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THE INFLUENCE OF HUMAN ACTIVITY ON COYOTES

Introduction

The Boulder Open Space comprises approximately 25,000 acres of open lands. The open space system provides passive recreation trails, scenic vistas, and wildlife habitat. Some of the system is leased to farmers and ranchers to preserve historic agricultural character. With Boulder's population quadrupling in the 1950s and 1960s, the need for a greenbelt encircling the city was critical as a means to control urban development and to preserve natural habitats.

This research is intended to be an observational study to gain insight into the relationship between humans and coyotes, recreation and habitat, landscape design and landscape ecology. The study explores how human activity on trails influences the behavior of coyotes. I hypothesized that daytime trail usage by recreationalists deters coyotes from using paths. I tested this hypothesis by tracking coyotes and observing both coyotes and people on the South Boulder Creek Trail, recording evidence for a total of five days from dawn on April 2, 1996 to dawn on April 7, 1996. Evidence and observations were inconclusive.

Since the objective of this research is to document and compare daytime and nighttime coyote movement on trails that are well-traveled by people, an extensive literature review on greenway ecology and design, with emphasis on trail design and planning and on coyote behavior was completed. The criteria used in selecting the site of South Boulder Creek include: (1) no dogs allowed; (2) highest density of people traveling trails in Spring period (52%) (Boulder Open Space study); (3) the highest density of coyotes in Boulder Open Space (C. Miller and M. Gershman-pers. comm.).

Assumptions

Assumption 1: coyotes' daily movement patterns occur mostly at night, but they also are active during dawn and dusk.
Assumption 2: trails are most populated by people between 10:30am and 1:30pm and three hours prior to sunset until sunset (during Winter 1995) (North Boulder Open Space, unpublished). I would expect most coyote encounters to occur around sunset.
Assumption 3: people who enter the trail from Highway 36 exit from same point. Anyone who enters or exits from Hwy. 36 will be counted for observation only once.

Background

Anecdotal evidence suggests that coyotes and humans are increasingly in conflict as urban development expands. Mountain lions snatch children from backyards in southern California and coyotes on occasion follow recreationalists on trails in Colorado (Miller, Wheeler-personal comm.). Coyotes lure dogs away from their owners by faking injury or by exhibiting play behavior in the Boulder Open Space zone (C. Miller-personal communication). This dilemma, a symptom of the larger problem of urban growth and thus, habitat loss (Harris 1984, Forman 1995, Soule 1991), has management implications. However, greater knowledge of movement patterns and time of use by both humans and coyotes is critical to implementing an effective management strategy.

Narrow unpaved roads with few vehicles often are used at night by predators, including fox, dingo, wolf, and coyotes (Forman 1995, Bennett 1990b, Saunders and Hobbs 1991). From both observations and from the presence of their tracks and feces (Pienaar 1968, Newsome et al. 1975, Mech 1970, Corbett 1989), it is clear that lightly used roads and tracks are favored by predators

as clear pathways for movement and hunting unimpeded by vegetation and other obstructions (Saunders and Hobbs 1991).

Although coyotes are most active and move the longest distances at night, they are also active during daylight (Atkinson and Shackleton 1991). It is well documented that human disturbance has made mammals change or abandon their home range, or modify their behavior (Gese et al. 1987 and 1989, Dorrance 1975, Van Dyke et al. 1986). Behavioral change already is evidenced in the Boulder Open Space in which increasing numbers of coyote sightings and encounters are reported (C. Miller - pers. comm.). This increase in the numbers of coyote sightings and encounters is particularly relevant in the Boulder Open Space because 1) it encircles urban development, thereby increasing the potential conflicts with humans (Gill and Bonnett 1973, Howell 1982, Shargo 1988, Quinn 1992); 2) the Boulder Open Space program is committed not only to preserving natural resources, but also to providing appropriate visitor access for recreational opportunities.[1] According to the 1993 Visitor Survey of the Boulder Open Space, people frequent places near home: 88% of visitors to the South Boulder Creek zone were residents of Boulder. Consequently, compatibility or avoidance of conflict between humans and wildlife is critical; 3) if human activity does influence coyote usage of trails, then the necessity for alternative guidelines for design, planning and management of recreational trails increases.

The anticipated value of this research lies in a framework for greenway planning. Greenways serve two primary functions. They link parks and open spaces for recreation and they link conservation areas to counter habitat fragmentation and benefit biodiversity (Harris 1984, Soulé 1991, Little 1990, Bennett 1990). More substantially, greenways protect and/or preserve natural, cultural, and historical lands, establish linear open space, and maintain connectivity between conservation lands, communities, parks and recreation facilities. Connectivity is a critical landscape characteristic important to the health, well-being, and aesthetic values of human communities and vital to the maintenance of functional native ecosystems (Florida Greenways Commission 1986).

Methods

Study site

Part of the Boulder County Open Space, the South Boulder Creek Trail is a 3-mile long hiking trail/service road. The portion to the south of South Boulder Road is the focus of this study. It is a 1.4 mile (2.25 kilometer) long, 8 foot wide dirt trail that has a public access gate at the northern end (off of South Boulder Road) and dead ends on the southern end. Park regulations prohibit dogs because of cattle grazing adjacent to the trail. The cattle ranchers use the trail as a service road twice per day, once in the morning and once at night, to distribute hay. South Boulder Creek lies adjacent to the trail on the east side. South Boulder Road, a 4-lane road, lies adjacent to the trailhead and Highway 36, a 4-lane highway, crosses the trail in the first half mile (Figure).

Coyote Tracking

Evidence of tracks, scats, and sightings were used to determine coyote presence and movement. Observations were recorded using three categories of movement times - dawn to noon, noon to dusk, dusk to dawn beginning on April 2 1996. The daytime interval was defined by Atkinson and Shackleton (1991): 24-h period divided into: *dawn* (1 h each side of sunrise); *day* (between dawn and dusk); *dusk*: (1 h each side of sunset); and *night*: (between dusk and dawn).

The following method was used to define the trail into sections and segments:

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[1] City of Boulder Open Space and Mountain Parks Research/Monitoring Program guidelines.

1) Divided 2.25 km (1.4 miles) South Boulder Creek Trail into five equal sections, plus one section across South Boulder Creek on the Abernathy Farm, of approximately 450 m each according to terrain or unique features such as urban density, proximity to Highway 36, proximity to creek, etc. (Figure 1). Each section will be marked on-site with a white flag placed along the edge of the trail.
2) Each section was divided into four equal segments (112.5 m long assuming the terrain of the site provides 5 equal sections). Each segment was marked on-site with an orange flag ribbon along the edge of the trail at the midpoint of each section.
3) One raked spot in middle section measuring 6 m long and as wide as the trail to provide for on-trail movement. Off-trail movement could not be determined via track beds because of dense grasses.

Observations of Recreationalists
People on trails were observed to understand the relationship between the presence of people and the presence of coyotes. Activity, group size and the time of entry from north entrance to the South Boulder Creek trail were recorded. Five categories of passive recreation were observed: jogging, hiking, biking, horseback riding and other (i.e. contemplation).

Results
Since most coyote activity occurs at dusk and dawn and most recreationalist activity occurs mid-day (10:30am to 1:30pm) and late (three hours prior to sunset until sunset) (North Boulder Open Space Study, date unknown), I hypothesized that the potential of a coyote-human encounter is greatest at sunset. On South Boulder Creek Trail, coyote activity indeed occurs primarily at dusk and dawn, while recreationalist activity is evenly distributed throughout the day, with slightly more individuals on the trail at noon. Of 6 coyote sightings, 4 occurred at dawn and 2 at dusk; of 329 recreationalist observations, 106 occurred at dawn, 115 at noon, and 108 at dusk (Figure). Additionally, fresh scats and tracks were observed primarily at dawn. One might infer, therefore, that because most coyote sightings, tracks and scats occurred at dawn and the distribution of recreationalists is similar throughout the day, potential human-coyote conflict might occur at dawn, rather than dusk as first hypothesized. Further analysis is required to investigate this notion.

The tracking beds located in each segment were not successful and were abandoned after Day 1. The ground was too hard, sand caused hazard to bicyclists, and flour blew away overnight. Therefore, coyote tracks were observed in along stream banks of sand, in mud, and in snow. Snow tracking on Day 3 led to the most conclusive evidence that coyotes parallel linear landscape elements including the trail, the creek, fence lines and Highway 36. They crossed the trail, the creek, and grasslands in search of voles and mice (Figure). This supports Bider's evidence that most animals have specific areas or paths of spatial utilization for short periods of time, eliminating the randomness of movement. It also upholds Saunders and Hobbs (1991) finding that predators use lightly used roads as paths for movement.

Coyote sighting and scat evidences were scarce near the recreation trail. The greatest likelihood of actually seeing a coyote was 75 to 120 yards off the trail (Figure). Of 12 fresh scats, only 2 were found at dusk on the trail, 1 was found at noon on the edge of the trail, and the remaining 9 were found throughout the day 15 to 500 yards off the trail (Figure). Although these animals command control over this territory, they tended to avoid people during daylight hours. Only the conscious observer may find clues of coyote activity.

Of the 12 scats, most were found at dusk and dawn, supporting prevailing evidence that coyotes move mostly at these times. An even distribution of scats were found on the dry side (the grasslands) and the wet side (the creek). Moreover, the combination of coyote sightings, tracks, and scats evidence were highest near riparian vegetation and along the creek bank.

Discussion

Management implications

Coyote movement increased as vehicle and pedestrian volume decreased. As human activity declined on South Boulder Road and Highway 36 and ceased on the trail overnight, coyotes became active. During the day, though coyotes evidences were discovered, no human-coyote conflict occurred. This might be attributed to the fact that the South Boulder Creek Trail in particular, is surrounded by gravel pits and mining. Suburbia is scattered at a distance. Moreover, the combination of the open grassland fields and South Boulder Creek provides excellent source of food, water and shelter. Coyotes in this particular territory do not need to venture into the urban areas for residential pets. However, should urban encroachment occur in the future, conflict may result, as is the case just to the north of the site.

It may be interesting to compare the flow of recreationalists on urban, suburban, and rural/agricultural trails to coyote densities. More stringent management may be required in increasingly urban areas. In the case of South Boulder Creek Trail, it does not appear that present management strategies need to change. However, should this 1.4 mile portion of trail be extended, as planned, to allow two-way public access, the existing management strategy may need to be tightened to not only prohibit dogs and vehicles (except as exists), but also limit public access. Although coyotes were not noticeably present to the casual user , I would caution that as development encroaches on this area, more aggressive management may be required, such as increased signage education and even temporary trail closures. A political hot potato, the public needs to decide the value of nature preservation and protection.

Because this study is meant to be a pilot study, it is difficult to make any definitive conclusions. Coyotes are known to adjust to urban environments as they have done with South Boulder Road and Highway 36. The constant flow of recreationalists, too, seems to be a part of an urbanizing environment. Although no direct human-coyote interaction occurred, the greatest likelihood of interaction may occur with single joggers at dawn. The lack of interaction thus far might be due to the physical context of this site: the trail lies along the suburban fringe to rural landscape, gravel pits and mining are adjacent, and scattered residential developments exist beyond their territory. Further study and analysis is required to implement proper management strategies. Similarly, a regional approach to development is required to prevent human-wildlife conflicts.

Characteristics of South Boulder Creek Trail by Section/Segment

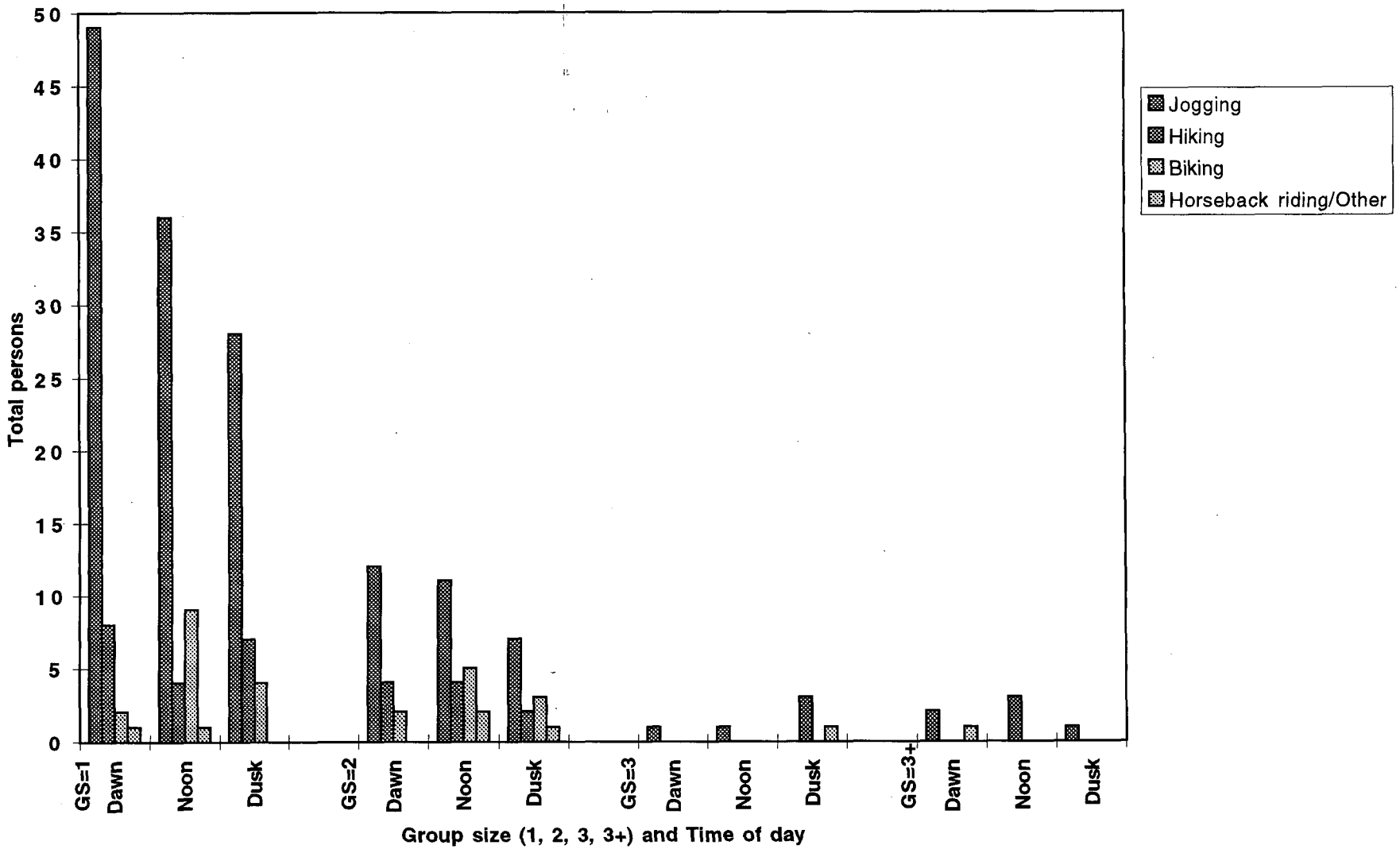
	General Description of Sections	Segment A	Segment B	Segment C	Segment D
Section 1	Between South Boulder Road and Hwy 36 SBR@4 lanes, 45mph Hwy 36@4 lanes, 55mph	Thick vegetation Access point to trail (most used)	Thin vegetation Both SBR and Hwy 36 noise River 100' off trail	Grassland, small wetland Hwy 36 noise constant River 400' off trail	Culvert (soft bottom, grassy) Hwy 36 noise high! / Wetland
Scat concentrations		Low	High (near woody vegetation)	High (near 1D) esp. by culvert	Very high (by water channel course)
Section 2	Hwy 36, woody vegetation	Riparian vegetation/creek, Hwy. 36 noise	Large cottonwoods (east side) Grasslands (west side)	Open grass Rip. veg. further away	Open grass
Scat concentrations		High (near rip. veg./creek) Also, same site of coyote crossings	Moderate	Moderate	Low
Section 3	Along South Boulder Creek	Approx. 50' from creek High water noise	Approx. 50' from creek Grassland	Quarry operation 500 yds off trail Grassland	Quarry operation 500 yds off trail Grassland
Scat concentrations		Low	Low	Low	Low
Section 4	Middle of grassland	Middle of grassland Path turns	Middle of grassland, culvert/ditch Path turns	Middle of grass Near fence	Grassland
Scat concentrations		Low	Moderate	Low	Moderate
Section 5	Rural residential	Parallel to shallow ditch Middle of grassland	Grassland	Crosses irrigation ditch Culvert beneath trail/grassland	Grassland Ponds
Scat concentrations		Moderate	Moderate	Low	None.
Section 6	No recreationalists	steep hillside grassland	steep hillside rip. veg./grassland	Riparian vegetation grassland	Parallel to historical 1900s house steep hillside
Scat concentrations		None	None	None	None

Notes: Section 6 is control section at Abernathy Farm. This is closed to the general public; scat concentration levels were recorded via observation during initial set-up of study.
Constant characteristics along trail: cattle grazing; drive on twice per day (dawn and dusk) to feed cattle.

Activity		Jogging	Hiking	Biking	Horseback riding/Other
Group size of 1					
	Dawn	49	8	2	1
	Noon	36	4	9	1
	Dusk	28	7	4	0
Group size of 2					
	Dawn	12	4	2	0
	Noon	11	4	5	2
	Dusk	7	2	3	1
Group size of 3					
	Dawn	1	0	0	0
	Noon	1	0	0	0
	Dusk	0	3	0	1
Group size of 3+					
	Dawn	2	0	0	1
	Noon	0	3	0	0
	Dusk	1	0	0	0

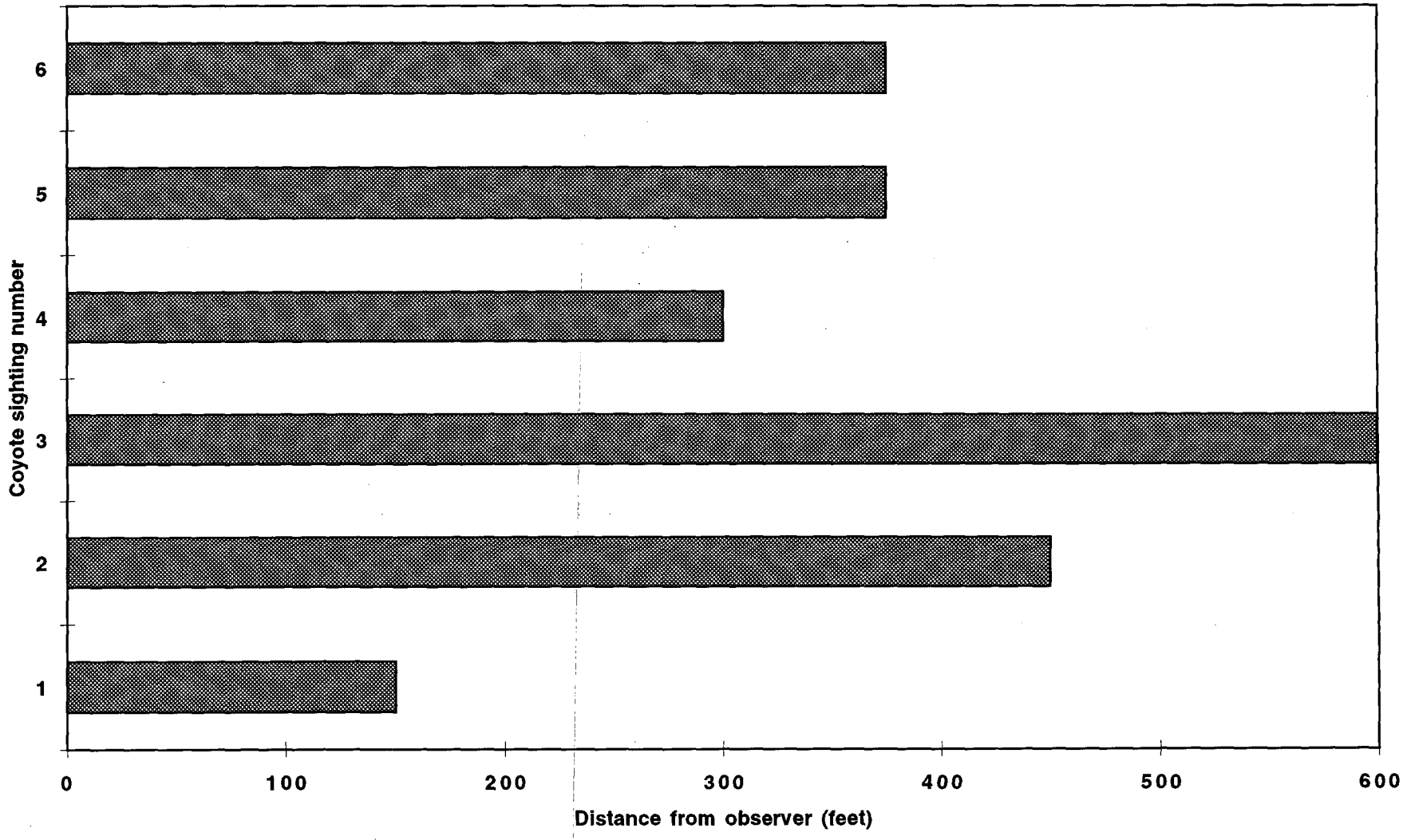
	Total individuals
Dawn	106
Noon	115
Dusk	108
Total Individuals Observed	329

Daily Recreational Activities on South Boulder Creek Trail

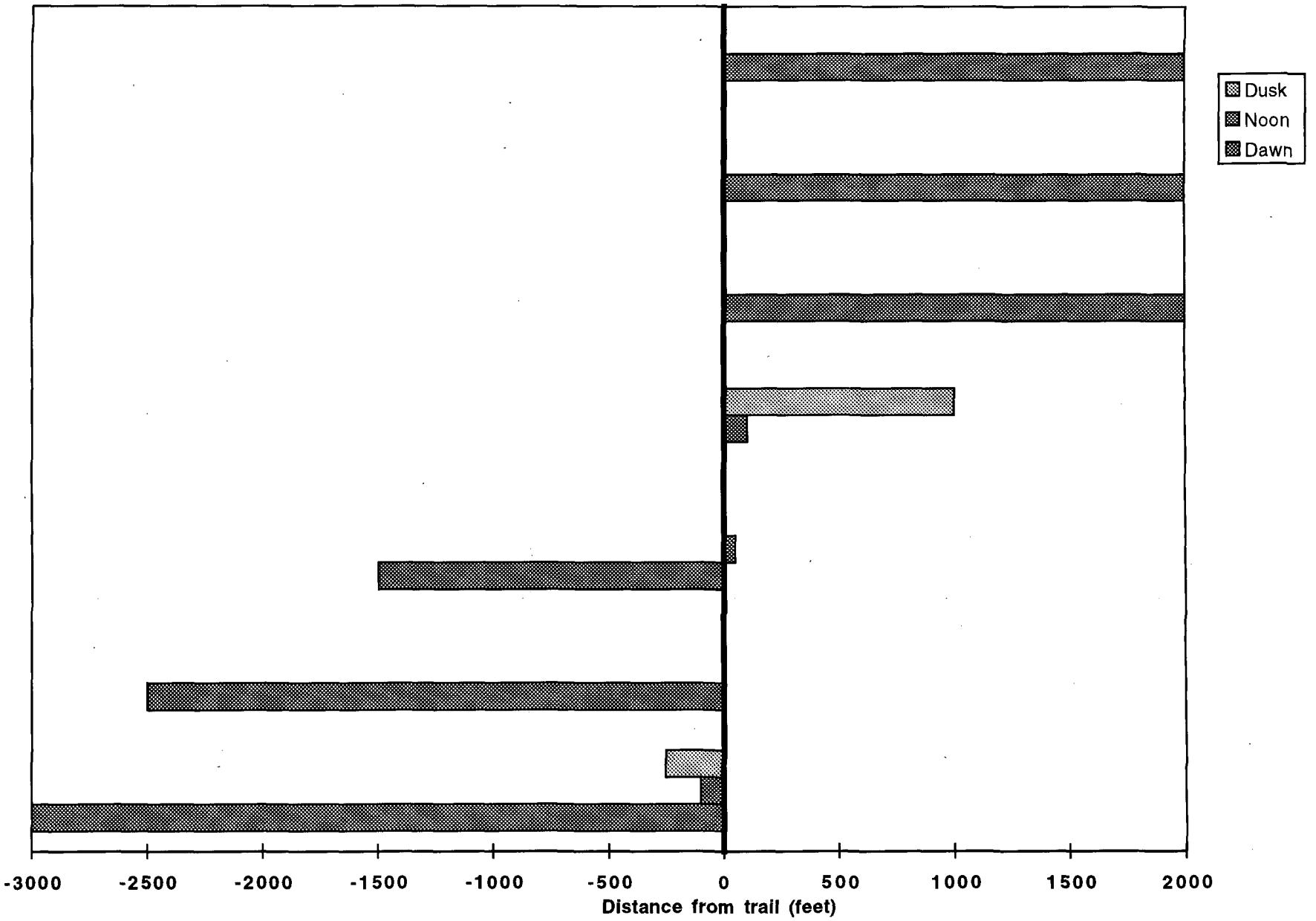


Individuals jogging at dawn is the most prevalent recreational activity on the trail.

Coyote Sightings
near South Boulder Creek Trail



Scat Distribution
in relation to South Boulder Creek Trail



Note: 3 of 12 scats lie on trail or along trail.

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September 26, 1996

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Dear Clint:

Enclosed please find the final report for the pilot study conducted in early April, 1996 on the South Boulder Creek Trail. I apologize for the delay. Hopefully, this information is useful for Boulder Open Space management.

Best Regards,

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