References.--Hansen and Flinders (1969); Lechleitner (1958); Tiemeier et al. (1965).

D.L.A.

WHITE-TAILED JACKRABBIT

Lepus townsendii

Distribution.--The white-tailed jackrabbit occurs in the northwestern United States, north of central California, and in southwestern Canada. Populations are also found in Nevada, New Mexico, Oklahoma, and southern Missouri. In Colorado it can be found on the eastern plains north of the Arkansas river and west to the Utah border including the San Luis Valley, but excluding the extreme southwest corner of the state. This once was the species of the grasslands of Boulder County, but they have mostly been replaced by black-tailed jackrabbits.

Description.--At higher altitudes the winter pelage of the white-tailed jackrabbit may be nearly white but in other areas of the state the October-November molt will produce a coat that is only slightly paler than the animal's grayish brown summer pelage. In all seasons the tail and rump remain white, which distinguishes this species from the black-tailed jackrabbit whose tail bears a prominent black dorsal stripe.

External measurements (averages and extremes) of males from Saguache County were: total length, 576 (514-645); hindfoot, 153 (140-163); ear, 115 (102-127); weight 1.4kg (1.0-1.8). Measurements of females were: total length, 602 (470-650); hindfoot, 156 (141-167); ear, 114 (99-123); weight, 1.7kg (1.3-2.2)

Natural History.--White-tailed jackrabbits in Colorado are found at elevations ranging from 1,500 m (5,000 ft) to 4,200 m (14,000 ft), an elevation well above timber line. The vegetation varies greatly over this large altitudinal range but, in general, white-tailed jackrabbits prefer open areas adjacent to dense cover. The animals prefer to feed on plants that are in pre-reproductive or early reproductive stages if available. During summer, grasses and forbs make up the majority of the diet but in winter shrubs will be predominant.

White-tailed jackrabbits are active throughout the year and, though mostly nocturnal, are particularly active during the early morning and evening hours. Amorphous fecal pellets are produced in the morning and reingested at that time. "Nuptial chases," in which groups of five and six males pursue a lone female in estrus, occur at night, however.

The breeding season lasts from March through August and the birth season from May through August. After a 42-day gestation period a litter of five is normally produced. In southern Colorado it appears there is but one litter produced per year per female but in other areas of the country as many as four litters may be produced
capacity for a post-partum estrus.

The fully-furred young are often born in burrows dug and abandoned by other animals. They average 88 g at birth but will attain adult weight in 110 days. Both males and females will begin breeding at one year of age.

Selected References.--Bear and Hansen (1966); Flinders and Hansen (1972, 1973); Hansen and Bear (1963); James and Seabloom (1969).

R.L.J.

LEAST CHIPMUNK

Eutamius minimus

Distribution.--The least chipmunk is a species of the western United States, ranging east to Wisconsin, Nebraska, Colorado, and New Mexico. In central Colorado, this is a species of the mountains, and the animals occur throughout much of the Boulder Mountain Park system.

Description.--A distinct pattern of four pale stripes and five blackish stripes, and two pale stripes on the face, characterize this animal. It is very difficult to distinguish this species from E. quadrivittatus or E. umbrinus in the field. Color and size, cranial details, and baculum are often good characters (depending on geographical location) to distinguish museum specimens.

Mean (and extreme) measurements of four females from Boulder County were: total length, 203.0 (200-208); tail, 86.0 (79-93); hind-foot, 31.7 (31-33); ear, 16.3 (15-18); weights range from 35 to 60 gr. Cranial measurements include: greatest length of skull, 32.20 (31.9-32.7); zygomatic breadth, 17.60 (17.2-17.9).

Natural History.--Least chipmunks are found almost anywhere but wholly open ground including sagebrush, pine and spruce forests, in brush along streams, and areas of brush and rocks. The animals use both ground and tree nests, and also may have underground burrows at the end of a somewhat intricate tunnel system. The chipmunk's peak activity is in the morning, only a few hours are spent above ground each day. There has been disagreement as to whether or not they hibernate during the colder months, but most probably go into torpor and remain underground most of the winter. Occasionally they surface to forage for food or to sun themselves.

Food consists of a variety of vegetation, with dandelions being the preferred source of food in west-central Colorado, and comprising over 80 percent of the diet during the summer. When readily available, fruits, nuts, berries, stems, seeds, and occasional insects are eaten.

Females are monoestrous, giving birth to five to eight altricial young. The chipmunk's breeding season is in late spring and early summer. By two weeks of age, the young are covered with a pale, silky fur, and the eyes are open. Based on tooth eruption patterns, ages are: juveniles, birth to 60 days; sudadults, 60-90 to 100 days; adult, older than 100 days. Longevity is unknown.

Coyotes prey upon chipmunks as do weasels and diurnal raptors. More study is needed on their ecology, as well as other aspects of their biology. Difficulties in identification have led to neglect of these conspicuous little squirrels.

Selected References.--Carleton (1966); Telleen (1976, 1978); Skryja (1974).

B.S.S.

COLORADO CHIPMUNK

Eutamias quadrivittatus

Distribution.--The Colorado chipmunk occurs in Colorado and neighboring parts of Utah, Arizona, New Mexico, and Oklahoma. In Colorado, it is found along the foothills, lower mountains and canyons of the Eastern Slope, north nearly to the Wyoming border as well as in the higher parts of Raton Section and on the Western Slope south of Gunnison River. Its elevational range is from 4200 to 10,500 ft.

Description.--Slightly stockier build and brighter color distinguish this chipmunk from the Uinta chipmunk and larger size distinguishes it it from the least chipmunk, but identification of chipmunks in the field is difficult. Indeed, they are quite difficult to distinguish even in the museum. The pelage of the adult is coarser than that of the young and the tail is bushier. The color pattern consists of blackish dorsal stripes with cinnamon to clay sides and a light drab crown. The head, rump, and sides are gray with an overwash of tawny on the sides, and the ears are blackish in front and white behind. The tail is tawny beneath, tipped with black, and bordered with white or pale tawny.

Average (and extreme) measurements of 13 males and of 12 females, all from near Canon City, were: total length 221.2 (215-229), 219.0 (200-228); length of tail, 99.8 (91-106), 98.2 (94-104); length of hindfoot, 32.9 (31-34), 33.2 (33-34); condylobasal length, 35.73 (35.5-36.1), 36.04 (35.5-36.7); zygomatic breadth, 19.35 (19.0-19.5), 19.61 (19.2-20.1).

Natural History.--The Colorado chipmunk inhabits areas of broken rock and open coniferous woodland, specifically ponderosa pine forests as well as brushy and rocky slopes, scrub-oak gulches, old burns, berry patches, and thickets of second growth. Home ranges cover 0.9 to 3.2 acres, with about six chipmunks inhabiting an acre. Burrows are excavated beneath rocks, shrubs, or exposed roots of trees and are often in open or brushy land away from forest shade. The animals do not actually hibernate, although they remain in burrows from mid-November to mid-February. They show short periods of torpidity alternating with consumption of stored food. The preferred diet is seeds and berries, but a variety of plant materials (including grains, nuts, tubers) and mushrooms are eaten, as well as insects.

In Colorado, mating occurs in late April through May. After a gestation period of 30 days, females give birth to an average of five young that weight 3 grams at birth and gain 0.5 m. per day for 3 months. The young are weaned at 6 to 7 weeks and reach reproductive capacity at 10-11 months. Females bear one litter annually.

This chipmunk is a nuisance when it interferes with reforestation. However, it has some positive value as a seed disperser, and--like other squirrels--they are interesting to people because they are so easily observed.

Selected References.--Armstrong (1982); Bailey (1932); Wadsworth (1969, 1972); White (1953).

C. S. S.

UINTA CHIPMUNK

Eutamias umbrinus

Distribution.--The Uinta chipmunk's distribution is poorly known because it is often confused with other Eutamias species. This species is found at high elevations in areas in California, Nevada, Idaho, Montana, Wyoming, and Colorado. In Colorado, they occur at high elevations in the central part of the state, south to Gunnison and Chaffee counties. They are to be expected at highest elevations in the Mountain Parks, especially atop Green Mountain or South Boulder Peak.

Description.--The head, rump and sides are gray. The sides are overwashed with dark brown stripes. The ears are blackish with white behind. The tail is tipped with black. This species is almost indistin uishable from quadrivittatus in the field. The Uinta chipmunk is a little smaller in size and somewhat darker in color. Details of skull and bacular morphology distinguish the animals in the museum.

Average ranges and of external measurements for 14 males from Boulder and Larimer counties were: total length 228.5 (215-235); length of tail, (88-110); hindfoot 33.8 (33-35); ear, 10.0 (16-19); weights range from 68 to 70 gr. Greatest length of skull ranges from 35.0 to 36.6 m (mean, 35.67); zygomatic breadth ranges from 18.6-19.3 (mean, 19.05).

Natural History.--The natural history of the Uinta chipmunk is almost entirely unknown, because of confusion in identification. It lives in the coniferous forest, and has an altitudinal range of 6500 to 12,000 ft. It is very likely that the Uinta chipmunk shares many characteristics with the Colorado chipmunk but further research will be needed to find out what these are.

Selected Reference.--Long and Cronkite (1970); Telleen (1978); White (1953).

T.T.W.

YELLOW-BELLIED MARMOT

Marmota flaviventris

Distribution.--The yellow-bellied marmot is widespread in western North America, extending north to southern Alberta, and south to the Great Basin. The species is usually found above 2770 meters (9000 ft.) elevation in the central and western parts of Colorado, and can be found in rocky, forest openings and alpine areas of Boulder County. The animals occur in the boulder fields below the Flatirons and live in the stone wall at the south end of the Mesa Trail.

Description.--The yellow-bellied marmot is the largest member of the squirrel family. It is recognized by a yellow-brown to tawny colored dorsum with white areas on the chin and sides of the mouth. The hazel-brown to buffy forefeet have four clawed digits. The skull is robust, the ears are stout, and the cheekpouches are very small. Juvenile marmots can be distinguished from pikas by their yellowish brown color and obvious tail.

External measurements of two males and three females from Gunnison County are: total length, 640, 654, 660, 620, 625; length of tail, 183, 175, 198, 177, 206; hindfoot, 89, 90, 80, 81, 80; condylobasal length of five females averaged 87.08 (83.5-89.2); zygomatic breadth, 57.98 (56.8-59.2); weights range from 2.5 to 5 kg.

Natural History.--Marmots typically inhabit rocky slopes near meadow vegetation. Being semi-fossorial, marmots burrow deep into hillsides. Winter is spent in hibernation when up to 50 percent of the summer body weight is lost. The availability of suitable burrowing sites may explain local marmot distribution.

In early spring, marmots emerge from burrows to mate and begin gaining fat as soon as forage is available. Daily activity includes mid-morning and late afternoon foraging, sunning, grooming, and long intervals in the burrow. After a 30-day gestation period, approximately five offspring (three to eight) are born. They are weaned in 20 to 30 days.

Marmots are often colonial, with single male, multi-female harems residing in favorable habitats. Adult males defend their territories by conspicuous tail flagging behavior and by scent marking with anal glands. All male yearlings disperse, often several miles from their home colony. Marmots seem to prefer seeds and flowering stalks but will eat the leaves of a variety of grasses and forbs. Marmots face many potential predators, including the coyote, badger, bobcat, eagle, hawk, owl, weasel, and marten. However, predation is a minor source of mortality, probably due to their system of alert and alarm calls. Although thousands of marmots (nearly 10,000 in 1980) are hunted for fur and fun each year in Colorado, they acclimate to humans.

Selected References.--Armitage (1975); Frase and Hoffmann (1980); Johns and Armitage (1979).

O.D.P.

WYOMING GROUND SQUIRREL

Spermophilus elegans

Distribution.--The Wyoming ground squirrel occurs in the grasslands of the northern Great Plains. It once was considered a subspecies of S. richardsonii. This species ranges from southern Canada southward through central Montana, southern Idaho, and northeastern Nevada and Utah. In Wyoming, Spermophilus elegans ranges statewide. It is spreading southward through Colorado, and occurs in mountainous parts of Boulder County. There are no records on the Boulder Mountain Parks but they are to be expected along the western edge. They do occur on Walker Ranch and along Magnolia Road.

Description.--The upper parts are drab or smoke gray dappled with cinnamon. The undersides are clay-colored, cinnamon-buff, brown, or ochraceous buff. The only similar squirrel in Boulder County is the smaller spotted ground squirrel of the plains.

Mean (and extreme external measurements of 10 females from Larimer County were: total length, 281.9 (260-302); tail, 76.8 (62-98); hindfoot, 42.3 (39-45); weights, 300 to 500 gr. Greatest length of skull in 11 females averaged 44.26 (42.3-46.6); zygomatic breadth, 29.0 (27.1-30.5).

Natural History.--The Wyoming ground squirrel lives in open country ranging in elevation from 6,000 to 12,000 feet in Colorado. They prefer sandy or gravelly ridges in open parklands or flats near streams and lakes.

Their burrows usually have several openings and are sometimes 50 feet long. The central cavity below frostline contains a nest chamber with a grass nest and is 6 to 9 in. in diameter. The Wyoming ground squirrel builds piles of debris downslope from the burrow entrance. These animals are strictly diurnal and hibernate from late summer (July or August) to late February.

The Wyoming ground squirrel prefers green vegetation. Their diet consists of young buds and tender sprouts of herbaceous plants in the spring, and insects, seeds of grasses, and leguminous plants latter in the year. They feed on carrion, including road-killed carcasses of their own species.

Females have one estrous cycle per year. They give birth to two to eleven young in May. The young are weaned at five weeks. Longevity is four to five years.

These ground squirrels live in colonies with densities of 20 to 50 animals per acre. Males establish territories during the mating season. Females also establish territories, which are around their burrows during gestation and lactation period. Members of the colony give off a very high-pitched, twittering call when alarmed. The badger is the primary predator. Other enemies include hawks, weasels, foxes, coyotes, bobcats, snakes, and ranchers armed with poison grain.

Selected References.--Fagerstone (1982); Pfeiffer (1980); Zegers (1977).

THIRTEEN-LINED GROUND SQUIRREL

Spermophilus tridecemlineatus

Distribution.--The thirteen-lined ground squirrel ranges from south-central Canada southward to Texas and from the Rocky Mountains to the northern Lake States. They occur throughout eastern Boulder County, extending in suitable habitat to the base of the foothills.

Description.--S. tridecemlineatus is similar in size to the sympatric spotted ground squirrel. The pelage is moderately bushy with a pattern consisting of a series of alternating brownish or blackish and light longitudinal stripes with a row of almost square white spots in each dark dorsal stripe.

Mean (and extreme) external measurements of eight males and of five females from Larimer County are: total length, 244.6 (212-260), 248.6 (228-260); tail, 84.2 (78-104), 89.2 (76-98); length hindfoot, 32.4 (30-35), 33.2 (31-35); weights of five males, 158.30 (125.0-193.5). Greatest length of skull of seven males, 40.33 (38.4-41.0), zygomatic breadth, 23.63 (23.0-24.1).

Natural History.--The thirteen-lined ground squirrel inhabits dry grasslands ranging from sea level to 2740 m. They prefer short grass such as grazed pastures, golf courses, and highway borders and commonly are found in farmland.

Home ranges of males are approximately 11.5 acres, largest during the breeding season. Home ranges of females are approximately 3.5 acres, largest during pregnancy and lactation. These animals are burrowers. Burrow openings are not marked by a mound of soil. Vocalization is a twittering or whistling alarm call.

Hibernation is preceeded by weight gain, aggressiveness, a reduction in home range and reduced activity. Males may enter hibernation in July, females in late July and early August, and most young by early September. Emergence occurs about mid-April, males emerging a week earlier than females. Periodic arousals, occurring every 10-26 days, interrupt hibernation. During summer the animals are diurnal and mostly solitary. Diet consists of insects and larvae, grass, seeds, and flower and fruit heads in summer.

In Colorado, mating occurs the first two weeks after emergence. After a 28-day gestation period, females bear an average of eight to ten young. The young are weaned at 28 days and reach reproductive capacity at nine months. Females bear one litter annually. Survivorship of young is 16 percent compared to 29 percent for adults. Longevity is 4 to 5 years.

Badgers, coyotes, skunks, foxes, weasels, hawks, and snakes are known to prey on these squirrels, which are beneficial economically due to their insect consumption and soil-building. However, they are also injurious to crops such as peas, beans, cucumbers, squash, wheat, and oats.

Selected References.--McCartey (1966); Streubel and Fitzgerald (1978b).

C.S.S.

SPOTTED GROUND SQUIRREL

Spermophilus spilosoma

Distribution.--The spotted ground squirrel is a species of semiarid grasslands, ranging from south-central South Dakota, south to central Mexico, and from western Nebraska, Oklahoma, and Texas westward to eastern Arizona, Colorado, and southeastern Wyoming. In Colorado, this squirrel is most abundant in the sand hills of the northeastern part of the state, and along the Arkansas River in the southeast. They once occurred in eastern Boulder County, and probably ranged to the base of the foothills.

Description.--This is small ground squirrel with cinnamon brown upper parts and white fur underneath, with white, non-linear, squarish dorsal spots and a black-tipped tail. It can be distinguished from the similar 13-lined ground squirrel because the latter has dorsal with longitudinal rows of spots.

Average (and extreme) external measurements of 11 males from Weld County were: total length, 232.6 (220-242); length of tail, 64.8 (50-75); hindfoot, 34.0 (30-37). Weights are 80 to 95. Greatest length of skull ranges from 39 to 43; zygomatic breadth from 22 to 24.

Natural History.--Spotted ground squirrels inhabit areas of deep sandy soils and sparse vegetation, either from natural factors or overgrazing. They are active burrowers, marking each entrance to their burrow by removing all loose soil and leaving hard soil behind.

The animals are active only about 95 to 135 days of the year. Males generally go into hibernation in late July, females and young in September, with all emerging from hibernation during April.

These squirrels are limited by air temperature (favorable being 19° to 34°C) and to a lesser extent, the amount of food in their stomach. They usually come out of burrow in morning after air temperature has reached 20°, and go in when it gets too hot or the appetite has been satisfied.

Food generally consists of seeds, green plant parts, and green grass shoots, although they have been known to feed on insect larvae, grasshoppers, and an occasional kangaroo rat or lizard.

Females bear five or eight young per litter, usually having one litter per season, but on occasion two. In Colorado, the average litter size is seven. The young receive care from the female until they are weaned between 28 to 31 days of age. Within 10 to 12 weeks, they have developed to adult size.

Bullsnakes, red-tailed hawsk, badgers, and coyotes are known to prey on these ground squirrels, as do cats, dogs, and men.

Selected References.--Struebel and Fitzgerald (1978a).

P.D.S.

ROCK SQUIRREL

Spermophilus variegatus

Distribution.--The rock squirrel is found from southern Mexico to northern Utah and Colorado and is locally abundant in rocky habitats. In Colorado it is found in Front Range canyons and quarries north to the Cache la Poudre drainage. In the course of this study the rock squirrel was observed in a wall at the south end of the Mesa Trail.

Description.--The rock squirrel is distinguished from other ground squirrels by its large size and long tail. The tail is not as bushy as the tail of a tree squirrel. The color is grayish black mixed with cinnamon brown, sometimes with the head and face blackish. There is a slightly mottled effect over the whole body.

Mean (and extreme) external measurements of five females from southern Colorado were: total length, 470 (440-498); length of tail, 197.2 (176-223); hindfoot, 59.2 (58-60); ear, 30 (29-31). Mean weight of females in Utah was 550 grams in the spring and 750 grams in the autumn. Greatest length of skull varies from 57.6 to 63.5 (mean, 60.56); zygomatic breadth varies from 35.6 to 39.1 (mean, 37.38).

Natural History.--The rock squirrel occurs over a remarkably wide climatic range. Everywhere it is found it is restricted to rocky habitat. nests are consctructed of dry leaves, grass, bark, and pine needles in burrows under rocks. The animals hibernate from one to six months per year, depending on elevation and food availability.

There are two breeding periods. In Utah average litter size was 6.1 (three to nine). Young emerge from the nest at about 56 days of age. Rock squirrels are not particularly social. There is no dominance heirarchy and communication is poorly developed. Mean home range is about 0.7 acres, larger for males than for females. Densities in Utah ranged from 2.3 per acre in spring to 6.1 per acre in fall.

Seeds, nuts, berries, insects, and carrion make up the diet. The squirrels are sometimes pests in orchards. Bobcats and badgers are known to prey on them. This is one of our least-studied ground squirrels. There have been no studies of the species in Colorado. Further study would be interesting, because the rock squirrel has traits not common in northern ground squirrels; such as two litters per year and short hibernation.

Selected References.--Johnson (1981); Juelson (1970); Steiner (1975).

J. I. K.

GOLDEN-MANTLED GROUND SQUIRREL

Spermophilus lateralis

Distribution.--The golden-mantled ground squirrel is a well known species in western areas where tourists visit. It occupies the Mountain West from central British Columbia and Alberta southward to Arizona and New Mexico and from California eastward to Colorado and Wyoming. In Colorado, this species is located in the western three-fifths of the state. It usually lives in open woodlands and forest-edge communities and rarely is seen in well developed forests. The animals occur throughout the Mountain Parks except at lowest elevations.

Description.--The golden-mantled ground squirrel is commonly mistaken for a large chipmunk. The two can be differentiated by the ground squirrel's larger size, shorter tail and most apparently the fact that the dorsal stripes run only from hip to shoulder rather than continuing onto the head. The golden-mantled ground squirrel has a soft golden to reddish buff pelage with a distinguishing golden "mantle" and dorsal stripes that run from shoulder to hip. The underside is a buffy brown to creamy white. In the late winter the pelage is grayer and the black stripes quite rust.

Mean (and extreme) measurements of five males and of eight females, from Larimer and Boulder Counties are: total length, 275.4 (269-294), 272.4 (246-285); length of tail, 96.2 (88-111), 88.0 (74-97); hindfoot, 41.2 (40-43), 41.6 (38-44); ear, 19.8 (16-22), 20.7 (18-23); weights range from 175 to 300 gr. Condylobasal length of five males was 43.58 (43.2-44.8), and that of nine females was 43.53 (42.8-44.1); zygomatic breadth was 27.04 (26.3-27.6), 26.99 (25.8-27.9).

Natural History.--The golden-mantled ground squirrel follows a bimodal daily activity pattern of foraging most commonly in the early morning, and then again in the late afternoon; however, it is more than happy to change these habits if tourists are available. If they are not, this ground squirrel is content to feed upon sagebrush leaves, dandelions, asters, and a variety of seeds and insects. June through September the bulk of their diet consists of dandelion stems.

Between late October and early May the golden-mantled ground squirrel hibernates. It arouses every 10-14 days to eat. During September is acculates fat around the shoulders to use while torpid. They generally burrow between rocks leaving little debris and concealing themselves well. The steep entrance leads to a maze of tunnels ending with a nest of aspen leaves, pine needles, kinnikinnick, which harbors many ectoparasites. There they give birth to a single litter of young per year. Litters range from three to eight.

The golden-mantled ground squirrel is preyed upon by raptors, weasels, and automobiles. Little is known of their behavior in natural settings. Their friendly, pestering response to people makes them difficult to study objectively.

Selected References.--Carleton (1966); Hatt (1927); McKeever (1964).

K. A. C.

BLACK-TAILED PRAIRIE DOG

Cynomys ludovicianus

Distribution.--An early traveler through Texas reported seeing 400 million prairie dogs in a town that covered 25 thousand acres. Though their numbers have decreased, prairie dogs still inhabit much of the western Great Plains. They range from the Rockies eastward to the Dakotas, central Kansas and Nebraska, and parts of Texas and Oklahoma. They are found across the plains of eastern Colorado, in places extending into lower, open areas of the foothills, such as the swale behind Red Rocks, above Settlers' Park.

Description.--Prairie dogs are medium-sized ground squirrel with short tails, short legs, and small ears. They have a larger body and shorter tail than the rock squirrel. The body is tan or yellowish above, whitish below. Mean (and extreme) size of 10 males and of eight females, from Larimer County are: total length, 378.7 (358-400), 371.4 (340-400); length of tail, 82.2 (71-95), 75.0 (60-84); hindfoot, 60.5 (57-63), 61.0 (55-63); ear, 14.2 (12-17), 14.5 (11-18); greatest length of skull, 64.02 (62.0-67.8), 63.09 (60.5-66.0); zygomatic breadth, 45.20 (43.6-48.5), 44.71 (42.6-48.0); weights range from 500 to 1000 gr.

Natural History.--Sitting erect atop earthen mounds, barking shrilly, these rodents are a common sight in mixed-grass prairie country. Mounds mark the entrances to complex burrow systems. They are constructed such that a convection current circulates air through the burrows. They also provide a vantage point from which to watch for predators such as coyotes, foxes, badgers and hawks. Different two-syllable calls convey different messages.

Social organization has been studied extensively. Towns are divided into smaller "wards" by geographic features and these are composed of several "coteries" or territories. A "coterie" usually consists of one or two adult males and two to eight females and young.

Prairie dogs feed on the "best of the season." In spring and summer they eat seeds, leaves, and stolons of grasses and forbs. In fall and winter, dried forbs, roots and occasional insects make up the diet. Grazing changes the plant community from perennials to the more productive annuals favored by prairie dogs. Once this grazing was by bison; now it is by cattle. Prairie dogs are more symptom than cause of overgrazing.

Active during the day, this species may reduce its activities during cold weather, but does not actually hibernate in our area. In March or April they give birth to two to eight young. In the seventh or eighth week they are weaned and come above ground. By their first winter, young will be almost full grown, and reproduce as yearlings. Average longevity is three years.

Selected References.--King (1955); Koford (1958); Lechleitner (1969) Smith (1967).

L. A. M.

FOX SQUIRREL

Sciurus niger

Distribution.--The fox squirrel is an inhabitant of the eastern, broad-leafed, deciduous forest of North America. It is absent in New England and much of the Northern Great lakes region. It ranges westward following riparian forest and woodland. In the early 20th century, it was introduced to the north and west of its natural distribution; more recently, it has reached our region by natural expansion. In Colorado, it occurs primarily in the South Platte and Republican drainages. The species is common in Boulder and ranges into lower foothills canyons, where it is sympatric with two other sciurids, the chickaree and Abert's Squirrel.

Description.--Large size, long and bushy tail and prominent ears without tufts distinguish the fox squirrel from the pine squirrel or chickaree. Fox squirrels are smaller than Abert's squirrels and the dorsal fur is tawny brown, grizzled with gray, rather than gray, black or brown. The undersides are pale to bright rufous or yellowish brown sometimes even white.

Measurements (mean and extremes) of eight males, and of ten females, from northeastern Colorado are: total length, 502.0 (462-576), 500.2 (470-537); tail, 222.1 (172-244), 232.8 (196-293); hindfoot, 66.0 (60-69), 63.4 (50-73); ear, 26.2 (19-33), 25.2 (20-31); greatest length of skull, 62.78 (61.1-65.5), 61.76 (59.5-65.5); zygomatic breadth, 35.31 (34.3-36.4), 35.34 (33.6-37.2).

Natural History.--The fox squirrel is found mostly in riparian communities along water courses and also in urban plantings. Typical habitat is cottonwoods, ash, elm, and box elder trees. Fox squirrels build leaf nests or have tree dens. They tend to have elliptical home ranges that are three-dimensional. The home range area is determined by habitat quality and size of seasonal food crop. For adult males the home range area is about 7.6 hectares.

The diet consists of nuts and seeds. In the spring they feed on the buds of trees and shrubs, flowers, tubers, bulbs, roots, arthropods and bird eggs, and summer on fruits, berries, and seeds.

Fox squirrels are active at three peak periods, several hours after sunrise, around noon, and just before sunset. In cold seasons late afternoon activity is minimal, as is midday activity in hot seasons.

Reproduction in females is seen at 10 months. It occurs in two peak seasons, December and January and April to June. The gestation period is about 45 days. They average two litters of about three young per year. The young are altricial and are weaned at week 10. Longevity is 4 to 7 years. Fox squirrels are preyed upon by coyotes, red foxes, bobcats, raccoons, weasels, hawks, owls, and housecats. In Colorado, they are a game species. Some 2800 were harvested in 1980, 66 of them from Boulder County.

Selected References.--Hoover and Yeager (1953); Jones et al. (in press); Longley (1963).

J. L. L.

ABERT'S SQUIRREL

Sciurus aberti

Distribution.--Abert's squirrel occurs in ponderosa pine communities of southwestern United States and northern Mexico. In Colorado, two populations exist, one along the Front Range, the other in the San Juans. They are to be seen throughout the Boulder Mountain Parks.

Description.--This is a large, attractive squirrel, not easily confused with other species because of the prominent tufts on the large, broad ears. The upperparts, including the top of the tail, are steel gray. The underparts are much paler, usually white, with a distinct black lateral line separating dorsum and ventrum. Two other color phases are present in Colorado, pure black, and brown.

Males and females are not significantly different in size. External measurements of a male and female are: total length, 572, 523; tail, 292, 240; hindfoot 70, 71; ear (without tuft), 37, 45; weights range from 500 to 750 gr.; greatest length of skull is 57 to 61, zygomatic breadth, 34 to 36.

Natural History.--This species lives in close association with ponderosa pine, on which it depends for food and shelter. They are strictly diurnal, and may be detected by a barking noise made when alarmed or in aggressive situations. Unlike many tree squirrels, they do not cache food and thus remain quite active through the winter. Nests of pine twigs are built 9 to 15 m. above the ground. They are round, 0.3 to 1 m. in outside diameter. They are lined with grass or other soft matter.

The diet consists of cones, inner bark, buds, and young cones of ponderosa pine, as well as carrion, fungi, and other vegetable matter. Cones are the primary summer food. Abert's squirrel shows wide fluctuations in abundance, perhaps related to reproductive output of pines.

Abert's Squirrels are semi-solitary most of the year, grouping only in the early spring for "mating bouts," in which males compete for females. Females bear one, possibly more, litters annually, giving birth to litters of two to five young from April to August. The young are weaned at ten weeks. Longevity is unknown.

Selected References.--Farentinos (1974); Hall (1981); Hoffmeister and Diersing (1978); Keith (1965); Nash and Seaman (1977).

H.E.B., Jr.

PINE SQUIRREL, OR CHICKAREE

Tamiasciurus hudsonicus

Distribution.--The pine squirrel is a species of coniferous forests, ranging throughout much of Canada and Alaska, the Rocky Mountain states, and the northeastern United States, southward along the Appalachians. In Colorado, the species occurs in the mountains, high plateaus, and mesas of the western part of the state, including the Boulder Mountain Parks.

Description.--*T. hudsonicus* is the smallest tree squirrel in its range. It is rust to grayish-red above and white below. The tail is outlined with a broad black band edged with white and there is a prominent white eyering.

Average (and extreme) external measurements of 13 males and 12 females from Lake and Chaffee counties are: total length, 320.0 (302-343), 319.9 (300-352); length of tail, 125.2 (116-135), 124.1 (117-132); hindfoot, 49.2 (46-51), 48.9 (46-52); ear, 24.6 (19-27), 25.3 (21-29); weights, 227.8 (202.5-252.0), 222.7 (193.7-238.6) gr.; greatest length of skull, 47.09 (46.0-48.1), 46.93 (46.1-47.8).

Natural History.--The pine squirrel inhabits denser forests of cooler zones and is restricted only by availability of food and nesting sites. They have been observed at elevations of 12,000 ft. A certain sign of their presence is middens (or caches) of cones and cone remnants. Nests are built in trees out of grass and shredded bark. Pine squirrels move about on the ground and may burrow a little in earth or snow. They are active morning and evening. They do not hibernate, and are solitary.

Food consists mainly of tree seeds, although some dry and cache fungi. Seeds of spruce and lodgepole pine make up the bulk of the diet.

Females bear a single litter each year, with two to five young born after a gestation period of 40 days in early to mid-summer. The female alone cares for the young; lactation lasts seven weeks. Longevity is 5 to 9 years.

T. hudsonicus has few competitors, although deer mice and red-backed voles may raid their cone caches. They harbor fleas and ticks and they are potential prey for a number of carnivores, especially pine martens, hawks, and owls.

A general survey of the biology of the pine squirrel in the Boulder Mountain Parks would be of interest. The area may be unique in supporting sympatric populations of three species of tree squirrels: Abert's squirrel, the fox squirrel, and the chickaree.

Selected References.--Dolbeer (1973); Finley (1969); Smith (1978).

K. L. S.

NORTHERN POCKET GOPHER

Thomomys talpoides

Distribution.—The northern pocket gopher is a mammal of western North America, ranging from New Mexico northward to central Canada. Mostly it occurs in mountainous areas; other kinds of pocket gophers occupy adjacent valleys and plains. However, the northern pocket gopher occurs away from the mountains in Boulder County, at Rocky Flats, for example, and near Eldorado Springs. Sign of these animals is abundant in suitable habitat throughout the study area.

Description.—These are relatively small pocket gophers, being adapted to rough upland soils. In our area, the animals are dark in color, deep brown washed with blackish; often there are small white spots about the head. The tail is nearly naked, brownish to silvery gray. With their short ears, short tail, external fur-lined cheek pouches, tiny eyes, and fossorial habit, these animals can be confused with no other local mammals except plains pocket gophers, which are larger in size and occupy mostly irrigated agricultural lands on the plains.

Mean (and extreme) external measurements of 25 males, followed by those of 21 females, all from northern Larimer County, are: total length, 226.9 (211-244), 228.7 (210-255); length of tail, 69.6 (58-79), 68.3 (60-83); length of hindfoot, 28.7 (27-31), 28.7 (26-31); length of ear, about 7 mm; weights range from 110 to 150 gr.; condylobasal length of those animals was 39.62 (37.1-42.2), 38.32 (36.7-40.7); zygomatic breadth was 23.72 (21.7-25.1), 22.91 (21.4-24.5).

Natural History.--Northern pocket gophers are strongly fossorial, coming to the surface only rarely to forage. Mostly, they meet all of their needs below ground, feeding on roots and tubers of a wide variety of plants, including forbs, grasses, and shrubs. Burrow systems may be 150 to 200 m in length, with several entrances (actually exits for excess soil) which typically are plugged. The burrow system may represent the movement of three tons of soil. Side tunnels are used as storerooms or latrines. The animals are active year round and evidence of their winter activity is in the form of ridges of earth ("gopher eskers") festooning the vegetation of mountain meadows and woodlands. Those ribbons of soil actually represent the contents of tunnels in snow. The tunnels are filled with excess soil and as the snow melts, the eskers are left behind.

Pocket gophers may be serious pests on rangelands or about irrigated fields, because their burrows can injure livestock or damage ditchworks. However, they are very important agents in the soil-forming process, aerating the soil and mixing it with organic matter.

Predators of pocket gophers include badgers, snakes, coyotes, and weasels. Owls take a few pocket gophers as well, particularly young that are dispersing above ground. The breeding season is in April or May and three to 10 (mean four to six) young are born after a gestation period of about 19 days.

Selected References.--Hansen (1960); Hansen and Ward (1966).

D.M.A.

PLAINS POCKET GOPHER

Geomys bursarius

Distribution.--The plains pocket gopher occurs from Central Alberta to Panama. In Colorado it is found from the foothills eastward. It has not been documented in the Boulder Park system; the southeastern corner is the most likely place for them.

Description.--The pelage usually resembles the color of the soil in which the pocker gopher lives. Bodies are thick-set and stout, with little suggestion of a neck. Eyes are small and ears inconspicuous. Two external, fur-lined cheekpouches give the pocket gopher its name. Geomys is distinguishable from Thomomys because it has longitudinal grooves on its incisors.

Mean (and extreme) external measurements of five females from Adams County are: total length, 243.0 (233-253); tail, 77.8 (74-81); hindfoot, 31.1 (30-33); weight, 181.16 (177.0-188.3); condylobasal length 41.48 (41.1-42.1), zygomatic breadth, 26.10 (25.4-26.7). Males are about 10 percent larger.

Natural History.--The plains pocket gopher builds extensive burrow systems consisting of two sets of tunnels. The superficial network of feeding tunnels connects with a deeper system used for nesting and storage. The burrows provide refuge for a variety of other mammals and invertebrates. The plains pocket gopher is not responsible for the extensive range damage caused by the northern pocket gopher, and it does not form the "eskers" of soil so typical of the latter species.

During spring and summer 57 percent of the diet consists of just four plants; Bouteloua gracilis, stipa comata, Agropyron smithii and Opuntia humifusa. In the colder months they are content to eat forbs.

G. bursarius does not hibernate, but is active all through the winter. Solitary save during the breeding season, April to June, they have a single annual litter, numbering one to eight. The Young leave the nest when two months old and begin to establish their own burrows. Gophers are fed upon by weasels, skunks, coyotes, gopher snakes, barn owls, hawks, and succumb to farmers' poisons and traps.

Selected References.--Downhower and Hall (1966); Miller (1964); Vaughan (1961, 1966).

K. A. C.

OLIVE-BACKED POCKET MOUSE

Perognathus fasciatus

Distribution.—The olive-backed pocket mouse ranges from Alberta, Saskatchewan, and Manitoba southward into the Wyoming Basin, northeastern Utah and northwestern Colorado. It also occurs in northwestern Nebraska and most of North and South Dakota. In Colorado, it is found along the piedmont grassland east of the Rocky Mountains. It is documented from Larimer, Weld, and Jefferson counties, and should be found in Boulder County in suitable habitat.

Description.--The species is buffy above with a pure white belly and a distinctive yellowish buff lateral line. *P. fasciatus* is sympatric with *P. flavescens*, *P. flavus*, and *P. hispidus*, over a large part of its range. It is discriminated from *P. flavescens* by a mid-dorsal band of black and olivaceous hairs and a lower premolar nearly as large as the first molar. *P. flavus* is smaller, with longer fur and buffy spots behind the ears; *P. hispidus* is set apart by its large size and harsh pelage.

Mean (and extreme) measurements of four males from Larimer County were: total length, 129.5 (128-131); tail, 60.0 (59-61); hindfoot, 17.2 (17-18); occipitonasal length, 21.55 (21.1-21.9); zygomatic breadth, 12.00 (11.8-12.3).

Natural History.--The olive-backed pocket mouse is often found on sandy soils with good plant cover. It inhabits grasslands and grazing lands of *Bouteloua*, *Stipa*, wildrose and sagebrush thickets, alfalfa and grain fields, and patches of cactus and yucca among pines. The animals are active burrowers. Entrances are plugged by day. The animals are nocturnal and active throughout the year.

Diet has not been detailed in Colorado. Seeds of weedy annuals are typical far on the Northern Great Plains. Insects may be exploited at times.

Pregnant females have been reported from mid-May to July. One, and possible two, litters occur per season, with four or five young each. Gestation takes four weeks; there is no record of rates of growth. Predators are poorly known, although owls must be important among them. Population status in Colorado is unknown.

There is some suggestion that the olive-backed pocket mouse along the Front Range represents a relict population. Its habitat is under intense development pressure. The grasslands along the eastern edge of the Boulder Mountain Parks could prove to be an excellent place to gain some insight into the biology of this poorly known species.

Selected References.--Armstrong *et al.* (1973); Genoways and Jones (1972); Jones *et al.* (in press); Williams and Genoways (1979).

D.J.A.

PLAINS POCKET MOUSE

Perognathus flavescens

Distribution.--As the common name suggests, this is a mammal of the Great Plains, ranging from northern Texas to North Dakota and from the Mississippi River to the base of the Rockies. Some authors consider this species to be the same as *Perognathus apache*, in which case the range would also encompass the Colorado Plateau. In the U. S. National Museum is a specimen from Boulder. Despite habitat disturbance, the plains pocket mouse could occur at the extreme southeast margin of the Mountain Parks, and is likely on open lands farther east in the county.

Description.--This is a tiny mouse, about the size of the harvest mice but with the external, fur-lined cheekpouches typical of the heteromyid rodents. The plains pocket mouse is slightly larger than the silky pocket mouse and is distinctly less furry. It is smaller and paler in color than the olive-backed pocket mouse. The color is grayish buff above and white below.

Mean (and extreme) measurements of four males from northeastern Colorado included: total length, 125.8 (123-132); tail, 56.5 (52-61); hindfoot, 17.5 (16-19); ear, 16.4 (14-18); weight, 10.83 (10.0-12.0); greatest length of skull, 21.40 (21.0-21.8); zygomatic breadth, 11.35 (11.1-11.6).

Natural History.--Plains pocket mice occur on sandy soils with vegetation of bunchgrasses, often with sage, yucca, and pricklypear. Probably they once were part of the mammalian community on areas of succession that followed disturbance by bison. Now they often occur in grainfields, especially along blowouts.

The animals burrow extensively, plugging entrances during the day. There are separate nest, pantry, and latrine chambers. Small seeds, the principal foodstuff, are stored for winter. (Pocket mice do not hibernate). During summer some insects are eaten. They seldom drink, for they are able to derive water metabolically from fats in the diet.

Females probably are polyestrous, reproducing throughout the warmer months, from May to August. Litter size is about four, which are born after a gestation period of about three weeks.

Probably any small predator will take pocket mice as opportunity allows, but owls may be the major hazard. Average longevity may be as short as two months in the field, although animals have lived as long as six years in captivity.

Selected References.--Beer (1961); Jones *et al.* (in press).

D.L.A.

SILKY POCKET MOUSE

Perognathus flavus

Distribution.--The silky pocket mouse is found in the sandy soils of the plains. It ranges from southeastern Wyoming through eastern Colorado southward to central Mexico. Perognathus flavus was not captured in the Boulder Mountain Parks, but should be expected in suitable habitat along the eastern boundary.

Description.--The upper parts are usually pale yellow, faintly to heavily sprinkled with black hairs. Juvenile pelage is dull gray, soft, and thin. The tail is slightly shorter than the total length. There are yellow postauricular patches and external fur-lined cheek pouches.

Mean (and extreme) measurements of five females from near Canon City are: total length, 100.4 (97-104); tail, 44.8 (41-49); hindfoot, 15.2 (12-17); occipitenasal length, 21.00 (20.8-21.3); zygomatic breadth, 10.10 (9.8-10.4).

Natural History.--The silky pocket mouse is found in shortgrass prairies, and ranges in elevation of 4,000-8,000 ft. on sandy or occasionally rocky soils. They dig complex tunnel systems into the sandy soil at the base of rocks, Yucca, Opuntia, or low shrubs. The hole reaches a depth of about 12 in. ending with a small chamber 1 by 2 in. where grass seeds are stored. The species is usually nocturanl, but it has been caught during the daytime. They are inactive on damp or rainy nights. They do not hibernate but do store seeds for winter. The home range is 0.6 to 1.6 acres; individuals home ranges overlap broadly.

Their food is almost exclusively seeds; only the inner part (endosperm) is eaten. Sunflower seeds are preferred. Russian thistle, lambquarters, fescue, Cryptantha, Amaranthus, prickly pear, ricegrass, and globe mallow also are eaten.

Females are polyestrous. They breed twice a year during the warmer months, usually April through June. The gestation period is four weeks, after which they birth from two to six altricial young. In captivity, the silky pocket mouse has lived for five years.

Owls and other nocturnal predators prey on these pocket mice. Much more research needs to be done on natural history aspects like reproduction, behavior, and ecological role.

Selected References.--Findley et al. (1975); Armstrong (1982); Jones et al. (in press).

S. C. W.

HISPID POCKET MOUSE

Perognathus hispidus

Distribution.--The hispid pocket mouse is a species of the Great Plains, ranging from southern North Dakota southward to central Mexico and from the Missouri River to the Rockies. In Colorado, the species occurs throughout the eastern plains, including eastern Boulder County. During the course of the present study, the species was captured on piedmont grassland at the south end of Mesa Trail.

Description.--Large size and spiny, harsh fur distinguish this from other pocket mice, and external, fur-lined cheek pouches, grooved incisors, and short ears distinguish it from the deer mouse, the only large-sized, long-tailed mouse with which it is sympatric. The animals are buffy above, white below, and have a fairly prominent yellowish lateral line.

External measurements of two females from Larimer County were: total length, 200, 220 mm.; tail, 98, 108; hindfoot, 25, 27; ear, 9, 8; weight, 39.1, 43.0 gr. Greatest length of skull ranges from about 30 to 35 mm., zygomatic breadth is 15 to 18.

Natural History.--Hispid pocket mice inhabit semi-arid grasslands. They are less restricted to areas of sandy soil than some other pocket mice are, and often they are found in areas of gravelly or rocky loam, typically with vegetation of bunchgrasses, low shrubs, yucca, and cacti. The animals are active burrowers. Burrows may have two or three entrances, which may be marked with small mounds of earth, rather like those of pocket gophers but smaller. They also may burrow into roadcuts, cutbanks, or beneath shrubs, as kangaroo rats do. Burrows are plugged during the day. The animals are nocturnal and active throughout the year. Mostly they are solitary.

Food consists almost entirely of seeds, including those of grasses, forbs, and shrubs. Diets in Colorado have not been detailed, but in West Texas, seeds of sunflower, sagebrush, cacti, Gaillardia, and bluestem were prominent in the diet, along with cultivated grains (sorghum, millet). Some insects were eaten, especially in spring.

Females bear two or more litters of young annually, giving birth to litters of two to nine young from April or May to September. The young are altricial, but development has not been studied, and longevity is unknown.

Owls are known to prey on these pocket mice, and other prairie predators do as well. No studies of the population ecology of this species have been done; indeed, its biology generally is poorly known.

Selected References.--Alcoze and Zimmerman (1973); Jones et al. (in press); Maxell and Brown (1968); Turner (1974).

D.M.A.

ORD'S KANGAROO RAT

Dipodomys ordii

Distribution.--Ord's kangaroo rat ranges over most of the western United States, parts of southern Canada and much of northern and central Mexico. It is found in arid and semi-arid areas at lower elevations in Colorado. The animals' local distribution is unknown, but they are to be expected on sandy, blown-out sites adjacent to the foothills.

Description.--Ord's kangaroo rat has a mouselike body adapted for richocetal locomotion, with greatly enlarged hind legs and feet and a long tufted tail. it can be confused with no other local species of rodent. The jumping mouse (genus Zapus) have no external fur-lined cheekpouches and they are less completely bipedal. Pocket mice (Perognathus) are quadrupedal and smaller in size.

Mean (and extreme) measurements of six males and of four females from eastern Colorado are: total length, 267.3 (256-289), 271.2 (263-283); tail, 149.3 (141-152), 151.2 (143-156); hindfoot, 41.7 (40-43), 41.5 (41-42); ear, 14.5 (13-15), 15.2 (14-16); greatest length of skull, 39.40 (38.6-40.7), 40.10 (38.1-41.9); breadth of skull, 21.20 (20.0-22.7), 21.88 (21.6-22.5). Weights range from 65 to 85 gr.

Natural History.--Ord's kangaroo rat shows a strong predilection for areas of sandy soils. Sand bars and sandy banks of ephemeral streams seem to be optimal. The animals often are present in large numbers in such areas. The vegetation typically is open shrub or grassland. Dense grass may hinder movement. Burrows are mounds of sand or fine soil and have a number of entrances. The species is active all year and is nocturnal.

In a Colorado shortgrass prairie, the species was found to be primarily herbivorous with seeds being the major dietary component. They tend to specialize in larger seeds, like sunflowers. Succulent leaves of grasses, forbs and shrubs and a few arthropods were also eaten. The animal is known to store seeds.

Two litters per year are possible with two to four young in each litter. The young are born from March to September in northeastern Colorado. Virtually nothing is known about growth and development. Coyotes and raptors are the primary predators of this rodent.

Selected References.--Flake (1973) (1974), O'Farrell (1980); Setzer (1949).

S.M.A.

BEAVER

Castor canadensis

Distribution -- The beaver occurs throughout North America except in the Arctic tundra, peninsular Florida, and the southwestern deserts. It lives wherever there are streams, ponds, or lakes.

Description -- The beaver has a thick-set body with short legs, webbed hind feet, and a flat, scaled, hairless tail. Its lips close behind its incisors. It is brownish in color although many beavers are shaded black, reddish or yellow. The outer pelage guard hairs are coarse and dense.

External measurements are: total length ranges from 950 to 1,200; tail, 280 to 300; hindfoot, 155 to 180; length of ear, 25-35; condylobasal length is 120 to 135; and zygomatic breadth is 90 to 100. Beavers can weigh up to 60 lbs.

Natural History -- The beaver is a semi-aquatic animal, always living where there is water. It makes its home either in holes in the bank of a pond or a stream or in a lodge built of sticks and mud. Often, beavers build dams with mud and sticks which increase the water level and allow ice-free passage in winter. These lodges usually have one or more underwater entrances. Beavers live in colonies of four to eight related individuals; the rule-of-thumb is that an active colony represents an average of five individuals.

Food consists of bark, cambium, leaves and twigs of woody plants; aspen and willow seem to be the preferred diet. Beavers can digest cellulose with 30% efficiency, with the aid of a symbiotic microbial flora.

The females first reproduce at 1½ years of age. They give birth to 1 litter per year; gestation is 107 days. The young are born in May or June and parents often give care for two years. Lactation is a minimal 90 days.

The beaver communicates through vocalization, posture, tail slapping, and scent mounding, although tail slapping is its most common response to danger. Predators are wolves, coyotes, wolverines, bears, minks, and humans, who hunt this animal as food, fur, and pest.

Beaver dams can cause floods, change soil composition, affect succession, and affect fish populations.

Selected References -- Jenkins and Busher (1979).

A.E.D.

PLAINS HARVEST MOUSE

Reithrodontomys montanus

Distribution--The plains harvest mouse is a species of the central and southern Great Plains. It occurs from the Missouri River westward to the Rockies and from western South Dakota southward to northern Mexico. In Colorado, the species is found in the plains of the eastern two-fifths of the state, probably including eastern Boulder County. The animals may be expected to the base of the foothills.

Description--This small, slender mouse with the tail about as long as the body without the head has a well-defined dark-colored medial stripe on the dorsum. The dorsal stripe of the bicolored tail is narrow, less than a quarter of the diameter of the tail. A deep, longitudinal groove in the front of the upper incisors distinguishes Reithrodontomys from the deer mice. The animals are brown and pale yellowish gray above. Outsides of the ears and flanks are pale yellowish brown without any rufous hairs. The mice are dull white below.

External measurements of four males from eastern Colorado were: total length, 136, 132, 127, 128; tail, 67, 59, 53, 62; hindfoot, 16, 17, 15, 16; ear, 14, 13, 12, 15; weights, 11.2, 12.9, 10.6, --; greatest length of the skull, 20.8, 20.6, 19.9, 19.8; zygomatic breadth, 10.9, 10.9, 10.7, 10.6.

Natural History--The plains harvest mouse inhabits semi-arid grasslands, typically with well developed cover and less than 50 percent bare soil. Often they are found in upland areas and stony pasturelands; many times nests are built beneath rocks. Often the vegetation of the habitat is weedy with patches of pricklypear cactus. Their home range has been measured as about a half acre. They are active at all times of the year and are nocturnal.

Their food consists almost entirely of seeds, but diet has not been studied in detail.

Females can reproduce at 12 weeks of age. They bear from two to five litters per season. The gestation period is 21 or 22 days with a litter size of two to five young. The young are altricial and need much care until about day 14 when they are weaned.

No studies of predation have been done, but one could hypothesize that they are vulnerable to common prairie predators. The biology of the plains harvest mouse is not well known and is in need of study.

Selected References--Hill and Hibbard (1943); Jones et al. (in press); Leraas (1938).

J.L.L.

WESTERN HARVEST MOUSE

Reithrodontomys megalotis

Distribution--The western harvest mouse has a wide distribution, from California to recently invaded Indiana. The species occurs at lower elevations throughout Colorado, on both sides of the Divide. It occurs in suitable habitat throughout the Boulder Mountain Parks; museum specimens are available from Gregory Canyon.

Description--Harvest mice are distinguished from other mice by the presence of grooved upper incisors. The animals are buffy above and vary from dark buff to white beneath, with prominent ears and a tail that is as long as the head and body. They are distinguished from the plains harvest mice by their externally larger size, a wider dorsal caudal stripe, and larger cranial size.

Mean (and extreme) measurements of nine males and five females, respectively, from the Big Thompson and South Platte river valleys were: total length, 139.5 (136-143),144.8 (141-152); tail, 66.7 (63-70), 70.2 (65-74); hindfoot, 17.7 (17-21), 16.5 (16-17); ear, 15.0 (13-17), 14.4 (13-16); weight, 14.19 (12.9-15.9), 16.08 (12-21); greatest length of skull, 21.96 (21.7-22.5), 21.73 (21.1-22.4); zygomatic breadth, 10.89 (10.7-11.1), 10.92 (10.7-11.2).

Natural History--Harvest mice are commonly associated with tall vegetation and are very resilient to perturbation of their habitat. They are found in rank vegetation of flood plains in disturbed situations. They were found to be the most abundant small mammals in ungrazed sand sage, grazed riparian, and ungrazed riparian ecosystems in revegetated agricultural land in eastern Colorado. The animals build grass nests, with one or more openings near the base on the surface of the ground, in holes, on grass stems, or in small shrubs.

The diet consists of seeds, green plant parts, and some insects. The animals are nocturnal and active year round. There are spring and autumn molts.

Females are polyestrous, with occasional postpartum estrus known. Reproductive activity commences in early spring and extends to late autumn, with reduced activity during mid-summer. There are one to seven young per litter, and there have been several litters per year when bred in captivity. The young are altricial, and are weaned at 24 days. The animals live about one year.

Owls, foxes, weasels, hawks, jays, skunks, and badgers are known to prey upon harvest mice. They have numerous parasites, including ticks, mites, chiggers, lice, and fleas. The animals are commonly associated with the house mouse, the meadow vole, and the prairie vole.

Selected References--Webster and Jones (1982).

B.S.S.

DEER MOUSE

Peromyscus maniculatus

Distribution-- The deer mouse ranges across most of North America. In Colorado, the species occurs statewide. This is doubtless the most abundant mammalian species in the Boulder ountain arks. In live trapping studies, it was taken at all localities.

Description--Medium in size, short ears and short tail distinguish the deer mouse from the rock mouse. Smooth incisors and larger size distinguish it from the harvest mice. The animals are brownish to reddish above and white below, including their feet.

Average (and extreme) external measurements of eleven males from Larimer County were: total length, 152.9 (142-161); length of tail, 64.5 (58-78); length of hindfoot, 19.8 (18-21); length of ear, 17.3 (15-19). The weights range from 19 to 24 gr. for a full grown adult. Greatest length of skull ranges from 24.9 to 25.9, and zygomatic breadth is 12.7 to 13.7.

Natural History--Deer mice range from above timberline down to the lowest elevations. They live in all types of topographic settings, from plains to rocky, broken surroundings. Vegetation may range from virtually none, to grass, to brush, to woodland. The animals are not active burrowers. They do remodel small burrows of other species by accumulating dirt under the body and then depositing it in front of the hole. Materials such as feathers, hair, plants, and dry grass may be accumulated to form comfortable living quarters. These animals tend to be most active at night.

Food consists of seeds, insects, and fungi. Food habits seem to shift through the season.

Average number of litters per year is about 3.5. Litter size was determined to be about 5.7 (range 2-10, n=4) in Coloradan subalpine forest. The breeding season is initiated during or after snowmelt and lasts for 5.5 months. Young deer mice may associate with their mothers past the age of weaning.

P.maniculatus has many natural predators. There are many birds of prey (owls, shrikes, hawks) that make these mice a part of their diet. Mammalian and reptilian predators also feed on them. Probably, deer mice are the most important prey base for the smaller carnivores of the Mountain Parks.

Selected References--Halfpenny (1980); King (1968); Merritt and Merritt (1980); and Stinson (1977).

M.S.T.

ROCK MOUSE

Peromyscus difficilis

Distribution--The continental distribution of the rock mouse is quite similar to that of the Mexican woodrat. The animals range from central Mexico northward in rough, rocky country and reach their northern limits in northern Colorado. In Boulder County they are confined to the foothills, from perhaps 5500 to about 8000 feet. The type locality of our local subspecies (Peromyscus difficilis nasutus) is at Estes Park; that would be near the upper limit of the speecies' range. Museum specimens have been reported from Gregory Canyon and Mount Sanitas. In the course of field work, individuals were live-trapped in abundance in Gregory Canyon, at the base of the Third Flatiron, and along South Boulder Creek near the south end of the Mesa Trail.

Description--These are handsome mice, noticeably larger than their sympatric relative, the deer mouse. They have longer ears, relatively longer tails, and the coat of adults tends toward grayish rather than clear buff. External measurements of two males and two females, respectively, are: total length, 171, 182, 200, 200; length of tail, 86, 80, 90, 100; length of hind foot, 22, 22, 22, 22; length of ear, --, 24, 22, 22; weights range from 25 to 30 gr. Condylobasal length of those individuals was 28.2, 28.7, 28.6, 29.0; zygomatic breadth, 13.8, --, 14.2, 14.2.

Natural History--These are mice of brushy, rocky country, being most abundant in rough foothills canyons. Careful studies of habitat requirements have not been made. We were a bit surprised to take them right along the water in montane riparian shrubbery in Gregory Canyon. The east-facing slopes of the foothills are more typical habitat for the species. Were limits of tolerance better understood, we might be able to explain why it is that this species (and several other kinds of Mexican affinities) reach strict distributional limits in northern Colorado, literally within sight of the Wyoming state line.

Rock mice feed mostly on seeds as available, but eat insects, fungi, green vegetation, and other organic materials also. Some food is stored in burrows, which are found beneath rocks or in abandoned woodrat dens.

The breeding season continues throughout the warmer months. Males come into breeding condition in March or April. Females begin to breed in April and are polyestrous, continuing to cycle through the summer until about August. Probably there is a post-partum estrus, and litters of two to six young are born after a gestation period of three to four weeks. Females born early in the season probably breed later on that same summer. Most mice surely do not survive two full summers. A mouse 12 to 15 months old would be aged indeed.

Selected References--Cinq-Mars and Brown (1969).

D.M.A.

NORTHERN GRASSHOPPER MOUSE

Onychomys leucogaster

Distribution--The northern grasshopper mouse occurs from central Canada to northern Mexico and from Minnesota and Iowa westward to northeastern California and central Oregon. In Colorado, the species is known from grasslands and shrublands of eastern and northwestern Colorado. Although not documented from the Boulder Mountain Parks, it should be expected on lower grassy or shrubby areas.

Description--This mouse is easily recognized by its stocky body, large size, and short tail. The pelage is bicolored, the upper parts grayish to pinkish cinnamon, the underparts white. Measurements of 4 males and 4 females from east-central Colorado were: total length, 138.2 (128-151), 145.5 (139-158); tail, 40.2 (34-46), 39.8 (38-42); hindfoot, 22.0 (20-23), 21.8 (20-23); ear, --, 16.7 (16-17). Cranial measurements of the animal were: condylobasal length,26.75 (26.2-27.6), 26.88 (26.2-27.6); zygomatic breadth, 14.50 (13.8-15.2), 14.67 (14.1-15.3). Weights range from 34 to 40 gr.

Natural History--The northern grasshopper mouse inhabits short-grass prairie, shrublands, semi-stabilized dunes, and sagebrush desert up to 8000 ft. Burrows are often found next to fenceposts. Several types of burrows are constructed, including nest, retreat, cache, and signpost or sandbath. The next burrow is U-shaped, 48 cm long and 14 cm deep and contains a nest chamber with two entrances.

The species has most unusual behavior for a rodent. Although closely related to the deer mouse, the grasshopper mouse has carnivorous dietary habits, and some behaviors resemble those of carnivores. Early papers described the call as very similar in miniature to the coyote howl. Favorite foods include larval and adult grasshoppers, beetles, moths and butterflies, as well as mice and lizards. Seeds may be important in the winter. The mice are nocturnal hunters. Olfaction is acute as well as hearing; the mice can hear insects walking.

Like some carnivores, but unlike other mice, grasshopper mice are reported to form monogamous pairs. Courtship patterns are very complex. The male and female cooperate in the construction of the nest. The pairs are attentive parents, and the relatively long period before weaning allows time for instruction of the young. Females are polyestrous, and breeding takes place from March to September. Gestation varies from 26-37 days or longer in lactating females. More than one litter of 4 (2-6) is usual. Females may breed first at 3 months.

In addition to vigorous defense of the young, pairs tenaciously defend their territory, and intruders may be killed. Home range size is quite large, about 2.3 hectares. Although usually widely dispersed, rather high populations are favored on disturbed land which supports a large population of nocturnal insects and has open ground for dust-bathing and den construction.

Selected References--Egoscue (1960); McCarty (1978); Ruffer (1965a, 1965b, 1968).

A.B.A.

MEXICAN WOODRAT

Neotoma mexicana

Distribution--The Mexican woodrat is a species of the Mexican Plateau and southwestern United States. It reaches its northern limits in Larimer County, Colorado. In the Boulder area it occurs in the foothills, in suitable habitat throughout the Boulder Mountain Parks. Specimens have been reported from the following localities: Skunk Canyon; base of Flagstaff Mountain; Gregory Canyon; Boulder Canyon; Bluebell Canyon. The type locality of the local subspecies, Neotoma mexicana fallax, is Gold Hill.

Description--Mexican woodrats are dirty grayish brown above and whitish below. The long, slender tail is obviously bicolored. They are smaller in size than the bushy-tailed woodrat, and the tail is not so fully haired.

Mean (and extreme) external measurements of eight males, followed by those of six females, from Larimer and Boulder counties, are: total length, 337.9 (313-361), 321.4 (303-334); length of tail, 153.8 (144-167), 141.7 (132-150); length of hind foot, 34.2 (33-36), 32 (20-24). A male weighed about 150 gr. Condylobasal length of 10 males and eight females was 42.68 (41.7-45.3), 41.83 (40.5-43.6); zygomatic breadth was 23.42 (22.3-24.6), 22.67 (21.8-23.5).

Natural History--The Mexican woodrat is a fairly common resident of the broken, rocky areas of the foothills. The character of the rock outcrops is a more important feature of habitat than is vegetation. Mostly these rats live in and among boulders and beneath shelves of sedimentary rock. There they build characteristic stick dens, festooned with whatever other material is at hand, including castoffs from civilization: paper, woodscraps, tin cans, bottle caps, and so forth. Within the den is a nest, usually lined with soft plant fibers, and nearby there will be a food supply.

The diet consists mostly of foliage of forbs and shrubs. Vegetation is stored in and around the den. Some cactus is eaten, although less in this species than some more southern kinds. Typical food plants in our area are skunkbush and mountain mahogany, although needles of conifers may be eaten. The animals are active throughout the year, feeding on food stored up in autumn.

The breeding season begins in March. Two to five young are born in April after a gestation period of about 30 days. Apparently, there is a postpartum estrus. Most females produce two litters per year. By autumn the young disperse to set up housekeeping on their own. Probably, most individuals are able to take over and rennovate some abandoned den. Woodrats without proper den sites are vulnerable to both predators and to physical extremes.

Predators include coyotes, bobcats, snakes and owls. Woodrats harbor a variety of parasites, including fleas and parasitic worms of various kinds.

Selected references--Armstrong (1982); Brown (1969); Finley (1958).

D.M.A.

BUSHY-TAILED WOODRAT

Neotoma cinerea

Distribution--The bushy-tailed woodrat is limited in its distribution to the mountains of western North America. Also known as the pack rat, this species ranges from northern Canada south to northern New Mexico, Arizona and central California. In Colorado, three subspecies of Neotoma cinerea are found, from the Front Range west to the state border, and in the northeastern corner of the state. The species has been reported locally from Gregory Canyon and the east face of Green Mountain.

Description--Bushy-tailed woodrats have a large rat-like shape with thick, soft, buffy pelage above and white below. Short, rounded ears and large eyes give these animals a pika-like appearance when viewed head-on. Neotoma cinerea are distinguished from other Colorado woodrats by their bushy tails, larger ears, and a fully furred sole of the hind foot.

Average (and extreme) external measurements for five males from Gunnison County were: total length, 391.8 (373-420); tail, 163.8 (146-176); hindfoot, 44.8 (43-46); weights range around 250-350 gr.; condylobasal length was 49.50 (47.4-52.5); zygomatic breadth 25.78 (24.7-28).

Natural history--N.c.orolestes, the mountain subspecies, characteristically inhabits open forests of Douglas fir or ponderosa pine in the central portion of the state, though individuals have been reported as high as 14,000 feet near the summit of Pike's Peak. Woodrats typically den in rock outcrops, where variably colored streaks of accumulated feces are easily visible. More rarely, stick houses are built in trees and sometimes in roofs and rafters. Dens consist of a wide range of natural and man-made materials. A variety of other animals, including lizards, salamanders, mice, rabbits, shrews and moles may be found in woodrat nests. These are the pack rats of folklore, and often inhabit cabins, mine tunnels, and other structures. Woodrats are nocturnal and, at least in human habitations, active throughout the year.

Woodrats eat a varied diet of vegetable material. Seeds, fruits and fungi are eaten in their seasons, but leafy, succulent vegetation is preferred. In Colorado, 219 species of plants have been found in the diet of the species.

Females bear one to two litters per year. Both the onset of estrus and the number of litters depend on the altitude at which the individuals occur. Laboratory observations indicate that one to six young are born after a gestation period of roughly one month; young are weaned at approximately one month.

Many mammalian carnivores, including weasels, skunks, foxes, and covotes prey on woodrats, as do hawks, owls, and snakes.

Selected References--Finley (1958).

B. B.

SOUTHERN RED-BACKED VOLE

Clethrionomys gapperi

Distribution--The red-backed vole is widely distributed through the North American boreal forests, ranging from the treeline of northern British Columbia to the Southern Rockies and the Appalachians. In Colorado, the species occurs throughout the central mountains of the state, including western Boulder County. The animals were live-trapped in Long Canyon.

Description--The most distinctive external feature of this species is a pronounced bright chestnut to yellowish brown dorsal stripe. The sides vary from gray to buffy gray; the venter silvery. The tail is bicolored, whitish below and dark brown to black above. The animal's slender tail comprises approximately 35 percent of the total length. The skull is narrower than those of closely related small voles.

Mean (and extreme) external measurements of six males from Boulder and Gilpin counties are: 130 (126-148); 38.5 (33-44); 18.5 (18-19); 13.3 (12-15); weight, 25.44 gr. (21.7-29.4). Mean (and extreme) condylobasal lengths are 23.37 (22.9-24.0), and of zygomatic breadth are 12.7 (12.3-13.3).

Natural History--Red-backed voles inhabit well-developed mountain coniferous forests. A good freshwater source is favorable and almost always present. Locally, they are the most abundant in stands of lodgepole pine. In damper habitats, the burrow consists of shallow tunnels in sphagnum moss, needle litter, or peaty loam.

This species appears to be primarily nocturnal in warm climates and warm seasons, but they may be active by day as well. Mostly non-colonial or gregarious, with groups being a family structure.

The diet consists of seeds, fungi, and fragments of leaves and stems, with a definite preference for fungi (both fruiting bodies and mycelium).

Females bear an average of two litters annually, ranging in size from five to eight young. Highest levels of sexual activity occur from April to August. The young are altricial, with eyes opening at approximately 12 to 13 days. Maximum ecological life span is about 10 months, few individuals surviving two consecutive winters.

Predators include small carnivores such as foxes and weasels, raptorial birds, and snakes.

Selected References--Merritt (1978, 1981).

C.S.V.

HEATHER VOLE

Phenacomys intermedius

Distribution--The heather vole occurs southward along the mountains in the Pacific Northwest and in the Rockies (to northern New Mexico), but is absent in the mountains of the east. In Colorado, the species occurs in the mountains of the central and northern part of the state. The species is not yet documented from the Boulder Mountain Parks, but should be expected at highest elevations.

Description--Grayish brown above and pale gray to white below, this species has a rather non-descript pattern. A distinctively short, salt-and-pepper colored tail is the only external distinguishing feature.

External measurements of two females from Grand Mesa were: total length, 139, 138; length of tail, 37, 33; length of hind foot, 19, 18; length of ear from notch, 15, 16; weight, 33.6, 40.1 gr. Condylobasal lengths of skull were 25.4 and 25.2, zygomatic breadths, 15.3 and 15.0.

Natural History--Heather voles inhabit mountainous regions between 7,000 and 12,000 feet. Few specimens have been obtained in rank grasses among willows, but the species is predominantly found in spruce fir and lodgepole pine forests, preferably near a fresh water supply. They burrow actively and connect their burrows by means of well concealed runways.

The diet consists of a variety of plant foods, including berries, herbage of forbs, seeds, and fungi. Bark is important, especially in winter.

Mean litter size is five (range two to eight), born after a three-week gestation period. Females mature rapidly and can reproduce as early as their first summer. Males are slower at maturing. Reproduction peaks from June through August.

Predation of heather voles has been poorly studied.

Selected References--Armstrong (1972); Williams (1952).

C.S.V.

MEADOW VOLE

Micotus pennsylvanicus

Distribution--The meadow vole has the most extensive range of any North American microtine, except the muskrat, occuring throughout Canada, the northern and eastern United States, and southward into Mexico. In Colorado, the species occurs in the valley of the South Platte River and in the mountains on the Eastern Slope, eastward on the Platte-Arkansas Divide at least to Ramah. On the Mountain arks, it has been captured at the foot of the First Flatiron and in Skunk Canyon.

Description--The meadow vole is a medium-sized, robust-bodied mouse with small eyes and ears and short legs. It is distinguishable from other voles by its larger size and relatively short tail. Its fur is long and soft, the summer pelage being sparser and coarser than winter, and the color varies from gray faintly washed with brown to dark brown, the belly being silvery to slightly buffy or dark gray. The tail is bicolored.

Measurements of three males and two females from Larimer County were: total length, 192, 180, 185, 187, 178; tail, 54, 44, 67, 56, 50; hindfoot, 23, 21, 22, 23, 22; ear, 15, --, 13, 15, 14; weight, 73.61, --, 68.49 gr. Condylobasal length ranges from 29.4 to 30.2, zygomatic breadth from 16.3 to 17.7.

Natural History--Meadow voles seem to prefer moist grasslands or wetlands, but are occasionally found in orchards or wooded areas with little ground cover. Choice of habitat seems to be related to the presence of sympatric species. The meadow vole is reported to be subordinate to other Microtus species. Voles are inclined to make surface runways in dense grass or sedge cover, and may burrow if the soil is not too waterlogged. They are good swimmers. Spherical nests are constructed of leaves and coarse grasses with softer vegetation as lining, and are usually found on the ground surface. The animals may be active both day or night, depending on temperature and ground cover; they do not hibernate. Meadow voles tend to be solitary, and breeding is promiscuous.

Voles are said to eat their own weight in food each day. Diet consists primarily of grasses, Poa, Panicum, and Muhlenbergia being prominent, but the voles will also eat grain, seeds, bark, roots, fruits, flowers, fungi, and sometimes insects. The animals may store food against thin seasons.

Mating in meadow voles occurs throughout the year, with up to 17 litters of one to nine young being born per year. Young are altricial, are weaned in about two weeks, and are independent soon after. Females begin reproducing in about a month, and males about two weeks later.

This vole is said to have more species of predators than any other North American mammal. Owls, hawks, snakes, weasels, foxes, and most other carnivores will prey on them. Densities of vole populations tend to run in cycles of two to five years. At high densities, this may cause serious damage, especially in orchards, due to girdling.

Selected References--Brown (1977), Jones et al.(in press); Reich (1981).

S.T.G.

MONTANE VOLE

Microtus montanus

Distribution--The montane vole is a species of the western mountain region, ranging from New Mexico and Arizona to British Columbia. In Colorado the species is found in the mountains and high plateaus of the northwestern and north central parts of the state, ranging from 5,900 to 11,600 feet in elevation.

Description--The montane vole is similar in form and size to other voles with a stocky, round body, a blunt nose, small rounded ears slightly longer than the fur, small eyes, and short legs. The upper parts are grayish-browh to blackish, the belly is whitish, and the feet are usually dusky. The tail is longer than the hindfoot, but less than one-third the total length.

Average (and extreme) external measurements of ten females from Colorado were: total length, 164.3 (156-180), tail length, 42.2 (38-49), hind foot, 18.9 (16-20), ear 12.7 (9-14). Males are slightly larger. The ten females had a mean weight of 41.85 grams and six males had a mean weight of 49.53 grams.

Natural History--In montane, subalpine and alpine meadows, the montane vole is probably the most abundant microtine in Boulder County. Grassy meadows are preferred over sedge or shrub. The montane vole is abundant in aspen forests in the Front Range. Montane voles construct runways and burrow to some extent. Nest building is well developed. Nests are constructed underground during the summer and at the interface between the snow and the ground during the winter.

Diet in Colorado consists primarily of the leaves of forbs. Grasses and sedges are also eaten and fungus is an important part of the diet early in summer. Activity is primarily nocturnal but periodic foraging during the day has been noted. Voles are active all year.

The breeding season begins in April under the snow at 9,200 feet in Boulder County. Reproduction is stimulated by lengthening photoperiod and perhaps by green vegetation in the diet. The reproductive rate is high, with a short gestation, large litter size and early weaning, and females undergo postpartum estrus. Young of the year can breed.

Females are territorial, defending the area around their nests, while males may show home range overlap. Normal densities in Colorado vary from six to 31 per hectare. During an irruption in California, densities as high as 30,000 per hectare were noted.

Montane voles are the prey of badgers, coyotes, foxes, skunks, weasels, bobcats, various snakes, hawks, owls and occasionally trout. They serve as intermediate hosts for many parasites of carnivorous animals.

Selected References--Cruzan (1968); Negus et al. (1977); Stinson (1977); Vaughan (1969, 1974).

J.I.K

LONG-TAILED VOLE

Microtus longicaudus

Distribution--The long-tailed vole is a mammal of the western mountains, occuring in the Rockies from east-central Alaska to southern New Mexico and Arizona, and in the Coast and Cascade-Sierra Nevada ranges as far south as southern California. It occurs in the western three-fifths of Colorado, including Boulder County.

Description--This vole is distinguished from other species of Microtus by its long tail, which is at least one-third its total length. The coat is dark gray washed with brown or blackish, the belly and feet being soiled whitish; the tail is bicolored. Color of the pelage varies with the season and becomes pale when worn.

External measurements (mean, extremes) of three males from Larimer and Boulder Counties were: total length, 187.7 (183-195); tail, 63.7 (61-65); hindfoot, 21.3 (20-22); ear, 15.0 (13-17); weight, 44.67 (40.0-49.4) gr. Condylobasal length of three males was 27.7, 26.8, 28.1; zygomatic breadth, 15.6, 15.4, 15.9.

Natural History--Long-tailed voles are found in streamside meadows, and sometimes in forested areas with little ground cover. They are a most euryecious species with habitat varying from dense coniferous forest to rocky alpine tundra to sagebrush semidesert. These voles also have a wide altitudinal range as they occur from sea level to at least 12,000 feet. The runway habit of the long-tailed vole is poorly developed compared to other microtines.

Long-tailed voles prefer green plant parts, but will eat seeds, berries, and fungi when they are abundant, especially in autumn. In winter they will eat the inner bark of shrubs and small trees.

These voles are polyestrous and breed throughout the warmer months, with births from May to September. About thirteen litters are born each year, with litter size ranging from one to seven individuals. The young are altricial and are weaned at about two weeks. Females reach reproductive maturity as early as three weeks, males a few weeks later.

Snakes, hawks, owls, weasels, foxes, and other carnivores prey on long-tailed voles. Regular fluctuation in vole populations occur in some places, and not so much in others, perhaps depending on other vole species present.

Selected References--Armstrong (1972, 1975, 1977); Jones et al. (in press); Turner (1974).

S.T.G.

PRAIRIE VOLE

Microtus ochrogaster

Distribution-- Prairie voles are found across central North America from Alberta to Ohio and Oklahoma, and west to the base of the Rocky Mountains. They occur in Colorado along the drainages of the South Platte and Republican rivers, westward to mesas and grassy canyon bottoms of the lower foothills.

Description--The species has a dark grayish to dark brown dorsum with coarse, tawny-tipped hair, giving it a grizzled appearance. The venter is pale and buffy and the tail is short, distinguishing it from the meadow vole which has a finer pelage, grayer belly, and slightly longer tail.

Average and extreme measurements of six males and of five females from Larimer County were: total length, 175.6 (162-188), 175.2 (168-182); tail, 45.2 (41-53), 45.0 (41-50); hindfoot, 21.5 (20-23), 21.5 (20.22); ear, 12.8 (12-15), 12.8 (12-14); weights, 60.0 (54-71), 59.2 (58-68); condylobasal length, 29.45 (28.2-30-5), 29.34 (28.9-30.1); zygomatic breadth, 16.55 (15.8-17.4), 16.72 (16.5-16.8).

Natural History--Prairie voles have been found in both dry and wet grasslands but tend to live in the drier areas when sympatric with meadow voles. Dominant plant cover consists of grasses and clover through which they have extensive runway systems. Burrows lead to nests and food chambers 6 to 18 inches below ground surface.

Diets locally are not documented but studies at Lawrence, Kansas, showed a preference to dicotyledons, although grasses dominated the vegetation. Grasses, seeds, and some insects supplement the diet.

Reproduction occurs year-round with no distinct season but reaching a height around March and a drop in winter dependant upon the percentage of adults in the population. Litter sizes tend to vary seasonally, averaging about 3.9 young. Females mature at 4 to 6 weeks. They have three or four litters per year. The gestation period is 21 days.

Predators include coyotes, raccoons, owls, and hawks, but predation does not seem to affect population densities strongly. Populations fluctuate in two- to six-year cycles, dependant on available adults, due to causes which are unknown but which may be related to aggressive behavior, immigration, and abundance of vegetation.

Selected References--Choate and Williams (1978); Cruzan (1968); Fitch (1957); Jameson (1947); Martin (1956).

M.J.W.

MUSKRAT

Ondatra zibethicus

Distribution--The muskrat is distributed nearly throughout the United States except in the southern reaches of Texas, Nevada, New Mexico and Florida. It is also not found in the northern California area and in southwestern Utah. In Colorado, the species occurs in all areas of the state, including Boulder County, being a commensal of the beaver.

Description--Muskrats are vole-like, but much more massive, with rich brown dorsal fur and silvery ventral fur. This species has a chunky, large, blunt head, with ears barely protruding from the fur. Its hind feet are partially webbed. The most distinguishing characteristic is the scalely, sparsely-hairedtail which is flattened laterally.

External measurements taken from two males and two females from Fort Collins were, respectively: total length, 647, 546, 475, 478; tail, 244, 257, 245, 223; hind foot, 80, 75, 80, 77; ear, 19, 23, 19, 25; weight, 1150, --, 1000, 934 gr. Condylobasal length ranged from 61.4 to 66.4, and zygomatic breadth is 37.8 to 39.8.

Natural History--Muskrats are always found near water sources such as marshes, edges of ponds, lakes and streams. They are often found near beaver dams. The muskrat builds stick lodges out of branches and vegetation somewhat similar to the beaver, but on a smaller scale, although the lodges can rise up to six feet high. They also burrow into the banks of streams. Burrows can extend up to 50 m. and may do considerable damage to man-made dams and irrigation ditches. Muskrats are usually nocturnal but may also be active during the day.

Muskrats eat mostly aquatic plants, roots and basal portions making up the majority of the diet. In agricultural areas, cultivated corn can become a major food source. When food becomes sparse, shell fish, salamanders and other animal matter is consumed.

During the breeding season, males establish territories and emit a strong, musky odor (from which they get their name) to attract females. Females bear two to six litters annually, giving birth to litters of one to 11 young all year round. The gestation period is 30 days, and the young are born altricial. Muskrats are weaned at four weeks of age and will live for a maximum of four years.

Snakes, owls, hawks, coyotes, foxes, and various weasels (especially mink) prey upon muskrats. Humans are also a major predator. The muskrat is eaten in some places, and the fur is used for coats. From 1976 to 1981, nearly 20,000 muskrats were harvested. Boulder County usually is among the top five muskrat-producing counties in the state. They are also trapped, poisoned, and shot to prevent damage to irrigation ditches and dams.

Selected References--Armstrong (1972); Errington (1963); Willner *et al.* (1980).

T.T.W.

MEADOW JUMPING MOUSE

Zapus hudsonius

Distribution--The meadow jumping mouse is a species of northeastern and central United States and southern Canada. Populations in Colorado are scarce, and they may be local relict populations. Museum specimens are available from a variety of localities about Boulder and may occur (or have occurred) on the lowest parts of the Mountain Parks.

Description--The animals are ochraceous to dark brown above and pale on the sides. The lateral line is ochraceous-buff. The belly is white or sometimes suffused with ochraceous. Hind legs are longer than fore legs; tails arelonger than their bodies. The meadow jumping mouse is smaller in size and paler in color (with less black on the back and a less prominent lateral line) than the western jumping mouse.

External measurements of three males from Boulder County were: total length, 202, 211, 219; tail, 123, 125.6, 127; hind foot, 29, 30, 31. Skull measurements were: zygomatic breadth, 11, 11, 11.2; length of maxillary toothrow, 3.9, 3.9, 4.0, and interorbital constriction, 4.0, 3.7, 3.9.

Natural History--Meadow jumping mice live in a variety of habitats. In our area, they occur mostly about prairie wetlands. Such areas have been much modified by humans, and this species may be threatened. The animals hibernate throughout the winter, remaining in hiberation an average of six months. They have poor metabolic activity and cannot adjust to cold temperatures. A nest may be a hollow log or tree, under some protecting object, or underground. Grass is the usual bedding material.

Jumping mice do not normally jump from one place to another. They frequently crawl through the grass or under the grass. If they do hop, leaps will only be 3 to 15 cm. long. If startled, however, a jumping mouse will often take several leaps of up to a meter long, then stop and remain motionless or proceed by shorter hops.

Food consists of insects, seeds, and fruit. Seeds are the main source in their diet. Water may be supplied from vegetation or dew, or both.

Females may bear two to three litters per year. Litter size may range from three to seven pups (average 5.1). The young are born naked and helpless, but by the third week are able to walk and make short hops. By their fourth week, the young look like adults and can fend for themselves. At birth, the young make a high-pitched squeaking sound and "sucking note." Few sounds are recorded in adults.

Red-tailed hawks, barnowls, and long-eared owls are known to prey on jumping mice. Population studies on this species are few in this area due to the low abundance of the species.

Selected References--Krutzsch (1954); Whitaker (1972).

M.S.T.

WESTERN JUMPING MOUSE

Zapus princeps

Distribution--The western jumping mouse is a resident of western North America, from the Yukon southward to Arizona and New Mexico. The animals occur in suitable habitat across the western three-fifths of Colorado. Probably, they occur locally on the Boulder Mountain Parks, in such areas as Long Canyon. However, the published records of occurrence nearest the Parks are near Pinecliff and near Sunset.

Description--These are beautiful and distinctive mice. The back is yellowish brown, heavily washed with blackish. The venter is pure white. There is an orangish buff lateral line. The tail is considerably longer than the head and body, sparsely haired, and very narrow. Among local rodents, only the meadow jumping mouse could possibly be confused with this species.

Average (and extreme) measurements of six females from Boulder County are: total length, 242.7 (228-257); length of tail, 147.3 (137-167); length of hind foot, 32.7 (31-34); length of ear, 18.7 (12-19); condylobasal length, 22.60 (22-23.6); zygomatic breadth, 12.38 (11.9-12.8); weights range from 20 to 30 gr.

Natural History--Typical habitat of the western jumping mouse is streamside willow thickets. The animals may be common under such circumstances. They occur in marshes about beaver ponds as well, but seldom are found at any great distance from water.

Jumping mice are not bipedal in their foraging movements, but when startled they can make leaps of a meter or more. The long tail is used as a balancing organ. The diet consists mostly of seeds, although insects are taken in summer, making up over half the June diet in a study population in northern Colorado.

Jumping mice have elongate home ranges, oriented along streams. In the home range is a burrow site, usually at the base of a shrub well above water line. The burrow is used as a hibernaculum. The animals enter hiberation about the time of the first frost, in August or perhaps September. They do not emerge until snow cover has left. Thus, they may not be active for more than three or four months a year. Perhaps as a result, jumping mice are long-lived for small mammals, with typical longevity in excess of four years.

The animals breed soon after emergence in spring. A single litter of four to eight (average about five) young is born after a gestation period of about 18 days. The young are weaned at about one month of age and immediately begin to fatten up to get ready for hibernation.

Selected References--Stinson (1977); Brown (1967a, 1970).

D.M.A.

PORCUPINE

Erethizon dorsatum

Distribution--The porcupine occurs from Alaska and Canada southward to northern Mexico. In Colorado, the species is mostly found in the higher mountainous regions but has also been recorded on the eastern plains and on the tundra. The animals occur in woodlands throughout the Boulder Mountain Parks.

Description--With 30,000 yellowish sharp quills covering its entire dorsum, the porcupine is easily distinguishable from other mammals. Other characteristics include small ears and eyes, a short neck, and a blunt nosed head.

External measurements of a male from Larimer County and a female from Montezuma County are respectively: total length, 630, 814; tail, 180, 280; hind foot, 82, 98; ear, 35, 25. Weights range between 3.5 and 18 kg. Zygomatic breadth for a male and female are: 73.4, 69.5. Greatest length of skull ranges between 93 and 112.

Natural History--Porcupines are most often found in country of varied relief and are frequently seen along ridge tops. Their most common habitat is in or near coniferous stands, especially of lodgepole pine in the montane zone and ponderosa pine in the foothills. The animals make dens in hollow logs or trees but do not defend them. Individual feeding trees, on the other hand, are strongly defended and marked by urination at the bottom of the tree. The animals are solitary, crepuscular and nocturnal, and active throughout the year.

The porcupine's diet is primarily the cambium layer of conifers. In the summer they may also eat roots, stems, leaves, berries, seeds, nuts, and grasses.

The breeding season is in the fall and the gestation period lasts 209-217 days. Females are seasonally polyestrous, and can recycle in 25-30 days if pregnancy does not occur with estrus itself lasting eight to twelve hours. One litter of one young is produced per year. Lactation occurs for seven weeks after which the precocial young are left on their own. Longevity is approximately six years.

Predators are relatively few, as a result of the porcupine's ability to erect and release its long, painful quills into an intruder's body. The few predators, in order of importance, are man and vehicles, mountain lions, bobcats, coyotes, wolves, wolverines, foxes, and birds of prey. Parasites contribute more to porcupines' deaths than do predators.

Selected References--Costello (1966); Woods (1973).

M.A.M.

COYOTE

Canis latrans

Distribution--The coyote is one of the most wide-ranging carnivorous mammals of North America. It occurs from northern Alaska to Costa Rica and from the Pacific Coast eastward across the Great Plains to New England. It is found throughout Colorado, and its presence on the Mountain Parks was confirmed by numerous scats and tracks observed in the course of our field work.

Description--Coyotes are similar in size and shape to a moderately large dog. Coyotes generally appear gray with a red or brown hue to their fur. The venter is paler than the rest of the body, and it can vary from tawny to white. The ears are also tawny. Coyotes have thick fur, and the tail is long and bushy.

Males usually are larger than females. Average weights of males vary from 11.2 to 14.1 kg., and female average weights range from 9.8 to 11.8 kg. Morphological measurements of the coyote include: total length, 1,000 to 1,500; tail, 300 to 500; condylobasal length, 165 to 185; zygomatic breadth, 85 to 100.

Coyotes can be confused with several other members of the Canidae. Several cranial measurements differentiate coyotes from the gray wolf and from domestic dogs. The coyote's nose is also more pointed than a dog's nose. All fox species are smaller than the coyote.

Natural History--The coyote occupies an extremely wide variety of habitats over almost any kind of topography from sea level to montane regions. These habitats include open grasslands, sagebrush grasslands, sagebrush deserts, oak woodland, grasslands, coniferous forests, riparian deciduous forests, and even large cities. Much of their present range extension is probably due to the extermination and withdrawal of other larger carnivores such as the gray wolf and the mountain lion.

Coyotes are omnivorous. Their diet includes everything from blueberries, pricklypear, grasshoppers, rodents, and lagomorphs to the large ruminants. The diet is seasonal. In winter, small rodents (voles) or large carrion (mule deer or elk) contribute much of the diet. In spring and summer, larger rodents (ground squirrels and rabbits) are eaten. Insects are taken most often in the spring, and fruit intake increases in summer and fall.

Coyotes mate from January to April. Gestation is 63 days, and pups are born during April or May. Average litter size varies from four to seven, and one litter occurs per season. Pups remain in the den until three weeks old, and they are weaned at five to seven weeks.

Undoubtedly, a few coyotes take domestic prey; however, the actual extent of economic losses by ranchers due to coyotes is not clear. This is an area sorely in need of scientific research. The coyote's diet of small rodents, rabbits, and carrion makes this much-maligned carnivore a very important and integral part of the ecosystems of the Boulder Mountain Parks.

Selected References--Bekoff (1977, 1978, 1982); Bekoff and Wells (1980, in press).

J.C.O.

GRAY WOLF

Canis lupus

Distribution--The gray wolf is an animal that occurs throughout the Northern Hemisphere. The wolf has been extirpated from almost all of its former ranges and is now found only in the remote areas of forest in the Great Lakes region, Canada, Alaska and remote areas of Europe and Asia. There are occasional supposed sightings in Colorado, but these surely are of dogs or coyotes; the last wolves were removed from Colorado 40 years ago.

Description--The wolf's large body size distinguishes it from most other canids. Its broad skull and size distinguish it from the coyote. The wolf has a long, coarse coat. It varies in color from black to white but is usually a grizzled gray with the venter being paler than the dorsum.

External measurements of a male and a female from western Colorado were: total length, 1777, 1701; height at shoulder, 806, 724; weight, 56.8, 50 kg. Condylobasal length ranges from 220 to 250, zygomatic breadth from 125 to 150.

Natural History--Gray wolves inhabit coniferous forests, usually of spruce or pine. They seldom are seen in the open unless there is a snow cover. Wolves usually sleep on the ground but do dig dens. A wolf mound is usually five feet wide and ten feet long.

Wolves live in packs consisting of a male and female pair with offspring. This family is part of a larger pack consisting of up to sixteen members. The packs are larger in winter and also have in them hunting packs which are not the same as a family group. Packs are active during most parts of the night and during the day if it is cool. Wolves are highly social animals with many complex behavior patterns, including dominance, mating, pup-rearing, social hunting, and vocalizations of which there are at least five distinct kinds.

Females have an estrus period of five to seven days, and breeding takes place from January to April. Gestation is 63 days long with an average litter of six (one to 11 is the range). Pups are weaned at about five weeks and usually join the pack their first winter. Pup mortality is about 90 percent. What is left of the wolf's habitat cannot sustain a high population. Maximum lifespan of the wolf is 16 years, though 10 is old in the wild. Wolves are subject to many typical canine diseases--rabies, distemper, arthritis, cancer, senility, and many parasites.

The diet in Colorado probably consisted mostly of elk in the summer and mule deer in the winter in mountainous areas and bison and elk on the plains. Wolves usually prey upon young, old and diseased individuals, keeping the prey populations healthy.

Selected References.--Armstrong (1972); Mech (1966, 1974).

A. M. J.

RED FOX

Vulpes vulpes

Distribution--The red fox is an Holarctic species, nearly ubiquitous in North America, occurring as far south as Texas and New Mexico and absent only from tundra, deserts, and uplands on the Central Plains. In Colorado, the species is found primarily in mountainous areas and in irrigated farming country. There are no museum records from the Boulder Mountain Parks, but sightings in the area are common.

Description--This small canid is distinguished from the similar gray fox by its white tipped tail and usually reddish-yellow pelage. Red foxes have several color phases; the most common in this area is reddish-brown with black markings on feet and ears.

Measurements from two males from Weld County were: total length, 1180, 1230; tail, 460, 470; hindfoot, 160, 164; ear, 84.89; condylobasal length, 143.1, 141.8; zygomatic breadth, 76.2, 72.9. Adults weigh 4000 to 5000 grams.

Natural History--Red foxes are found in a variety of habitats from plains riparian woodlands to subalpine meadows, but seem to prefer moist forest-edge areas. Abandoned burrows of other species are utilized by red foxes. Communal denning may occur while pups are young; at other times the animals are solitary. The species is primarily crepuscular or nocturnal and active all year. The size of the area in which a single adult or pair conduct their activites ranges from less than 200 acres in diverse woodland habitat to two square miles in open farm country.

Red foxes are opportunistic omnivores, eating a variety of small rodents, birds, insects, fruit and carrion. Red fox stomach contents were analyzed in Iowa and Wisconsin to determine their impact on game species such as pheasant and cottontail. The fox did not take a significant number of game animals. The farmer's former complaint against the red fox, decimation of chicken flocks, is less widespread at present, owing to rural habitat destruction and changes in poultry management techniques. Contrary to popular opinion, foxes are not major rabies vectors.

Females give birth in the spring to litters of one to eleven young. One litter of 17 pups, all of whom were starving, has been reported. When adult foxes are found in social groups, usually only one female successfully rears young. Other females often assist in rearing the pups. The young are weaned at two months and disperse in the early fall.

Hawks, owls, bobcats and other medium-sized carnivores prey on pups. Golden eagles, lynx and wolves may kill adult foxes. Mortality varies with the year and the locale, but may be as high as 80% annually. Red foxes are hunted as varmints in Colorado, or trapped for fur. In 1980, 135 red foxes were reported trapped in Boulder County. Harvest statewide was over 2,000 animals.

Selected References--Rue (1969); Storm (1982).

B.B.

SWIFT FOX

Vulpes velox

Distribution--The swift fox is a species of the Great Plains, formerly occurring from Alberta south to west-central Texas and from extreme western Minnesota and Iowa west to the Rockies; its range is now much reduced. It is found in the prairies of eastern Colorado. The swift fox may well have occurred in suitable areas of the Boulder Mountain Parks before widespread persecution of large predators began in the late 1800s.

Description--This small fox is characterized by its large ears, bushy tail with a prominent black tip, and blackish spots on the sides of the snout. It is reddish-gray above, with orangish-tan sides, legs, ears, and lower surface of tail. The underparts are buff to pure white. The swift fox is closely related to the kit fox of the southwestern deserts; in fact, some authors consider the two to be conspecific.

Males average slightly larger than the females. A male from eastern Colorado measured: total length, 700; tail, 243; hind foot, 115; ear, 60; weights range fron 1.8 to 3.0 kg.; condylobasal length is 108 to 115 mm.; zygomatic breadth, 63 to 65.

Natural History--The swift fox is an inhabitant of the short- and mid-grass prairies of the Midwest. They are the most subterranean of North American canids, building large and elaborate burrows that are used year-round. The dens may be remodelled burrows of other species or excavated by the foxes themselves. They usually are located in hillsides, ridgetops, rangeland, or cultivated fields, and may be shallow with one entrance or very deep with four to nine entrances. The entrance averages 20 cm. in diameter.

The diet of the swift fox consists of mainly mammals, especially lagomorphs, but it also includes birds, reptiles, amphibians, insects, arthropods, and some carrion and plant material. It is almost entirely nocturnal and may travel up to 26 m. a night in search of food. In the winter, it may sun itself at the entrance to the burrow during the day.

Breeding takes place in the first winter after birth, with the female giving birth to a single litter of three to six pups from March to early May. The young resemble the adult in pelage and weight by August and disperse in the early autumn. Swift foxes are thought to mate for life. There is a record of an individual in captivity that lived nearly 13 years.

The swift fox was a casualty of predator-control programs directed against coyotes and wolves and was thought to be extinct over much of its range until the 1950s, when it began a modest, unexplained comeback.

Selected References.--Egoscue (1979); Jones et al. (in press); Kilgore (1969).

H. E. B., Jr.

GRAY FOX

Urocyon cinereoargenteus

Distribution-- The gray fox is a southern species, ranging northward from South America through Middle America and thence to Washington in the West and to southern Canada in the East. In Colorado, the species occurs on either side of the mountains, both in western valleys and along the foothills of the Eastern Slope. There is a specimen in the University of Colorado Museum from northwest of Lyons, and the animals occasionally are seen along the foothills west of Boulder.

Description--This is a distinctive fox, partial to rocky country and sometimes climbing trees. Hence, one distinguishing feature is its habitat. Furthermore, it is distinctly colored, and that helps distinguish it from the much smaller swift fox and from the red fox. The gray fox has a distinctly dark back and a black mane of stiff hairs on the tail. The tail is tipped with black, and the face is red (as are the backs of the ears).

A male from southeastern Colorado had the following measurements: total length, 940; tail, 425; hind foot, 35; ear, 65; weights range from 3.5 to 4.5 kg., with males being 15 to 20 percent larger than females. Cranial measurements of a male from Douglas County were: condylobasal length, 117.2; zygomatic breadth, 64.6. The skull of the gray fox is quite distinctive becuase the ridges that form the attachment for the temporal muscles are lyre-shaped.

Natural History--These are peculiar foxes, much better known in the East than in western United States. They live mostly in broken, brushy country in our area and feed on birds, mice, and fruit. Sometimes they become pests in orchards, for they readily forage in trees. They are almost strictly nocturnal, although sometimes they forage at dawn or dusk.

They den in hollow logs, beneath rocks, or under piles of brush; they tend not to burrow as their red fox relatives do, but there is little need, for there is plenty of ready-made cover in their habitat.

Gray foxes mate about February. The gestation period is some nine weeks long. Average litter size is about four. The male provisions the female while she is confined with a nursing litter. Newborn gray foxes are blind but well-furred. In fall the family unit breaks up; the young disperse and the parents go separate ways until the next mating season. Gray foxes generally breed as yearlings.

Selected References--Fritzen and Haroldson (1982).

D. M. A.

BLACK BEAR

Ursus americanus

Distribution--At one time the black bear ranged throughout forested areas of North America. Recently, its distribution has become more restricted, due to a great reduction in forested habitats. In Colorado they are found in the mountainous areas of the state from the foothills to the western border. There have been several recent sightings in the Boulder Mountain Parks. In the fall of 1980, one was seen near Walker Ranch, and a sow with cubs was seen near Eldorado Springs

Description--The black bear is the smallest of North American bears and is suspected to be the only species of bear remaining in Colorado. The fur varies greatly in color with the two most prominent color phases in this area being brown (cinnamon) and black with a brown snout. Measurements of a young male from Boulder County were: total length, 1549 mm; tail, 89; hind foot, 235; ear, 127. A population study in Colorado found males ranging in weight from 32 kg. as yearlings to 159 kg. for a 9-year-old. The weight of black bears varies seasonally, and a bear may put on up to 60 percent of its early summer weight before winter denning. Some adults may weigh over 200 kg.

Natural History--Spruce-fir, lodgepole pine and gamble oak forests are typical habitat. Bears seem to prefer areas which provide more cover. Dens are natural rock cavities or excavated areas at the base of trees. They enter dens usually between mid-October and the end of November and spend the winter in an inactive state of dormancy, a deep sleep, but with body temperature remaining high. They emerge from the dens between the end of March and late May. Males and females with their cubs den separately.

Bears are omnivorous, with vegetable matter forming the largest portion of their diet. In early spring, they feed primarily on ants, ant eggs, juniper berries and fresh green vegetation. As summer progresses, berries such as blueberries, raspberries and strawberries become the most desired food sources. In fall, acorns and conifer seeds become staples. Bears also eat meat year-round, usually in the form of carrion; however, black bears have been observed to take down large animals such as elk and also to catch fish. True to their reputation, bears will raid bee trees or domestic hives to get to the honey.

Black bears may be active day or night. They are basically solitary animals with partially overlapping home ranges and a well-defined territory.

Females give birth to a litter of two to three cubs in January and February while denning. This family group remains together through the next year's denning period.

Selected References--Beck (1981, 1982); Jonkel and Cowan (1971).

S.W.H.

GRIZZLY BEAR

Ursus arctos

Distribution--The journals of Lewis and Clark include many accounts of a "most tremendious looking anamal," the grizzly bear. They encountered them throughout the Great Plains and into the Rocky Mountains. Today, Alaska and parts of northern Canada still maintain large populations of grizzlies, but they have been considered a threatened species in the lower 48 states since 1975. The exact status of the grizzly in Colorado is unknown. It is possible that a few individuals still live along the Continental Divide between the Rio Grande and San Juan drainages of south-central Colorado. Surely, they no longer occur in Boulder County.

Description--The grizzly may be distinguished from the usually smaller black bear by its prominent shoulder hump, long straight foreclaws, and dished-in facial profile. Coat colors vary from blond to tan to chocolate brown, with the fur of the back sides being "grizzled"--lighter at the tips. Underparts are darker. Young may retain a light collar around the neck, which they lose before their third year. Grizzly bears have inconspicuous tails, noticeable but small ears, and generally thick-looking bodies. Adults are up to 2 m. long and may weigh as much as 350 kg. Condylobasal length is 200 to 350 mm.; zygomatic breadth is 175 to 240.

Natural History--Though not true hibernators because they may be aroused from "winter lethargy," bears spend the cold months in dens which may be dug out of steep banks, at the base of trees, or in piles of forest debris. In the early spring bears leave their dens and head hungrily for lower elevations where greening vegetation and carcasses of winter-killed animals may be found. As the snow melts, they will range from moist river valleys, through spruce-fir forests, to areas above timberline, feeding on bulbs, grasses, herbs, roots, berries, an occasional small mammal, and fish, depending on the season and habitat.

Grizzlies mate in early summer, but the embryos do not implant until the female dens up for winter. Altricial young are born in January or February, weighing only 1½ lbs., and covered with a thin fuzz of hair. Litter sizes are usually one to three. Cubs remain with the mother for three years; thus, females mate every two or three years. With no predators or diseases, bears may live to be 25 years old. They occupy large home ranges, from 50 to 180 square kilometers; males have larger ranges, and come in contact with females only during mating season. Often described as a "symbol" of wildness, the grizzly bear also can be seen as an "indicator species" of the influence of civilization on the West since the days of Lewis and Clark.

Selected References.--Armstrong (1975); Craighead (1979); Murie (1981); Schneider (1977).

L. A. M.

RACCOON

Procyon lotor

Distribution--The raccoon is abundant from southern Canada south to Panama except at extreme altitudes in some of the Rocky Mountain states and in the southwestern deserts. The raccoon population has been increasing in size in Colorado in recent years due to their adaptability to human-influenced areas. They are abundant in the Boulder Mountain Parks and can often be seen in the evening along the riparian vegetation of Boulder Creek and elsewhere.

Description--The raccoon is most clearly identified by its black facial mask and tail with 5 to 7 dark rings. The fur has a grizzled appearance ranging in color from red-gray to black and brown.

Measurements of an adult male from Boulder County were: total length, 910; tail, 266; hindfoot, 135; ear, 72. The weight of this raccoon was 8.8 kg. Weight varies seasonally; raccoons put on much weight before winter denning. A raccoon was found in Wisconsin weighing 29 kg.

Natural History--Raccoons are a very adaptable species and can be found in habitats varying from swamps and salt marshes to northern forests. However, they tend to be most common along wooded streams. Raccoons are omnivorous. A study in eastern Colorado found their diet to consist of 73% plant material and 27% animal material. Corn is a favorite food source. Insects are important, and when available, crayfish form a major part of the diet. Raccoons also prey on such animals as young muskrats, rabbits, birds' eggs. The diet varies seasonally with animal material making up a larger portion in spring when corn and berries are not available.

Raccoons have a highly sensitive sense of touch and feel the food extensively before eating it. This has often been misinterpreted as food washing behavior. Raccoons have relatively poor eyesight and a well-developed sense of hearing. They are very vocal animals.

Raccoons are nocturnal, being most active in the early evening. They prefer to den in hollow trees, but will also use old logs, rock ledges, and caves. In winter, raccoons may remain in the dens for several weeks at a time. Males tend to den separately from females with young. Males venture from their dens in January and February to breed. The male remains with a female in her den for a week or so and then moves on to find another mate. The female gives birth to a litter of four to five young in April or May after a 63-day gestation period. The young remain in the den until about 10 weeks old.

Raccoons are killed by coyotes, bobcats, large dogs, and vehicles. They also harbor a great variety of parasites. Harvest of raccoons in 1980 was 5055 statewide and 254 in Boulder County.

Selected References--Lotze and Anderson (1979); Rue (1965); Tester (1953).

S. W. H.

RINGTAIL

Bassariscus astutus

Distribution--The ringtail occurs throughout western North America, from southern Oregon and northern Utah southward to the Isthmus of Tehuantepec in Mexico. As yet, the species is not known from Boulder County. However, one should strongly suspect its presence. Ringtails have persisted at fairly high densities in many localities for many years before they ever were seen or captured, and the Boulder Mountain Parks contain a great deal of suitable habitat. The locality of record nearest the Parks is a place 3 miles west of Golden in Jefferson County. Ringtails should be expected at such places As Eldorado Springs, Gregory Canyon, and Buckingham Park.

Description--With their immense, ringed tails, these clearly are relatives of the raccoon, but ringtails are much smaller and more slender than their cousins. Adults are 650 to 700 mm. long and have tails 300 to 350 mm. in length. Condylobasal length is about 70 to 75 mm., and zygomatic breadth is 40 to 50 mm. The animals are grayish yellow above, paler below.

Natural History--Ringtails are wonderfully agile animals, well suited to life in rocky terrain. They move quickly and quietly, ricocheting off walls and "chimney-stemming" to make their way through the habitat. By doing a hand-stand, they can turn around with ease on a shelf narrower than their own body, and they are slim enough to pursue mice or woodrats into quite small crevices.

Their abilities as "mousers" won them a place in the mining camps of the Southwest, where they were known as miners' cats or ringtailed cats, but, of course, they are not cats at all.

The animals den among rocks or in treeholes. There is no permanent home, however. Ringtails are active throughout the year.

The diet consists mostly of rodents, lizards, birds and their eggs, and occasional insects and carrion. The kidneys are sufficiently efficient that the animals probably never need to drink. Unlike raccoons, they may be found well away from standing water.

Ringtails often hunt in pairs or larger family groups. The breeding season is in spring. A litter of three or four altricial young is born in May or June. The young grow quickly and disperse their first autumn.

Selected References--Armstrong (1982); Taylor (1954); Trapp (1972).

D.M.A.

PINE MARTEN

Martes americana

Distribution--The pine marten ranges from Alaska southward to northern California, northern New Mexico, and through Canada to the east coast. In Colorado, the species occurs in higher mountain elevations in the western two-fifths of the state. They may range occasionally onto the western edge of the Boulder Mountain Parks.

Description--The marten's beautiful brownish, soft, and silky fur is its most distinguishing characteristic. The long, slender body is the size of a house cat and is supported by short legs with hairy feet. The ears are small and rounded and the bushy tail is darker in color than the body. The throat has a large, orange patch.

External measurements of a female from Garfield County were: total length, 612; tail, 210; hindfoot, 76; weight 570 gr. Skull measurement means for males and females respectively are: condylobasal length, 71.3; zygomatic breadth, 39.1.

Natural History--The pine marten is found principally in mountainous areas from 9,000 feet to the tundra zone. Its preferred habitat is subalpine forest. The marten is arboreal and nests in old stumps, tree hollows, or under rocks. Pine martens are active throughout the year and are mostly crepuscular, except during the breeding season when they are diurnal. The animals are solitary; male encounters are wholly antagonistic.

The bulk of the pine marten's diet consists of small mammals, especially chickadees, red-backed voles and meadow voles. In winter the marten also eats snowshoe hares, and in summer eats insects, berries, fruits, and seeds. The marten's highly developed senses of hearing, smell and sight make it an excellent hunter.

Martens breed in midsummer; females have a fifteen day estrous cycle and give birth approximately 260-280 days after copulation. The gestation period is so long due to delayed implantation. One litter of three is produced per season. Young are precocial. They suckle for six to seven weeks; they are independent at three months.

Predators include the golden eagle, bobcat, weasel, fox, coyote, great horned owl, goshawk, and man, who traps the animal for its valuable and popular fur. Diseases are few, although roundworm and lungworm do occur occasionally. Longevity is approximately ten years.

Selected References--Remington (1952); Rue (1981); Yeager (1957).

M.A.M.

ERMINE

Mustela erminea

Distribution.--The ermine, or short-tailed weasel, is found in woodlands and brushy areas covering most of Canada, south to northern California and northern New Mexico and also in northeastern U. S., from Iowa to Maryland. In Colorado, the species occurs in forests of mountainous parts of the state, sometimes above timberline and often reaching the foothills, as in Boulder Mountain Parks. Museum specimens are available from Boulder.

Description.--An elongate body, dark brown above and yellowish-white below, with a short tail (35-40 percent of body length), characterize the ermine and distinguishes it from the long-tailed weasel. The least weasel (M. nivalis) is not known to occur in Colorado; its tail lacks a prominent black tip. During winter, the pelage of the ermine is completely white except for the black tip on the tail.

Measurements of two males and a female from the Colorado mountains are: total length, 227, 243, 206; tail, 60, 64, 51; hindfoot, 30, 31, 25; condylobasal length, 33.6, 33.9, 31.5; zygomatic breadth, 17.0, 17.6, 16.2. Females weigh about 50 gr., males as much as 100.

Natural History.--Ermines are the smallest carnivores in North America. In Colorado they inhabit a diversity of ecosystems, from sagebrush and aspen woodlands to sparsely scattered ponderosa pine, to dense forests and tundra. They den in hollows beneath logs, stumps, brush piles, and stone walls, usually with several entrances to a chamber which contains a nest of vegetation and hair. Ermines rarely are seen anywhere on their range.

The animals are carnivorous, preying on shrews, voles, chipmunks, larger rodents, and small lagomorphs. Two species, the deer mouse and the long-tailed vole, are staples of the diet. These two prey species are active all winter and thus are a principal food for the ermine, which forages beneath the winter snow.

Females mate in July but do not give birth until the following April. Delayed implantation of the zygote allows development to proceed for two months following fertilization, with a dormant period until January, when the embryo implants. Average litter size is four to six. Young are born blind, but with fine hair. Few studies have been done on further development; indeed, little is known about most aspects of the biology of the ermine, especially in the West.

This species sometimes falls prey to an owl or eagle and occasionally one is hit by a car. The winter fur is highly valued and leads to trapping by man.

Selected References.--Armstrong (1972, 1975); Hall (1951); Quick (1951).

K. L. S.

LONG-TAILED WEASEL

Mustela frenata

Distribution--The long-tailed weasel is a species which occurs from southern Canada southward to northern Bolivia. In Colorado, the species occurs statewide, from the lowest elevations to well above timberline in the mountains. They are found on the eastern plains, in open woodlands, forested areas, and in alpine habitats. They occur throughout the Mountain Parks.

Description--In summer, weasels are brown above, white below, tinged with yellow and continuous to the inguinal region, and have a short black tip on the tail. In winter the animals are completely white, except for this black tip on the tail. The species is slender bodied with a tail longer than 44 percent of its body. This long tail distinguishes it from Mustela erminea, a sympatric species with which it is sometimes confused.

Mean (and extreme) external measurements of four males, followed by those of nine females, all from Delta and Gunnison counties were: total length, 427.5 (410-441), 351.3 (318-378); tail, 148.5 (139-126.5 (111-155); hindfoot, 44.0 (41-49), --; ear, 21.5 (16-26), --; weight, --, 148.23 gr. (113-196). Condylobasal length ranges from 48.1 mm. to 51.2 in males and 41.0 to 43.9 in females. Zygomatic breadth is 27.4 to 29.9 in males and 22.5 to 23.6 in females.

Natural History--Long-tailed weasels inhabit all types of areas as long as water is available. The animals nest in burrows which are usually originally excavated by ground squirrels. Burrows are sometimes located in rock piles, crevices, or rotten logs and usually no more than 3 feet long. Nest is 9 to 11 inches below ground and sometimes lined with shrew and mouse fur as well as grass material. The animals are mainly nocturnal, although they are active during the day. They usually hunt alone.

Food consists almost entirely of small mammals. Females feed on smaller prey such as mice and shrews, while males prefer young snowshoe hares, cottontails, and tree squirrels. Males hunt more small voles and mice in winter when these species are more abundant. Snakes, frogs, birds, and insects also are eaten to a lesser degree.

Breeding takes place in July or August, but the species exhibits delayed implantation and all development is suspended at the blastocyst stage for 9½ months. The embryo is implanted in spring, and females give birth to one litter per year in April or May. Young are cared for entirely by the mother. They begin to disperse when 10 to 12 weeks old. Longevity is unknown.

Predators on this species include owls, hawks, coyotes, foxes, and snakes. Home ranges are greatly influenced by the abundance of prey and may be as small as 30 to 40 acres when prey is readily available.

Selected References--Hall (1951); Jones et al. (in press); Quick (1951).

B.J.L.

BLACK-FOOTED FERRET

Mustela nigripes

Distribution--The black-footed ferret once occurred throughout central North America, including the Great Plains and the Wyoming Basin. There are no records from Boulder County, but the species doubtless once occurred here, because the range of this carnivore was virtually coextensive with that of its typical prey, prairie dogs. At present, the range of the black-footed ferret seems to be restricted to parts of South Dakota and Wyoming, although there are occasional reports unconfirmed from eastern Colorado.

Description--This is a fairly large, rather heavy-bodied weasel with a prominent face mask. The general body fur is dirty tan in color, and the face, ears, feet and tip of the tail all are black. In some parts of their range they may be confused with long-tailed weasels, but locally Mustela frenata does not have a face-mask. The European ferret sometimes is released or escapes from captivity. Aside from subtle differences in color and cranial details, domestic ferrets are virtually indistinguishable from native, black-footed ferrets.

Ferrets are 450 to 500 mm. long, with a tail 100 to 120 mm. in length. Condylobasal length ranges from 60 to 67, and zygomatic breadth is 37 to 42 mm. Males average larger than females, but sexual dimorphism is much less pronounced than in many other weasels.

Natural History--Black-footed ferrets are highly specialized predators, preying almost exclusively on prairie dogs. They also are known to capture ground squirrels and probably eat some carrion as well.

Ferrets live in abandoned prairie dog burrows and are almost entirely nocturnal. However, in winter there may be some diurnal activity about the entrance to the den.

It is to be hoped that efforts to save the black-footed ferret from extinction will be successful. Perhaps one day there will be enough ferrets that they can be reintroduced to parts of their historic range where prairie dogs still are allowed to persist.

Selected References--Hillman and Clark (1980).

D.M.A.

MINK

Mustela Vison

Distribution--The mink is found throughout the continental United States except the extreme southwest, and in Canada except the extreme north of the Hudson's Bay region. In Colorado the mink is found in the central mountains around beaver ponds to above 10,000 feet elevation, and in localized populations in wet areas on the plains. Perhaps they occur occasionally in the Boulder Mountain Parks.

Description--The mink is weasel-like in shape with a long, thin body and short legs. The toes are partially webbed. The rich, dark pelt, with scattered white spots on the chin and belly in some individuals, distinguish this species from other members of the weasel family. External measurements of a male from eastern Rio Blanco County, Colorado, were: total length, 548; tail, 171; hindfoot, 58. Weight of males ranged from 875 to 1475 gr. (mean, 1150). Condylobasal length ranges from 61.6 to 69.5; zygomatic breadth from 36.6 to 39.7. Males are about 10 percent larger and twice as heavy as females.

Natural History--Being semi-aquatic predators, mink are found in the vicinity of water. Preferred habitats are marshy areas and relatively shallow rapid streams with complex pool and eddy structure. Distribution of activity follows areas of prey availability, though distribution of small mammals does not account for mink distribution. The animals are primarily nocturnal, though diurnal activity may increase in periods of extreme cold. Mink do not hibernate. They frequently inhabit the dens of muskrats. They are not efficient burrowers.

The diet consists of whatever they can catch in their aquatic and terrestrial habitat. Adult muskrats are rarely taken, but muskrat young and other small mammals, fish, frogs, waterfowl and eggs and invertebrates such as crayfish and aquatic insects are taken according to availability.

Mink begin breeding in late February, and mating continues through the first week of April. There is some delay of implantation of ova from earlier matings. Litters of two to eight altricial kits are born in May, and lactation continues through late June. Litters stay together until late August and groups of kits or mothers and kits may remain together until late autumn.

Young disperse in the autumn. Migration of adults as far as 20 miles in search of new habitat in times of drought has been recorded. Home range averaged 50.4 acres for males and 19.3 acres for females along a stream in Montana. Mink are not territorial. Density varied from 22 to 9 per 259 hectares over two years in Montana.

Selected References.--Enders (1953); Errington (1943); Linscombe et al. (1982); Poole and Dunstone (1976).

J. I. K.

WOLVERINE

Gulo gulo

Distribution--The wolverine is a Holarctic species. In North America it ranges from the Arctic tundra and boreal forests, southward into the higher western mountains where they are scarce. In Colorado, early reports showed a few animals scattered throughout the higher mountains.

Description--As the largest mustelids, wolverines look like small bears with stocky, powerful legs and dark, bushy tails. Their blackish-brown pelage is interrupted by two pale brown or yellowish stripes which extend from behind each shoulder to the base of the tail. Also, they often have paler patches from eye to ear on each side of the head, on the throat, and irregularly on the underside.

Measurements from Alaska display sexual dimorphism with males generally larger than females. They range in total length from 650 to 1050; tail, 170 to 260; weight, 14 to 27.5 kg.; height at the shoulders, 355 to 432. Greatest length of skull ranges from about 139.8 to 170.3 mm. for males and 139.3 to 161.4 mm. for females, with a zygomatic breadth of 100.3 to 107.3 mm. and 90.7 to 103.8 mm. for males and females, respectively.

Natural History--Due to their scarcity, virtually nothing is known about wolverine habitat requirements locally. Their dens often are found among boulders and in caves, especially along ravines. They are active throughout the year and, although primarily nocturnal, they have also been reported to display a continuous activity cycle of alternate 3 to 4 hour periods of activity and sleep.

Diets in Colorado have not been documented, but elsewhere they are reported to eat any meat, from small rodents and birds to moose. Although most food items are taken as carrion, they have been known to actively hunt large animals, especially when the prey is hindered by deep snow. Wolverines also may eat larvae, eggs, and berries seasonally.

Breeding occurs from May to July with the blastocysts remaining unimplanted 5 to 8 months, followed by a 30- to 40-day active gestation period. Most young are born in February and March, with litter size ranging from one to six and averaging about 3.5.

Selected References--Halfpenny, et al. (1979); Rausch and Pearson (1972); Wilson (1982).

M.J.W.

BADGER

Taxidea taxus

Distribution--The badger ranges from northern Alberta and Saskatchewan southward deep into Mexico, including Baja California. Its boundary in the West is almost the Pacific Coast, and it ranges eastward to the Great Lakes region and eastern Kansas, Oklahoma, and the middle of Texas. It is found throughout Colorado, and sign is scattered throughout the Mountain Parks.

Description--The badger is a fairly large mammal of a stocky build with short legs and a flattened, cylindrical body. The fur is grayish white with some light brown or yellow. The feet are black, and the fore-feet claws are extremely long and strong. A median white stripe runs from the nose across the head and partway down the back. The sides of the face are mostly white, but the eyes and nose are black. The badger is not easily confused with sympatric species.

Total length is 560 to 740; tail length of 98 to 155; hind foot 95 to 128. Males are larger than females and typically weigh around 8.5 kg., but they nay be as large as 11.5 kg. Females average from 6.4 to 7.1 kg. Cranial measurements also emphasize the sexual dimorphism in badgers. Greatest length of the skull in males ranges from 109.1 to 138.2, in females, from 108.5 to 130.5.

Natural History--The badger is adapted to a wide variety of habitats. It is found from alpine tundra down to sea level, and it can occur in almost any terrain, except for areas with heavy tree growth and large amounts of talus, features that hinder digging.

The badger is carnivorous, but some vegetation has been found in scats. Its primary food sources are fossorial and semifossorial rodents like pocket gophers, ground squirrels, marmots, chipmunks. However, badgers take many other kinds of rodents including mice and tree squirrels. Although the badger's diet is basically mammalian, the availability of reptiles and insects in summer can increase dietary diversity.

Badgers are not hibernators, but during cold winter days they confine their activities to their burrows for extended periods, and they may also undergo a decreased heart rate and diurnal hypothermia. Normally, badgers are nocturnal, but they can be seen at any time of day.

Mating occurs in late July and August; however, like many members of the weasel family, implantation is delayed in badgers until February. Only one litter occurs per season, and the young are born in late March or early April. Litter size varies from one to five, and lactation lasts from five to six weeks. Cubs remain in the den until four or five weeks old, and the female takes care of the young until ten or twelve weeks of age.

Selected References--Lindzey (1982); Long (1972, 1973); Wright (1966).

J.C.O.

WESTERN SPOTTED SKUNK

Spilogale gracilis

Distribution--The western spotted skunk is distributed over most of the western United States, from Colorado and Wyoming westward and southward into Mexico. There are records from several localities along the foothills of Boulder County.

Description--The spotted skunk is smaller in size than the more familiar striped skunk, and its black coat is marked with white spots instead of stripes.

Measurements of two males are: total length, 430, 390; tail, 45, 45; weights of males range from 500 to 900, females, 450-600. Condylobasal length of males ranges from 54 to 60; zygomatic breadth, 35 to 39; females average 10 percent smaller.

Natural History--Spotted skunks inhabit brushy, grassy, or sparsely wooded areas, often near farms or settlements. Dens are usually underground in abandoned holes, under buildings or occasionally in holes in trees. There are three major requirements for dens--darkness during daylight hours, protection from inclement weather (especially moisture), and protection from enemies. Because skunks are nocturnal, they rely heavily on their keen sense of smell and hearing which aids them in their search for food--mice, birds' eggs, insects, carrion and some vegetable matter.

Western spotted skunks show delayed implantation. Copulation occurs in September, but development is suspended at the blastocyst stage until April. Young are born in May. Females have been known to have up to six young.

Although spotted skunks have been thought of as a menace because of their musk, which they are capable of propelling from a "hand-stand" position over their heads to a distance of six feet, they are probably a very effective controller of rodent populations. Humans and dogs reportedly account for as much as 50 percent of mortalities.

Selected References--Crabb (1948); Mead (1968); Van Gelder (1959).

P.J.W.

STRIPED SKUNK

Mephitis mephitis

Distribution--The range of the striped skunk extends from southern Canada to northern Mexico and through most of the United States, except for the most arid regions. Coloradan skunks occupy most of the state, especially wooded urban areas and heavily cultivated areas. In Boulder County, skunks are most common in woodland and riparian ecosystems, but may be encountered anywhere.

Description--The characteristic color pattern of these skunks makes them easily distinguishable from other mammals. Skunks are most commonly black with a white dorsal stripe, but there are color morphs of seal brown and yellow. Another common trait is a white tuft at the end of the tail. Two males and a female from eastern Colorado showed the following external measurements: total length, 640, 745, 640; tail, 285, 320, 285; hindfoot, 75, 75, 75. Condylobasal length of 16 males averaged 77.38 (73.4-82.9), of all females, 69.96 (68.3-71.7); zygomatic breadth, 50.19 (44.8-52.6), 44.44 (43.2-46.2). Females average about 2.5 kg., males perhaps 5 kg.

Natural History--The habitats of skunks vary greatly from woodlands to cultivated fields to urban areas. Although skunks themselves normally do not burrow, they inhabit single-entranced burrows abandoned by badgers and woodchucks. They use these burrows as shelter in the winter and females communally occupy them throughout the year to protect their young. Skunks do not hibernate and are mostly nocturnal.

Skunks are opportunistic feeders. They eat insects, especially grasshoppers, fallen fruit and foliage, small mammals, birds' eggs, and nestlings, and carrion.

The breeding season is in February and March and the young are born 60 to 77 days later. The females have one litter of two to ten young which are altricial and remain in or near the nest for at least two months.

Flying predators, such as eagles and owls, often prey on striped skunks, as do terrestrial predators, including coyotes, badgers, and foxes. Skunks have a unique and well known defense mechanism of spraying musk from their anal canal up to 6 meters. This foul smell repels many predators. Their distinctive coloration provides added protection by warning would-be predators of their potential. These defenses are not effective against vehicles, of course, and hence, skunks become traffic fatalities to a disproportionate extent. Striped skunks carry numerous parasites and diseases of which rabies causes the most concern.

Selected References--Verts (1967); Wade-Smith and Verts (1982).

K. M. K.

RIVER OTTER

Lutra canadensis

Distribution--The river otter is a wide-ranging mammal, occurring from northern Canada and Alaska southward through most of temperate North America, except for some parts of the desert Southwest. The animals apparently never were very abundant in Colorado, partly because the winter flow of streams is so low that suitable habitat for winter foraging was minimal. However, there are historic records for all of the major drainages of the state, and probably the animals once occurred sparingly in Boulder County. At least, an otter was among the species exhibited by pioneer Boulder naturalist, Mrs. M. A. Maxwell, at the Philadelphia Exposition in 1876. Otters were extirpated from Colorado at about the turn of the century. Now they are being reintroduced from populations in the Great Lakes states and eastern Canada. One can hope that the Division of Wildlife will be successful in these efforts. Otters are wonderfully entertaining carnivores, if nothing else, and they also are important members of their riverine ecosystems, wherever they are abundant.

Description--Otters are of cylindrical build and have a long, round tail. The dense fur is brown above, and brownish gray beneath. The feet are almost completely webbed. A male from Nebraska was 1346 mm. long, of which the tail was 457 mm. The hindfoot was 120, and the ear 16.5. Weights of male otters average about 7 to 8 kg., and females are some 10 percent lighter.

Natural History--River otters are the most strongly aquatic of North American carnivores. They feed on a variety of aquatic species, including fish, crayfish, frogs, turtles, and young muskrats and beavers.

Otters do not burrow, but do den in holes dug by other species, and also in abandoned beaver or muskrat lodges, which they may enlarge a bit. Where otters are common, a sure sign of their presence is a slide down a muddy or snowy bank into open water. However, one must be careful not to interpret similar signs made by beavers as that of river otters.

Otters breed in early spring, but the blastocysts remain unimplanted until the following winter, January or February. The young are born in March or April and are highly altricial, although fully furred. The eyes open at about five weeks. Mating occurs during the lactation period. Beyond that, males generally avoid other otters until the young are about six months old, but then may play with his offspring. Play is the proper term for what otters do; they seem to have abundant leisure time and they enjoy spending it in unproductive pursuits, like romping through the marsh or skidding down mudbanks.

Selected References--Hamilton and Eadie (1964); van Zyll de Jong (1972).

D.M.A.

MOUNTAIN LION

Felis concolor

Distribution--The natural distribution of the mountain lion is one of the most extensive known for mammals of the Americas, once extending from the tip of South America into the northern parts of British Columbia, and continent-wide. In Colorado, it is restricted mostly to areas west of the plains, but, in the past, it occasionally moved east along streams. They are occasionally reported from the Mountain Parks.

Description--Mountain lions are variable in color; the upper parts of the local subspecies are tawny to light cinnamon-colored. On the underside of its neck, chest, belly, and on the inner sides of its legs, they are whitish. Ears and tail are black-tipped. Distinguishing the mountain lion from other species of local cat is not very difficult; they are much longer and have very long tails. A male from Grand County was 2105 mm. long, of which 803 mm. were tail. The hindfoot was 292 and the ear 105. Condylobasal length is 160 to 200, zygomatic breadth, 125 to 150. Males weigh to 40 kg., females somewhat less.

Natural History--The mountain lion is secretive, preferring rugged areas which have high relief and provide abundant stalking cover in the form of thick vegetation and/or rocks.

The hunting prowess of this animal is extraordinary. Silently stalking its prey, and then pouncing on the back of its victim, the mountain lion will capture up to 100 deer over the course of a year. Because of its dietary preference for these herbivores, it will often be found in association with large populations of deer. Less frequently, this felid will also prey on porcupines, elk, and domestic animals. Sometimes, they even eat grass in small quantities, possibly for roughage.

These animals first reproduce when they are two or three years old, breeding thereafter at one- or two-year intervals, at any time of the year. After 3 months of gestation, females give birth to litters of one to six kittens. Lactation usually lasts about 5 weeks, and the young will depart 1 or 2 years after birth. The longest they have been known to live is about 18 years.

They have no natural enemies, other than man, though it is said that they will tend to avoid conflict with grizzly bears. In 1975, 90 mountain lions were harvested in Colorado.

Selected References--Currier, et al. (1977); Hornocker (1969); Robinette, et al. (1959, 1961); Young and Goldman (1946).

J. M. McC.

LYNX

Felis canadensis

Distribution--The lynx is an Holarctic animal that inhabits parts of the U.S. and Canada and northern Eurasia. In Colorado, the lynx is found in boreal forests, mostly above 9,000 feet. Its occurrence in the Boulder Mountain Parks would only have been occasional.

Description--The lynx is moderate in size with long legs, especially the hind ones. It has large, well-furred paws, tufted ears, and long, black whiskers. It is a pale grayish brown color with a buffy venter and mottled black spots on the back and legs. The black-tipped tail is important in distinguishing the lynx from the bobcat, which has a black-striped tail. The tail of the lynx is also shorter, less than one-half the length of the hindfoot, whereas a bobcat's tail is longer than one-half the length of the hindfoot.

External measurements of a male from Gunnison County are: total length, 940; length of tail, 121; length of hindfoot, 241. The cranial measurements include condylobasal length, 117.2; zygomatic breadth, 91.2. Male lynx weigh anywhere from 6.8 to 18.1 kg. Females are smaller than males.

Natural History--Lynx live in dense boreal forests, with mean intertree distance less than 5 ft. Lynx seldom are seen as they avoid man. When a lynx is sighted, however, it is usually at large boulder outcroppings and on a north-facing slope. Lynx are not known to make dens. They lie on the snow leaving shallow indentations which then serve as nests. Another sign of lynx is the distinct tracks. They are shallow and less than 85 mm. wide; straddle, greater than 180 mm.; and stride, greater than 430 mm. Lynx are solitary animals except during mating and kit rearing.

Not much is known about the reproductive cycle of the lynx. The estrus pattern of the female is thought to be similar to that of the mountain lion and domestic cat, which are seasonally polyestrus. Kittens are born from mid-May to mid-June. Gestation is from 67 to 74 days, and it is thought that the lynx may be an induced ovulator. A female has one litter per season which ranges in size from one to five kittens. Kittens are usually weaned at five months.

The lynx population in the north is closely parallel to the population of its chief food source, the snowshoe hare. The population rises and falls in a ten-year cycle; what causes this cycle is still unknown with certainty. The peaks and lows of the hare population can be seen in the lynx population the following year in the cycle. This pattern can also be seen in the reproduction pattern of the lynx.

Selected References--Halfpenny and Miller (1981); Nellis *et al.* (1959).

A.M.J.

BOBCAT

Felis rufus

Distribution--The bobcat is found in rough, broken terrain from southern British Columbia southward to southern Mexico and in suitable habitat over most of the contiguous United States. The species occurs in canyon and foothill areas throughout Colorado and sparingly on the eastern plains where adequate cover exists. Several animals have been documented in Boulder County. The animals occasionally are sighted on the Mountain Parks.

Description--This medium-sized predator can be compared to a large domestic cat with average weights up to 25 pounds (11.4 kg.). A record individual from Colorado weighed 69 pounds (31.4 kg.). Distinguishing features include a very short tail and short tufts of hair extending from the ear tips. A shorter, redder, more brownish coat, tail with black top and white bottom, shorter ear tufts, and a preference for rough, broken country rather than dense forests separates the bobcat from the lynx. Adults have grayish, buffy, or reddish upper parts and whitish under parts. Black spots appear on the upper body and legs.

External measurements of a male from Delta County were: total length, 928; tail, 152; hindfoot, 187. Average (and extreme) cranial measurements of four males from Rio Blanco and Garfield counties were: condylobasal length, 122.32 (120.1-126.3); zygomatic breadth, 94.37 (91.2-97.4).

Natural History--The bobcat inhabits rough areas with brushy cover and rocky outcrops. Typical cover includes sagebrush, mountain mahogany, and juniper. Such habitat provides excellent hiding places important to the stalking and surprise tactics used in hunting.

Bobcats are nocturnal and rarely seen. Scratch marks on the soil around partially covered scat on trees or stumps are indicators of its presence. Tracks may also be found in snow, since this animal is active year round. Dens are located in crevices, caves, hollow logs, or other protected places, and are utilized only a few days, unless young are being reared.

Females have one litter from mid-January to July. Litter size ranges from one to six. Kittens are nursed two months before prey is brought to the den. Males do not participate in care of young. In three to five months, kittens are led from the den to search for prey. Adults usually are solitary and seek areas with adequate cover and food supply. Bobcats may reach 12 years of age in the wild.

Diet is composed chiefly of rodents and rabbits though bobcats feed on anything they can surprise and overpower. In winter or times of stress, carrion may be utilized, and sometimes a small deer will be taken. Hunting prowess depends on well-developed sight, hearing, and swiftness. It will seldom pursue prey more than a few meters if it cannot make a quick kill.

Selected References--Bailey (1974); Crowe (1975); Ryden (1982); Young (1958).

D.J.A.

WAPITI, OR AMERICAN ELK

Cervus elaphus

Distribution--With the exception of a few reintroduced populations, the wapiti or American elk is now restricted in its distribution to the western United States and Canada. Populations occur in Nebraska, South Dakota, and all states west of the Colorado-Kansas border. In Colorado it occurs west of the Front Range to the Utah border, including western portions of Boulder County. Occasionally, they wander onto the Boulder Mountain Parks, but that is not a typical part of their range.

Description--Both male and female wapiti are large, standing 160 cm. (5 ft.) at the shoulder, but the weight of males (330 kg., or 480 lbs.) is, on average, 35% greater than that of females (220 kg., or 480 lbs.). In winter the pelage of both sexes is brown, but the head and long neck mane are typically much darker than the sides which are covered with varying amounts of gray. The legs are normally darker still, being almost black. The summer pelage, although it retains the same pattern, is more reddish and lacks the soft insulating undercoat of the winter pelage. The tail is rudimentary and the rump patch tawny.

Natural History--Wapiti, being migratory, have ecologically distinct summer and winter ranges. Herds in Rocky Mountain National Park spend the summer months at elevations between 3,000 and 3,600 meters and prefer the Krumholz ecotone to all other habitats. Vegetation in this area includes stunted Englemann spruce and subalpine fir. The summer diet is composed primarily of grasses with shrubs and forbs making up progressively smaller portions.

During September and October, wapiti migrate to the winter range between 2,500 and 2,800 meters. Within the winter range, no one habitat is clearly preferred, but pine, ponderosa pine-shrub, and wet meadow habitats predominate. In summer grasses make up the bulk of the diet, but shrubs are browsed and forbs are of lesser importance than in winter.

Wapiti return to the summer range in May and June. However, pregnant cows separate from the rest of the migrating herd to calve. Usually, there is but one calf born (twins make up less than 1% of all births) following a gestation period of approximately 250 days. The odorless calf, after being hidden by its mother, remains motionless and separated from her for much of the day. The cow contacts the calf only to nurse it and to stimulate it to void feces. Newborn calves weigh between 10.4 and 20.4 kg. (23-45 lbs.) and develop rapidly; cow and calf may rejoin the herd within three weeks after birth.

Mature wapiti are bothered little by predators, but calves may be taken by coyotes, bobcats, and mountain lions. Some calves have been reported killed by domestic dogs. Thirty-one elk were harvested in Boulder County in 1975; nearly 15,000 were taken statewide.

Selected References--Baker and Hobbs (1982); Murie (1951); Thomas and Toweill (1982).

R.J.J.

Odocoileus hemionus

Distribution--The mule deer is a western species, ranging from the Pacific Coast eastward to the Great Plains and from southern Alaska to central Mexico. In Colorado it occurs statewide, wherever suitable forest edge, woodland, or brush habitat occurs. It is a common species throughout the Boulder Mountain Parks.

Description--Mule deer are of moderate size, standing 1 meter tall at the shoulder. They have a coarse pelage that is reddish to yellowish brown in summer and dark brown to gray speckled with white in winter. The large ears are black on their front borders, and there is a white rump patch, a narrow, black-tipped tail, and males have dichotomous antlers. Average weights of bucks are about 120 kg., and of does 60 to 70 kg. Total length is 1,200 to 1,800, and the tail is 100 to 230 mm. long. Basilar length of skull ranges from 200 to 290, and zygomatic breadth is 90 to 135.

Antlers grow on males and are a rare freak on females. Mature deer normally have five tines on each side. Fewer tines indicate youth, disease, or old age, and more indicate parasite damage or injury. Most mature racks measure 60 to 90 cm. across and are shed in February or March of each year; replacement begins immediately.

Natural History--Mule deer are browsers, feeding on the terminal shoots of a variety of shrubs. The most important foods in summer are aspen, willow, and vaccinium, and winter foods are skunkbush, sagebrush, bitterbrush, and mountain mahogany, with a preference for recent growth. No one browse species furnishes all needed nutrients at a given season. A variety of browse species is essential to a healthy population.

Mule deer migrate between summer and winter range. Summer range for bucks may extend above timberline, but does and fawns remain somewhat lower. Deer are driven to winter range by snows in about October and move back up with the melt in spring. Deer typically concentrate on winter range, but the high year-round populations on the Boulder Mountain Parks are atypical. That herd very much deserves the studies now planned and in progress.

Rut begins in November; bucks' necks swell and sparring begins. Breeding is polygamous. The peak of the breeding season is mid- to late November. Both bucks and does begin breeding at about 18 months. Gestation is about 200 days, with peak of fawning in mid-June. Birth weights are 4 to 5 kg. The precocial fawns are covered with spots which disappear at the end of the first summer. Fawns are kept kidden; mothers return to them only to feed them. After a few weeks, fawns follow the mother as she feeds. Does usually are mutually intolerant when with fawns, but there are reports of does cooperating to defend fawns from coyotes. Fawns are weaned in autumn and are independent of their mother at 12 months.

Predators of the mule deer include coyotes, bobcats, mountain lions, black bear, golden eagles, and dogs. Deer serve as host to a variety of parasites. Hunting is now the principal check on populations. In 1975, nearly 128,000 deer were harvested in Colorado, most of them mule deer; of those, only 128 were taken from Boulder County.

Selected References--Anderson and Medin (1979); Loveless (1967); Taylor (1956); Wallmo (1982).

S.V.H.

WHITE-TAILED DEER

Odocoileus virginianus

Distribution--The white-tailed deer has a wide distribution over the continental United States; its range includes most of North America with the exception of Utah, most of Nevada, northern New Mexico, California, northwest Arizona, and parts of western Colorado. They wander into the Boulder Mountain Parks occasionally, but they are much more abundant farther eastward on the Plains.

Description--Two distinct pelages, summer and winter, characterize this deer. The summer pelage is predominantly a chestnut brown to grayish color, whereas the winter pelage is of much grayer color. In both pelages, however, the underparts, the lower surface of the tail, chin and throat, a band around the muzzle, and rings around the eyes remain white throughout the year. The young are spotted.

The white-tailed deer is distinguished from the mule deer by antlers that develop tines from a single main beam, whereas those of the mule deer develop as Y-shaped branches. The tail of the white-tailed deer is a broad, white flag; that of the mule deer is rope-like.

External measurements for a male were: total length, 1826 mm.; tail, 152; hindfoot, 488; ear, 140; and weight, 150 lbs. Females appeared to be a quarter to a third smaller than males. Greatest length of skull ranges from 290 to 350 mm. in males, 250 to 290 in females. Zygomatic breadth ranges are 120 to 145 mm. in males, 102 to 120 in females.

Natural History--Optimum habitat for white-tailed deer is areas of secondary growth in intermediate stages of succession. Forests, woods, and swamps provide protective cover for the deer during the day.

At dawn and dusk, they come out to feed. Because of its ruminant stomach, the deer is able to eat first and chew later, when it is more comfortable and in a more protected situation. Food consists mainly of twigs, mosses, evergreens, grass, leaves, lily pads, clover, nuts, and berries.

Females bear one fawn the first year and generally two thereafter, giving birth in late spring. Females provide all care for the young. The spotted coat of the young allows for blending into most any background. Longevity is from 10 to 15 years, with the animals' prime at 7 to 8 years of age.

Home range generally is about one square mile. The animals are not strongly migratory, but they may make occasional shifts to more sheltered areas in winter or due to lack of food. Predators include mountain lions, bobcats, coyotes, and man, who harvests them deliberately as game and kills others inadvertantly in vehicular accidents.

Selected References.--Cahalane (1961); Rue (1962, 1968); Seton (1929).

P. D. S.

PRONGHORN

Antilocapra americana

Distribution--The pronghorn once ranged over most of western North America, from southern Canada to northern Mexico. It ranged throughout most of Colorado, including mountain parks as well as the eastern plains and the broad basins of the northwest. The species no longer occurs in Boulder County, but once was part of the fauna of the eastern prairies, doubtless ranging up to the base of the foothills.

Description--Pronghorn are familiar and unmistakable mammals. Their forked horns are unique among living species (although their peculiarly North American family was widespread and abundant in the geologic past). Adults are about 1,400 mm. long (of which 100 mm. is tail), stand 1 meter high at the shoulder and weigh 50 to 60 kg. (bucks being heavier than does). Basilar length of the skull is 240 to 260 mm., and zygomatic breadth of the skull is about 135.

The pale reddish brown pelage is of coarse, hollow, brittle hairs, which provide excellent insulation. The underparts and rump are white and the face has prominent white markings. The eyes appear to be abnormally large, partly because they are set on the sides of the head and hence give the animals a wide view of their environment, both fore and aft.

Natural History--Pronghorn are opportunistic herbivores, feeding on brush (especially sagebrush), grasses, and forbs, as opportunity allows. The most actively growing, hence most nutritious and succulent, species are taken in season.

Pronghorn are highly adapted to open country. They live in herds and have keen eyesight. A tail flash warns of danger. These are the swiftest of North American land mammals, capable of short bursts of speed to 70 miles per hour.

On summer range, does form small bands with kids, and bucks form bachelor herds. Mature, breeding bucks are solitary and territorial, repelling other bucks through the warmer months, until the end of the rut in autumn. These solitary bucks do most of the breeding. Females occasionally breed their first summer, but typically breed first as yearlings. Males generally are unable to establish breeding territories until three years old.

Gestation takes about 36 weeks and the young (usually twins) are born in spring. Within three weeks they begin to move with the mother as she feeds.

Bobcats feed on pronghorn, as do coyotes and eagles. Adults are susceptible to predation mostly when deep snow hampers movement. Pronghorn are a major big game species in Colorado. This is rather remarkable, considering the fact that 60 years ago they were on the verge of extinction.

Selected References--Einarsen (1948); O'Gara (1978); Van Wormer (1969).

D.M.A.

AMERICAN BISON

Bison bison

Distribution--Originally the American bison ranged over most of North America except for the Pacific Coast and the southwestern deserts. In Colorado, they were found both on the open plains and in the mountains. However, because of extensive hunting and habitat destruction, these animals today are found only in game reserves, zoological parks, and other managed herds. The last wild bison seen in Colorado was in the Lost Park region of Park County.

Description--The American bison is a large animal with a massive head, humped shoulders, and a small tail. Long, wooly, brownish-black hair covers the head and shoulders. The rest of the body is covered with shorter, paler brown hair. An average male weighs about 800 kg., whereas females weigh about 550 kg. Total length is more than 2 m.; length of tail, 300 mm. The greatest length of the skull is over 500 mm.

Natural History--American bison were found mainly in open country, prairies, and mountain parks. Herd size varied greatly with season and locality. Mountain herds tended to be much smaller. Herds were divided into bull groups and cow groups, the latter including young of both sexes.

The bison was highly migratory, moving from place to place, but with no set pattern. When food was scarce or the weather bad, they would just move on to any suitable location. Basically, bison are slow moving, timid animals, yet when brought to bay or wounded, they will fight with ferocity.

Grama and buffalo grass were the main sources of food. However, when grass was scarce, they would browse on shrubs, such as sagebrush.

Females give birth to one offspring, very rarely twins, approximately every three years. The gestation period is nine months, and the young stay with their mother almost until the time that her next offspring is born. The young are quite precocial and wander with the herd a short time after birth. Bison live from 20 to 30 years.

Wolves and grizzly bears were the main natural predators of the American bison, yet the most dangerous predator proved to be man. From an estimated population of sixty million at the time of the arrival of the European settlers in North America, bison were reduced to fewer than one thousand individuals by 1889. Most of this killing was done for sport and market. During the peak years of the slaughter, an estimated 1,250,000 bison were killed annually. Fortunately, through the work of conservation organizations and governmental agencies, a few herds of bison have been left to increase their numbers, and we have not lost this magnificent species.

Selected References--Garretson (1934); McHugh (1972); Rorarabacker (1970).

E.M.M.

BIGHORN SHEEP

Ovis canadensis

Distribution--The bighorn sheep inhabits the Rocky Mountains from British Columbia to northern Mexico. There are some 42 bighorn bands in Colorado, in most of the major mountain ranges of the state. The bands closest to Boulder are those in Rocky Mountain National Park. Once the animals ranged throughout the foothills, but today they occur in the Boulder Mountain Parks only as occasional wanderers.

Description--Bighorn sheep are strong, agile climbers, distinguished by a yellowish-white rump patch which extends down the inside of the hind legs. Horns on mature rams curl back, whereas those of females and juveniles are rather erect spikes.

Total length ranges from 1200 to 2000; tail, 70-150; hindfoot, 275-480; weight of males, 55 to 125 kg.; females, 35 to 70. Zygomatic breadth is 117-135 (male), 107-123 (female).

Natural History--At present, bighorn sheep are inhabitants of timberline areas, which often are isolated and hard to reach. They occur year around on what once was summer range; formerly, they migrated to the foothills to winter. The diet is primarily grasses, supplemented with browse (willow, cinquefoil, spruce) and forbs (clover, bluebells, bistort, stonecrop, penstemon).

Bighorns often remain near precipitous ledges and cliffs as an escape route. They feed and sleep in a very restricted area, especially in winter where grazing grounds may be limited. Inclement weather, especially heavy snow, forces them to feeding grounds at lower elevations. High herd densities may affect disease transmission.

The rut occurs in fall. Rams dual for the right to breed by rearing on their hind legs and clashing horns. The female usually produces one lamb in late spring.

An important limiting factor in Colorado bighorn populations is a lungworm parasite, of which the intermediate host is a small snail. The resulting disease affects the respiratory tract, induces coughing spasms, pneumonia, and eventually death.

Selected References--Capp (1908); Contor and Contor (1964); Moser (1962).

O. D. P.

APPENDIX I. Forms and other hand-out materials associated with Mammalogy term project (EPO 476-576).

Mammals of the Boulder Parks - LIVE-TRAPPING RECORD

Date: _____ Time Set: _____

Time Checked: _____

Locality: _____

_____

_____ Elevation _____

Observers: _____

_____

Weather Conditions: _____

SPECIES	AGE	SEX	REPRODUCTIVE CONDITION	HABITAT

Mammals of Boulder Parks - FIELD RECONNAISSANCE

Date: _____ Time: _____

Route: _____

Distance: _____

Observers: _____

Weather Conditions: _____

Species: (Comment*)

*Indicate form of observation, (Animal, sign, call, scat, etc.), ecological setting ("in dead spruce snag", "under east-facing rock shelter", etc.), abundance, or anything else of possible interest.

EPOB 476/576--Mammalogy--1982

TERM PROJECT

In courses of this sort, students typically do a field project or research a term paper. We shall do both, combined in a peculiar (but I hope interesting) way.

Our term project will be a cooperative one. All of us will be involved in the research (field, library) and writing of a report on "Mammals of the Boulder Mountain Parks."

The report will be useful to the City of Boulder Parks and Recreation Department in both management and interpretive activities. The project is being done with their cooperation.

The project ought to be useful to students as well. It will provide experience in field and library research, writing, technical illustration (maps, graphs), and some aspects of publishing. The project should be great fun because it is not just an exercise.

Each student will have the following tasks:

1. Choose two or three mammalian species of the Boulder Mountain Parks.

2. Sign up in the laboratory on the form provided.

3. Prepare a review of all pertinent literature. For most species that will mean a complete annotated bibliography for that species in Colorado, including unpublished theses, technical reports, harvest records, etc., in addition to relevant papers from elsewhere in the species' range.

4. Complete a data summary sheet for each species, as thoroughly as the literature allows, with all entries referenced (name, date).

5. Write species accounts (400-500 words, 2 pp. typewritten, double-spaced) for final report. Details on format will be available later.

You may choose your species and get started immediately. In lab we will have a session on the literature of mammalogy which should be of help in your preliminary work.

EPOB 476/576--Mammalogy

Instructions for Field Trip Leaders

1. In the Laboratory (109 Hunter) Select an ecosystem for intensive study. Write your name on the Schedule Sheet.

2. In consultation with Armstrong and/or Freeman, select a location for study on the Boulder Mountain Parks system.

3. Schedule the field trip at your convenience, trying to account for the probable (or known) convenience of possible participants. Select a date and time not in conflict with other field trips.

4. Indicate meeting place and arrange transportation if needed.

5. Indicate on Scedule form if FIELD RECONNAISSANCE or TRAPPING SESSION.

6. If FIELD RECONNAISSANCE:

   Take white 5x7" forms from field notebook, clipboard, pencil or pen with permanent ink

   binoculars

   plaster of Paris (for casts)

   field guides (Burt, Murie, etc.)

   all mammals, sign, scat, burrows, etc. should be noted and detailed ecological situation indicated on the white form.

   trip should be to a single major ecosystem-type, and cover a fairly small area (say 80-160 acres) in a 3-4-hour period.

7. If TRAPPING SESSION

   take white and green forms from 5x7 field notebook, hard pencil or pen with permanent black ink.

   200 live traps

   plastic flagging

   rolled oats (bait)

   (cotton nesting material)

   handling bag

   (mist nets, poles)

   scents (for tracking pit)

   "Baggies" (for accidental casualties)

   establish transects away from trails, observation points, other well-travelled areas.

make transects of 50 traps, set in two parallel lines of 25 traps each.

The lines should be 10 m. (generous paces) apart; traps are set 5m.

apart.

Set traps at dusk, ca. 18:30-19:30 hrs. MDT; collect them early AM--6:00-7:00. Take every precaution to guard against vandalism. Try not to attract the attention of passersby to your work. Live traps are very expensive and grant funds to buy them are very scarce.

Animals captured are identified to species, sexed, aged (adult, subadult, juvenile), reproductive condition noted (testes scrotal, inguinal, abdominal?; vulva turgid, cornified, inactive? mammae lactating, pre- or post-lactating?), and then released.

Any accidental casualties of livetrapping (and there will be some, unavoidably) should be placed in a plastic bag with a tag giving full details of capture, and then returned to the freezer in 109 Hunter immediately. Full locality information includes place, sec., township, range, elevation (read from topo map s in lab), as well as date and collector's name.

Carry a copy of Armstrong's Colorado Scientific Collecting Permit and our City of Boulder Research Permit at all times in the field.

EPOB 476/576--Mammalogy--SUMMARY DATA SHEET

MAMMALS OF BOULDER MOUNTAIN PARKS*

Species

Common name(s)

Local subspecies

Distribution: Continental--

State--

Mountain Parks--

Documented by Sight record, 1982_____ Museum Specimen_____
Literature report_____ Other (specify)_____

Description: Color--

General form--

Pattern--

Texture of pelage--

Field marks--

Skull--

Dental formula--

Size: (locality:_____)

	enter mean (extremes)	
	males (n =)	females (n =)
total length		
length of tail		
length of hindfoot		
length of ear		
weight		

* Reference each entry by author, date.

INSERT ADDITIONAL PAGES WHERE NECESSARY

cranial measurements: enter mean (extremes)
male (n =) female (=)

condylobasal length

greatest length of skull

zygomatic breadth

interorbital constriction

length of maxillary toothrow

_____

_____

_____

_____

_____

Confusing species, differentia

Field recognition: sign

scat

burrow

nest

call

Habitat

Altitudinal range

Topographic setting

Vegetation of habitat

Common animal associates

Natural History

Diet--General

Qualitative Composition

Quantitative Composition

Seasonal Variation

Juvenile/adult differences

Metabolic Rate

Conversion efficiency

Seasonal Cycle

Hibernal activity

Diel Cycle/Activity rhythm

Reproduction: Seasonality

Estrous Pattern

Age at first reproduction: male
female

Gestation period

Litter size (mean, range)

Embryo count (mean, range)

Litters per season (mean, range)

Lactation period

Reproductive efficiency

Growth and Development: Sex ratio

Age at weaning:

Nesting behavior

Parental care

Development curve

Molt

Survivorship

Longevity

Behavior

Vocalization

Sensory acuity

Scent marking

Sociability

Agonistic patterns

Ethogramatic patterns

Response to humans

Ecological Role

Predators

Disease

Dispersion

General Pattern

Home Range (area)

Density

Territory size

Marking

Defense

Dispersal

- Dispersal Pattern
  - Seasonality
- Migration
  - Pattern
  - Seasonality
- Population Dynamics
  - Natality Rate
  - Mortality Rate
  - Biotic potential
  - Population trend (local)
    - regional trend

Utilization by humans

- Economic value
- Harvest data (compile for management unit, state for past five years)
- Aesthetic/Social value

Beneficial management practices

Detrimental Management practices

Extent of Knowledge:local--

- Colorado--
- Entire range

Needs for research

Selected references:

Annotated Bibliography

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BIRDS OF THE MOUNTAIN PARKS

INTRODUCTION

David J. Cooper

The data on birds presented here was organized from records of local ornithologists. The primary emphasis was to create a model of birds by habitat type which could be used to predict what species would be found where. Also data is given for the number of birds found to occur in summer and winter in one habitat type the Ponderosa Pine type of Enchanted Mesa, and frequency of sightings on the southern end of the Mesa Trail. The data are not copious, but do give an indication of the birds to be found in the mountain parks area. An important perspective could be gained from the old literature on reports of birds of the Boulder area. These reports indicate that many birds that were common breeders in the Boulder area in the early part of the century do not now occur. Some of this decline may be attributed to degradation or total destruction of the habitats required by these species. It is clear that a more formal study of this subject is warranted and is essential for the management of the region, especially the riparian habitats. More long-term studies are desperately needed because populations of birds are dynamic and must be seen over many years to fully appreciate the changes. Bird watching in the mountain parks has become an extremely popular activity and has made it obvious that we need to preserve habitats critical for the persistence of all species.

FREQUENCY OF SIGHTINGS OF
BIRDS AT THE SOUTHEND OF THE MESA TRAIL
October 1977 - June 1982

During the period, 1 October 1977 through 30 June 1982, I visited the area at the south end of the Mesa Trail, the Dunn property, 140 times for periods of approximately one to three hours per visit. During these visits I would always walk through the riparian, grassland, and dry shrub ecosystems immediately adjacent to the parking area and, in most instances, traverse a fairly consistent route through an area that included ponderosa pine and foothills riparian ecosystems. Boundaries of the area covered and the general path followed are shown on the attached map.

In the course of these visits I observed 116 species and sub-species and a Lazuli x Indigo Bunting shown on List A. The Black-billed Magpie was seen on 136 of 140 visits, 97 percent of the time. The Red-shafted Flicker was seen on more than 70 percent of the visits, in all seasons. Some species, such as the Rufuous-sided Towhee, Robin, Starling, W. Meadowlark, and Mourning Dove were seen regularly in the period April through September, while the Stellar's Jay was seen regularly from October through March. Some species such as the Canada Goose, Broad-winged Hawk, Clark's Nutcracker, Tennessee Warbler, Rufuous Crowned Sparrow and others were seen only once and numerous species were seen occasionally. While the rare and occasional sightings are what help to make birdwatching interesting, the species which are seen regularly are more significant because they indicate the species which use this area for roosting, foraging and/or breeding. Species seen on 25 percent or more of the 140 visits during the periods April through September and October through March are contained on List B. Finally, List C indicates the species for which I have seen some evidence of breeding, such as a territorial male, active nest, or immature birds during June and July.

February 7, 1983
Joe Krieg
1030 Hemlock Way
Broomfield, CO 80020
466-6290

LIST A

Species Sighted

Great Blue Heron
Canada Goose
Mallard
Turkey Vulture
N. Goshawk
Sharp-shinned Hawk
Cooper's Hawk
Red-tailed Hawk
Swainson's Hawk
Rough-legged Hawk
Ferruginous Hawk
Golden Eagle
N. Harrier
Prairie Falcon
Merlin
Festrel
Blue Grouse
Killdeer
Rock Dove
Mourning Dove
Great Horned Owl
Common Nighthawk
White-throated Swift
Broad-tailed Hummingbird
Belted Kingfisher
Common Flicker (R.S. race)
Hairy Woodpecker
Downy Woodpecker
N. three-toed Woodpecker
Western Kingbird
Say's Phoebe
Wellow Flycatcher
Western Flycatcher
Western Pewee
Olive-sided Flycatcher
Violet-green Swallow
Rough-winged Swallow
Barn Swallow
Cliff Swallow
Blue Jay
Stellar's Jay
Scrub Jay
Black-billed Magpie
Northern Raven
American Crow
Penyon Jay
Clark's Nutcracker
Black-capped Chickadee
Mountain Chickadee
Bushtit
White-breasted Nuthatch
Red-breasted Nuthatch
Pygmy Nuthatch
Brown Creeper
Dipper
House Wren
Winter Wren
Canyon Wren
Rock Wren
Catbird
Sage Thrasher
Robin
Mountain Bluebird
Townsend's Solitaire
Golden-crowned Kinglet
Ruby-crowned Kinglet
Cedar Waxwing
Northern Shrike
Starling
Solitary Vireo
Red-eyed Vireo
Warbling Vireo
Tennessee Warbler
Virginia's Warbler
N. Parula Warbler
Yellow Warbler
Yellow-rumped Warbler
"Myrtle" race
"Audubon's" race
Black-thrtd. Gray Warbler
MacGillivray's Warbler
Yellow-breasted Chat
Welson's Warbler
American Redstart
W. Meadowlark
Red-winged Blackbird
"Bullock's" race, N. Oriole
Brewer's Blackbird
Common Grackle
Brown-headed Cowbird
Western Tanager
Black-headed Grosbeak
Blue Grosbeak
Indigo Bunting
Lazuli Bunting
Lazuli x Indigo Bunting
Evening Grosbeak
House Finch
Pine Siskin
American Goldfinch
Lesser Goldfinch
Red Crossbill
Green-tailed Towhee
Rufous-sided Towhee
Lark Sparrow
Rufous-crowned Sparrow

LIST A (con't)

Northern Junco
"Slate-colored" race
"White-winged" race
"Oregon" race
Gray-head Junco
Tree Sparrow
Chipping Sparrow
Clay-colored Sparrow
Brewer's Sparrow
White-crowned Sparrow
Lincoln's Sparrow
Song Sparrow

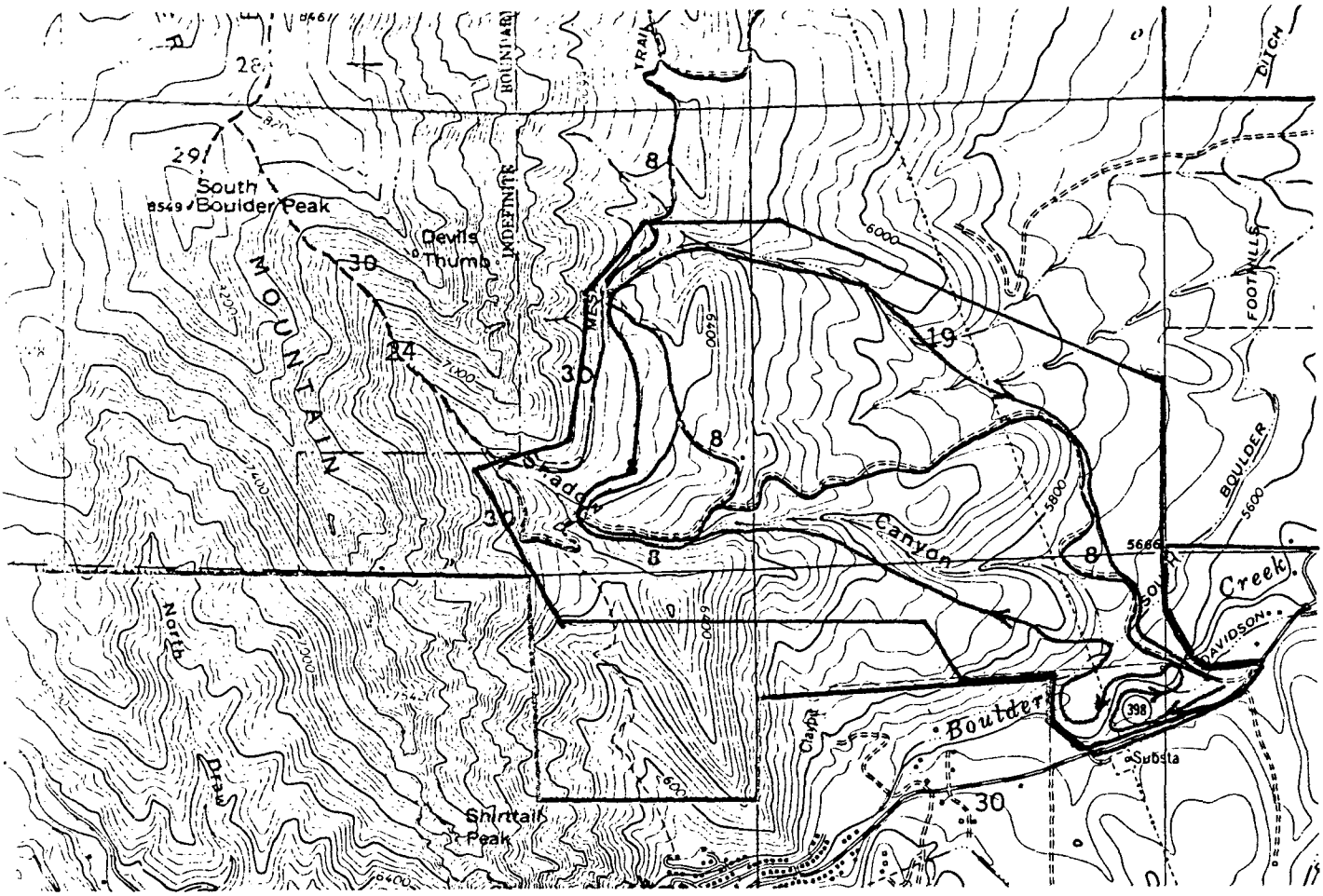
List B
Species seen on 25% or more of visits

OCTOBER - MARCH	
Black-Billed Magpie	100%
Red-Shifted Flicker	72%
Stellar's Jay	60%
Black-Capped Chickadee	52%
Slate-Colored Junco	46%
Mountain Chickadee	40%
Downy Woodpecker	37%
Belted Kingfisher	36%
Townsend's Solitaire	35%
Robin	27%
Oregon Junco	27%
Tree Sparrow	27%
Common Crow	26%
Nuthatch (WB, RB, & Pygmy)	26%
Starling	26%

APRIL - SEPTEMBER	
Black-Billed Magpie	93%
Rufous-Sided Towhee	85%
Red-Shafted Flicker	71%
W. Meadowlark	71%
Robin	69%
Starling	68%
Mourning Dove	60%
Song Sparrow	56%
Yellow Warbler	51%
American Goldfinch	51%
Yellow-Breasted Chat	49%
Brown-Headed Cowbird	42%
Mallard	40%
Kestrel	36%
Lazuli Bunting	36%
Broad-Tailed Hummingbird	34%
Wren (SP)	34%
Chipping Sparrow	32%
Stellar's Jay	32%
Redwing Blackbird	31%
Belted Kingfisher	29%
Flycatcher (SP)	29%
Blackcapped Chickadee	29%
Downy Woodpecker	27%
Swallow (SP)	25%

List C
Sure and Probable Breeders

SPECIES	SINGING MALE	ACTIVE NEST	IMMATURES June/July
Mourning Dove			X
R.S. Flicker	X		X
Magpie		X	X
B.C. Chickadee			X
Robin			X
Starling		X	X
Yellow Warbler	X		X
Yellow Breasted Chat	X		X
Meadowlark	X		X
N. Oriole		X	
Brewer's Blackbird		X	X
Brown-Headed Cowbird	X		
W. Tanager		X	
Blue Grosbeak			X
Lazuli Bunting	X		X
American Goldfinch	X		
Rufous-Sided Towhee	X		X
Lark Sparrow			X
Chipping Sparrow	X		
Song Sparrow	X	X	



—— = AREA COVERED
—— = ROUTE TAKEN

Bird Population Studies on the Enchanted Mesa

Louise Hering

The Enchanted Mesa, just south of Chautauqua, is covered by a pondersosa pine forest of about 160 acres. This is a unique habitat between the Flatirons rock formation and higher foothills on the west and an entirely different life zone on the east--the plains.

With an interest in the bird population on the Mesa, a 20-acre (8.1 hectare) portion of the forest was surveyed in 1953. The first winter bird count on the acreage was made in 1953-54 and the first breeding-bird census was taken in the spring and summer of 1954. Since then, 24 winter counts and 23 spring counts have been made, with the last 18 years being consecutive. These studies followed specific rules of the National Audubon Society (directions can be obtained by writing American Birds, 950 Third Avenue, New York, NY 10022.) Over the years the acreage was never disturbed in any way by these studies; no markers were ever used.

Results of several of these counts have appeared in Audubon Field Notes (now American Birds), a bimonthly journal published by the National Audubon Society. Such censuses of bird life are valuable to naturalists and ornithologists as they give both qualitative and quantitative descriptions of bird populations.

As an example, the results of the breeding bird census taken in the spring and summer of 1972 were: Western Wood Pewee, 11 per 20 acres, 136 per square kilometer, 55 per hundred acres; Chipping Sparrow, 10 (124,50); Mourning Dove, 6 (74, 30); Pygmy Nuthatch, 6 (74, 30); Robin, 4 (49, 20); Solitary Vireo, 4 (49, 20); Broad-tailed Hummingbird, 2; Western Tanager, 2; Pine Siskin, 2; Red-shafted Flicker, 1; Hairy Woodpecker, 1; Steller's Jay, 1; White-breasted Nuthatch, 1; House Wren, 1. Total: 14 species, 52 territorial males or females (642 per square kilometer, 260 per 100 acres). The nesting count varies from year to year.

The results of the winter count taken during the winter of 1981-82 were: Red-breasted Nuthatch, 20 (247, 100); Pygmy Nuthatch, 18 (225,90); Red Crossbill, 8 (100,40); Mountain Chickadee, 7 (87, 35); White-breasted Nuthatch, 3 (37, 15); Steller's Jay, 2 (25, 10); Black-billed Magpie, 2 (25, 10); House Finch, 2 (25, 10); Brown Creeper, 1 (12, 5); Common Flicker, +; Hairy Woodpecker, +; Downy Woodpecker, +; Common Crow, +; Townsend's Solitaire, +; Pine Siskin, +; Dark-eyed Junco (White-winged Race), +; Junco spp., +. Average Total: 63 birds (788/Km^2, 315/100 acres.) The invasion of Red-breasted Nut hatches and Red Crossbills was unusual and boosted the winter population to well above average.

During the summer of 1982 extensive cutting of the pines was done on the area by the Boulder City Forester and the Colorado State Department of Forestry. Future censuses will be interesting, as changes in the bird population brought about by the thinning of the forest will be noted.

Qualitative results: A list of winter birds observed on the study plot since 1953:

Goshawk	Red-shafted Flicker	Mountain Chickadee
Sharp-shinned Hawk	Hairy Woodpecker	White-breasted Nuthatch
Cooper's Hawk	Downy Woodpecker	Red-breasted Nuthatch
Ferruginous Hawk	Steller's Jay	Pygmy Nuthatch
Great Horned Owl	Black-billed Magpie	Brown Creeper
Long-eared Owl	Clark's Nutcraker	Townsend's Solitaire

Golden-crowned Kinglet
Bohemian Waxwing
Cedar Waxwing
Evening Rosbeak
Cassin's Finch
Pine Siskin
Red Crossbill
White-winged Junco
Slate-colored Junco
Oregon Junco
Gray-headed Junco

Nesting Species

Mourning Dove
Great Horned Owl
Long-eared Owl
Broad-tailed Hummingbird
Red-shafted Flicker
Hairy Woodpecker
Downy Woodpecker
Hammond's Flycatcher
Western Wood Pewee
Steller's Jay
Black-billed Magpie
Mountain Chickadee
Bushtit
White-breasted Nuthatch
Red-breasted Nuthatch
Pygmy Nuthatch
House Wren
American Robin
Solitary Vireo
Audubon's Warbler
Western Meadowlark
Western Tanager
Black-headed Grosbeak
Pine Siskin
Lesser Goldfinch
Red Crossbill
Rufous-sided Towhee
Gray-headed Junco
Chipping Sparrow

Spring and summer visitors

Red-tailed Hawk
Swainson's Hawk
Prairie Falcon
Merlin
American Kestrel
Blue Grouse
Ring-necked Pheasant
Rock Dove
White-winged Dove
Yellow-billed Cuckoo
Poor-will
Common Nighthawk
Chimney Swift
White-throated Swift
Lewis Woodpecker
Northern Three-toed Woodpecker
Western Kingbird
Say's Phoebe
Olive-sided Flycatcher
Violet-green Swallow
Blue Jay
Scrub Jay
Common Raven
Common Crow
Black-capped Chickadee
Red-breasted Nuthatch
Brown Creeper
Gray Catbird
Cedar Waxwing
Starling
Red-eyed Vireo
Virginia's Warbler
Audubon's Warbler
Northern Oriole
Brewer's Blackbird
Brown-headed Cowbird
Indigo Bunting
Lazuli Bunting
Evening Grosbeak
House Finch
American Goldfinch
Red Crossbill
Green-tailed Towhee

Spring and fall migrants

Rufous Hummingbird
Yellow-bellied Sapsucker
Williamson's Sapsucker
Olive-sided Flycatcher
Pinyon Jay
Canyon Wren
Rock Wren
Hermit Thrush
Swainson's Thrush
Western Bluebird
Mountain Bluebird
Blue-gray Gnatcatcher
Ruby-crowned Kinglet
Warbling Vireo
Black-and-white Warbler
Orange-crowned Warbler
Audubon's Warbler
Myrtle Warbler
Townsend's Warbler
Blackburnian Warbler
Ovenbird
Brewer's Sparrow

BIRD LIFE IN BOULDER CITY PARKS, OPEN SPACES, AND SAWHILL PONDS

Freeman Hall

There are ten or more habitat types in the subject lands that are used by over 225 species of birds as breeders, migrants, regular visitors, or irregular visitors. (Migrants do not usually stay the winter while visitors may.) In this preliminary report, an annotated matrix of birds versus habitat is presented. This form of data presentation serves to illustrate the richness of avifauna in the Boulder region. Superscript numbers refer to the references at the end of the report, and are used to call attention to special features or habitat requirements of the species.

This report is based not only on the author's many thousands of hours of bird study in the field, but also on ten consecutive years of the Boulder Audubon Society's wildlife inventory records.

REFERENCES

1. Breeds nearby -- a few minutes flight away.
2. Shy and secretive; requires extensive reed or marsh habitat.
3. Needs mature-size snags or cavities in trees for nesting.
4. Eruptive, depending on food supply.
5. Needs isolated shelfs on undisturbed cliffs.
6. Rare, only seen a few times in the past ten years.
7. Irregular -- may be common one year and not seen the next.
8. A rare breeder -- seen in June, 1976 at the narrow mouth of Bear Canyon.

HABITAT AMPHENA

BREEDERS

PONDS & REEDS	GRASSLAND (INCL. MARSH)	PLAINS RIPARIAN	GRASSLAND-FOREST ECOTONE	PONDEROSA FOREST	MIXED PINE-DOUGLAS FIR	DOUGLAS FIR FOREST	FOOTHILLS RIPARIAN	MOUNTAIN RIPARIAN	ROCK FACES ROCKY CANYON
SAWHILL PONDS VALMONT RES. BOULDER RES.	SAWHILL S. BOULDER CREEK CHAUTAUQUA BOULDER RES.	SAWHILL COTTONWOOD GROVE S. BOULDER CREEK BOULDER RES.	LOWER STUNK CREEK DAKOTA RIDGE	ENCHANTED MESA WALKER RANCH	CRECORY CANYON BEAR CANYON FERN CANYON	UPPER GRECORY CAN UPPER BEAR CAN.	BLUEBELL CANYON LOWER GRECORY CAN ELDORADO CAN.	LONG CANYON	FLATIRONS FLAGSTAFF MT.
PIED-BILLED GREBE	LEAST BITTERN[2]	AMERICAN KESTREL	AMERICAN KESTREL	TURKEY	BLUE GROUSE	GOSHAWK	AMER. KESTREL	COOPER'S HAWK	RED-TAILED HAWK
CANADA GOOSE	VIRGINIA RAIL	MOURNING DOVE	MOURNING DOVE	BLUE GROUSE	MOURNING DOVE	RED-TAILED HAWK	MOURNING DOVE	BLUE GROUSE	GOLDEN EAGLE[5]
MALLARD	SORA	YELLOW-BILL. CUCKOO	SCREECH OWL[3]	MOURNING DOVE	GREAT-HORNED OWL	BLUE GROUSE	SCREECH OWL	MOURNING DOVE	PRAIRIE FALCON[5]
BLUE-WINGED TEAL	COMMON SNIPE	SCREECH OWL[3]	GREAT HORNED OWL	GREAT HORNED OWL	LONG-EARED OWL	BAND-TAILED PIGEON	GREAT HORNED OWL	BROAD-TAIL. HUMMER	PEREGRINE F. (MIGR.)
CINNAMON TEAL	AMERICAN KESTREL	GREAT HORNED OWL	BROAD-TAIL. HUMMER	PYGMY OWL	SAW-WHET OWL	MOURNING DOVE	PYGMY OWL	COMMON FLICKER[3]	GREAT HORNED OWL
GREEN-WINGED TEAL	RING-NECK. PHEASANT	COMMON NIGHTHAWK	COMMON FLICKER[3]	SAW-WHET OWL	PYGMY OWL	GREAT-HORNED OWL	COMMON NIGHTHAWK	YELLOW-B. SAPSUCKER[3]	POOR-WILL
AMERICAN BITTERN[2]	MOURNING DOVE	BELTED KINGFISHER	WESTERN W. PEWEE	POOR-WILL	BROAD-TAIL. HUMMER	LONG-EARED OWL	BROAD-T HUMMINGBIRD	HAIRY WOODPECKER[3]	WHITE-THR. SWIFT
AMERICAN COOT	EASTERN KINGBIRD	COMMON FLICKER[3]	BLACK-BILLED MAGPIE	BROAD-TAIL. HUMMER	COMMON FLICKER[3]	SAW-WHET OWL	BELTED KINGFISHER	DOWNY WOODPECKER[3]	SAY'S PHOEBE
KILLDEER	WESTERN KINGBIRD	BLUE JAY	N. HOUSE WREN	COMMON FLICKER[3]	HAIRY WOODPECKER[3]	BROAD-T. HUMMER	COMMON FLICKER[3]	WESTERN FLYCATCHER	CLIFF SWALLOW
BARN SWALLOW	HORNED LARK	COMMON CROW	CATBIRD	HAIRY WOODPECKER[3]	DOWNY WOODPECKER[3]	C. FLICKER[3]	YELLOW-B. SAPSUCKER	WESTERN W. PEWEE	VIOLET-GREEN SWAL.
TREE SWALLOW	BARN SWALLOW	BLACK-BILL. MAGPIE	ROBIN	DOWNY WOODPECKER[3]	HAMMOND'S FLYCATCHER	HAIRY WOODPECKER[3]	HAIRY WOODPECKER[3]	WHITE-BR. NUTHATCH	C. RAVEN
	CLIFF SWALLOW	BLACK-CAP. CHICKADEE	MT. BLUEBIRD[3]	HAMMOND'S FLYCATCHER	WESTERN WOOD PEWEE	DOWNY WOODPECKER[3]	DOWNY WOODPECKER[3]	BROWN CREEPER	ROCK WREN
	C. YELLOWTHROAT	N. HOUSE WREN	VIRGINIA'S WARBLER	WESTERN WOOD PEWEE	STELLER'S JAY	HAMMOND'S FLYCATCHER	WESTERN WOOD PEWEE	N. HOUSE WREN	CANYON WREN
	W. MEADOWLARK	AMER. ROBIN	WESTERN MEADOWLARK	STELLER'S JAY	COMMON RAVEN	WESTERN-W PEWEE	BLACK-BILL. MAGPIE	ROBIN	
	Y-HEAD. BLACKBIRD	STARLING	BROWN-H. COWBIRD	BLACK-BILL. MAGPIE	COMMON CROW	STELLER'S JAY	BLACK-CAP. CHICKADEE	SOLITARY VIREO	
	RED-WING. BLACKBIRD	YELLOW WARBLER	INDIGO BUNTING	COMMON CROW	MOUNTAIN CHICKADEE[3]	COMMON RAVEN	N. HOUSE WREN	WARBLING VIREO	
	BREWER'S BLACKBIRD	HOUSE SPARROW	LAZULI BUNTING	MOUNTAIN CHICKADEE[3]	WHITE-BR. NUTHATCH[3]	COMMON CROW	CATBIRD	VIRGINIA'S WARBLER	
	BLUE GROSBEAK	COMMON GRACKLE	DARK-BACK. GOLDFINCH	WHITE-BR. NUTHATCH[3]	RED-BR. NUTHATCH	MOUNTAIN CHICKADEE	ROBIN	MACGILLIVRAY'S WARB.	
	VESPER SPARROW	BROWN-H. COWBIRD	RUFOUS-S. TOWHEE	RED-BR. NUTHATCH[3]	PYGMY NUTHATCH	WHITE-BR. NUTHATCH	STARLING	GREEN-T. TOWHEE	
	LARK SPARROW	N. ORIOLE	CHIPPING SPARROW	PYGMY NUTHATCH[3]	BROWN CREEPER	RED-BR. NUTHATCH	YELLOW-BR CHAT	GRAY-HEAD. JUNCO	
	SONG SPARROW	HOUSE FINCH		AMER. ROBIN	AMER. ROBIN	PYGMY NUTHATCH	VIRGINIA'S WARBLER	CHIPPING SPARROW	
		AMER. GOLDFINCH		MOUNTAIN BLUEBIRD	TOWNSEND'S SOLITAIRE	BROWN CREEPER	YELLOW WARBLER		
				SOLITARY VIREO	GOLDEN-CR KINGLET	ROBIN	MACGILLIVRAY'S WARB.		
				WESTERN TANAGER	SOLITARY VIREO	TOWNSEND'S SOLITAIRE	BROWN-HD. COWBIRD		
				EVENING GROSBEAK	SCARLET TANAGER	GOLDEN-CR KINGLET	N. ORIOLE		
				CASSIN'S FINCH	WESTERN TANAGER	SOLITARY VIREO	WESTERN TANAGER		
				PINE SISKIN	EVENING GROSBEAK	BROWN-H. COWBIRD	BLACK-HEAD. GROSBEAK		
				DARK-BACK GOLDFINCH	CASSIN'S FINCH	WESTERN TANAGER	INDIGO BUNTING		
				RED CROSSBILL[4]	PINE SISKIN	EVENING GROSBEAK	LAZULI BUNTING		
				GRAY-HEADED JUNCO	RED CROSSBILL[4]	PINE SISKIN	DARK-BACK. GOLDFINCH		
				CHIPPING SPARROW	GRAY-HEAD JUNCO	GRAY-HEAD JUNCO	GREEN-TAIL. TOWHEE		
					CHIPPING SPARROW		RUFOUS-SID. TOWHEE		
							CHIPPING SPARROW		

MIGRANTS	PONDS & REEDS SAWHILL PONDS VALMONT RES. BOULDER RES.	GRASSLAND (INCL. MARSH) SAWHILL S. BOULDER CREEK CHAUTAUQUA BOULDER RES.	PLAINS RIPARIAN SAWHILL COTTONWOOD GROVE S. BOULDER CREEK BOULDER RES.	GRASSLAND-FOREST ECOTONE LOWER SKUNK CREEK DAKOTA RIDGE	PONDEROSA FOREST ENCHANTED MESA WALKER RANCH	MIXED PINE-DOUGLAS FIR GREGORY CANYON BEAR CANYON FERN CANYON	DOUGLAS FIR FOREST UPPER GREGORY CAN UPPER BEAR CAN.	FOOTHILLS RIPARIAN BLUEBELL CANYON LOWER GREGORY CAN ELDORADO CAN.	MOUNTAIN RIPARIAN LONG CANYON	ROCK FACES ROCKY CANYON FLATIRONS FLAGSTAFF MT.
	COMMON LOON WHITE-FRT. GOOSE CADWALL N. SHOVELER REDHEAD CANVASBACK LESSER SCAUP RUDDY DUCK WHITE-FACED GLOSS IBIS BLACK-BELLIED PLOVER SEMIPALMATED PLOVER LONG-BILLED CURLEW SOLITARY SANDPIPER SPOTTED SANDPIPER WILLET GRT. YELLOWLEGS LES. YELLOWLEGS LONG-BILL DOWITCHER BAIRD'S SANDPIPER LEAST SANDPIPER SEMIPALM. SANDPIPER WESTERN SANDPIPER	TURKEY VULTURE COOPER'S HAWK SHARP-SHINNED HAWK BURROWING OWL SAY'S PHOEBE SAGE THRASHER MOUNTAIN BLUEBIRD WATER PIPIT SAVANNAH SPARROW LARK BUNTING CHIPPING SPARROW CLAY-COL SPARROW BREWER'S SPARROW LINCOLN'S SPARROW	TURKEY VULTURE COOPER'S HAWK SHARP-SHINNED HAWK OSPREY BARN OWL SAY'S PHOEBE WILLOW FLYCATCHER HAMMOND'S FLYCATCHER DUSKY FLYCATCHER WESTERN FLYCATCHER WESTERN WOOD PEWEE HERMIT THRUSH SWAINSON'S THRUSH VEERY RUBY-CR KINGLET BLACK & WH. WARBLER TENNESSEE WARB. ORANGE-CR. WARBLER VIRGINIA'S WARBLER MAGNOLIA WARBLER YELLOW-RUMP. WARB. BLACKPOLL WARBLER N. WATERTHRUSH	TURKEY VULTURE GOSHAWK COOPER'S HAWK SHARP-SHINNED HAWK N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK RED-TAILED HAWK SWAINSON'S HAWK BROAD-WINGED HAWK BALD EAGLE OSPREY PRAIRIE FALCON PEREGRINE FALCON MERLIN WHITE-THR. SWIFT CHIMNEY SWIFT RUFOUS HUMMINGBIRD SAY'S PHOEBE HAMMOND'S FLYCATCHER DUSKY FLYCATCHER WESTERN FLYCATCHER OLIVE-S. FLYCATCHER BARN SWALLOW CLIFF SWALLOW VIOLET-GREEN SWALLOW ROUGH-WINGED SWALLOW RUBY-CR. KINGLET YELLOW-RUMP WARBLER WILSON'S WARBLER VESPER SPARROW LARK SPARROW	TURKEY VULTURE COOPER'S HAWK SHARP-SHINNED HAWK N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK RED-TAILED HAWK SWAINSON'S HAWK BROAD-WING. HAWK BALD EAGLE OSPREY DUSKY FLYCATCHER WESTERN FLYCATCHER OLIVE-SIDED FLYCATCHER SAGE THRASHER RUBY-CR. KINGLET YELLOW-RUMP. WARB. TOWNSEND'S WARBLER WILSON'S WARBLER BROWN-HEAD COWBIRD N. ORIOLE CLAY-COL. SPARROW BREWER'S SPARROW	TURKEY VULTURE COOPER'S HAWK N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK RED-TAILED HAWK SWAINSON'S HAWK BALD EAGLE OSPREY OLIVE-S. FLYCATCHER RUBY-CR. KINGLET YELLOW-RUMP. WARBLER TOWNSEND'S WARBLER WILSON'S WARBLER CLAY-COL. SPARROW BREWER'S SPARROW	TURKEY VULTURE N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK BALD EAGLE OSPREY BLACK SWIFT CALLIOPE HUMMER RUFOUS HUMMINGBIRD OLIVE-S. FLYCATCHER ORANGE-CR. WARBLER YELLOW-RUMP WARBLER TOWNSEND'S WARBLER	TURKEY VULTURE COOPER'S HAWK SHARP-SHINNED HAWK N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK RED-TAILED HAWK SWANSON'S HAWK BROAD-WING. HAWK CALLIOPE HUMMER RUFOUS HUMMINGBIRD HAMMOND'S FLYCATCHER DUSKY FLYCATCHER WESTERN FLYCATCHER OLIVE-SIDED FLYCATCHER HERMIT THRUSH SWAINSON'S THRUSH VEERY RUBY-CR. KINGLET SOLITARY VIREO WARBLING VIREO BLACK & WH. WARBLER TENNESSEE WARBLER ORANGE-CR. WARBLER NASHVILLE WARBLER YELLOW-RUMP. WARBLER CHESTNUT-S. WARBLER WILSON'S WARBLER AMERICAN REDSTART ROSE-BR. GROSBEAK VESPER SPARROW CLAY-COL. SPARROW BREWER'S SPARROW FOX SPARROW SONG SPARROW	TURKEY VULTURE SHARP-SHINNED HAWK N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK RED-TAILED HAWK SWAINSON'S HAWK BROAD-WING HAWK CALLIOPE HUMMER RUFOUS HUMMINGBIRD WILLIAMSON'S SAPSUCKER OLIVE-S. FLYCATCHER HERMIT THRUSH SWAINSON'S THRUSH RUBY-CR. KINGLET TENNESSEE WARBLER ORANGE-CR. WARBLER NASHVILLE WARBLER YELLOW-RUMP. WARBLER TOWNSEND'S WARBLER	TURKEY VULTURE GOSHAWK COOPER'S HAWK SHARP-SHINNED HAWK N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK SWAINSON'S HAWK BROAD-WINGED HAWK BALD EAGLE OSPREY MERLIN AMER. KESTREL YELLOW-RUMP. WARBLER
	WILSON'S PHALAROPE FRANKLIN'S GULL BONAPARTE'S GULL FORSTER'S TERN BLACK TERN ROUGH-WING. SWALLOW VIOLET-GR. SWALLOW		MACGILLIVRAY'S WARB. WILSON'S WARBLER AMER. REDSTART W. TANAGER ROSE-BR. GROSBEAK RUFOUS-S. TOWHEE GREEN-T. TOWHEE							

HABITAT / SEASON	PONDS & REEDS SAWHILL PONDS VALMONT RES. BOULDER RES.	GRASSLAND (INCL. MARSH) SAWHILL S. BOULDER CREEK CHAUTAUQUA BOULDER RES.	PLAINS RIPARIAN SAWHILL COTTONWOOD GROVE S. BOULDER CREEK BOULDER RES.	GRASSLAND-FOREST ECOTONE LOWER SKUNK CREEK DAKOTA RIDGE	PONDEROSA FOREST ENCHANTED MESA WALKER RANCH	MIXED PINE-DOUGLAS FIR GREGORY CANYON BEAR CANYON FERN CANYON	DOUGLAS FIR FOREST UPPER GREGORY CAN UPPER BEAR CAN.	FOOTHILLS RIPARIAN BLUEBELL CANYON LOWER GREGORY CAN ELDORADO CAN.	MOUNTAIN RIPARIAN LONG CANYON	ROCK FACES ROCKY CANYON FLATIRONS FLAGSTAFF MT.
REGULAR VISITORS	WESTERN GREBE HORNED GREBE EARED GREBE DBL-CRT CORMORANT WHISTLING SWAN SNOW } GOOSE BLUE } PINTAIL AMER. WIDGEON WOOD DUCK RING-NECKED DUCK COMMON MERGANSER RED-BR. MERGANSER HOODED MERGANSER GOLDEN EAGLE BALD EAGLE GREAT BLUE HERON BLACK-CR. NT. HERON AMERICAN AVOCET HERRING GULL CALIFORNIA GULL RING-BILLED GULL ~~PHILADELPHIA GULL~~	N. HARRIER ROUGH-LEG. HAWK FERRUGINOUS HAWK RED-TAILED HAWK SWAINSON'S HAWK GOLDEN EAGLE PRAIRIE FALCON FRANKLIN'S GULL SHORT-EARED OWL CHIMNEY SWIFT LONG-BILL. MARSH WREN NORTHERN SHRIKE LOGGERHEAD SHRIKE OREGON JUNCO SLATE-COL. JUNCO TREE SPARROW WHITE-CR. SPARROW	RED-TAILED HAWK MERLIN BLACK-CR. NT. HERON BAND-TAIL PIGEON SHORT-EARED OWL RED-HEAD. WOODPECKER YELLOW-BL SAPSUCKER HAIRY WOODPECKER DOWNY WOODPECKER COMMON CROW MOUNTAIN CHICKADEE BROWN CREEPER WHITE-BR. NUTHATCH WINTER WREN TOWN. SOLITAIRE BROWN THRASHER CEDAR WAXWING EVENING GROSBEAK GRAY-HD. JUNCO	GOLDEN EAGLE POOR-WILL COMMON NIGHTHAWK HAIRY WOODPECKER DOWNY WOODPECKER STELLER'S JAY SCRUB JAY BLUE JAY PINYON JAY COMMON RAVEN COMMON CROW BLACK-CAP. CHICKADEE MOUNTAIN CHICKADEE WHITE-BR. NUTHATCH RED-BR. NUTHATCH TOWNSEND'S SOLITAIRE STARLING NORTHERN SHRIKE SOLITARY VIREO WARBLING VIREO N. ORIOLE WESTERN TANAGER BLACK-H. GROSBEAK EV. GROSBEAK CASSIN'S FINCH HOUSE FINCH GRAY-CR. ROSY FINCH BROWN-CP. ROSY FINCH PINE SISKIN RED CROSSBILL GREEN-T. TOWHEE DARK-EYED JUNCOS GRAY-HEADED JUNCO	GOSHAWK GOLDEN EAGLE PRAIRIE FALCON AMER. KESTREL N. THREE-TOED WOODPK. VIOLET-GRN. SWALLOW PINYON JAY CLARK'S NUTCRACKER COMMON RAVEN BLACK-CAP. CHICKADEE BROWN CREEPER TOWNSEND'S SOLITAIRE BOHEMIAN WAXWING GRAY-CR. ROSY FINCH BROW-CP. ROSY FINCH WHITE-WG JUNCO OREGON JUNCO SLATE-COL. JUNCO	SHARP-SHIN. HAWK GOLDEN EAGLE PRAIRIE FALCON AMER. KESTREL N. 3-TOED WOODPK VIOLET-GRN. SWALLOW BRACK-BILL MAGPIE CLARK'S NUTCRACKER WHITE-WG. JUNCO SLATE-COL. JUNCO OREGON JUNCO	COOPER'S HAWK SHARP-SHINNED HAWK SWANSON'S HAWK GOLDEN EAGLE PRAIRIE FALCON AMER. KESTREL WHITE-THR. SWIFT N. 3-TOED WOODPECKER VIOLET-GR. SWALLOW BLACK-BILL. MAGPIE CLARK'S NUTCRACKER RUBY-CR. KINGLET SLATE-COL. JUNCO OREGON JUNCO	GOSHAWK COLDEN EAGLE MERLIN STELLER'S JAY COMMON RAVEN COMMON CROW MT. CHICKADEE WHITE-BR. NUTHATCH RED-BR. NUTHATCH BROWN CREEPER WINTER WREN TOWNSEND'S SOLITAIRE BOHEMIAN WAXWING CEDAR WAXWING EVENING GROSBEAK CASSIN'S FINCH GRAY-CR. ROSY FINCH BROWN-CP. ROSY FINCH PINE SISKIN AMER. GOLDFINCH RED CROSSBILL WHITE-WINGED JUNCO SLATE-COL. JUNCO OREGON JUNCO GRAY-HEAD. JUNCO	GOSHAWK GOLDEN EAGLE PRAIRIE FALCON MT. CHICKADEE RED-BR. NUTHATCH TOWNSEND'S SOLITAIRE	GRAY-CR. ROSY FINCH BROWN-CP. ROSY FINCH
IRREGULAR VISITORS/MIGRANTS	ROSS' GOOSE WHITE-WINGED SCOTER OSPREY COMMON EGRET SNOWY EGRET GREEN HERON NORTHERN PHALAROPE GLAUCOUS GULL THAYER'S GULL SABINE'S GULL	GOSHAWK BROAD-WINGED HAWK CATTLE EGRET SCISSOR-T. FLYCATCHER SPRAGUE'S PIPIT BOBOLINK RUSTY BLACKBIRD GRASSHOPPER SP. BAIRD'S SPARROW FIELD SPARROW SWAMP SPARROW LAPLAND LONGSPUR SNOW BUNTING	RED-SHOULDERED HAWK RED-BELLIED WOODPK MOCKINGBIRD BROWN THRASHER WOOD THRUSH GRAY-CHEEK. THRUSH BLUE-GRAY G.CATCHER PROTHONOTARY WARB. WORM-EATING WARB. NASHVILLE WARBLER CAPE MAY WARBLER BLACK-THR. GRN WARB. CHESTNUT-S. WARBLER OVENBIRD WHITE-THR. SPARROW	LEWIS' WOODPECKER ROSE-BR. GROSBEAK BLACK ROSY FINCH FIELD SPARROW	PEREGRINE FALCON WESTERN BLUEBIRD HERMIT WARBLER YELLOW-THR. WARB. OVENBIRD BLACK ROSY FINCH COMMON REDPOLL	PEREGRINE FALCON	PEREGRINE FALCON VARIED THRUSH SCARLET TANAGER	COMMON BUSHTIT MOCKING BIRD VARIED THRUSH WOOD THRUSH WESTERN BLUEBIRD PHAINOPEPLA RED-EYED VIREO PHILADELPHIA VIREO BLACK-THR. GRN. WARBLER BLACK-THR. BL. WARBLER OVENBIRD KENTUCKY WARBLER SCARLET TANAGER PURPLE FINCH BLACK ROSY FINCH COMMON REDPOLL FIELD SPARROW	N. 3-TOED WOODPECKER	BLACK ROSY FINCH