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MANAGING MT. PARK ECOSYSTEMS FOR BIRDS AND MAMMALS

Stephen R. Jones
13 December, 1990

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MANAGING BOULDER MOUNTAIN PARK ECOSYSTEMS FOR BIRD AND MAMMAL POPULATIONS

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The vegetation map of the Boulder Mountain Park was produced by Diane C. Lorenz based on my interpretation of aerial photographs and ground surveys. Copies of the map are on file at the City of Boulder Parks and Recreation office.

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Introduction and Methods

Introduction

The Boulder Mountain Park is a unique and precious resource. Its cool, north facing canyons support a remarkable variety of plant life (Hogan 1989), including several species of rare orchids and the southernmost stand of paper birch in North America. The grasslands, shrublands, cliffs, and forests of the Mountain Park support more than 100 species of breeding birds (Jones 1989), including golden eagles, prairie falcons, wild turkeys, and flammulated owls. Black bears, mountain lions, gray foxes, and coyotes are frequently sighted along Mountain Park trails; in all the Park supports at least 50 species of mammals (Cooper 1984).

Located within walking distance of a city of 80,000, the Boulder Mountain Park receives more visitors than many national parks. Potential for conflict between recreational uses of the Park and wildlife is enormous. In the fall black bears use popular hiking routes in Bear Canyon and Gregory Canyon to work their way down into foothills ravines to forage on wild fruits. Mountain lions follow deer to the edge of the Park and into foothills subdivisions. Popular climbing routes in the Flatirons pass directly through active golden eagle and prairie falcon nests.

Management conflicts are amplified when a wild area lies close to an urban population. Forest fires started by illegal campers may threaten the Park's natural resources; naturally occurring

fires may, in turn, threaten west Boulder subdivisions. Forest thinning programs, construction of new hiking trails, and management of recreation within the Park receive careful scrutiny from nearby residents. Under these circumstances, management of the Park must be based on sound environmental principles, including a thorough understanding of natural resources and potential human uses.

Previous studies, conducted under the auspices of the City of Boulder Parks and Recreation Department, have examined Mountain Park plant communities (Cooper 1984, Hogan 1989,), rare plant associations (Hogan 1989), small mammal populations (Cooper 1984), bird populations (Jones 1989), deer populations (Boulder Park Rangers, in progress) and forest structure (Colorado State Forest Service 1974, 1982). Information from these studies has been useful in managing the Park, but the information has not been synthesized into a comprehensive management plan.

This study begins with an inventory of Mountain Park ecosystems. A vegetation map shows the extent and distribution of 13 ecosystems in the Park. Site descriptions of 32 management units within the Park include information on dominant plant species, breeding bird populations, and mammal populations. Management recommendations take into account existing natural resources and potential human uses of each site.

Study Area

The Boulder Mountain Park is a 24km^2 area of forested mountains to the west of Boulder, extending south to north from Eldorado Springs to Sunshine Canyon (Figure 1). Elevations within the Park range from 1,640m (5,400') to 2590m (8,549'). The most conspicuous physiographic feature within the Park is "The Flatirons," triangular shaped remains of hogback ridges steeply tilted against the flanks of Green Mountain, Bear Peak, and South Boulder Peak. The summits of these peaks rise approximately 900m (3,000') above the plains. Steep canyons cut through the east slope of these mountains. Topography on the west side of these peaks is less severe, with long, relatively gently sloping ridges, tablelands, and canyons. Several small streams flow from west to east through the Park.

Cooper (1984) described eight general categories of vegetation within the Mountain Park: Ponderosa pine forest, Douglas-fir forest, mixed ponderosa pine/Douglas-fir forest, grassland-forest ecotone, mountain riparian, foothills riparian, grassland, rock faces and rock canyons. Coniferous forest is the dominant vegetation type throughout the Park (Colorado State Forest Service 1982). The composition of this forest varies considerably (Colorado State Forest Service 1982, Cooper 1984). Douglas-fir forest generally occurs on steep north-facing and east-facing

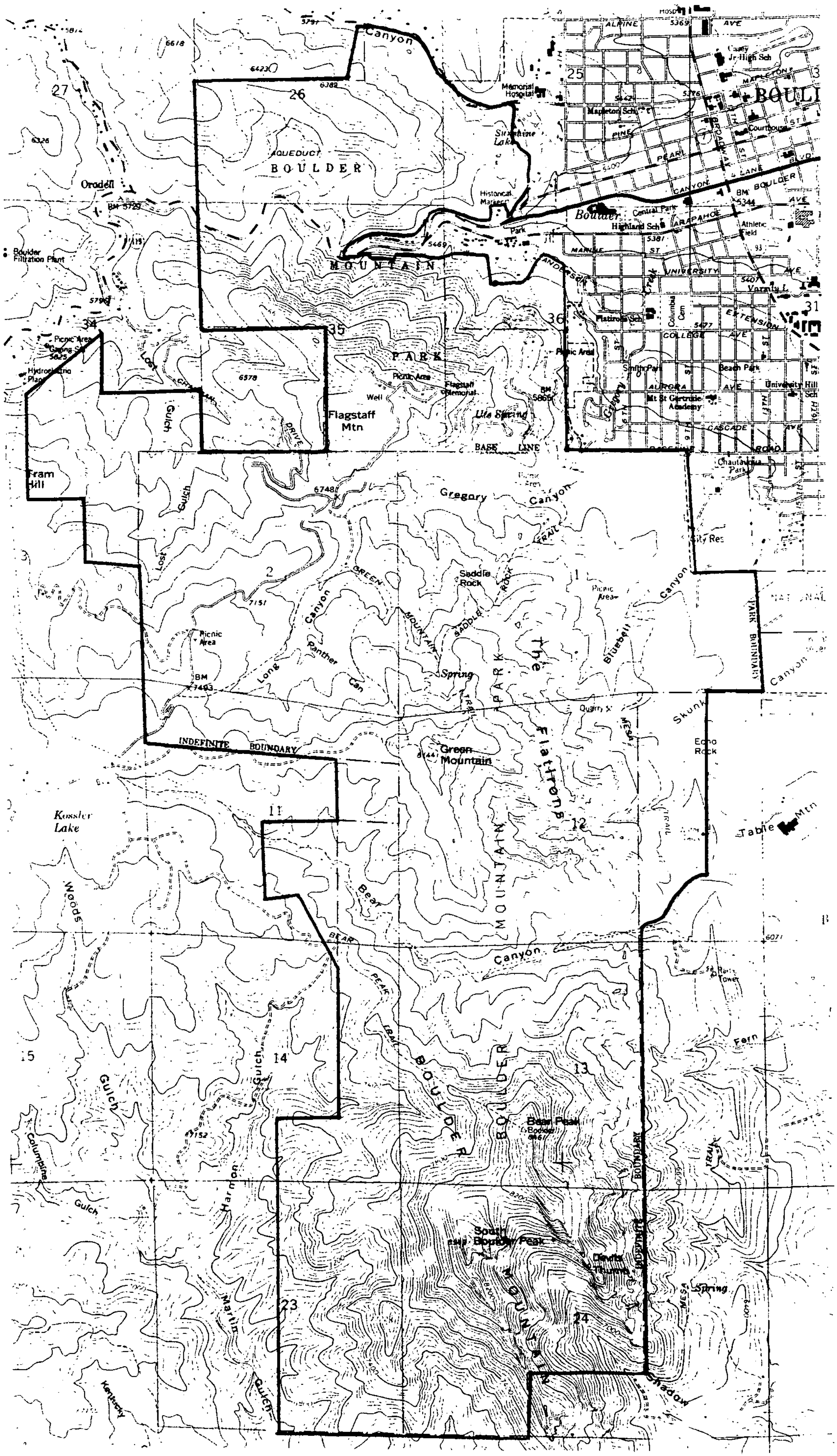


Figure 1. Boulder Mountain Park

slopes. South-facing slopes and ridges usually support more open stands of ponderosa pine.

The disturbance history of the Mountain Park forest is not well known. Much of the coniferous forest along the Front Range was cut or burned by miners and other settlers during the latter half of the 19th Century (Smith 1981, Colorado State Forest Service 1982, Goldblum 1990). Although old trees are found throughout the Mountain Park, the area is mostly forested by second-growth stands with a majority of the canopy trees in the 75 to 150-year age class (Colorado State Forest Service 1982). Historical photos indicate that the ponderosa pine forest west of Boulder has increased in density and extent since the late 19th Century (Smith 1981). Fire suppression has contributed to the expansion of the ponderosa pine forest into the foothills grasslands and to the generally dense and stunted appearance of many coniferous stands throughout the Mountain Park (Colorado State Forest Service 1982).

Methods

To facilitate an inventory of natural resources, the Park was divided into 32 relatively homogeneous geographic units (Figure 2). Each unit was visited and dominant plant species noted. Five-hectare breeding bird plots were established within 30 of the 32 units (due to time constraints, breeding bird surveys were not conducted in the two most inaccessible units). Fifteen plots were sampled during 1989, and the other 15 were sampled during 1990. Each plot was sampled three times 15 May-8 July between sunrise and 9:30 a.m., using belt transects laid out along rectangular coordinates (Emlen 1971). Transects were either 500m or 250m long. The observer walked slowly along the transect line, stopping every 25m to watch or listen for birds. All birds heard or seen within 50m of transect lines, except young of the year, were counted. Abundance values for each species in each plot represent the highest number of a given species observed on a single survey.

A forest structure inventory was conducted within each of 22 breeding bird plots that lay within predominantly coniferous forest. Mean DBH (diameter at breast height) was determined and a number 10 BAF prism was used to estimate tree density (basal area factor) within variable plots located every 50m along transect lines. Estimates were made of ground cover within variable plots, and all snags visible within 50m of transect lines were counted.

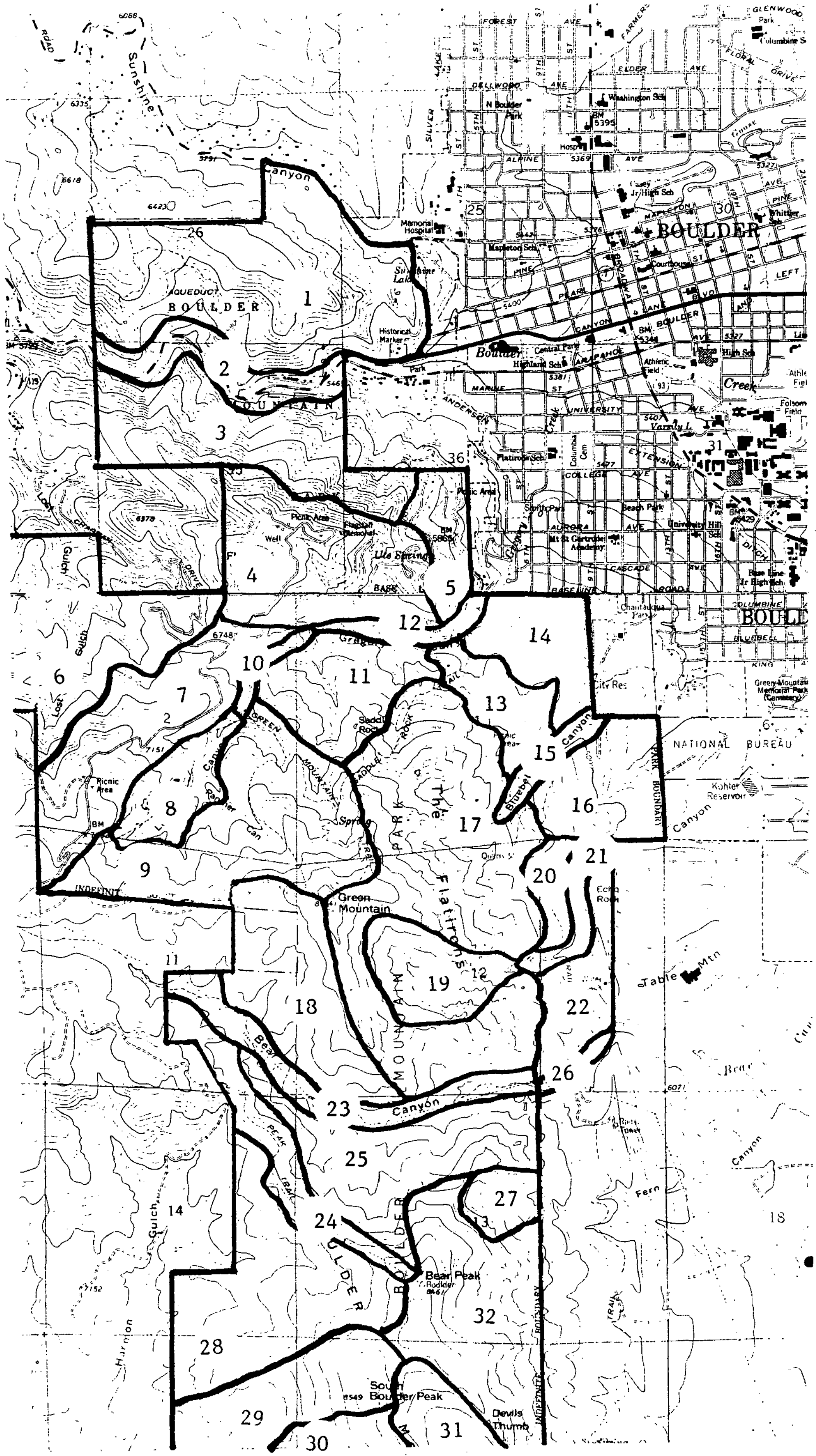


Figure 2. Management Sites and Plot Locations

Figure 2 (continued).

1. Sunshine Reservoir
2. Boulder Creek
3. Flagstaff North
4. Flagstaff Mountain
5. Flagstaff East
6. Lost Gulch
7. Cathedral Park
8. Long Canyon
9. Green Mt. West Ridge
10. Upper Gregory Canyon
11. Saddle Rock
12. Lower Gregory Canyon
13. Bluebell Mesa
14. Chautauqua Meadow
15. Bluebell Canyon
16. Kohler and Enchanted Mesas
17. Flatirons North (Royal Arch)
18. Green Mt. West
19. Upper Skunk Canyon
20. Middle Skunk Canyon
21. Lower Skunk Canyon
22. Mesa Trail, NCAR
23. Upper Bear Canyon
24. Bear Peak West Ridge
25. Bear Peak North
26. Lower Bear Canyon
27. Fern Canyon
28. Bear Peak West
29. Aspen Canyon
30. South Boulder Peak
31. Shadow Canyon
32. Flatirons South

Snags were defined as dead or dying trees (less than 50% crown growth) greater than 15cm *DBH* and taller than 5m.

A more detailed forest structure inventory was conducted on four sites that exhibited characteristics of old-growth forest. These sites were located in Lost Gulch, Upper Skunk Canyon, Shadow Canyon, and Aspen Canyon. Fixed plots, $100m^2$ and distributed evenly along 500m transect lines, were sampled at each of these sites. Diameters of all trees within these plots were measured. Size distribution of trees within these sites was compared with size distribution of trees in other coniferous stands along the Front Range characterized as "old-growth" (Peet 1988).

Information on mammal populations was derived from a deer population study conducted by the Parks and Recreation Department (in progress), a study of Mountain Park mammals conducted by David Armstrong (Cooper 1984), and sightings of predatory mammals (black bear, mountain lion, bobcat, gray fox, red fox, and coyote) reported to the Mountain Park rangers between 1983 and 1990. Sighting locations for predatory mammals were plotted on 7-1/2' topographic maps. These maps and Armstrong's list of potential mammalian fauna of the Boulder Mountain Parks were used to estimate the potential of each geographic unit to support mammal populations. Human use estimates for geographical units within the Mountain Park (low, moderate, high) were supplied by the Mountain Park rangers.

Vegetation Map

A vegetation map of the Mountain Prk was drawn using ground surveys and 1985, 1:4800 aerial photographs. Thirteen vegetation types were mapped. Vegetation classifications were derived from Marr (1961) and Cooper (1984).

Two methods were used to estimate species composition of coniferous forest stands. Stands that were inaccessible or located on steep slopes were sampled using binoculars to count the number of canopy trees of each species type. Other stands were sampled by counting the number of mature stems of each species within variable plots located every 50m along representative 500m transects.

All major riparian corridors within the Park were walked. Only those riparian corridors that exceeded 10m in width were included on the vegetation map.

Results and Discussion

Mountain Park Ecosystems

Thirteen general vegetation types (ecosystems) were identified and mapped within the Boulder Mountain Park (Table 1). A short description of each vegetation type, including dominant plants, common birds, and common mammals is given below. Scientific names are from Weber (1976).

Rock and Talus

Rock and Talus occurs throughout the Mountain Park at all elevations but is most prominent on the eastern slopes of Green Mountain and Bear Peak. Sparse vegetation on rock and talus slopes may include scattered ponderosa pines (Pinus ponderosa) and Douglas firs (Pseudotsuga menziesii), shrubs such as wax flower (Jamesia americana) and Rocky Mountain maple (Acer glabrum), and several species of ferns. Cliffs provide important nesting sites for raptors including prairie falcon, peregrine falcon, American kestrel, golden eagle, and red-tailed hawk. Common mammal species include least chipmunk, Colorado chipmunk, golden-mantled ground squirrel, and deer mouse.

Dry Scrub

This vegetation type includes shrub areas on east-facing hillsides and in dry canyons between 1760m (5800') and 1940m (6400'). Vegetation includes wax current (Ribes cereum) skunkbush

Table 1. Boulder Mountain Park Ecosystems.

Vegetation Type	Elevation (ft.)	Extent (%)	Location
Rock and Talus	5800-8549	9	Throughout
Dry Scrub	5800-6400	1	East-facing slopes and ravines
Grassland	5600-6000	3	East-facing slopes and mesas
Ponderosa Pine Woodland	5600-7600	25	South-facing slopes and other slopes with steepness less than 30%
Ponderosa Pine Forest	5800-7400	12	South-facing slopes, other gentle slopes, and mesas
Ponderosa Pine-Douglas-Fir Forest	6000-8540	38	All aspects on slopes steeper than 20%
Douglas-Fir Forest	6000-8200	8	North-facing and east-facing slopes steeper than 30%
Douglas Fir-Ponderosa Pine-Limber Pine Forest	7500-8400	<1	North face of Green Mt. and north ridge of Bear Pk.
Douglas Fir-Ponderosa Pine-Aspen Forest	6800-7600	1	Shaded canyons
Lodgepole Pine Forest	7300-8200	<1	West slope of Bear Pk.
Cottonwood-Willow Riparian	5600-6700	1	Foothills canyons, moist sites
Box Elder-Maple Riparian	5600-7000	<1	Foothills canyons, slightly drier sites
River Birch-Aspen-Hazelnut Riparian	6700-7600	<1	Shaded canyons

(Rhus trilobata), smooth sumac (Rhus glabra), hawthorn (Crataegus succulenta), chokecherry (Prunus virginiana), wild plum (Prunus americana), and ninebark (Physocarpus monogynus). This is an extremely rich avian habitat. Nesting species include gray catbird, lazuli bunting, indigo bunting, broad-tailed hummingbird, house wren, Virginia's warbler, and rufous-sided towhee. Coyotes and gray foxes den in shrub thickets, and the shrubs provide important browse for mule deer.

Grassland

Grassland (defined as areas where grasses are the dominant vegetation and conifers are absent) occurs in Chautauqua Meadow, on lower Flagstaff Mountain, and in lower Sunshine Canyon. Common grass species include mountain muhly (Muhlenbergia montana), blue gramma-grass (Bouteloua gracilis), western wheat grass (Agropyron smithii), green needle grass (Stipa viridula), and little bluestem (Schizachyrium scoparium). Today these grasslands seem of little importance to nesting birds. Western meadowlark was the only grassland species observed in Chautauqua Meadow during the 1990 breeding season. Prior to human disturbance, these grasslands may have hosted other common nesting species of mid-grass and tall-grass prairies, such as vesper sparrow, savannah sparrow, lark sparrow, and grasshopper sparrow. Common small mammals include deer mouse, prairie vole, and yellow-bellied marmot. Coyotes are frequently sighted.

Ponderosa Pine Woodland

Ponderosa pine woodland occurs throughout the Park on south-facing hillsides and gently sloping ridges and is characterized by scattered ponderosa pines (canopy cover is less than 50%) with a mixed grass and shrub understory. Douglas-fir and juniper (Juniperus scopulorum) may also be present. Understory species include wax current, yucca (Yucca glauca), buckbrush (Ceanothus fendleri), prickly pear (Opuntia sp.), and skunkbush. Breeding birds include common nighthawk, western wood-pewee, house wren, Townsend's solitaire, Virginia's warbler, western tanager, and chipping sparrow. This ecosystem provides habitat for a potential of 38 species of mammals (Cooper 1984), including mountain lion, mule deer, long-tailed weasel, gray fox, and coyote.

Ponderosa Pine Forest

Ponderosa pine forest (defined here as forest where canopy cover exceeds 50% and where more than 75% of mature trees are ponderosa pines) occurs on south-facing slopes and other gentle slopes at lower elevations of the Park. Douglas-fir and juniper are usually present in these stands. Common understory species are kinnikinnik (Arctostaphylos uva-ursi), chokecherry, Oregon grape (Mahonia repens), buckbrush, and low juniper (Juniperus communis). Ponderosa pine forests are particularly important for cavity-nesting birds. Flammulated owl, northern pygmy owl, northern saw-whet owl, Williamson's sapsucker, hairy woodpecker, and pygmy nuthatch all depend on dead ponderosa pines for nest sites. Other

birds include wild turkey, western tanager, western wood-pewee, pine siskin, and chipping sparrow. This ecosystem provides habitat for a potential of 48 species of mammals (Cooper 1984) including Abert's squirrel, pine squirrel, porcupine, mountain lion, and bobcat.

Ponderosa Pine/Douglas-Fir Forest

This is the predominant forest type throughout the Mountain Park, occurring on all slopes steeper than 20% and above 1,800m (5,940'). There is considerable variation in density and structure of ponderosa pine/Douglas-fir forests throughout the Park. In canyons at lower elevations these forests are often quite dense with a well developed shrub understory of Rocky Mountain maple, waxflower, kinnikinnik, Oregon grape, and other low shrubs and forbs. Birds and mammals include most species found in ponderosa pine forests and Douglas-fir forests. At higher elevations this forest type often consists of isolated groves of conifers scattered across steep rock and talus slopes. Here vegetation is sparse and bird and mammal populations are probably lower.

Douglas-Fir Forest

Douglas-fir forest (defined here as coniferous forest where more than 75% of mature trees are Douglas-firs) occurs on steep north-facing and east-facing slopes above 1,820m (6,000'). In some areas of the Park, such as the south slope of Long Canyon, trees

are extremely dense and stunted, and understory growth is sparse. In other areas, such as Lost Gulch and Shadow Canyon, Douglas-fir forest approaches an old-growth condition, with large trees, abundant snags and downed logs, and a well developed understory. These areas support high densities of breeding birds and are particularly important for forest interior species such as flammulated owl, hairy woodpecker, red-breasted nuthatch, and hermit thrush. Vegetation along water-courses provides forage for black bear, red fox, and porcupine. Other common mammals include chickaree, deer mouse, and montane vole.

Douglas-Fir/Ponderosa Pine/Limber Pine Forest

This ecosystem occurs on rocky, windswept ridges near the summits of Green Mountain and Bear Peak. The understory includes many of the species found in the Douglas-fir/ponderosa pine system. Breeding bird populations and mammal populations are probably relatively low.

Douglas-Fir/Ponderosa Pine/Aspen Forest

In the Boulder Mountain Park, aspen groves usually occur in moist, shaded canyons above 2,000m (6,600'), interspersed with stands of ponderosa pine and Douglas-fir. Along spring-fed streams between 2,000m (6600') and 2,300m (7590') this community often merges with the river birch-aspen-hazelnut riparian community, forming an extremely rich environment for breeding birds and mammals. Flammulated owl, tree swallow, house wren, mountain

bluebird, and warbling vireo nest in aspen groves. Mammals of aspen groves include elk, porcupine, long-tailed weasel, Nuttall's cottontail, and montane vole.

Lodgepole Pine Forest

Lodgepole pine (Pinus contorta) forest occurs only on the west side of Bear Peak between 2,200m (7,260') and 2,460m (8200') Mature lodgepole pines (mean DBH is approximately 20cm) grow on north-facing slopes in this area. Lodgepole seedlings and saplings were observed within these stands, although the sparse understory vegetation is dominated by young Douglas-firs. No bird or mammal surveys were conducted within these stands.

Cottonwood-Willow Riparian and Box Elder-Maple Riparian (Foothills Riparian)

These communities, often lumped together as foothills riparian (Marr 1961, Cooper 1984), occur in foothills canyons between 1,700m (5610') and 2,200m (7,260'). Plains cottonwood (Populus sargentii), narrowleaf cottonwood (Populus angustifolia) and various species of willow (Salix sp.) make up the dominant overstory at lower elevations and on moister sites. On drier sites the dominant overstory consists of Rocky Mountain maple, box-elder (Acer negundo), and beaked hazelnut (Corylus cornuta). A well developed shrub understory includes chokecherry, wild plum, hawthorn, ninebark, pin cherry, and poison ivy (Toxicodendron rydbergii). Multi-layered vegetation growth supports relatively

high numbers of breeding birds. Broad-tailed hummingbird, house wren, Virginia's warbler, MacGillivray's warbler, lazuli bunting, and rufous-sided towhee nest in the shrub understory. Western wood-pewee, black-capped chickadee, warbling vireo, and black-headed grosbeak nest in the overstory. These ecosystems are important foraging areas for a number of mammals, including black bear, porcupine, red fox, and fox squirrel. In late summer and early fall, black bears move down from higher elevations into these riparian areas to feed on chokecherries, sumac, apples, and other fruits prior to hibernation.

River Birch-Aspen-Hazelnut Riparian (Montane Riparian)

This community occurs at slightly higher elevations than the foothills riparian community and usually grows in association with ponderosa pine/Douglas-fir forests. Cooper (1984) refers to it as "probably the most unique area in the foothills of the entire Colorado Front Range." It contains the southernmost stand of paper birch (Betula papyrifera) in the western United States and many regionally rare and disjunct species including wood lily (Lilium philadelphicum), white adders-mouth (Malaxis monophyllos), alaskan orchis (Piperia unalascensis) common rattlesnake-plantain (Goodyera oblongifolia), dwarf raspberry (Rubus pubescens), and wild sarsparilla (Aralia nudicaulis). Two locally rare warblers (ovenbird and chestnut-sided warbler) probably nest in this ecosystem, as do MacGillivray's warbler, house wren, and dark-eyed junco. Wild berry crops provide forage for a variety of mammals

including black bear, Abert's squirrel, chickaree, porcupine, and racoon.

Coniferous Forest Structure

The structure of Boulder Mountain Park coniferous forests as measured on 22, 5-hectare plots is summarized in Tables 2 and 3. Basal areas ($ft.^2$/acre) were lowest in ponderosa pine woodlands and ponderosa pine forest plots and highest in Douglas-fir plots. Mean DBH was slightly higher in ponderosa pine woodland and ponderosa pine forest plots than in mixed coniferous forest and Douglas-fir forest plots. This largely reflects a difference in regeneration patterns. In most ponderosa pine stands sampled, saplings and small trees were scarce or absent; whereas in most Douglas-fir stands sampled, numerous small trees were intermixed with larger, more mature trees. Maximum DBH (mean diameter of largest trees within each of 10 variable plots within each stand) and mean height (mean height of 10 site trees within each stand) were higher in Douglas-fir forest stands than in ponderosa pine forest stands.

Snags

Snag densities varied considerably throughout the Park, from a low of 0.4 snags/ha on a ponderosa pine forest plot to a high of 18 snags/ha on a mixed coniferous forest plot. This variation probably reflects the patchy nature of ponderosa pine beetle and spruce budworm infestations throughout the Park. Many of the dead trees in the Park were killed by beetle infestations during the 1970's and budworm infestations during the

Table 2. Forest Structure of Coniferous Plots

Plot No.	Location	Composition	BAF[1]	Mean DBH (in.)	Max.[2] DBH	Snags/ha >6" DBH	Snags/ha >10" DBH	Ground[3] Cover	Mean[4] Height
1	Sunshine Res.	100%PP	37	10.8	14.0	3.2	1.0	2.0	30
3	Flagstaff North	84%PP, 16%DF	74	8.1	11.1	2.4	1.0	2.5	28
4	Flagstaff Mt.	97%PP, 3%DF	70	11.9	17.5	0.4	0.0	2.7	41
6	Lost Gulch	77%DF, 23%PP	133	10.5	18.6	13.6	6.4	3.5	50
7	Cathedral Park	53%PP, 47%DF	82	9.8	12.8	3.8	1.6	2.5	41
8	Long Canyon	84%PP, 16%DF	38	11.6	14.9	6.2	2.5	3.3	43
9	Green Mt. W. Rdg.	55%DF, 45%PP	80	9.0	12.5	18.0	6.0	2.7	30
11	Saddle Rock	90%PP, 10%DF	90	10.7	13.0	2.0	0.0	2.0	40
13	Bluebell Mesa	100%PP	73	14.2	19.1	0.4	0.4	3.8	46
16	Kohler Mesa	100%PP	74	12.7	18.2	9.2	2.4	2.0	49
17	Royal Arch	61%PP, 31%DF	66	12.4	17.6	3.2	0.8	3.9	49

[1]Basal area in square ft. per acre.

[2]Mean diameter of largest tree within each of 10 variable plots.

[3]Ground cover within each of 10 variable plots was rated 1-5. 1--less than 25%; 2--25-50%; 3--50-75%; 4--75-100%; 5--75-100% and significant brushy cover. This is the mean rating.

[4]Mean height in feet of site trees within each of 10 variable plots.

Table 2. (continued)

Plot No.	Location	Composition	BAF[1]	Mean DBH (in.)	Max.[2] DBH	Snags/ha >6" DBH	Snags/ha >10" DBH	Ground[3] Cover	Mean[4] Height
18	Green Mt. West	70%PP, 30%DF	47	10.0	13.5	14.8	6.4	3.2	45
19	Upper Skunk Canyon	81%DF, 11%PP	130	10.4	15.8	8.0	2.2	3.4	52
20	Middle Skunk Canyon	71%DF, 29%PP	96	9.7	16.3	1.6	0.8	4.0	40
22	Mesa Trail, NCAR	95%PP, 5%DF	21	14.2	18.8	0.8	0.0	4.8	46
24	Bear Peak W. Rdg.	64%PP, 36%DF	45	7.6	9.2	12.2	2.0	2.0	30
25	Bear Peak North	53%PP, 47%DF	74	9.5	14.5	11.6	1.2	2.8	43
27	Fern Canyon	81%DF, 19%PP	97	9.9	15.1	2.8	1.8	3.1	42
28	Bear Peak West	87%PP, 6%DF	31	10.8	14.3	6.0	4.0	2.9	33
29	Aspen Canyon	46%PP, 46%DF	132	11.1	17.7	16.0	5.6	3.3	58
30	S. Boulder Peak	89%PP, 8%J	28	7.7	9.4	3.8	2.5	3.3	31
31	Shadow Canyon	85%DF, 15%PP	89	12.4	19.9	7.4	4.5	3.0	49

Table 3. Coniferous Forest Structure by Forest Type

Forest Type	No. Plots	BAF	Mean DBH	Max. DBH	Snags/ha >6" DBH	Snags/ha >10" DBH	Ground Cover	Height
Ponderosa Woodland	5	31	11.0	14.3	4.4	2.0	3.3	36.6
Ponderosa Pine Forest	5	76	11.5	15.8	2.8	0.8	2.6	40.8
Mixed Coniferous Forest	8	82	9.9	14.3	10.0	3.1	3.1	42.0
Douglas-Fir Forest	4	112	10.8	17.4	8.0	4.7	3.3	48.2

1980's. The majority of snags (68%) were in the 15-25cm (6-10") diameter class. Snags in this size class may be of marginal use for cavity-nesting birds (Scott et. al. 1980, Mannan et. al. 1980, Cunningham et. al. 1980). Density of snags greater than 25cm (10") DBH throughout the park was 2.4/ha. This is about half the snag density that has been recommended for maintaining cavity- nesting bird populations in Rocky Mountain coniferous forests (Balda 1975, Scott 1978, Cunningham et. al. 1980, Ffolliott 1983, Marzluff and Lyon 1983,).

Old-Growth

In the simplest sense, old-growth forests can be defined as those forests that have evolved over time in the absence of catastrophic disturbances or major human disturbances (Franklin et. al. 1981, Greene 1988). Unfortunately the disturbance history of coniferous forests within the Boulder Mountain Park is not well known. Therefore, examination of old-growth within the Mountain Park must rely on analysis of stand characteristics.

There is little knowledge about typical stand characteristics of old-growth Rocky Mountain ponderosa pine and Douglas-fir forests. Generalized definitions of old-growth may be marginally applicable to conditions within the Boulder Mountain Park. Greene (1988) described old-growth Douglas-fir forests as having the following characteristics: (1) Two or more tree species with a wide range in size and age, often including a long-lived seral dominant and a shade-tolerant associate; (2) a deep, multi-layered

canopy; and (3) significant coarse woody debris, including snags and downed logs. The U.S. Forest Service Old Growth Definition Task Group (1986) listed the following characteristics of old-growth Douglas-fir forests in the Pacific Northwest: (1) Two or more species with wide age range and full range of tree sizes; (2) a multi-layered canopy; (3) conifer snags greater than 1 1/2 per acre that are greater than 20" in diameter and greater than 50' tall; (4) logs greater than or equal to 10 tons/acre including two pieces per acre that are greater than 24" in diameter and greater than 50' long. Moir and Dieterich (1988) characterized old growth ponderosa pine forests as those containing: (1) Trees 350-425 years old; (2) high snag density; and (3) an open understory dominated by grasses.

Peet (1988) outlined four stages of coniferous forest development along the Colorado Front Range. An initial invasion stage is followed by a second stage consisting of dense forest with stagnated growth. During the third stage climax species replace seral species, and seedling establishment begins to take place as the canopy slowly opens. The final phase is the true climax or "steady-state" forest. Douglas-fir forests at higher elevations along the Front Range often exhibit a "reverse-J" or negative exponential diameter distribution pattern, with high numbers of saplings and greatly reduced numbers of middle-aged or middle-sized trees (Peet 1988). Second stage forests at higher elevations exhibit bell-shaped diameter distribution curves with low numbers of saplings and high numbers of intermediate size trees. Peet

noted that the reverse-J distribution pattern of mature Douglas-fir forests at higher elevations did not seem to apply to lower elevation Douglas-fir forests or to ponderosa pine forests. In the latter forests he observed relatively even size distribution patterns with periodic bulges resulting from episodes of high seedling establishment.

Diameter distributions of Douglas-firs and ponderosa pines in four 5-hectare plots in the Boulder Mountain Park are shown in Table 4. Douglas-fir stands in Lost Gulch, Aspen Canyon, and Shadow Canyon exhibited the reverse-J diameter distribution pattern with bulges in the 8-10", 10-12", and 12-14" diameter classes. These stands may be evolving toward the structure typical of mature montane Douglas-fir forests. By contrast, the Skunk Canyon Douglas-fir stand shows a near perfect bell-shaped size distribution curve. Without further research, it would be impossible to determine whether these structural differences among Douglas-fir stands result from differences in disturbance history or from site characteristics such as soil moisture, soil texture, and slope. All four ponderosa pine stands sampled exhibited random size distribution.

In table 5 a generalized list of old-growth characteristics is applied to the four stands. It is interesting to note that the Shadow Canyon, Lost Gulch, and Aspen Canyon stands, which exhibited the reverse-J size distribution pattern, also meet many of the criteria for old-growth; whereas the Skunk Canyon stand, which

Table 4. Diameter Distribution of Douglas-Fir and Ponderosa Pine in Four Mountain Park Stands.[1]

Plot Name and Forest Type	S[2]	Number of Trees by Diameter Class (Inches) 0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22+
Lost Gulch													
Douglas-Fir	36	30	21	17	8	13	8	8	5	5	0	1	0
Ponderosa Pine	0	1	5	3	4	1	1	2	2	0	0	1	2
Shadow Canyon													
Douglas-Fir	26	18	17	14	9	11	9	12	5	5	1	1	2
Ponderosa Pine	1	3	2	1	2	0	2	1	0	1	1	0	1
Aspen Canyon													
Douglas-Fir	70	15	12	6	4	10	5	9	2	0	0	0	0
Ponderosa Pine	2	0	4	2	7	4	3	5	2	8	2	1	0
Skunk Canyon													
Douglas-Fir	3	1	2	4	2	8	9	7	4	3	1	0	0
Ponderosa Pine	0	0	1	0	1	3	0	1	0	0	0	0	0

[1]Ten 100m^2 plots were sampled within stands in Lost Gulch, Shadow Canyon, and Aspen Canyon. Five 100m^2 plots were sampled in Skunk Canyon.

[2]Saplings less than 1.5m (5') tall.

Table 5. Old-Growth Attributes of Four Douglas-Fir Stands in the Boulder Mountain Park

Stand Location	Large Trees >20" DBH	Multilayered Canopy	Abundant Snags	Downed Logs	Regeneration
Lost Gulch	x	x	X	x	X
Shadow Canyon	x	x	x		X
Aspen Canyon		x	X	X	X
Upper Skunk Canyon			x	x	

X--Fits this attribute

x--Partially fits this attribute

exhibited a bell shaped distribution curve, meets only two of the five criteria for old growth.

Prior to European settlement, Front Range forests were subjected to periodic natural disturbances. Ground fires probably eliminated litter on the forest floor and opened up the forest by killing smaller trees. Less frequent catastrophic fires may have killed entire stands of trees over large areas. The phase-four, or old-growth, forest type may not have been the dominant type along the Front Range. It is likely that a mosaic of forest types in various stages of development existed (Peet 1988). Thus, it is difficult to say to what extent forest structure in the Mountain Park today conforms to or diverges from forest structure in pre-settlement times.

Breeding Bird Populations

A total of 102 breeding bird species has been documented in the Boulder Mountain Park (Table 6). Of these species, 67 are confirmed nesters (definite evidence of nesting), 18 are probable nesters (strong indications of nesting), and 17 are possible nesters (seen or heard in appropriate breeding habitat during the breeding season). Tables 7 and 8 summarize breeding bird densities on 30, 5-hectare plots in the Mountain Park. The number of species observed ranged from 9 in a grassland plot in Chautauqua Meadow to 29 in a mixed coniferous plot on Green Mountain. Number of individuals observed ranged from 23 in the Chautauqua Meadow plot to 69 in a dry scrub plot in Lower Skunk Canyon. Breeding bird density was highest in dry scrub plots (64.0 individuals per plot) and riparian plots (52.3 individuals per plot). Among the coniferous forest plots, breeding bird density was highest in ponderosa pine/Douglas-fir plots (48.4 individuals per plot) and lowest in ponderosa pine woodland plots (39.0 individuals per plot).

Breeding bird densities were highest on plots that contained more than one vegetation type. For example, the four coniferous forest plots with the highest breeding bird densities (Long Canyon, Green Mountain West Ridge, Royal Arch, and Green Mountain West) all contained small areas of river birch-aspen-hazelnut or box elder-maple riparian growth.

Table 6. Breeding Birds of Boulder Mountain Park.[1]

Species	Habitat	Status	Abundance	Breeding Behavior
Turkey Vulture	N	Pr	U	Pair
Sharp-shinned Hawk	C	Cf	FC	Occupied nest
Cooper's Hawk	C	Cf	FC	Occupied nest
Northern Goshawk	C	Cf	U	Occupied nest
Red-tailed Hawk	C,N	Cf	FC	Used nest
Golden Eagle	N	Cf	FC	Nest with young
American Kestrel	A,C	Cf	FC	Feeding young
Peregrine Falcon	N	Cf	R	Historic nest
Prairie Falcon	N	Cf	FC	Nest with young
Blue Grouse	C	Cf	FC	Fledged young
Wild Turkey	C	Cf	U	Fledged young
Rock Dove	N	Cf	FC	Nest with young
Band-tailed Pigeon	C	Pr	U	Territory
Mourning Dove	C,D,R	Cf	FC	Occupied nest
Flammulated Owl	A,C	Cf	U	Occupied nest
Eastern Screech Owl	R	Pr	U	Pair
Great Horned Owl	C,R,N	Cf	C	Nest with young

Habitat Codes: A--Aspen, C--Coniferous Forest, D--Dry Scrub, G--Grassland, N--Cliffs and Canyons, R--Riparian

Breeding Codes: Po--Possible Breeder, Pr--Probable Breeder, Cf--Confirmed Breeder

Abundance Codes: C--Common, FC--Fairly Common, U--Uncommon, R--Rare, I--Irregular

[1]Jones, S. (1989). Boulder Mountain Park Forest Bird Study.

Table 6, continued

Species	Habitat	Status	Abundance	Breeding Behavior
Northern Pygmy Owl	C	Cf	U	Nest with young
Long-eared Owl	C	Cf	R	Nest with young
Northern Saw-whet Owl	C	Cf	U	Occupied nest
Common Nighthawk	C,D,R	Pr	U	Territory
Common Poorwill	C,D	Pr	U	Pair
White-throated Swift	N	Cf	FC	Occupied nest
Broad-tailed Hummingbird	A,C,D,R	Cf	C	Occupied nest
Belted Kingfisher	R	Po	R	Observed
Lewis's Woodpecker	D,R	Cf	R	Nest with young
Williamson's Sapsucker	C	Cf	FC	Nest with young
Downy Woodpecker	C,R	Cf	U	Nest with young
Hairy Woodpecker	C	Cf	FC	Nest with young
Three-toed Woodpecker	C	Po	R	Observed
Northern Flicker	C,R	Cf	C	Nest with young
Olive-sided Flycatcher	C	Pr	U	Territory
Western Wood-Pewee	C	Pr	C	Multiple males
Hammond's Flycatcher	C	Cf	FC	Nest with young
Dusky Flycatcher	A,C,R	Pr	U	Multiple males
Western Flycatcher	A,C,R	Cf	C	Occupied nest
Say's Phoebe	D	Po	R	Observed
Western Kingbird	R	Po	R	Observed
Tree Swallow	A,C,N	Cf	U	Occupied nest
Violet-green Swallow	A,C,N	Cf	FC	Occupied nest
Steller's Jay	C	Cf	C	Feeding young

Table 6, continued

Species	Habitat	Status	Abundance	Breeding Behavior
Blue Jay	R	Po	U	Observed
Scrub Jay	D	Po	R	Observed
Clark's Nutcracker	C	Po	I	Observed
Black-billed Magpie	C,D,R	Cf	C	Nest with young
American Crow	C,N	Cf	FC	Occupied nest
Common Raven	N	Cf	FC	Occupied nest
Black-capped Chickadee	R	Cf	FC	Occupied nest
Mountain Chickadee	C	Cf	C	Occupied nest
Bushtit	D	Cf	R	Nest with young
Red-breasted Nuthatch	C	Cf	I	Occupied nest
White-breasted Nuthatch	C	Cf	FC	Occupied nest
Pygmy Nuthatch	C	Cf	C	Occupied nest
Brown Creeper	C	Pr	U	Territory
Rock Wren	D,N	Cf	U	Feeding young
Canyon Wren	N	Cf	FC	Occupied nest
House Wren	A,C,D,R	Cf	C	Feeding young
American Dipper	R	Cf	U	Fledged young
Ruby-crowned Kinglet	C	Pr	U	Mutliple males
Blue-gray Gnatcatcher	C,D	Po	R	Singing males
Western Bluebird	C,G	Cf	U	Nest with young
Mountain Bluebird	A,C,G	Cf	U	Occupied nest
Townsend's Solitaire	C	Cf	FC	Fledged young
Swainson's Thrush	C	Po	U	Singing Male
Hermit Thrush	C	Pr	FC	Multiple males

Table 6, continued

Species	Habitat	Status	Abundance	Breeding Behavior
American Robin	A,C,D,R	Cf	C	Occupied nest
Gray Catbird	D,R	Cf	U	Occupied nest
Northern Mockingbird	D,R	Po	R	Observed
Cedar Waxwing	R	Po	R	Observed
Starling	R	Cf	U	Occupied nest
Solitary Vireo	C	Cf	FC	Occupied nest
Warbling Vireo	A,R	Cf	FC	Occupied nest
Virginia's Warbler	C,D	Cf	C	Feeding young
Yellow-rumped Warbler	C	Cf	C	Feeding young
Yellow Warbler	R	Pr	U	Multiple males
Chestnut-sided Warbler	R	Cf	R	Nest with young
American Redstart	R	Po	R	Singing male
Ovenbird	R	Po	R	Singing male
MacGillivray's Warbler	R	Cf	FC	Feeding young
Yellow-breasted Chat	D	Cf	FC	Feeding young
Western Tanager	C	Cf	FC	Nest with young
Black-headed Grosbeak	C,R	Cf	FC	Nest with young
Blue Grosbeak	D	Po	R	Pair
Lazuli Bunting	C,D,R	Cf	C	Fledged young
Indigo Bunting	D,R	Pr	U	Territory
Green-tailed Towhee	C,D,R	Cf	FC	Fledged young
Rufous-sided Towhee	D	Cf	C	Nest with young
Chipping Sparrow	C,R	Cf	C	Occupied nest
Vesper Sparrow	G	Po	U	Observed

Table 6, continued

Species	Habitat	Status	Abundance	Breeding Behavior
Lark Sparrow	G	Po	U	Observed
Gray-headed Junco	A,C	Cf	C	Fledged young
Western Meadowlark	G	Cf	FC	Nest with eggs
Brown-headed Cowbird	A,C,D,R	Cf	FC	Fledged young
Northern Oriole	R	Cf	FC	Nest with young
Cassin's Finch	C	Pr	I	Pair
House Finch	D,R	Cf	U	Occupied nest
Red Crossbill	C	Pr	I	Fledged young
Pine Siskin	C	Pr	C	Multiple males
Lesser Goldfinch	C,D	Pr	FC	Multiple males
American Goldfinch	C,R	Pr	U	Multiple males
Evening Grosbeak	C	Po	U	Observed
House Sparrow	D	Po	U	Observed

Table 7. Plot Densities of Breeding Birds

Plot Location	Vegetation Type	Species	Individuals	% Cavity Nesters	% Forest Interior
Chautauqua Meadow	Grassland	9	23	4	0
Flagstaff East	Dry Scrub	25	59	15	2
Lower Skunk Canyon	Dry Scrub	24	69	12	1
Boulder Creek	Riparian	16	35	46	3
Bluebell Canyon	Riparian	26	53	17	6
Lower Gregory Canyon	Riparian	20	56	2	0
Upper Gregory Canyon	Riparian	25	48	15	8
Lower Bear Canyon	Riparian	26	62	7	3
Upper Bear Canyon	Riparian	19	41	10	0
Sunshine Res.	Ponderosa Woodland	13	24	39	0
Long Canyon	Ponderosa Woodland	27	59	33	12
Mesa Trail, NCAR	Ponderosa Woodland	19	33	6	0
Bear Peak W. Ridge	Ponderosa Woodland	15	29	38	10
S. Boulder Peak	Ponderosa Woodland	17	30	24	3
Flagstaff Mt.	Ponderosa Forest	16	50	10	2
Saddle Rock	Ponderosa Forest	18	28	7	4
Bluebell Mesa	Ponderosa Forest	17	38	16	0
Kohler Mesa	Ponderosa Forest	19	46	48	6
Bear Peak West	Ponderosa Forest	20	40	28	5
Flagstaff North	Mixed Coniferous	18	34	12	6
Cathedral Park	Mixed Coniferous	21	46	22	5
Green Mt. W. Rdg.	Mixed Coniferous	27	66	56	14
Royal Arch	Mixed Coniferous	25	55	25	4

Table 7, continued

Plot Location	Vegetation Type	Species	Individuals	% Cavity Nesters	% Forest Interior
MiddleSkunk Canyon	Mixed Coniferous	19	39	5	0
Green Mt. West	Mixed Coniferous	29	55	39	7
Bear Peak North	Mixed Coniferous	24	49	14	16
Aspen Canyon	Mixed Coniferous	24	48	21	13
Lost Gulch	Douglas-Fir Forest	22	42	24	19
Fern Canyon	Douglas-Fir Forest	16	43	25	8
Shadow Canyon	Douglas-Fir Forest	26	51	20	14

Table 8. Plot Densities of Breeding Birds by Vegetation Type.

Vegetation Type	No. Plots	Species	Individuals	% Cavity Nesters	% Forest Interior
Grassland	1	9.0	23.0	4.0	0.0
Dry Scrub	2	24.5	64.0	13.5	1.5
Riparian	6	22.0	52.3	16.2	3.3
Ponderosa Woodland	5	19.2	39.0	25.8	4.0
Ponderosa Forest	5	17.6	39.2	18.6	3.6
Mixed Coniferous Forest	3	23.0	48.4	27.5	8.6
Douglas-Fir Forest	3	21.3	45.3	23.0	13.7
All Plots	30	20.7	44.4	21.3	5.7

There was a strong correlation between snag density per plot and number of species per plot (r^2=.37, p<.007). This relationship is illustrated in Figure 4.

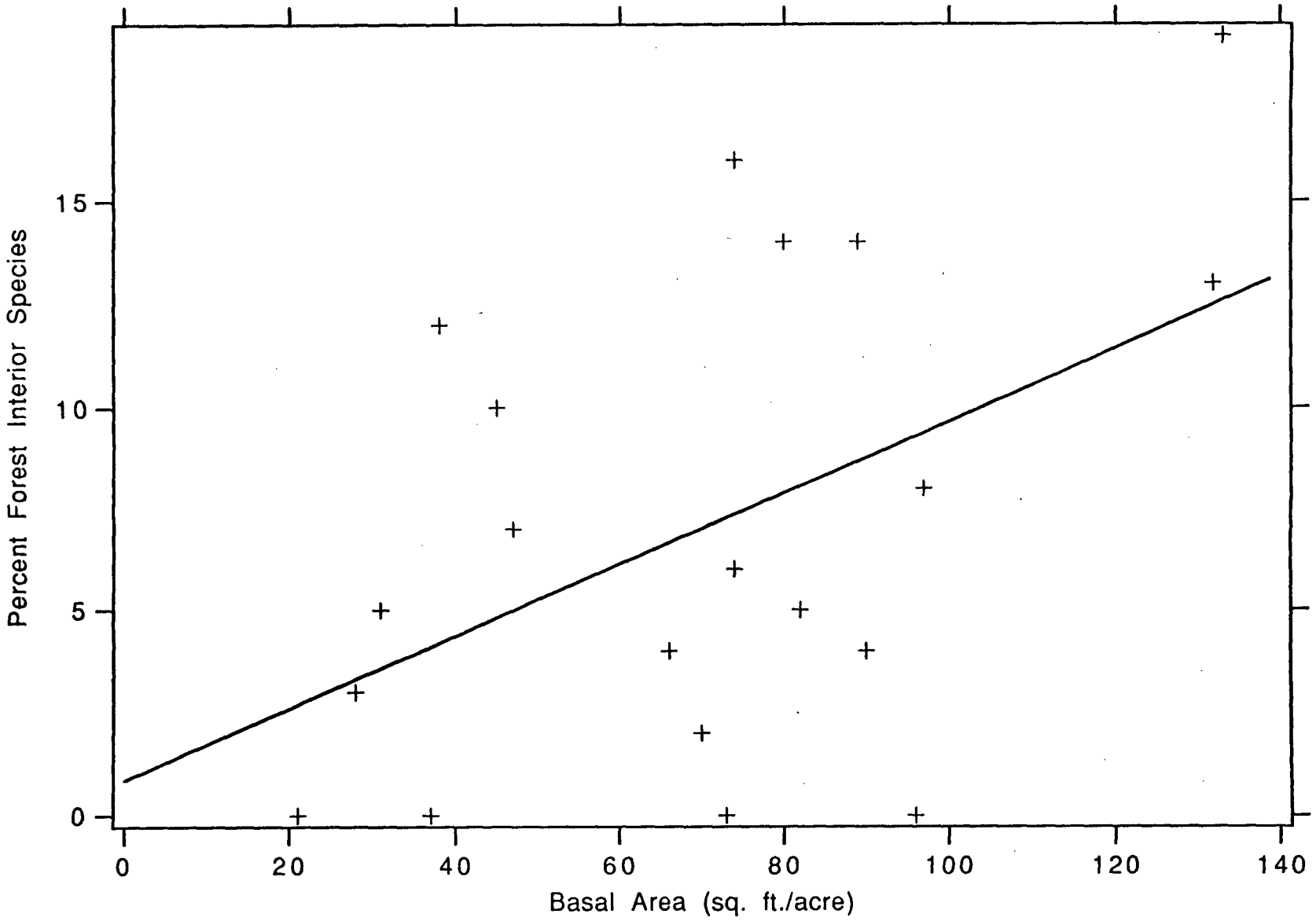
Tree height also appeared to influence breeding bird density (Figure 5). On coniferous plots there was a weak positive relationship between mean tree height per plot and number of individuals per plot (r^2=.135, p<.07).

These findings are consistent with those of previous studies which have determined that habitat diversity, snag density, and foliage volume are good predictors of breeding bird density and diversity (MacArthur 1964, Balda 1975, Wiens 1978, Mannan et. at. 1980, Diem 1980, Mannan and Meslow 1984).

Cavity-Nesting Birds

Cavity-nesting birds comprised 24.4% of all individuals observed on 21 coniferous forest plots. This cavity-nester density is considerably lower than that reported in other breeding bird studies of Rocky Mountain coniferous forests. Scott, Wheylen, and Svoboda (1980) summarized the results of eight such studies in ponderosa pine/Douglas-fir forests in Arizona and Colorado. They reported a mean cavity-nester density in ponderosa pine forests of 42% with a range of 32-46%. The mean density of cavity-nesters in two Douglas-fir plots was 26% (12% and 40% respectively). The low number of cavity-nesting birds observed in Mountain Park coniferous forest plots may stem in part from low snag density throughout much

Figure 3. Tree Density and Percent Forest Interior Species On 21 Coniferous Forest Plots.



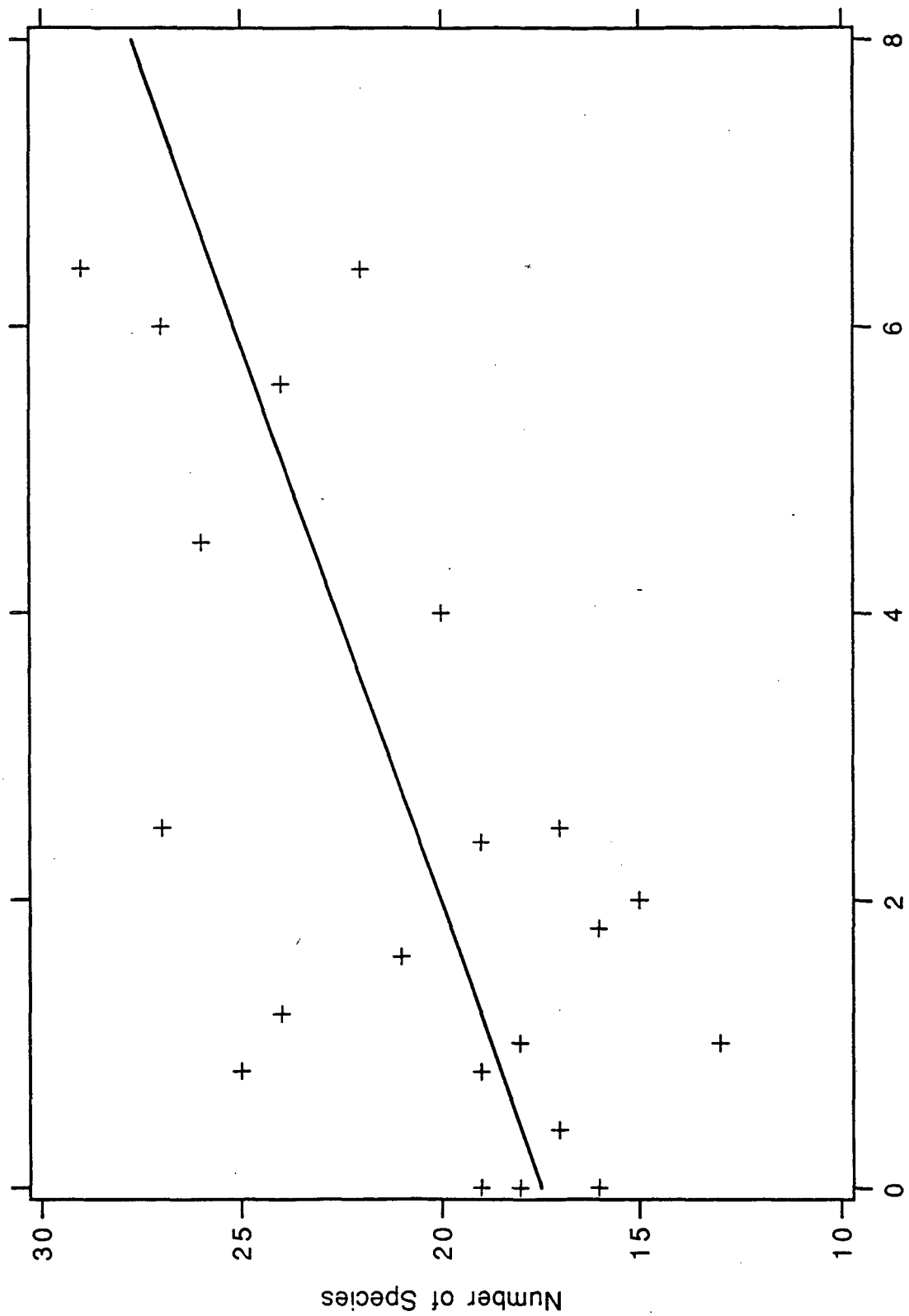


Figure 4. Number of Species and Snag Density on 21 Coniferous Forest Plots.

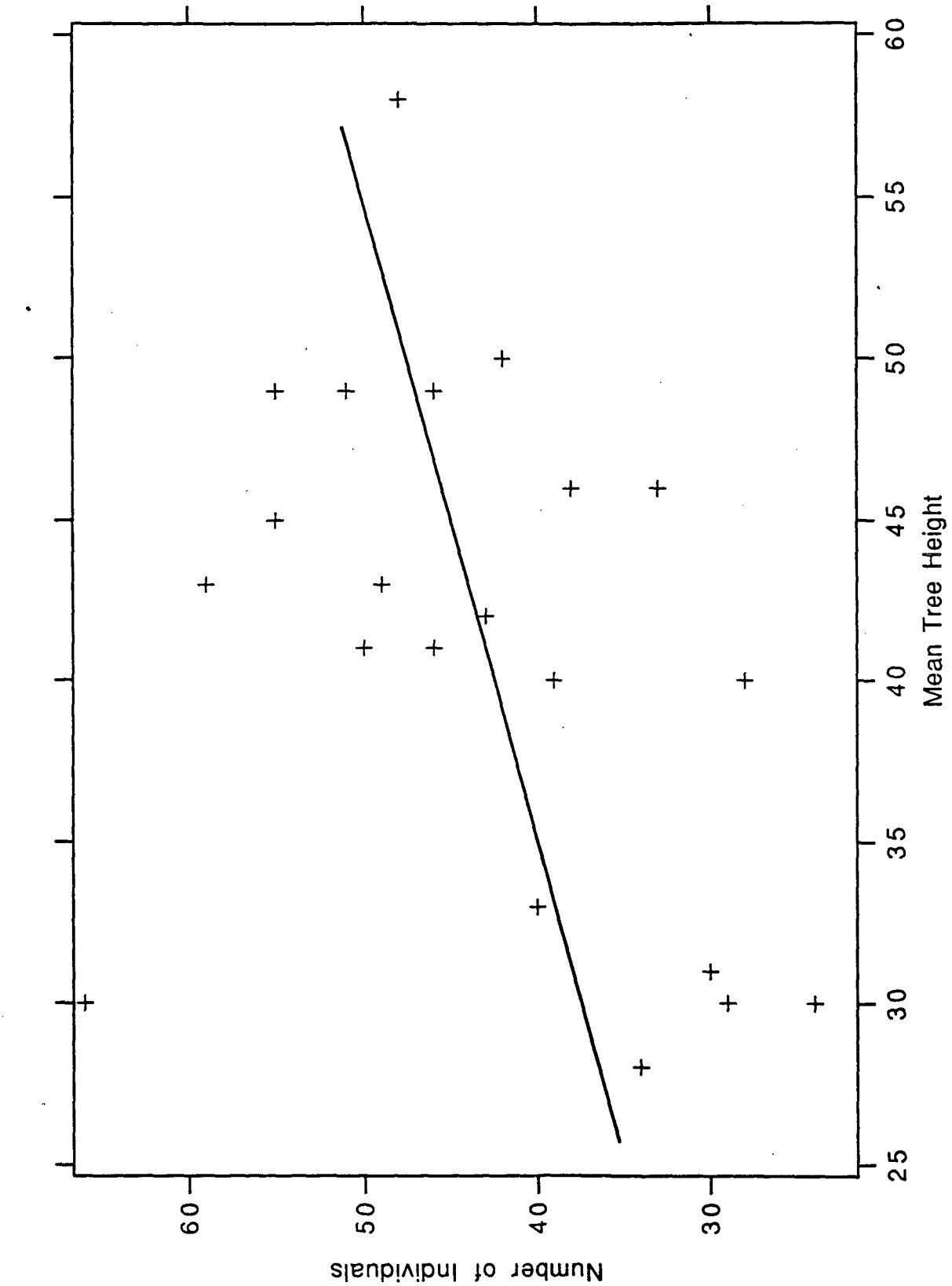


Figure 5. Number of Individuals and Mean Tree Height on 21 Coniferous Forest Plots.

of the Park. There was a significant positive relationship between snag density and percent cavity-nesting species (r^2 = .24, $p < .03$).

Forest Interior Birds

Forest interior birds are those species that usually occur in closed canopy or old-growth forests (Hallock 1987). Densities of seven forest interior birds found in the Boulder Mountain Park (flammulated owl, hairy woodpecker, western flycatcher, red-breasted nuthatch, brown creeper, ruby-crowned kinglet, and hermit thrush) are shown in Tables 2 and 3. These species were most abundant in Douglas-fir forest plots. Distribution of four forest interior species is shown in Figure 6-9.

Flammulated owls, which are associated with old-growth ponderosa pine/Douglas-fir forests (Reynolds and Linkhart 1987), were found in four canyons in the Mountain Park: Shadow Canyon, Aspen Canyon, Upper Skunk Canyon, and Long Canyon. These canyons contain relatively dense Douglas-fir stands, dense shrub understories along streams, and relatively high snag densities. Hermit thrushes are foliage gleaners that nest on the ground or low in conifers (Ehrlich 1987). Hermit thrushes were found in the same habitat as flammulated owls in Lost Gulch, Long Canyon, Bear Canyon, Aspen Canyon, and Shadow Canyon. Red-breasted nuthatches and hairy woodpeckers are insectivorous cavity nesters (Ehrlich 1987). They, too, were found in relatively dense Douglas-fir forests in Lost Gulch, Long Canyon, Bear Canyon, Aspen Canyon, and Shadow Canyon.

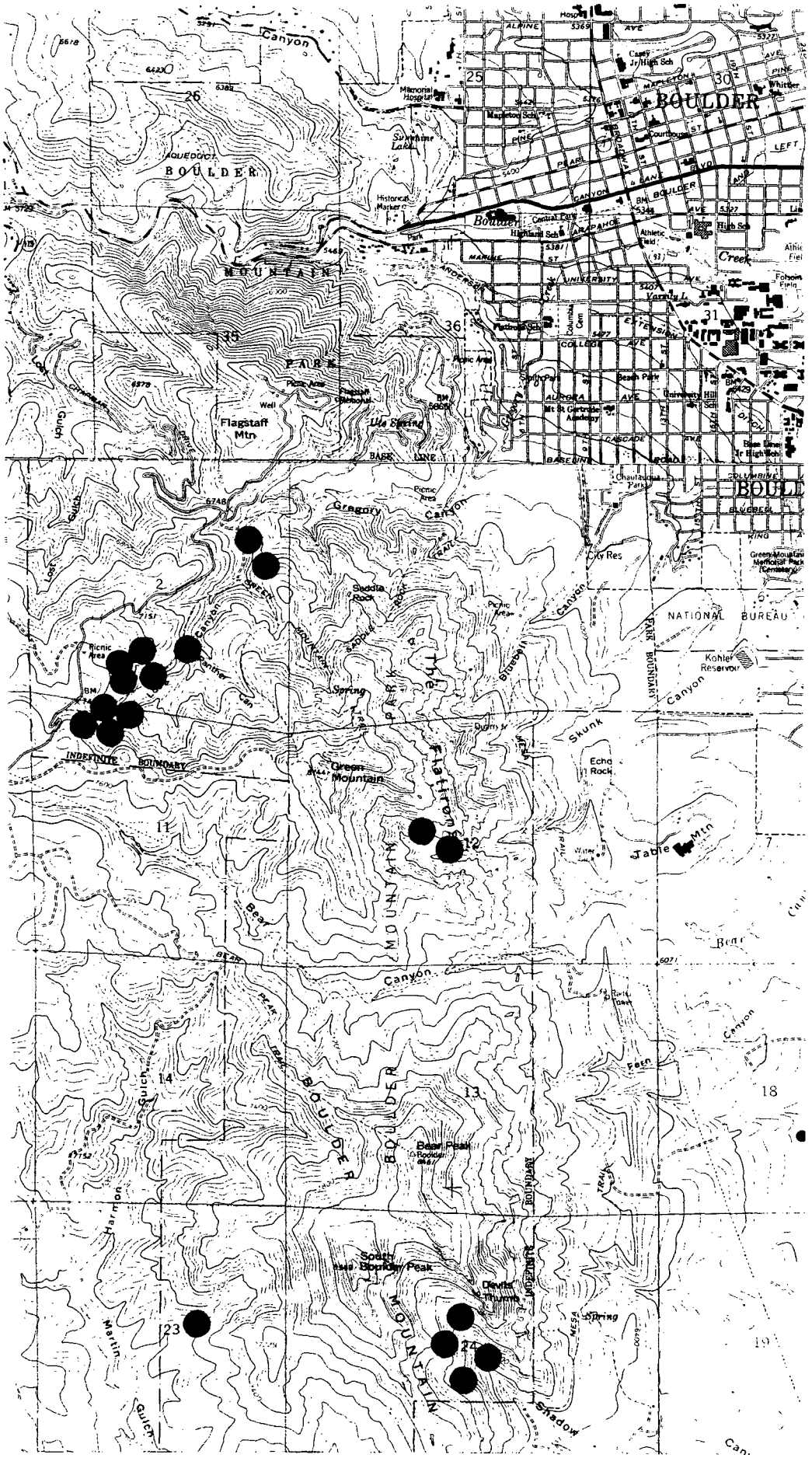


Figure 6. Flammulated Owl Distribution, 1986-90.

Each dot represents one singing owl during one breeding season.

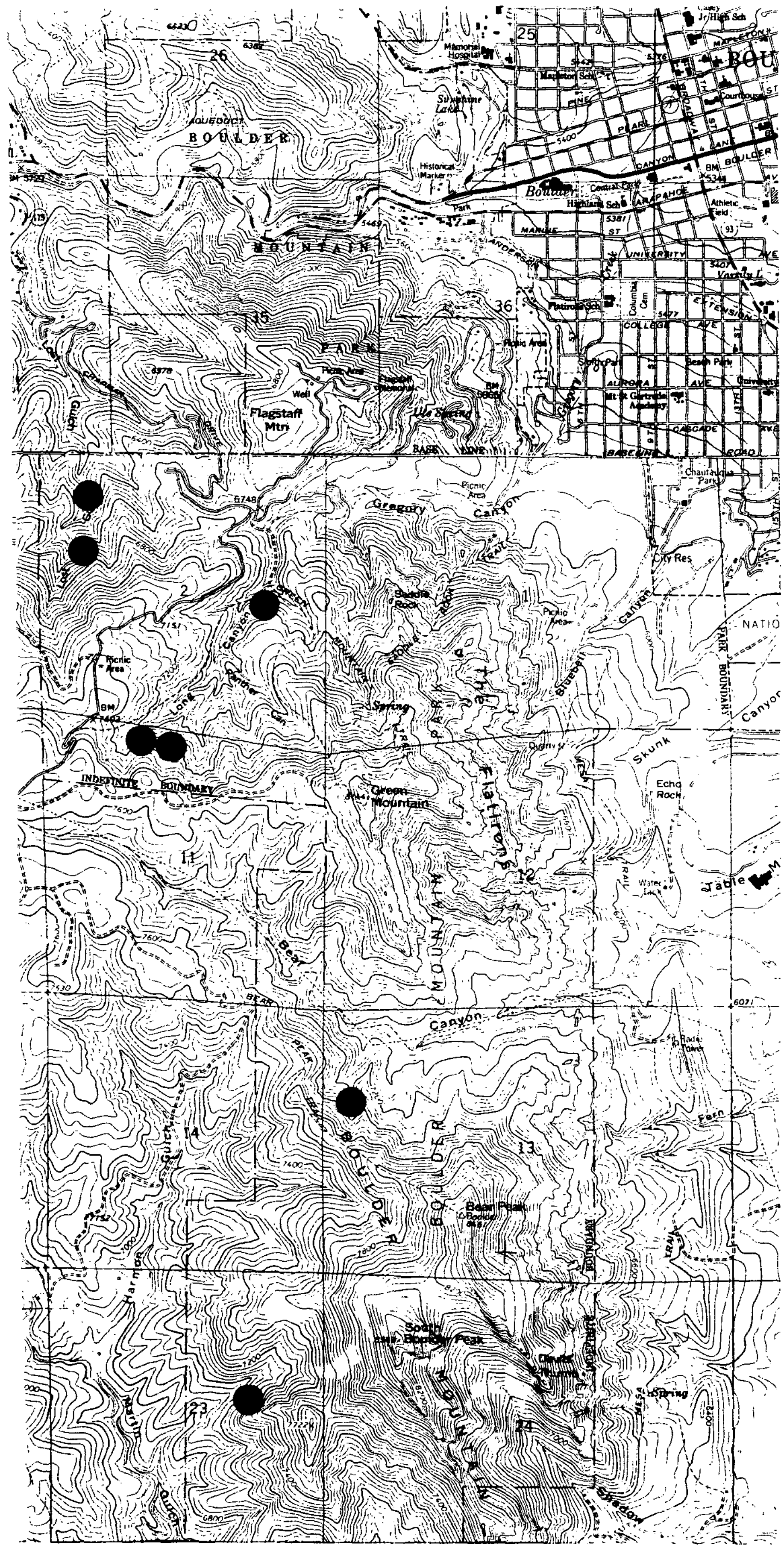


Figure 7. Hermit Thrush Distribution, 1989 and 1990 Breeding Seasons
Each dot represents one singing male.

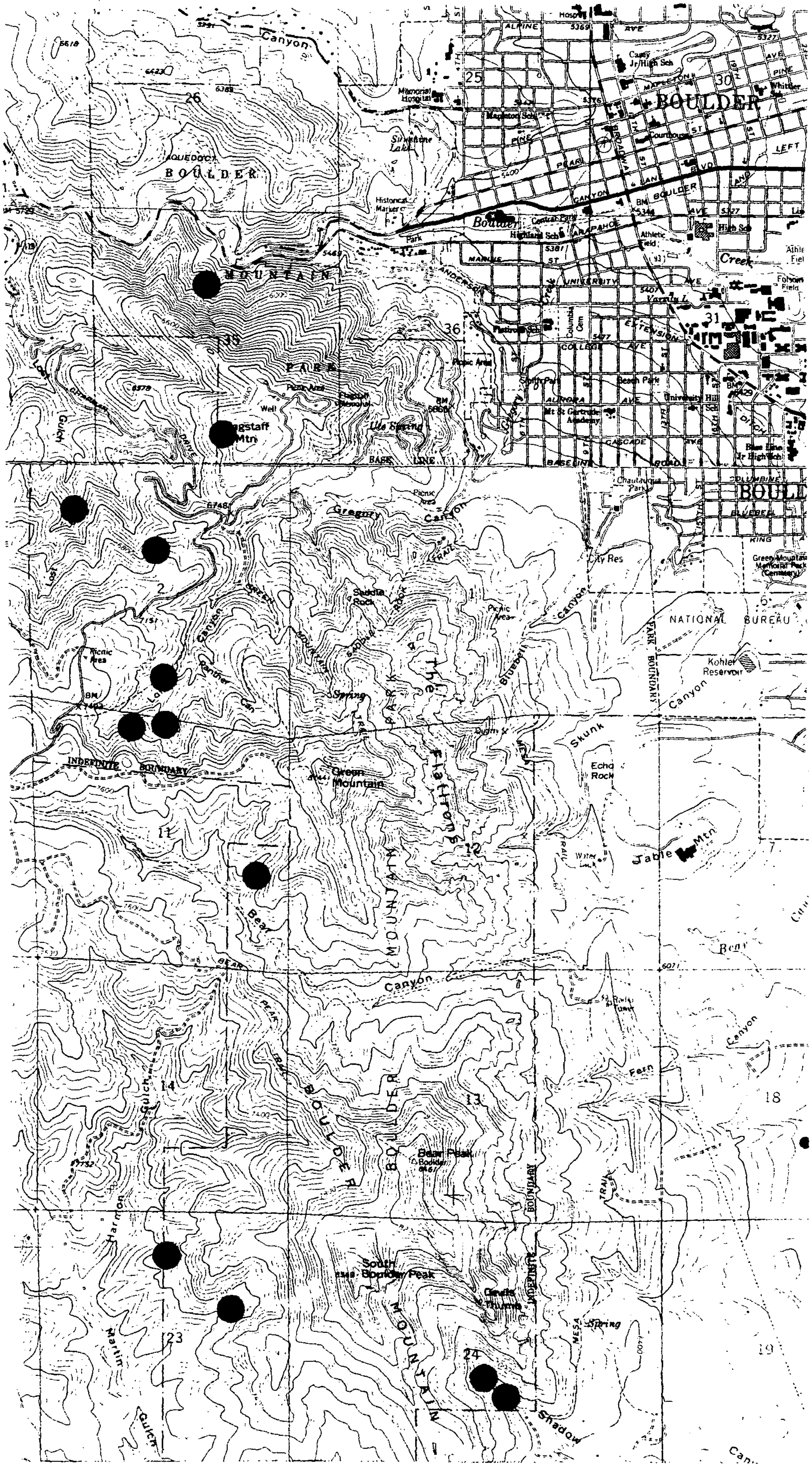


Figure 8. Red-breasted Nuthatch Distribution, 1989 and 1990. Each dot represents one calling nuthatch.

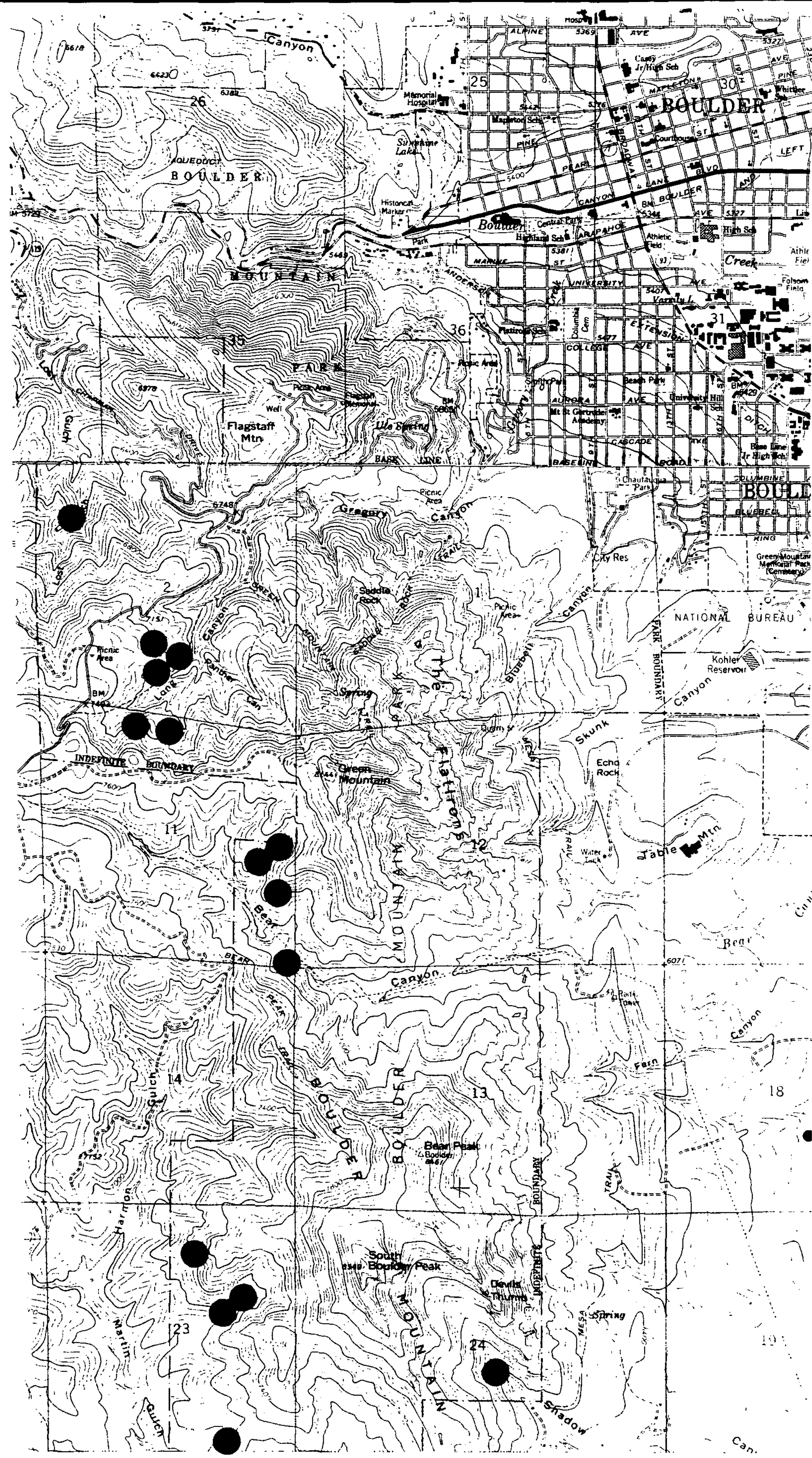


Figure 9. Hairy Woodpecker Distribution, 1989 and 1990 Breeding Seasons. Each dot represents one sighting.

Basal area factor was a predictor of forest interior species density on coniferous forest plots (r^2 = .22, $p < .05$). This relationship is illustrated in Figure 3. Preservation of those areas within the Mountain Park where basal areas are high and snag density is high may be necessary for maintaining viable populations of forest interior birds within the Park.

Accipiters

Accipiters are small forest-dwelling hawks that usually nest in dense coniferous or deciduous stands (Schuster 1976, Ehrlich 1987). Between 1978 and 1990, five accipiter nests were observed within the Mountain Park (Figure 10). All were situated in north-facing or east-facing canyons containing stands of Douglas-fir. Nesting accipiters are particularly sensitive to human disturbances (Jones 1981, Ehrlich 1987), so these areas should be carefully monitored and protected.

Cliff-Nesting Raptors

Location of golden eagle and prairie falcon nests and perch sites is shown in Figure 11. Most of these sites are close to or on popular climbing routes (Thompson and Strauch 1986, Jones 1989). Golden eagle and prairie falcon productivity within the Mountain Park appears to have been steady over the past ten years (Thompson and Strauch 1986), but nesting activities have been periodically disrupted by rock climbers. Prior to the seasonal closure of Skunk Canyon beginning in 1988, golden eagles nesting there were forced

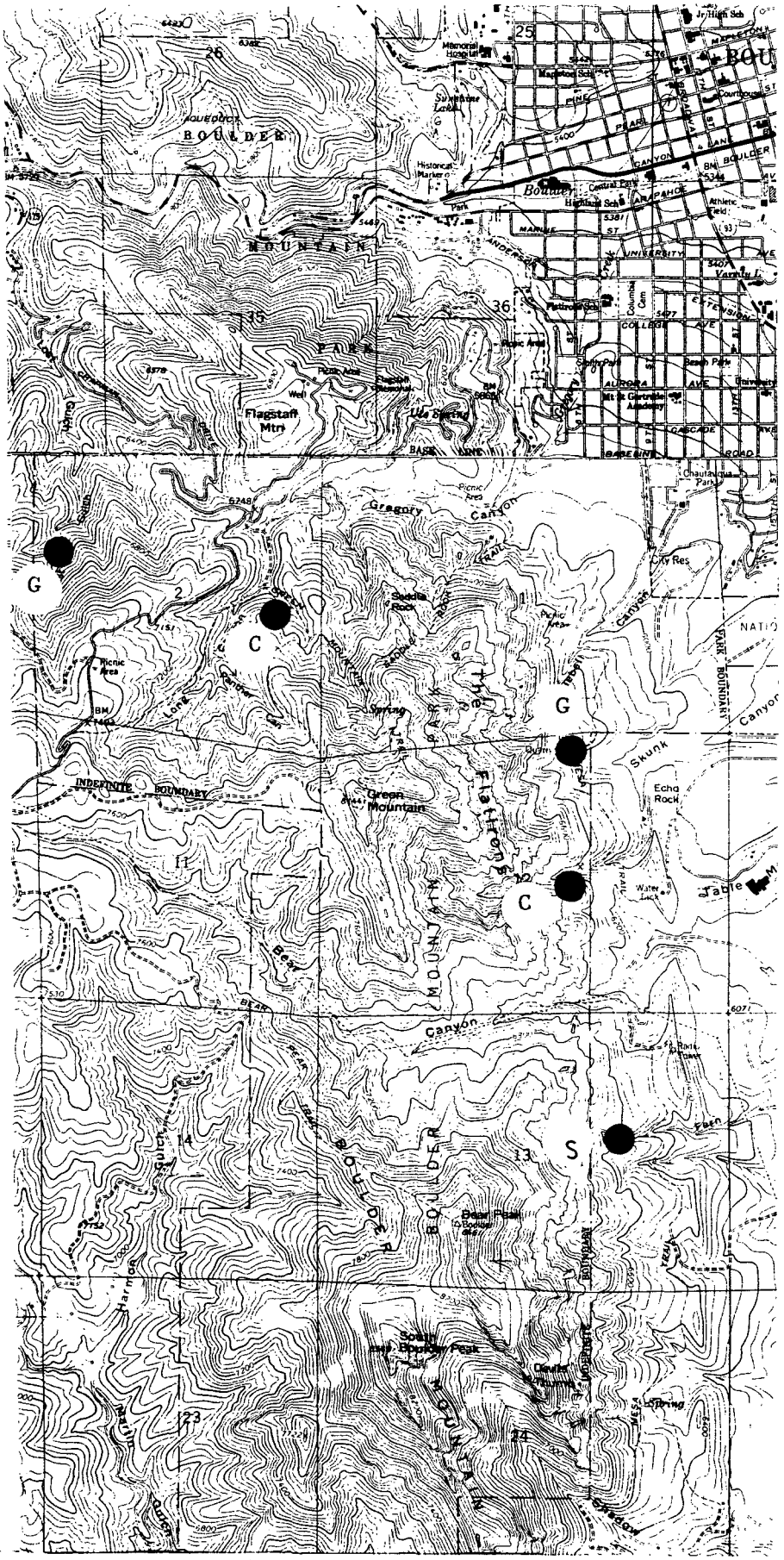


Figure 10. Accipiter Nest Sites, 1978-90.

G--Goshawk C--Cooper's Hawk S--Sharp-shinned Hawk

off their nests by rock climbers on several occasions (Figgs and Lederer 1990). Similar disturbances of golden eagle nests have occurred at Buckingham Park in Left Hand Canyon and on the Mickey Mouse Ears Cliffs in Eldorado Canyon.

Continued monitoring of raptor nest sites and seasonal closure of some rock climbing areas is necessary to maintain viable cliff nesting raptor populations in the Boulder Mountain Park. Closure of entire areas such as Upper Skunk Canyon and Fern Canyon during the early stages of the nesting season will provide raptors the best opportunity to establish successful nests.

Species of Special Interest

The term "Species of Special Interest" describes breeding birds in the Mountain Park that fall into one or more of the following categories: (1) extirpated species, (2) federal or state endangered or threatened species, (3) species undergoing long-term non-cyclical population declines, (4) locally rare or endangered species, (5) species with isolated or restricted populations, and (6) species with increasing populations posing a threat to species in category 1-5. Twenty-four species of special interest are listed in Table 9. Population status and nesting locations for these species were discussed in the Boulder Mountain Park Forest Bird Study (Jones 1989). Management recommendations for each species were also included in that report.

Table 9. Birds of Special Interest in the Boulder Mountain Park.

Species	Class	Breeding Habitat
Sharp-shinned Hawk	3,5	C
Cooper's Hawk	3,5	C
Northern Goshawk	4,5	C
Golden Eagle	3,5	N
Peregrine Falcon	1,2,4,5	N
Prairie Falcon	3,5	N
Flammulated Owl	5	A,C
Long-eared Owl	3,4,5	C
Common Nighthawk	3	C,D
Lewis's Woodpecker	3,4	C,R
Williamson's Sapsucker	3	C
Hairy Woodpecker	3	C
Common Raven	6	N
Brown Creeper	5	C
Rock Wren	3	N
American Dipper	5	R
Western Bluebird	3,4	C
Mountain Bluebird	3	C
Gray Catbird	3,5	D,R
Starling	6	R
Ovenbird	4,5	R
Chestnut-sided Warbler	4	R

Table 9, continued

Species	Class	Breeding Habitat
Indigo Bunting	4	D
Brown-headed Cowbird	6	All

Class Codes: 1--Extirpated, 2--Federal or State Endangered or Threatened, 3--Declining Population, 4--Locally Rare, 5--Isolated or Restricted Population, 6--Increasing Populations Posing a Threat to Other Species.

Habitat Codes: A--Aspen, C--Coniferous Forest, D--Dry Scrub, N--Cliffs and Canyons, R--Riparian

Mammal Populations

David Armstrong listed 88 mammal species as potentially occurring in City of Boulder Mountain Parks and Open Space (Cooper 1984). Of these species 59 had been documented, 21 were hypothetical but strongly expected, and 8 had been extirpated within historic times. Since 1984 3 additional species (black-tailed jackrabbit, gray fox, and white-tailed deer) have been documented. The potential mammal population of the Boulder Mountain Park proper is probably slightly less than 88 species; fourteen of the species on Armstrong's list are endemic to plains grassland and plains riparian ecosystems, which are poorly represented within the Mountain Park.

A list of mammals of special interest in Boulder County was included in the environmental resources element of the Boulder County Comprehensive Plan (Boulder County Comprehensive Plan 1988). This list included 41 species, 39 of which potentially occur in Boulder Mountain Parks and Open Space (See Table 10). Mammals of special interest were those that met one or more of the following criteria:

1. Extirpated species. Species for which there is historical documentation but that no longer occur in Boulder County.

2. Threatened and endangered species.

   A. Federally listed threatened or endangered species.

Table 10. Mammals of Special Interest in the Boulder Mountain Park

Scientific Name	Common Name	Status	Class.	Habitat
Didelphis marsupialis	Virginia Opposum	D	4,5	R
Sorex nanus	Dwarf Shrew	H	5	A,C,D,N,R
Sorex palustris	Water Shrew	D	4	A,C,R
Sorex merriami	Merriam's Shrew	D	4,5	C,D
Cryptotis parva	Least Shrew	D	4	G,R
Myotis thysanodes	Fringed Myotis	H	5	C
Sylvilagus floridanus	Eastern Cottontail	H	5	R
Lepus townsendii	White-Tailed Jackrabbit	D	3,5	A,C,N
Eutamias umbrinus	Uinta Chipmunk	D	5	A,C,N
Spermophilus tridecemlineatus	13-lined Ground Squirrel	D	4	G
Spermophilus spilosoma	Spotted Ground Squirrel	D	4,5	G
Spermophilus variegatus	Rock Squirrel	D	4	C,D,R
Sciurus aberti	Abert's Squirrel	D	4	C
Geomys bursarius	Plains Pocket Gopher	H	4,5	G

Status: D--Documented by specimen or certain observation in Boulder Parks and Open Space, H--Hypothetical but strongly expected, E--Extirpated within historic times.

Classification: See Text, page 56 .

Habitat: A--Aspen, C--Coniferous Forest, D--Dry Scrub, G--Grassland, N--Rock and Talus, R--Riparian.

[1]From Armstrong, D., "Potential natural mammalian fauna of Boulder Mountain Parks," in Cooper (1984); and Boulder County Comprehensive Plan, Environmental Resources Element (1988).

Table 10. Mammals of Special Interest in the Boulder Mountain Park[1]

Scientific Name	Common Name	Status	Class	Habitat
Perognathus fasciatus	Olive-backed Pocket Mouse	H	4,5	C,G
Perognathus flavescens	Plains Pocket Mouse	H	4,5	G
Perognathus flavus	Silky Pocket Mouse	H	4,5	G
Perognathus hispidus	Hispid Pocket Mouse	D	4,5	G
Dipodomys ordii	Ord's Kangaroo Rat	H	4,5	G
Castor canadensis	Beaver	D	4	R
Reithrodontomys montanus	Plains Harvest Mouse	H	5	G
Peromyscus difficilis	Rock Mouse	D	4	C,D
Onychomys leuocagaster	Northern Grasshopper Mouse	H	5	G
Phenacomys intermedius	Heather Vole	H	4,5	A,C,R
Microtus pennsylvanicus	Meadow Vole	D	4	A,R
Ondatra zibethicus	Muskrat	D	4	R
Zapus hudsonius	Meadow Jumping Mouse	H	4,5	R
Canis lupus	Gray Wolf	E	1	A,C,D,G,N,R
Vulpes velox	Swift Fox	H	4,5	G
Urocyon cinereoargenteus	Gray Fox	D	4	C,D,N
Ursus arctos	Grizzly Bear	E	1,2,A,B	A,C,D,G,N,R
Bassariscus astutus	Ringtail	H	5	D,N
Mustela nigripes	Black-Footed Ferret	E	2,A,B	G
Gulo gulo	Wolverine	E	2,B	C
Lutra canadensis	River Otter	E	1	R
Felis canadensis	Lynx	E	2,B	C
Felis rufus	Bobcat	D	3	C,D,N,R
Antilocapra americana	Pronghorn	E	1	G
Bison bison	Bison	E	1	C,G

B. State listed threatened or endangered species.

3. Species undergoing long-term, non-cyclical population declines.

4. Species with restricted habitats.

5. Species of undetermined status.

6. Additional mammal species of special concern, Colorado Natural Heritage Inventory, Colorado Department of Natural Resources, and the Nature Conservancy.

From 1983 to the present, the Boulder Park rangers have kept records of sightings of large mammalian predators. These sightings are summarized in Tables 11-13, Figure 12, and Figures 14-17.

Black Bear

Numbers of black bear sightings increased dramatically from 1986 to 1990 (Table 13). The majority of sightings were reported during August, September, and October, when black bears moved down into foothills canyons to forage on wild fruits (Table 12, Figure 12). Bear Canyon, Gregory Canyon, and Long Canyon serve as migration corridors for bears. It should be noted that although the majority of bear sightings occur on the east side of the Park where recreational uses are highest, black bears range over most of the Park (See Figure 13).

Mountain Lion

Numbers of mountain lion sightings increased from 1986 to 1989 and then decreased slightly in 1990. Reports of interactions

Table 11. Predatory Mammal Sightings by Habitat, 1983-90.[1]

Species	Dry Scrub	Grassland	Ponderosa Woodland	Coniferous Forest	Riparian	Total
Black Bear	3	0	5	27	22	57
Mountain Lion	0	0	9	6	2	17
Coyote	0	1	14	12	3	30
Red Fox	0	0	0	1	1	2
Gray Fox	0	0	4	4	0	8

[1]Compiled from a list of sightings voluntarily reported to the Boulder Mountain Park Rangers.

Table 12. Predatory Mammal Sightings by Month, 1986-90.[1]

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Black Bear	0	2	1	0	0	1	5	9	24	14	1	0	57
Mountain Lion	1	2	1	1	1	2	3	4	2	0	0	0	17
Coyote	1	0	0	3	1	1	2	4	1	2	0	1	16
Red Fox	0	0	0	0	0	1	0	0	0	0	0	1	2
Gray Fox	0	0	1	0	0	0	0	1	0	2	1	3	8

[1]See Table 11. Data were incomplete for 1983-85.

Table 13. Predatory Mammal Sightings by Year, 1986-90.[1]

Species	1986	1987	1988	1989	1990
Black Bear	0	2	6	12	37
Mountain Lion	0	0	5	7	5
Coyote	3	0	10	3	0
Red Fox	0	0	2	0	0
Gray Fox	0	1	5	2	0

[1]See Table 11

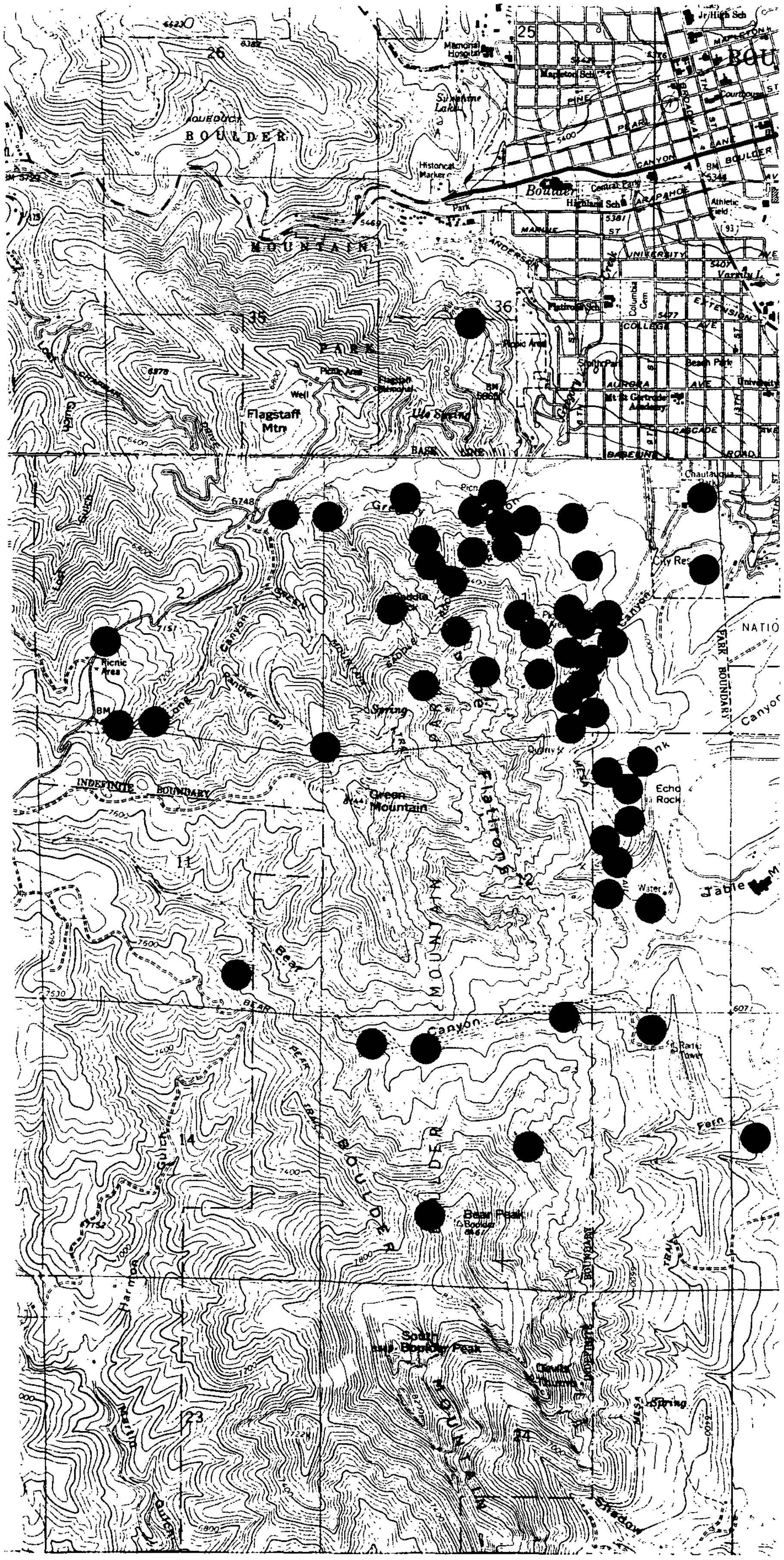


Figure 12. Black Bear Sightings, 1983-90.

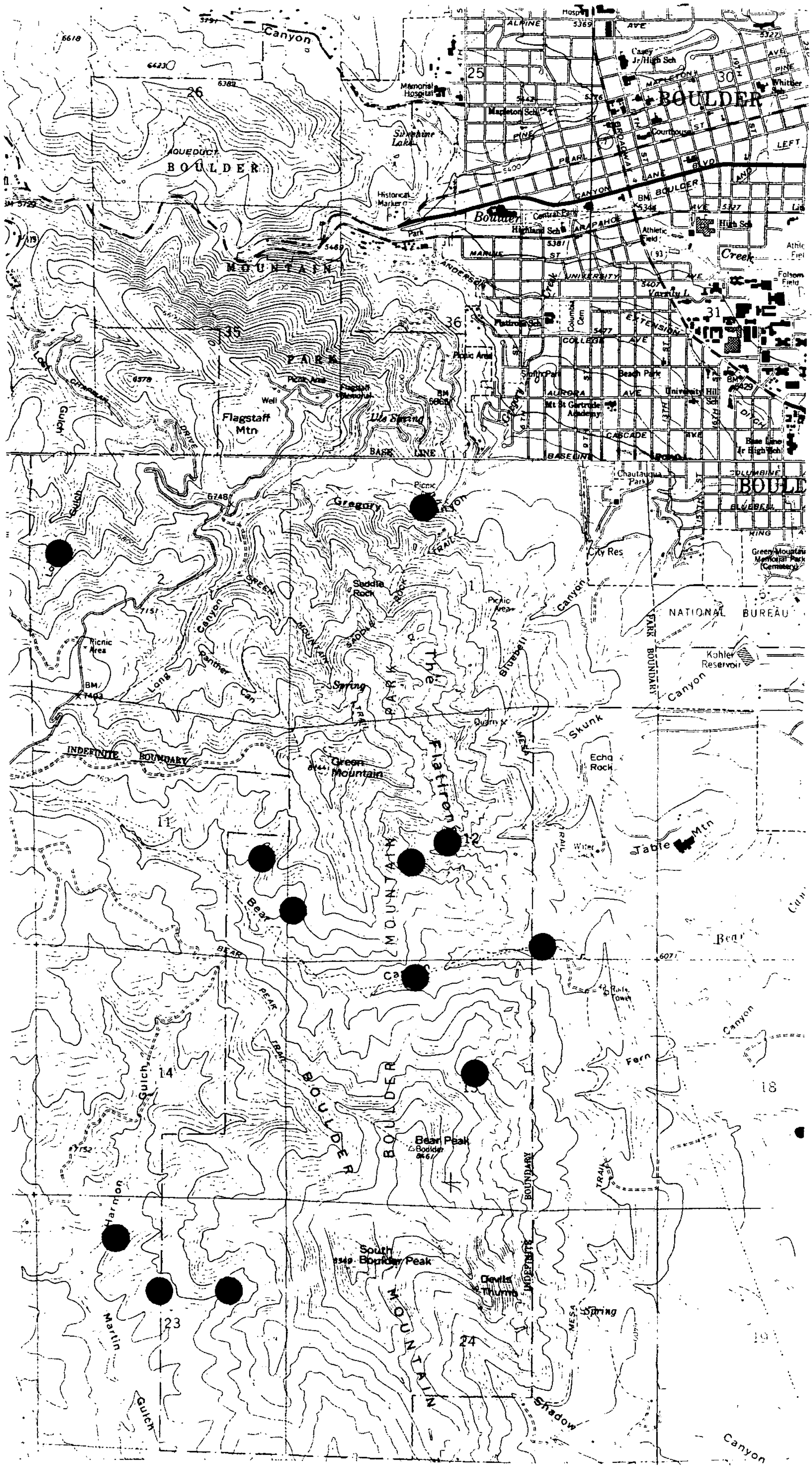


Figure 13. Black Bear Scat and Sign, 1989-90 Field Seasons.

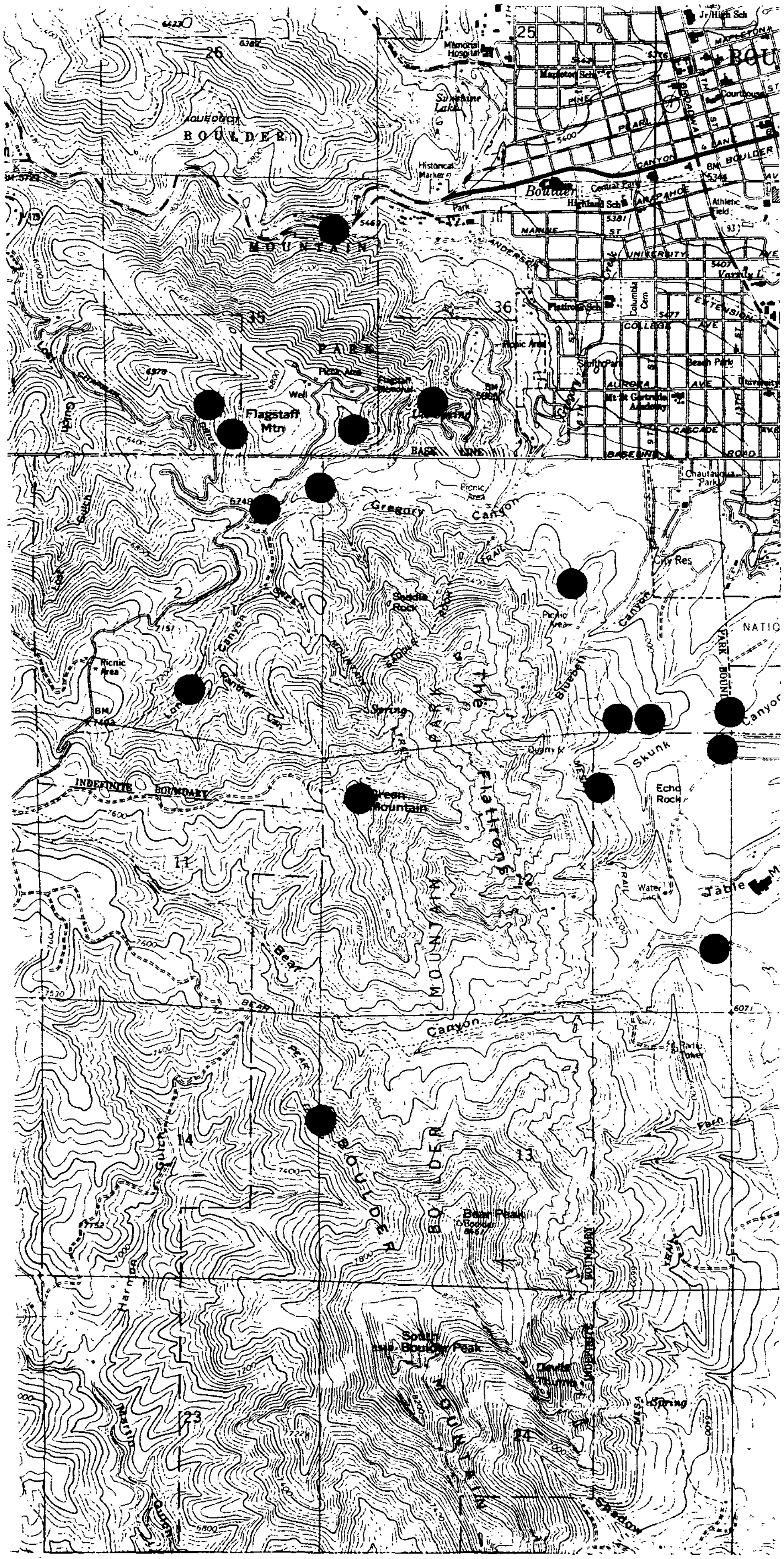


Figure 14. Mountain Lion Sightings, 1983-90.

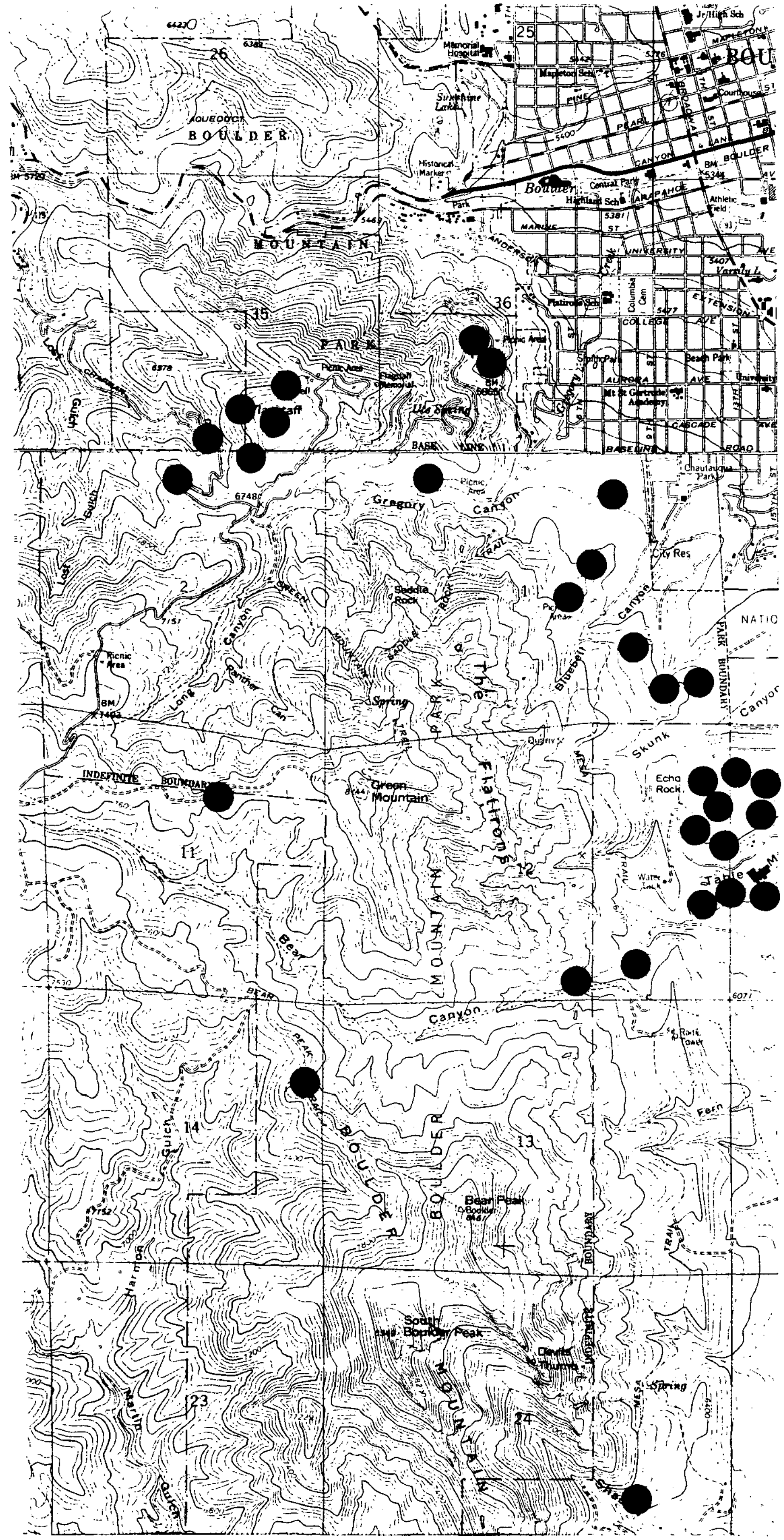


Figure 15. Coyote Sightings, 1983-90.

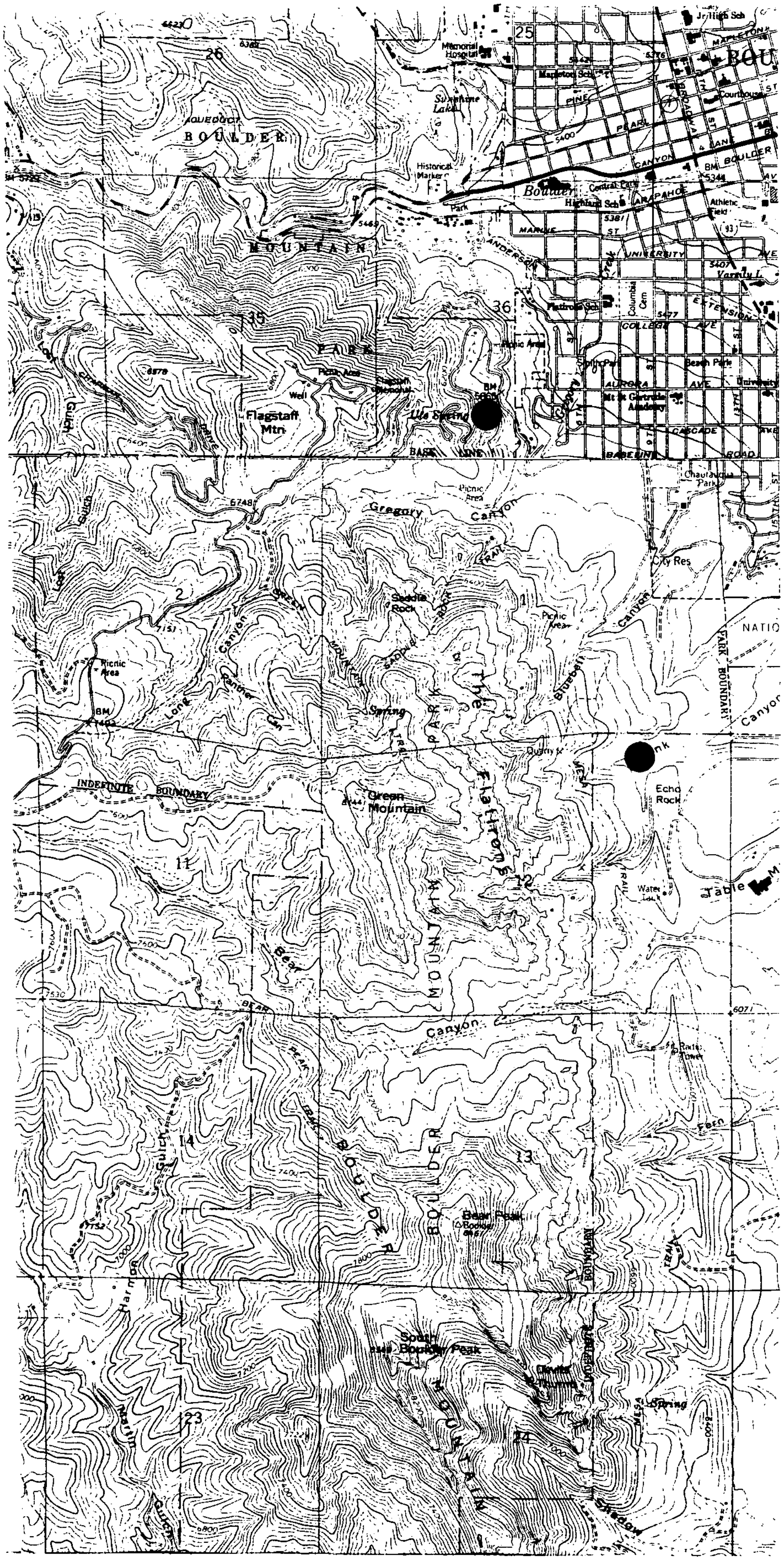


Figure 16. Red Fox Sightings, 1983-90.

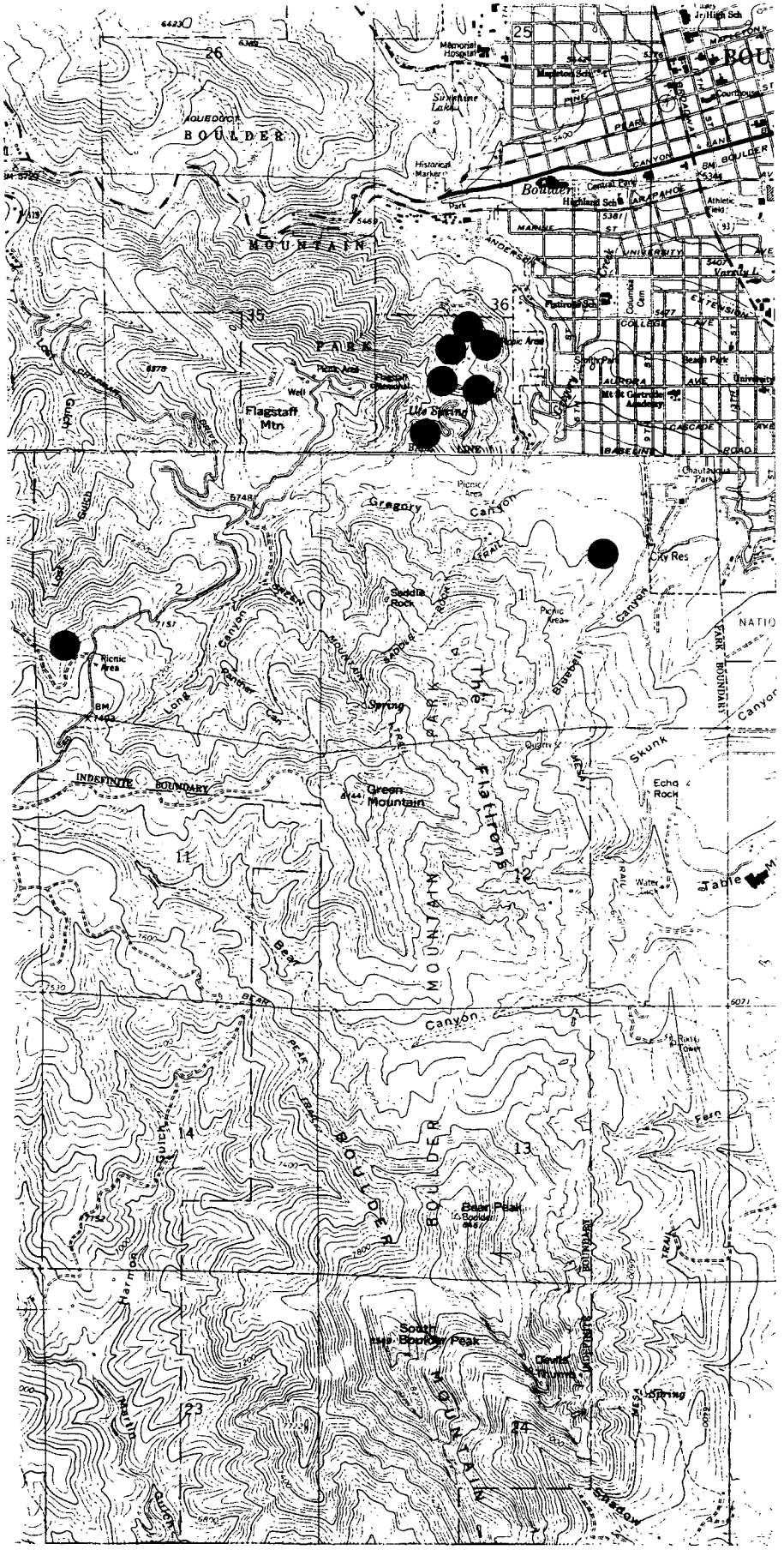


Figure 17. Gray Fox Sightings, 1983-90.

between humans and mountain lions have increased during recent years. In summer, 1990, a jogger in Four Mile Canyon was followed up a tree by two mountain lions. In August, 1990, a small mountain lion was observed chasing a dog near the Skunk Canyon substation (Ann Wichmann, pers. comm.). During summer, 1990, a mountain lion was shot and killed in Boulder Canyon by a man who believed the lion had been preying on his captive deer population. Another lion was shot and killed in Coal Creek Canyon by a man who believed the lion posed a threat to his children.

Mountain lions are most frequently sighted in ponderosa woodland areas with high deer populations (Table 11, Figure 14). No mountain lion dens have been reported in the Mountain Park, but I found a prominent scrape, with several scats, beside the western-most tributary to Lost Gulch. In November, 1990, Brian Peck observed a scrape with scats on Green Mountain West Ridge.

It is not known whether mountain lion populations in the Park are increasing, or whether increased interactions between lions and people result from other factors such as increased human use and increased boldness of lions. The Boulder County Nature Association is currently conducting a study of countywide mountain lion populations.

Bobcat

No bobcat sightings were reported in the Mountain Park between 1983 and 1990. Three bobcats were observed along Prado Drive near Eldorado Springs in October, 1987, and another bobcat was seen on

Open Space property near Left Hand Valley Reservoir in winter, 1988 (Ann Wichmann, Ruth Carol Cushman, pers. comm.). Brian Peck observed bobcat tracks on Rangeview trail in winter, 1987 and winter, 1989. Little is known about the status of bobcat populations in Boulder County. A study of bobcats in the Mountain Park is strongly recommended.

Coyote

Coyotes are common throughout the Mountain Park. I observed active coyote dens with pups in NCAR Meadow and near Chapman Drive. Coyotes were usually seen in grassland areas and ponderosa pine woodlands (Figure 15). Because coyotes are common, sightings are infrequently reported, so the figures in Table 13 do not accurately reflect coyote populations in the Mountain Park.

Red Fox

From 1983-90 only two red fox sightings were reported in the Park. An active red fox den was observed in Lower Skunk Canyon from 1980-82 (Dave Hill, pers. comm.). Red foxes are found throughout Boulder County and are common in some areas on the plains (Boulder County Wildlife Inventory 1977-90). Red fox numbers in the Mountain Park may have been reduced by illegal trapping activities (Boulder park rangers illegal trapping records) or by competition with coyotes.

Gray Fox

Gray fox sightings were reported in the Flagstaff Mountain area during 1987, 1988, and 1989 (Figure 17, Table 13). A canine distemper outbreak may have reduced gray fox populations in the Park in 1989. In April, 1989, the park rangers found two gray foxes that had died from distemper. I found another dead gray fox at the foot of Flagstaff Mountain in June, 1988. Gray foxes are considered uncommon residents of foothills shrub and pine woodland areas (Armstrong 1972), and they are occasionally seen in west Boulder neighborhoods (Boulder County Wildlife Inventory, 1976-90). Feeding of gray foxes by residents of these neighborhoods and interactions between gray foxes and urban mammal populations may increase the spread of canine distemper in this species.

Management Recommendations

Managing for Natural Processes

The Boulder Mountain Park is an ecological oasis surrounded by highly disturbed ecosystems. To the east native grasslands have been destroyed by urban development or altered by farming and grazing. To the west foothills and montane forests have been significantly changed by timber harvest, fire suppression, and construction of mountain subdivisions.

The Mountain Park provides essential habitat for a number of bird and mammal species that might not be able to survive in nearby areas. Northern goshawk and flammulated owl, which nest within the Park, have not been observed nesting in adjacent forests. The only documented nesting sites in Boulder County for chestnut-sided warbler and peregrine falcon lie within the Mountain Park. Western bluebird nests observed within the Mountain Park are the only nests for this species documented in the County during the past three years. Though black bears no doubt range far beyond the Park boundaries, frequency of bear sightings in Gregory, Bluebell, Skunk, and Bear canyons suggests that bears depend on these areas for late summer and early fall foraging.

Old-growth forests are particularly important for many species of birds. Northern goshawk, flammulated owl, hermit thrush, ovenbird, and other forest interior species depend on old-growth forests for breeding habitat. Since old-growth forests are disappearing throughout North America and are scarce in the Montane

Life Zone of Colorado, preservation and fostering of old-growth stands in the Mountain Park is extremely important.

Minimizing human disturbance of natural ecosystems within the Park has been, and should continue to be, a primary management goal. Strategies for implementing this goal include: (1) Restricting recreational use in sensitive and fragile areas, (2) avoiding additional trail construction throughout the Park, (3) leaving large areas of the Park in a completely undisturbed condition.

Unfortunately the management goal of minimizing human disturbance sometimes conflicts with the goal of recreating natural processes. Because of the residual effects of prior human disturbances and fire suppression within the Park, some additional human intervention, such as thinning or controlled burning, may be necessary to restore Mountain Park forests to an old-growth, or near old-growth condition. For example, many studies have suggested that recurrent fire is necessary both to establish and maintain old-growth ponderosa pine forests (Jensen 1985, Moir and Dieterich 1988, Wright 1988).

Core Areas and Fragmentation

To ensure that extinction of bird and mammal species will not occur within natural areas, these areas must be large enough to support stable and genetically diverse populations of each species. Unfortunately no natural areas within the contiguous 48 states are large enough to meet this requirement. The total area of the

Boulder Mountain Park, for example, is smaller than the home range of one black bear, one mountain lion, or one pair of golden eagles. Several ecologists have suggested that to protect against extinctions and perpetuate natural ecosystems, it is necessary to create networks of core preserves connected by migration corridors and buffer areas (Diamond 1984; Noss 1983, 1987).

The core area concept can be applied on several levels, depending on the species under consideration. For black bears and mountain lions, the entire Mountain Park serves as a core area of essential and relatively undisturbed habitat; migration corridors and buffer areas outside the Park provide access to other core areas within Boulder County. For flammulated owls Long Canyon, Aspen Canyon, Upper Skunk Canyon, and Shadow Canyon serve as core areas of essential and relatively undisturbed habitat connected by buffer areas within the Park.

Fragmentation of core areas results in a reduction of species populations (Lovejoy 1981, Levenson 1981, Matthiae and Stearns 1981, Mader 1984). Studies conducted in Arizona and Utah have demonstrated that mountain lion and black bear populations vary inversely in relationship to road density, timber sales, and home construction in national forests (Van Dyke 1986, Mollohan 1988). Breeding bird densities in eastern deciduous forests are directly related to forest tract size and the level of forest fragmentation (Whitcomb et. al. 1981, Hickman 1990).

To effectively provide for the needs of all wildlife in the Boulder Mountain Park, habitat fragmentation both within and

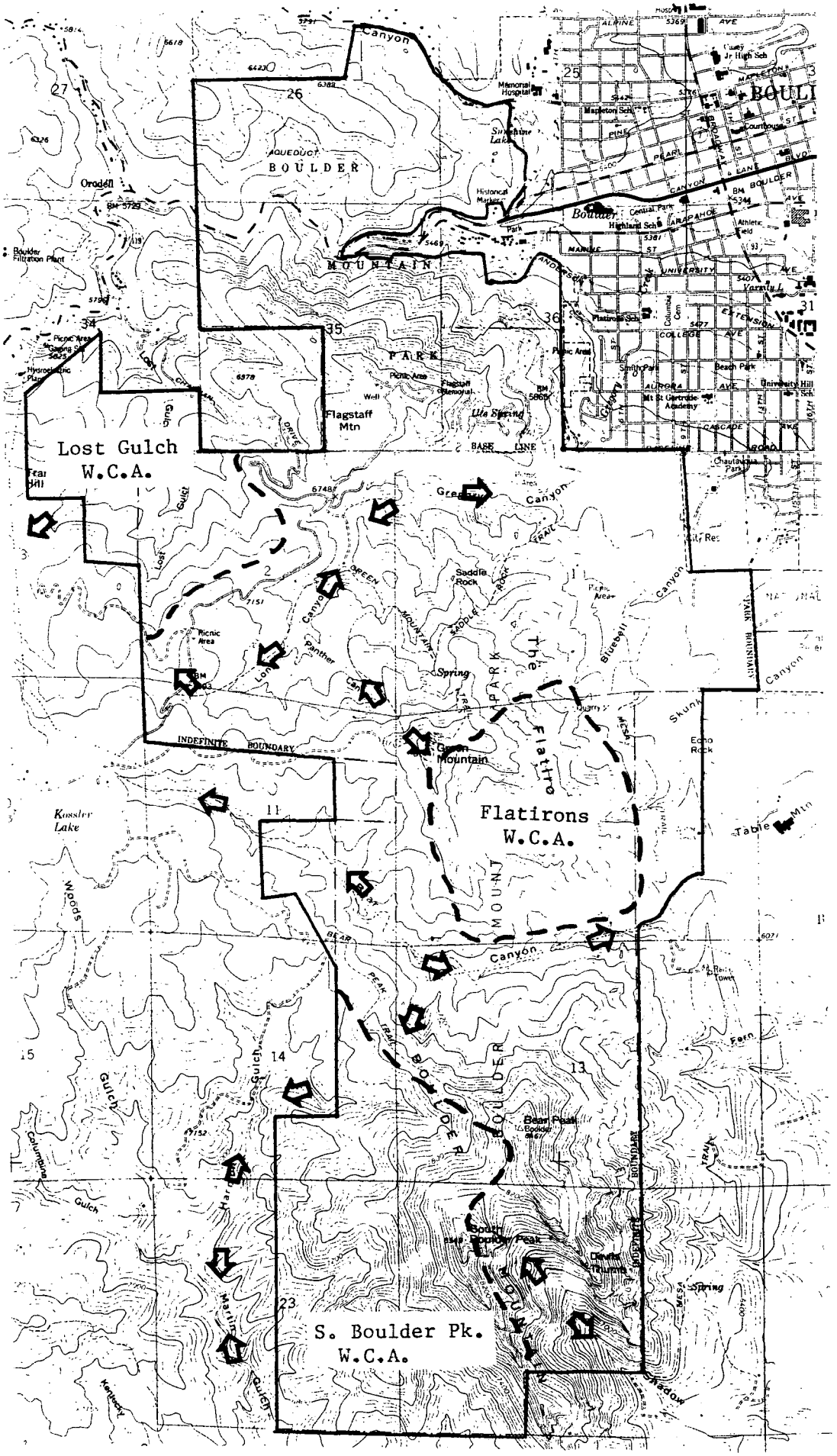


Figure 18. Wildlife Conservation Areas (W.C.A.'s) and Corridors.

outside the Park must be addressed. Roads and trails within the Park limit the movements and foraging activities of large mammals such as black bear and elk, and may reduce nesting habitat available for hawks and songbirds. Human activities outside the Park have wide-ranging effects on large mammals and birds of prey.

Figure 18 shows those areas within and adjacent to the Park that contain no roads or hiking trails and show relatively few signs of other human disturbances. These are referred to as "wildlife conservation areas" and are linked by corridors and buffer areas. Preservation of these areas may be essential for maintaining populations of some bird and mammal species within the Park. Preservation strategies for these core areas should include: (1) Avoidance of all trail or road construction, (2) avoidance of forest management activities, including fire suppression where practicable, (3) discouragement of recreational use.

Corridors

One prominent and disturbing feature of the Boulder Mountain Park is the presence of trails along every major riparian corridor. Riparian corridors are heavily used by black bears, mountain lions, and other mammals (Noss 1987, Mollohan 1989). As human use of these areas increases, interactions between wild mammals and humans are bound to increase. Permanent or seasonal closure of one or more of these trails would facilitate large mammal migration within the Park and decrease the chances of potentially dangerous interactions.

Bear Canyon probably serves as a migration corridor for many species of mammals. It is the most direct route from the ravines and canyons at the base of the Flatirons to the wilder, less populated areas on the west side of the Park. Since human use of the Bear Canyon Trail is relatively low compared to other riparian trails within the Park, permanent or seasonal closure of the Bear Canyon Trail may be indicated.

Outside the Park, attention should be focused on maintaining migration routes between the Lost Gulch area and the Hawkin Gulch area to the west, and between the Aspen Canyon/South Boulder Peak area and the Walker Ranch/Crescent Mountain area to the southwest. Development of trails or roads in these areas would be detrimental to large mammals including elk, black bear, and mountain lion.

Fire

Naturally occurring fires were an important component of Front Range ecosystems prior to nineteenth century settlement (Goldblum 1990, Veblen and Lorenz 1990). Historical frequency of naturally occurring fires along the Front Range is not well known. In ponderosa pine forests of Arizona and New Mexico, fire intervals varied from 2-12 years, with catastrophic, widespread fires occurring every 8-26 years (Swetnam 1988, Wright 1988). Fire frequency in montane ponderosa pine and Douglas-fir forests of central Montana was probably 5-20 years (Fisher and Clayton 1983).

Existing data concerning fire intervals along the Colorado Front Range are inconclusive. Fire intervals have been determined

for only three small ponderosa pine/Douglas-fir plots in the montane life zone of the Front Range (Laven 1978, Goldblum 1990). Mean fire intervals for all three plots were higher during presettlement times (22-47 years) than during the twentieth century (10-27 years). Fire history data for the Boulder Mountain Park are available only for the past 20 years (Boulder Park Rangers, fire history records). During this period, numerous small fires occurred, but less than 15% of the total area of the Park was affected by fire.

The effects of naturally occurring fires on coniferous forests varied according to the frequency, season, intensity, and duration of fires (Zwolinski 1988). Low to moderate intensity fires in ponderosa pine and Douglas-fir forests probably had the effects of: (1) Reducing the density of litter on the forest floor, (2) reducing basal areas by killing small trees and saplings, (3) providing the opportunity for germination of seedlings, (4) increasing herbage production on the forest floor, (5) opening up the forest and increasing growth potential of larger canopy trees (White 1985, Ffolliott and Guertin 1988, Swetnam 1988). Snag density was increased or reduced, depending on fire intensity (Horton and Mannan 1988). Fires probably reduced forest infections of dwarf mistletoe by killing off infected trees (Harrington and Hawksworth 1988). In the very short term, fires may have reduced bird and mammal populations while providing habitat for some species that were not present in unburned areas (Lowe et. al. 1978).

As far as wildlife is concerned, an important effect of periodic fires was to create or maintain old-growth forests. Post-settlement fire suppression has probably resulted in the replacement of some old-growth forests by dense stands of suppressed and stunted trees (Cooper 1960). One result may have been loss of habitat for old-growth dependent species such as northern goshawk, flammulated owl, and some species of voles (Corn et. al. 1988, Horton and Mannan 1988). A secondary result is the creation of heavy fuel loads that increase the risk of stand-destroying, catastrophic fires.

A "let burn" policy in the Boulder Mountain Park would be desirable but hardly practical given the close proximity of the Park to the City of Boulder and to mountain subdivisions. Prescribed burns could be conducted in relatively remote areas of the Park during times of low fire hazard. Prescribed burns have been carried out in Arizona ponderosa pine forests for more than 20 years (Grier 1988, Harrington and Sackett 1988, Severson 1988). Fire Effects Information System (FEIS), a computer-based storage and retrieval system relating to prescribed burn methods, has been developed at the Intermountain Fire Sciences Laboratory in Missoula and is available for use by land managers desiring information on fire effects in plant communities and associated individual plant and animal species. When fire suppression efforts are deemed absolutely necessary they should avoid highly sensitive areas such as rare plant communities in Lost Gulch, Long Canyon, and Greenman Canyon.

Thinning

In the absence of recurrent fire, some selective thinning of Mountain Park forests may be necessary to maintain their health and to reduce the potential for stand-destroying, catastrophic fires. Though selective thinning can mimic natural fire in some ways, it is questionable whether thinning, alone, can create the conditions necessary to restore forests to an old-growth condition (Moir and Dieterich 1988).

To best mimic the effects of low to moderate intensity fires, thinning should be carried out under the following guidelines: (1) Mostly small trees should be removed, (2) patch cutting should be utilized to create openings in the forest, (3) all standing snags should be retained, (4) areas of dense growth, which serve as habitat for forest interior species and mammals such as Abert's squirrel (Patton and Green 1969, States et. al. 1988) should be retained.

One immediate effect of forest thinning is to create habitat for brush-foraging birds while removing habitat for forest interior birds (Jones 1989). Since populations of forest interior birds appear to be declining throughout the County (Hallock 1987), it is recommended that forest thinning be limited to selected areas of the Park and that large areas be left in an undisturbed condition.

Snags

Low snag density may continue to be a problem in the Park in the near future. Recent insect infestations have mostly run their

course, and the proportion of large, old trees in Mountain Park forests appears to be small. This problem can be rectified by creating snags in areas where current snag density is especially low. A long term snag creation program is recommended for Kohler Mesa, Enchanted Mesa, Bluebell Mesa, and Flagstaff Mountain.

Site Management

Management recommendations were developed for 32 sites within the Mountain Park. Each site was rated for its potential to support breeding birds and mammals. The following scale was used to rate each site for its potential to support breeding bird populations:

1. Sites supporting low densities of breeding birds and with no species of special interest.

2. Sites supporting low to moderate densities of breeding birds and no or few species of special interest.

3. Sites supporting moderate densities of breeding birds and several species of special interest.

4. Sites supporting moderate to high densities of breeding birds and several species of special interest. Sites containing nests of rare species (those with two or fewer nest sites within the Mountain Park) or local, state, or federal endangered species.

5. Sites supporting high densities of breeding birds, several species of special interest, and containing nests of rare or endangered species.

The following rating scale was used to evaluate site potential to support mammals:

1. Sites where human disturbance has eliminated most of the native vegetation and with the potential to support low numbers of mammal species.

2. Sites characterized by extensive human disturbance and with the potential to support below average numbers of mammal species.

3. Sites characterized by low to moderate levels of human disturbance and with the potential to support average numbers of mammal species.

4. Relatively undisturbed sites with the potential to support moderate to high numbers of mammal species. Sites containing important foraging areas, denning areas, or migration corridors for large mammals.

5. Relatively undisturbed sites with the potential to support high numbers of mammal species and containing important foraging areas, denning areas, or migration corridors for large mammals.

Clearly these are subjective criteria open to varying interpretations. They are used only to give a general view of the quality of bird and mammal habitats in the Park. Specific information about bird populations (plot densities), and bird and mammal species of special interest, is included with site descriptions. For site locations, see the map on page 8.

1. Sunshine Reservoir

Site characteristics: Ponderosa pine woodland on moderate to steep slopes with one small area of dry scrub vegetation and one small cottonwood-willow stand. Snag density throughout is low to

moderate. A fire in winter, 1988, burned 200 acres (81 ha) of grasses and shrubs, scorching many ponderosa pines.

Birds: Plot density of 13 species and 24 individuals. Rock wren. Rating: 2.

Mammals: Potential of 48 species. Potential elk winter range. Moderate to high mule deer population. Rating: 3.

Recreational Use: Moderate

Management Recommendations: Forest thinning does not seem necessary or desirable on this site. Basal areas are low and snags were created by the 1988 fire. Additional trails are not planned, but existing trails should be signed and re-routed for erosion control.

2. Boulder Canyon

Site Characteristics: Most of the natural vegetation appears to have been removed from this site during construction of a railroad, a highway, and, later, a bike path. The creek has been partially channelized and the creek banks denuded of vegetation. The dominant vegetation type is cottonwood-willow riparian, which consists of a few cottonwoods, willows, and scattered shrubs.

Birds: Plot density of 16 species and 35 individuals. Rating: 2.

Mammals: Potential of 37 species, but habitat is in an extremely disturbed condition. Rating: 1.

Recreational Use: High

Management Recommendations: Vegetation restoration along the banks of Boulder Creek would improve bird and mammal habitat on this site.

3. Flagstaff North

Site Characteristics: Mixed ponderosa pine/Douglas-fir forest and ponderosa pine woodland grow on steep north-facing slopes. Small areas of dry scrub and maple-box elder riparian growth occur in steep ravines. Snag density is low. The coniferous forest appears to be in a relatively undisturbed condition. Several semi-permanent campsites are visible above Boulder Creek.

Birds: Plot density of 18 species and 34 individuals. Cooper's hawk and prairie falcon were observed, but there was no evidence of nesting. Rating: 3.

Mammals: Potential of 57 species. Moderate deer population. Rating: 3.

Recreational Use: Moderate

Management Recommendations: Due to steepness of terrain and low basal areas, forest thinning is probably neither necessary nor desirable on this site. Extensive use of this site by transients probably creates a fire hazard and may need to be controlled.

4. Flagstaff Mountain

Site Characteristics: Ponderosa pine forest and ponderosa pine woodland grow on gentle to moderate slopes. A small area of scrub vegetation occurs in a ravine on the south side of Flagstaff

Mountain. Western bluebirds were observed here during the 1989 and 1990 breeding seasons. Snag density is low. Much of the forest on this site was thinned during Project Greenslope. This is probably the heaviest human use area of the Park with extensive trails, roads, parking lots, and picnic grounds.

Birds: Plot density of 16 species and 50 individuals. Western bluebird pair in 1990. Rating: 4.

Mammals: Potential of 52 species. Foraging area for gray fox, black bear, and mountain lion. Moderate deer population. Rating: 3.

Recreational Use: High

Management Recommendations: Creation of snags in this area would increase nesting opportunities for western bluebirds and other cavity-nesting birds. Removal of any existing snags or cutting of trees greater than 25cm DBH should be avoided. Potential conflicts between automobiles and wildlife might be reduced by posting informational signs and aggressively enforcing speed limits on Flagstaff road.

5. Flagstaff East

Site Characteristics: Extensive stands of dry scrub vegetation, interspersed with ponderosa pine woodland and rock outcrops, support a rich variety of birds and mammals. Slopes are moderate to steep. Snag density is low.

Birds: Plot density of 25 species and 59 individuals. Sharp-shinned hawk, rock wren, gray catbird. Rating: 4

Mammals: Potential of 50 species. Denning area for gray fox. High deer population. Rating: 4.

Recreational Use: High

Management Recommendations: Due to low basal areas, no forest thinning is anticipated in this area. Trails should avoid dense shrub growth, including gray catbird nest sites.

6. Lost Gulch

Site Characteristics: Mixed ponderosa pine/Douglas-fir forest occurs on moderately steep north-facing slopes and ravines. Some ponderosa pine forest occurs on the higher ridges. Snag density is high, and in some locations the forest exhibits old-growth characteristics. Riparian growth along Lost Gulch Creek and tributaries provides food and cover for birds and mammals. This is one of the least disturbed areas of the Mountain Park, with no trails and few signs of recent forestry activity.

Birds: Plot density of 22 species and 42 individuals. Northern goshawk, wild turkey, Williamson's sapsucker, hairy woodpecker. High density of forest interior species. Rating: 5.

Mammals: Potential of 60 species. Foraging area for black bear. Potential denning area for mountain lion. Large mammal migration corridor. Low deer populations. Rating: 5.

Recreational Use: Low

Management Recommendations: Any disturbance of this area, including forest thinning, trail construction, and cutting of fire breaks and fire roads, should be avoided. The Lost Gulch, Tram

Hill, and Hawkin Gulch complex is one of the last wild, trail-less areas within close proximity to Boulder. This region has been designated as a core area for wildlife on the Boulder County Ecosystem Map.

7. Cathedral Park

Site Characteristics: A mixture of ponderosa pine woodland, ponderosa pine forest, and ponderosa pine/Douglas-fir forest occurs on moderate to steep slopes. Snag density is low to moderate. Shrub understory growth is patchy. Much of this site was thinned during Project Greenslope.

Birds: Plot density of 21 species and 46 individuals. Hairy woodpecker, Williamson's sapsucker. Rating: 3.

Mammals: Potential of 58 species. Low to moderate deer population. Rating: 3.

Recreational Use: Moderate

Management Recommendations: Removal of snags and stems greater than 25cm DBH should be avoided. Creation of snags in this area would benefit cavity-nesting birds.

8. Long Canyon

Site Characteristics: A variety of rare plant communities occur in this shaded, moist canyon. Vegetation types include ponderosa pine woodland, ponderosa pine forest, Douglas-fir forest, mixed ponderosa pine/Douglas-fir forest, and river birch-aspen-hazelnut riparian. Snag density is moderate to high, and lush

shrub vegetation along upper Gregory Creek supports a high concentration of bird and mammal species.

Birds: Plot density of 27 species and 59 individuals. Flammulated owl, hairy woodpecker, Williamson's sapsucker, ovenbird, chestnut-sided warbler. Rating: 5.

Mammals: Potential of 65 species. Foraging area and migration corridor for black bear and other large mammal species. Low deer population. Rating: 5.

Recreational Use: Moderate

Management Recommendations: This is a unique area not just in the Mountain Park but in all of Colorado. All forest management activities should be avoided in this area, particularly the removal of snags, downed logs, and brush. Additional trail construction or construction of fire roads or fire breaks should also be avoided. Heavy recreational use of Long Canyon trails should be discouraged.

9. Green Mountain West Ridge and Ranger Canyon (includes Ranger Canyon, Panther Canyon, and Upper Greenman Canyon)

Site Characteristics: This is an ecologically diverse area which contains many unique bird and mammal habitats. Dominant vegetation types are Douglas-fir forest, mixed ponderosa pine/Douglas-fir forest, mixed Douglas-fir/ponderosa pine/aspen forest, and river birch-aspen-hazelnut riparian. Steep north-facing slopes are cut by spring-fed streams which support a variety of rare plant communities. Snag density is low to high.

Birds: Plot density of 27 species and 66 individuals. Cooper's hawk, flammulated owl, hairy woodpecker, Williamson's sapsucker, mountain bluebird, western bluebird. Rating: 5

Mammals: Potential of 65 species. Foraging area and migration corridor for black bear and mountain lion. Low deer population. Rating: 5.

Recreational Use: Low to moderate.

Management Recommendations: Some forest thinning has already occurred on this site and additional thinning is scheduled for the future. Any forest management activities that occur here should avoid brush removal along upper Gregory Creek and its tributaries, avoid removal of all snags or large stems greater than 25cm DBH, and retain patches of dense Douglas-fir on the south side of Long Canyon and in Ranger Canyon. The Cooper's hawk nest site in Ranger Canyon and all rare plant sites should be protected and buffered from any forestry activities in this area. Fire suppression efforts should be limited to ridge tops. Additional trail construction should be avoided.

10. *Upper Gregory Canyon*

Site Characteristics: This riparian corridor between Green Mountain Lodge and Gregory Canyon proper is important because of its rare plant sites and because it supports a high diversity of breeding bird species. Dominant vegetation is cottonwood-willow riparian, river birch-aspen-hazelnut riparian, and ponderosa pine/Douglas-fir forest. Recreational use of this area is quite

high, and Green Mountain Lodge is used for school and scout functions.

Birds: Plot density of 25 species and 48 individuals. Rating: 3.

Mammals: Potential of 44 species. Migration corridor for black bear and other large mammals. Low deer population. Rating: 4.

Recreational Use: High

Management Recommendations: Foot traffic should be diverted as much as possible from the riparian area along Gregory Creek.

11. Saddle Rock

Site Characteristics: Mixed ponderosa pine/Douglas-fir forest and ponderosa pine woodland dominates on steep north-facing slopes and ravines. Snag density is low. Site disturbance appears minimal.

Birds: Plot density of 18 species and 28 individuals. Rating: 2.

Mammals: Potential of 59 species. Abert's squirrel habitat and foraging area for black bear. Rating: 3.

Recreational Use: Moderate to high.

Management Recommendations: Due to the steepness of slopes here, no forestry activities are anticipated. Creation of snags would enhance this area as a habitat for cavity-nesting birds.

12. Lower Gregory Canyon

Site Characteristics: This area contains a well-developed cottonwood-willow overstory with a dense understory of chokecherry, pin cherry, Rocky Mountain maple, wild plum, and other shrubs. An access road to Baird Park parallels the riparian corridor; foot and vehicle traffic are heavy.

Birds: Plot density of 20 species and 56 individuals. Rating: 3.

Mammals: Potential of 37 species. Dense shrub understory with some signs of human disturbance. Black bear foraging area. Rating: 3.

Recreational Use: High

Management Recommendations: This riparian area supports a high density of breeding birds and serves as a migration route for black bear, raccoon and other mammals. It should be protected by diverting foot traffic to established trails and roads. Drinking parties and overnight camping are problems in this area. Closure of the access road may be desirable during some hours of the night.

13. Bluebell Mesa

Site Characteristics: Ponderosa pine woodland and ponderosa pine forests grow on gentle to moderate northeast-facing slopes. Understory is mostly mixed grasses with some areas of dry scrub. Snag density is low. Signs of human disturbance are minimal; several moderately to heavily used trails cut through this area.

Birds: Plot density of 17 species and 38 individuals. Rating: 2.

Mammals: Potential of 52 species. Abert's squirrel habitat and black bear foraging habitat. Mule deer populations are low to moderate. Rating: 3.

Recreational Use: High

Management Recommendations: No forest thinning is projected for this area. Snag creation would improve habitat for cavity-nesting birds.

14. Chautauqua

Site Characteristics: This is the largest area of grassland within the Mountain Park. Dry scrub vegetation is present within ravines crossing the meadow from south to north. Recreational use of this area is extremely high and the numerous trails crossing the meadow have caused soil erosion and have created sites for the invasion of exotics such as cheat grass.

Birds: Plot density of 9 species and 23 individuals. This is one of few potential nest sites in the Park for grasshopper sparrow, vesper sparrow, and savannah sparrow; none of these species were detected during breeding bird surveys. Rating: 2.

Mammals: Potential of 31 species. Rating: 2.

Recreational Use: High

Management Recommendations: Continued efforts to control soil erosion and trail proliferation will maintain or improve this site as potential habitat for grassland-nesting birds.

15. Bluebell Canyon

Site Characteristics: This canyon contains some of the densest shrub growth found in the Mountain Park and the only known chestnut-sided warbler nest site in the Park. Vegetation types include cottonwood-willow riparian in the lower part of the canyon, box elder-maple riparian higher up, as well as dry scrub and ponderosa pine woodland on the south side of the canyon.

Birds: Plot density of 26 species and 53 individuals. Bushtit, chestnut-sided warbler. Rating: 5.

Mammals: Potential of 65 species. Black bear foraging habitat. Potential denning habitat for gray fox and red fox. Rating: 5.

Recreational Use: Moderate to high

Management Recommendations: Currently, Bluebell Road and the McClintock Nature Trail effectively channel foot traffic away from the riparian area. In the future it may be necessary to post signs to keep recreational users out of this riparian area.

16. Kohler and Enchanted Mesas

Site Characteristics: This site contains the most extensive ponderosa pine forest in the park. All of the site was thinned during Project Greenslope, and the remaining trees are largely of uniform size, most falling into the 20-40cm diameter class. Mixed grasses and small shrubs such as kinnikinnik and Oregon grape dominate the understory. Snag density is low to moderate.

Birds: Plot density of 19 species and 46 individuals. Bushtit, hairy woodpecker, brown creeper. Rating: 4.

Mammals: Potential of 47 species. Prime Abert's squirrel habitat. Moderate deer populations. Rating: 3.

Recreational Use: Moderate to high.

Management Recommendations: Any future forestry activities on this site should take into account the need to retain large areas of dense ponderosa pine with canopy closure for Abert's squirrels and the need for large numbers of snags for such cavity nesting species as saw-whet owl, northern pygmy owl, hairy woodpecker, pygmy nuthatch, and brown creeper. Creation of additional snags on this site would be desirable. Due to favorable growing conditions for ponderosa pine, this site appears to have the potential to support high densities of breeding birds.

17. Flatirons North (Royal Arch)

Site Characteristics: Dense stands of Douglas-fir forest and ponderosa pine/Douglas-fir forest grow in steep, shaded ravines cutting through the Flatirons. At higher elevations coniferous forest is interspersed with rock and talus. Rock outcrops serve as important nest and perch sites for cliff-nesting raptors. Dense riparian growth occurs along upper Bluebell Creek. Snag density throughout this site is low to moderate.

Birds: Plot density of 25 species and 55 individuals (Royal Arch Trail near Bluebell Creek). Peregrine falcon, prairie falcon, northern goshawk, hairy woodpecker, brown creeper. Rating: 5.

Mammals: Potential of 52 species. Foraging and potential denning area for black bear. Low deer population. Rating: 4

Recreational Use: Moderate

Management Recommendations: Rock climbing and other recreational uses of this area need to be carefully monitored to protect cliff-nesting raptors. The nest site on the north side of the Third Flatiron currently being used by prairie falcons is the last known peregrine falcon nest site within the Park. Peregrine falcons have been returning to this area (Jeanne Scholl, pers. comm.). Closure of climbing routes on the Third Flatiron may be necessary to protect nesting prairie falcons and peregrine falcons.

18. Green Mountain West

Site Characteristics: This area on the back side of Green Mountain is extremely diverse. Gentle ridges support ponderosa pine woodland. Ponderosa pine/Douglas-fir forest and river birch-aspen-hazelnut riparian growth occurs in shaded canyons. The forests on this site have been heavily impacted by spruce budworm and ponderosa pine beetle infestations, and snag density is high.

Birds: Plot density of 29 species and 55 individuals. Hairy woodpecker, Williamson's sapsucker, mountain bluebird. Rating: 5.

Mammals: Potential of 64 species. Potential elk wintering area. Potential black bear and mountain lion denning area. Low deer population. Rating: 4.

Recreational Use: Low.

Management Recommendations: Retention of all snags in this area is recommended so that this site can continue to support a high density of breeding birds. Future trail construction should be avoided here so that the remoteness of this area and its potential as a refuge for large mammals can be protected.

19. Upper Skunk Canyon

Site Characteristics: Because of its inaccessibility, Upper Skunk Canyon was probably never logged by settlers or grazed by cattle. Nevertheless, the south side of the canyon is covered with dense, stunted Douglas-fir forest and the north side supports a surprising number of exotic grasses. Aspen, box elder, and a variety of ferns and other low vegetation grow along a spring-fed stream on the canyon bottom. Slopes in the canyon are extremely steep. Snag density is moderate.

Birds: No breeding bird survey was conducted in this area. Nesting golden eagle, brown creeper. Rating: 4

Mammals: Potential of 62 species. Potential black bear denning area. Rating: 4.

Recreational Uses: Low

Management Recommendations: Continued closure of Upper Skunk Canyon February-July, to protect nesting golden eagles, is strongly recommended. Since this area provides a refuge for large mammals and birds of prey, trail construction is strongly discouraged.

20. Middle Skunk Canyon

Site Characteristics: A dense stand of ponderosa pine/Douglas-fir forest, growing on a moderate east-facing slope above Skunk Creek, is the only known nest site for long-eared owl in the Park. This species is designated as rare and declining in the Boulder County Comprehensive Plan. Dry scrub and box elder-maple riparian growth occurs in the tributary to Skunk Creek that flows through this area. Snag density is low.

Birds: Plot density of 19 species and 39 individuals. Long-eared owl, rock wren, brown creeper. Rating: 4.

Mammals: Potential of 50 species. Black bear foraging area. High deer population. Rating: 3.

Recreational Use: Moderate

Management Recommendations: Trail construction, tree removal, or brush removal within 100m of long-eared owl nest site (see Forest Bird Study for location) should be avoided.

21. Lower Skunk Canyon

Site Characteristics: This site, which includes ponderosa pine woodland, dry scrub, and cottonwood-willow riparian vegetation, is an extremely rich avian habitat. Shrub growth in Lower Skunk Canyon is dense, and wild fruits attract black bears each fall. Slopes are gentle to moderate.

Birds: Plot density of 24 species and 69 individuals. Scrub jay, gray catbird. Rating: 4.

Mammals: Potential of 57 species. Denning area for red fox. Foraging area for black bear. High deer population. Rating: 4.

Recreational Use: Moderate to high

Management Recommendations: Trails in this area should avoid dense shrub areas in the canyon bottom.

22. Mesa Trail, NCAR

Site Characteristics: Ponderosa pine woodland, growing on gentle to moderate slopes, is interspersed with small areas of dry scrub. Snag density is low. An extensive trails network has resulted in vegetation loss and soil erosion.

Birds: Plot density of 19 species and 33 individuals. Cooper's hawk, rock wren. Rating: 3.

Mammals: Potential of 50 species. High deer population. Rating: 3.

Recreational Use: Moderate to high.

Management Recommendation: Due to low basal areas in this area, no forest thinning is anticipated. Continued management of trails to reduce soil erosion is recommended.

23. Upper Bear Canyon

Site Characteristics: All three types of riparian vegetation found in the Mountain Park, as well as ponderosa pine/Douglas-fir forest and Douglas-fir forest, grow in Upper Bear Canyon. Signs of human disturbance are minimal. Snag density is low to moderate. This canyon is of particular interest because it cuts all the way

through the Flatirons, serving as a migration corridor for large mammals.

Birds: Plot density of 19 species and 41 individuals. Prairie falcon, American dipper, rock wren. Rating: 4.

Mammals: Potential of 51 species. Foraging area for black bear. Migration corridor for black bear, mountain lion, and coyote. Low deer population. Rating: 4.

Recreational Use: Moderate

Management Recommendations: All major riparian corridors within the Mountain Park lie within areas that receive moderate to heavy recreational use. Recreational use of these areas probably restricts the movements of large mammals such as black bear, mountain lion, and coyote. Seasonal closure of Bear Canyon trail would create one trail-free migration corridor within the Park. Another option would be to post signs encouraging people to voluntarily choose other trails during summer and fall months. Additionally, people should be strongly discouraged from hiking into the riparian area along Bear Creek directly above the Mesa Trail, where the only American dipper nest in the Mountain Park is located.

24. Bear Peak West Ridge

Site Characteristics: Ponderosa pine woodland and mixed ponderosa pine/Douglas-fir forest occur on a gently sloping ridge running northwest from Bear Peak. Trees are mostly stunted with

small diameters. Snag density is moderate. Some forest thinning occurred in this area in 1977.

Birds: Plot density of 15 species and 29 individuals. Hairy woodpecker. Rating: 2.

Mammals: Potential of 59 species. Moderately disturbed site. Low deer population. Rating: 3.

Recreational Use: Moderate

Management Recommendations: Due to previous disturbances or to unfavorable growing conditions, basal areas are low and trees are stunted. No further forest management activities are projected for this region in the near future.

25. Bear Peak North

Site Characteristics: This is a diverse area with Douglas-fir forest, mixed ponderosa pine/Douglas-fir forest, aspen, and river birch-aspen-hazelnut riparian growing on steep north-facing slopes cut by ravines. Snag density is low to moderate. There are few signs of human disturbance.

Birds: Plot density of 24 species and 49 individuals. Rock wren. Historic golden eagle nest. Rating: 4.

Mammals: Potential of 44 species. Foraging area for black bear. Low deer population. Rating: 3.

Recreational Use: Low

Management Recommendations: Due to steepness of slopes in this area, no forest management activities are anticipated, and

recreational use will probably remain low. Trails should avoid riparian corridors which may contain rare plant communities.

26. Lower Bear Canyon

Site Characteristics: Dense riparian growth occurs in this section of Bear Canyon, with a cottonwood-willow overstory and an understory of chokecherry, hawthorn, wild plum, and other shrubs. Breeding bird densities are extremely high, and this is an important foraging area for black bear and other mammals.

Birds: Plot density of 26 species and 62 individuals. Rock wren. Rating: 4.

Mammals: Potential of 55 species. Foraging area and migration corridor for black bear. Frequent mountain lion sightings and mountain lion kills observed. Moderate human disturbance. Rating: 4.

Recreational Use: High

Management Recommendations: As much as possible foot traffic should be restricted to the road on the north side of the canyon to limit disturbance of the riparian corridor along Bear Creek.

27. Fern Canyon

Site Characteristics: This steep, shaded canyon contains dense stands of Douglas-fir forest and dramatic rock outcrops. A prairie falcon nest site lies on the north side of the canyon, a popular rock climbing area. A sharp-shinned hawk nest was observed by Howard Weinberg (1987) in the lower canyon near the Mountain

Park boundary. Snag density is moderate. Soil erosion is becoming a problem beneath popular rock climbing routes.

Birds: Plot density of 16 species and 43 individuals. Prairie falcon, sharp-shinned hawk, brown creeper. Rating: 4.

Mammals: Potential of 45 species. Black bear foraging area and potential denning area. Low deer population. Moderate disturbance. Rating: 4.

Recreational Use: Moderate

Management Recommendations: Avoid thinning or timber removal in the Douglas-fir stand in the canyon between the Mesa Trail and the 6800' contour line. Close climbing routes seasonally to protect nesting prairie falcons. Additional route closures or restrictions may be necessary to reduce soil erosion beneath popular climbing cliffs.

28. Bear Peak West

Site Characteristics: This unique and relatively remote area contains the most extensive aspen stands and the only lodgepole pine stands in the Mountain Park. Dominant vegetation is ponderosa pine woodland, with ponderosa pine/Douglas-fir forest, lodgepole pine forest, aspen woodland, and rock and talus. Snag density is low to moderate. Slopes are moderate to severe. There is little human use of this area and there are few signs of disturbance.

Birds: Plot density of 20 species and 40 individuals. Williamson's sapsucker, rock wren. Rating: 3.

Mammals: Potential of 63 species. Black bear foraging area. Black bear and mountain lion potential denning area. Elk wintering area. Low to moderate deer population. Rating: 5.

Recreational Use: Low

Management Recommendations: As one of the most remote and ecologically diverse areas of the Park, this site deserves careful protection. Trail construction and forestry activities should be avoided. Human access should be discouraged.

29. Aspen Canyon

Site Characteristics: Douglas-fir/ponderosa pine/aspen forest growing in this shaded, box canyon exhibits some old-growth characteristics. Snag density is high, and there is a well developed shrub understory which includes river birch-aspen-hazelnut riparian growth along a seasonal stream. Ponderosa pine forest, ponderosa pine woodland, and rock and talus also occur in this ecologically diverse canyon. Human disturbance is minimal.

Birds: Plot density of 24 species and 48 individuals. Flammulated owl, hairy woodpecker, Williamson's sapsucker, rock wren. Rating: 4.

Mammals: Potential of 67 species. Black bear foraging area. Potential black bear and mountain lion denning area. Elk wintering area. Low deer population. Rating: 5.

Recreational Use: Low

Management Recommendations: Trail construction and forestry activities, including forest thinning, removal of dead trees or brush, and fire suppression, should be avoided in this canyon.

30. South Boulder Peak

Site Characteristics: Ponderosa pine woodland and mixed ponderosa pine/Douglas-fir forest grow on steep south-facing slopes. Snag density is low to moderate. Human disturbance in minimal.

Birds: Plot density of 17 species and 30 individuals. Cooper's hawk (observed during breeding season), hairy woodpecker. Rating: 3.

Mammals: Potential of 59 species. Elk wintering area. Rating: 4.

Recreational Use: Low

Management Recommendations: Due to low basal areas and steep slopes, no forestry activities are anticipated on this site. Future trail construction should be avoided.

31. Shadow Canyon

Site Characteristics: Douglas-fir forest, which exhibits some old-growth characteristics, predominates in this steep, southeast-facing canyon. A small riparian area in the lower canyon supports a rich diversity of plant and bird life. Prairie falcons nest on cliffs on the northeast side of the canyon. Snag density is moderate to high. Site disturbance is minimal.

Birds: Plot density of 26 species and 51 individuals. Prairie falcon, flammulated owl, hairy woodpecker, brown creeper. Rating: 4.

Mammals: Potential of 45 species. Potential black bear denning area. Low deer population. Rating: 4.

Recreational Use: Low to moderate.

Management Recommendations: Shadow Canyon contains some of the largest trees found in the Mountain Park, including one Douglas-fir that measures 87cm (35") DBH. Forest thinning and removal of any large trees or snags should be avoided. Climbing routes should be closed seasonally as necessary to protect nesting prairie falcons. Currently there are several small trails meandering up the canyon; construction of one well marked trail would reduce soil erosion and vegetation disturbance.

32. Flatirons South

Site Characteristics: Douglas-fir forest and mixed ponderosa pine/Douglas-fir forest grow on extremely steep, rocky slopes. A small stand of mixed Douglas-fir/ponderosa pine/limber pine forest occurs on the north ridge of Bear Peak above 2400m (8,000').

Birds: No breeding bird survey was conducted in this area. Historic prairie falcon nest.

Mammals: Potential of 45 species. Potential black bear denning area. Rating: 3.

Recreational Use: Low

Management Recommendations: Due to the extreme ruggedness of terrain, no forestry activities or trail construction is anticipated in this area.

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Appendix

Scientific Names of Birds Mentioned in Text

Family	Common Name	Scientific Name
Cathartidae	Turkey Vulture	*Cathartes aura*
Accipitridae	Sharp-shinned Hawk	*Accipiter striatus*
	Cooper's Hawk	*Accipiter cooperii*
	Goshawk	*Accipiter gentilis*
	Red-tailed Hawk	*Buteo jamaicensis*
	Golden Eagle	*Aquila chrysaetos*
Falconidae	American Kestrel	*Falco sparverius*
	Peregrine Falcon	*Falco peregrinus*
	Prairie Falcon	*Falco mexicanus*
Phasianidae	Blue Grouse	*Dendragapus obscurus*
Columbidae	Rock Dove	*Columba livia*
	Band-tailed Pigeon	*Columba fasciata*
	Mourning Dove	*Zenaida macroura*
Strigidae	Flammulated Owl	*Otus flammeolus*
	Eastern Screech Owl	*Otus asio*
	Great Horned Owl	*Bubo virginianus*
	Northern Pygmy-Owl	*Glaucidium gnoma*
	Long-eared Owl	*Asio otus*
	Northern Saw-whet Owl	*Aegolius acadicus*
Caprimulgidae	Common Nighthawk	*Chordeiles minor*
	Common Poorwill	*Phalaenoptilus nuttallii*
Apodidae	White-throated Swift	*Aeronautes saxatalis*
Trochilidae	Broad-tailed Hummingbird	*Selasphorus platycercus*
Alcedinidae	Belted Kingfisher	*Ceryle alcyon*
Picidae	Lewis's Woodpecker	*Melanerpes lewis*
	Williamson's Sapsucker	*Sphyrapicus thyroideus*
	Downy Woodpecker	*Picoides pubescens*
	Hairy Woodpecker	*Picoides villosus*

Family	Common Name	Scientific Name
	Northern Three-toed woodpecker	Picoides tridactylus
	Northern Flicker	Colaptes auratus
Tyrannidae	Olive-sided Flycatcher	Contopus borealis
	Western Wood Pewee	Contopus sordidulus
	Hammond's Flycatcher	Empidonax hammondii
	Dusky Flycatcher	Empidonax oberholseri
	Western Flycatcher	Empidonax difficilis
	Say's Phoebe	Sayornis saya
	Western Kingbird	Tyrannus verticalis
Hirundiade	Tree Swallow	Tachycineta bicolor
	Violet-green Swallow	Tachycineta thalassina
Corvidae	Steller's Jay	Cyanocitta stelleri
	Blue Jay	Cyanocitta cristata
	Scrub Jay	Aphelocoma coerulescens
	Clark's Nutcracker	Nucifraga columbiana
	Black-billed Magpie	Pica pica
	American Crow	Corvus brachyrhynchos
	Common Raven	Corvus corax
Paridae	Black-capped Chickadee	Parus atricapillus
	Mountain Chickadee	Parus gambeli
Aegithalidae	Bushtit	Psaltriparus minimus
Sittidae	Red-breasted Nuthatch	Sitta canadensis
	White-breasted Nuthatch	Sitta carolinensis
	Pygmy Nuthatch	Sitta pygmaea
	Brown Creeper	Certhia americana
Troglodytidae	Rock Wren	Salpinctes obsoletus
	Canyon Wren	Catherpes mexicanus
	House Wren	Troglodytes aedon
Cinclidae	American Dipper	Cinclus mexicanus
Muscicapidae	Ruby-crowned Kinglet	Regulus calendula
	Blue-gray Gnatcatcher	Polioptila caerulea
	Western Bluebird	Sialia mexicana
	Mountain Bluebird	Sialia currucoides
	Townsend's Solitaire	Myadestes townsendi
	Hermit Thrush	Catharus guttatus
	American Robin	Turdus migratorius

Family	Common Name	Scientific Name
Mimidae	Gray Catbird	Dumetella carolinensis
	Northern Mockingbird	Mimus polyglottos
Bombycillidae	Cedar Waxwing	Bombycilla cedorum
Sturnidae	European Starling	Sturnus vulgaris
Vireonidae	Solitary Vireo	Vireo solitarius
	Warbling Vireo	Vireo gilvus
Emberizidae	Orange-crowned Warbler	Vermivora celata
	Virginia's Warbler	Vermivora virginiae
	Yellow Warbler	Dendroica petechia
	Yellow-rumped Warbler	Dendroica coronata
	American Redstart	Setophaga ruticilla
	Ovenbird	Seiurus aurocapillus
	McGillivray's Warbler	Oporornis tolmiei
	Yellow-breasted Chat	Icteria virens
	Western Tanager	Piranga ludoviciana
	Black-headed Grosbeak	Pheucticus melanocephalus
	Blue Grosbeak	Guiraca caerulea
	Lazuli Bunting	Passerina amoena
	Indigo Bunting	Passerina cyanea
	Green-tailed Towhee	Pipilo chlorurus
	Rufous-sided Towhee	Pipilo erythrophthalmus
	Chipping Sparrow	Spizella passerina
	Vesper Sparrow	Pooecetes gramineus
	Lark Sparrow	Chondestes grammacus
	Savannah Sparrow	Passerculus sandwichensis
	Dark-eyed Junco	Junco hyemalis
	Western Meadowlark	Sturnella neglecta
	Brown-headed Cowbird	Molothrus ater
	Northern Oriole	Icterus galbula
Fringillidae	Pine Grosbeak	Pinicola enucleator
	Cassin's Finch	Carpodacus cassinii
	House Finch	Carpodacus mexicanus
	Red Crossbill	Loxia curvirostra
	Pine Siskin	Carduelis pinus
	Lesser Goldfinch	Carduelis psaltria
	American Goldfinch	Carduelis tristis
	Evening Grosbeak	Coccothraustes vespertinus
Passeridae	House Sparrow	Passer domesticus