WILDLIFE RESPONSES TO PEDESTRIANS AND DOGS

Final Report

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by

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ABSTRACT

We measured the responses of two grassland passerines, one forest passerine, and one large mammal exposed to recreational treatments both on- and off-trail, including a pedestrian alone, a pedestrian accompanied by a dog-on-leash, and a dog alone. Responses measured included flush response (whether the animal flushed or not), flush distance (distance between disturbance and animal when flushed), distance of flush (distance the animal moved after flushing). All wildlife species in our study exhibited greater responses when the treatment occurred off-trail than when on-trail. In the grasslands, the dog-alone treatment elicited the least response by vesper sparrows (*Pooecetes gramineus*) and western meadowlarks (*Sturnella neglecta*), whereas pedestrian-alone and pedestrian accompanied by a dog-on-leash elicited greater responses. In the forest, American robins (*Turdus migratorius*) responded similarly to a pedestrian-alone and a pedestrian accompanied by a dog-on-leash. Mule deer (*Odocoileus hemionus*) exhibited the greatest response when a pedestrian was accompanied by a dog. Our results have important implications for the design and implementation of management policies, such as using spatial and behavioral restrictions, to ensure the coexistence of wildlife and recreationists.

STATEMENT OF OBJECTIVES AND HYPOTHESES

Participation in nonconsumptive outdoor recreational activities has increased substantially in recent years (Flather and Cordell 1995). Coinciding with the increased recreational use of natural areas is the increasing number of recreational trails crossing these lands, inevitably leading to an escalation in recreationist-wildlife conflicts (Knight and Gutzwiller 1995). As a result, natural-lands managers are showing increasing awareness of harmful impacts of outdoor recreation on wildlife communities.

Wildlife respond differently when exposed to various types of recreational activity. For example, Skagen (1980), Klein (1993), and Holmes et al. (1993) reported that responses of wildlife were greater when approached by pedestrians than by vehicles. Responses of wildlife can also be affected by the presence or absence of dogs. MacArthur et al. (1979;1982) found that mountain sheep (*Ovis canadensis*) were most alarmed when dogs accompanied humans. Likewise, golden plovers (*Pluvialis apricaria*) flushed more readily to dogs than to humans (Yalden and Yalden 1990). Marmots (*Marmota marmota*) also exhibited a greater reaction to pedestrians accompanied by a dog than a pedestrian alone (Mainini et al. 1993).

The location and predictability of an activity also plays an important role in shaping the response of wildlife to disturbance. If wildlife perceive an activity as predictable and non-threatening, habituation to that activity may occur. For example, humans approaching from a parking area (predictable activity) elicited less of a response from mountain sheep than did humans approaching from over a ridge (unpredictable activity) (MacArthur et al. 1982). Bald eagles (*Haliaeetus leucocephalus*) (Stalmaster and Newman 1978) and passerines (Cooke 1980, Burger and Gochfeld 1991) tolerated closer approaches by pedestrians in areas were human activity was common. Hikers on trails elicited less of a response from marmots than did hikers off-trail (Mainini et al. 1993).

Because human presence may cause wildlife to avoid areas, affect fecundity and survival, as well as alter energy budgets (Knight and Cole 1991), developing an understanding of how wildlife respond to various recreational activities becomes important (Knight and Cole

1995). Most studies of wildlife disturbance have focused on a single type of recreational activity in a single location and have addressed single species. As a result, information comparing wildlife responses to various types of recreational activities is lacking. Furthermore, we lack an understanding of how wildlife responses may vary from areas with differing disturbance histories.

We recorded responses of two grassland passerines, one forest passerine, and mule deer disturbed by a pedestrian alone, a pedestrian accompanied by a dog-on-leash, and a dog alone. Disturbances occurred along recreational trails (predictable disturbance) and on control sites where no trails existed (unpredictable disturbance). Our objectives were to compare species-specific responses to the 3 disturbance types as well as to compare responses when the disturbance occurred on-trail or off-trail.

METHODS AND STUDY AREA

We conducted our study on City of Boulder Open Space land, an area encompassing approximately 8,000 ha in and around the city of Boulder, Colorado (40° 00' N, 105° 18'45" E). Part of this land is in agricultural production to preserve the historic culture of Boulder County; other parcels are set aside for outdoor recreation. Elevation within the study area ranges from 1,219 to 2,438 m encompassing forest, riparian, shrubland, and grassland habitats. Visitor use on City of Boulder Open Space is almost 2 million visits per year with most visitors from the city of Boulder and surrounding communities. Visitor intensities are highest during the spring, followed by summer, fall, and winter seasons (Zeller et al. 1993). Recreational activities include hiking, wildlife viewing, exercising pets, jogging, mountain biking, horseback riding, and rock climbing. Hunting is prohibited on the property.

Study sites were located in pine forest and mixed-grass prairie ecosystems. Forest ecosystems were dominated by ponderosa pine (*Pinus ponderosa*) associated with a mix of shrubs, grasses, and forbs. Mixed-grass prairie ecosystems contained a variety of tall, mid, and shortgrass species including little bluestem (*Schizachyrium scoparium*), western wheat (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), and side oats grama (*Bouteloua curtipendula*).

We collected data between 14 April and 20 July 1996. To reduce the probability of sensitizing wildlife (Knight and Cole 1991), we systematically rotated visits to trails and control sites in which treatments took place so as to avoid repeatedly sampling the same section of trail or control site during the study period.

In the grassland ecosystem, we recorded responses of vesper sparrows and western meadowlarks to three treatments both on- and off-trail. Treatments were considered off-trail if they occurred greater than 800 m from an existing trail. We believed this was an adequate distance to negate any influence from established trails as Miller (1996) found that a reduction in abundance of grassland birds due to trails was generally less than 100 m from the trail. Treatments included: (1) a single pedestrian, (2) a single pedestrian accompanied by a dog-on-leash, and (3) a single dog. For treatments involving dogs we used one of two trained dogs weighing 25 Kg and 40 Kg, respectively. Leash length was 1.8 m. For on-trail treatments involving a dog alone, the dog remained on the trail maintaining an average distance of 22.0 m (SE = 0.84) in front of the observer. For off-trail sites, the dog remained in front of the observer at an average distance of 19.9 m (SE = 0.63). For dog alone treatments we assumed that the birds were responding to the dog only, and not the observer. In no case did the dogs attempt to chase the birds.

On-trail treatments consisted of proceeding along the center of a trail at a constant speed of 1.5 m/second. Birds were located on or near the trail ahead of us. Information recorded consisted of flush response (whether the bird flushed or not), flush distance (the distance between the disturbance and the bird when flushed), distance of the flush (the distance the bird moved after flushing), and the distance between the pre-flush position of the bird and the trail. On off-trail sites, we located birds on or near our line-of-movement and proceeded (constant speed of 1.5 m/second) toward the bird's position so as to pass by at varying distances from the subjects. Information recorded was the same as that for on-trail treatments with the exception that we measured the distance between the pre-flush position of the bird and our line-of-movement.

In the forest ecosystem, we recorded responses of American robins and mule deer to two types of treatments both on- and off-trail. Treatments included: (1) a single pedestrian, and (2) a pedestrian accompanied by a dog-on-leash. Treatments were considered off-trail if they occurred greater than 400 m from an existing trail. The same dogs used in the grassland ecosystem were used in the forest ecosystem. We were unable to obtain information for a dog alone because we could not maintain a great enough distance between the dog and the observer and still observe wildlife responses.

On-trail treatments consisted of proceeding along the center of a trail at a constant speed of 1.5 m/second. Robins and deer were located on or near the trail ahead of us. Information recorded for robins consisted of flush response, flush distance, distance of the flush, height of bird (if perched in tree) pre-flush, and distance between the pre-flush position of the bird and the trail. Information recorded for deer consisted of alert response (head up looking at observer), alert distance (distance between the treatment and the deer when it becomes alert), flush response, flush distance, distance of flush, and the distance between the pre-flush position of the deer and the trail. On off-trail sites, we located robins and deer ahead of us on or near our line-of-movement and proceeded (constant speed of 1.5 m/second) toward the animal's position so as to pass by at varying distance from the subjects. Information recorded was the same as that for on-trail treatments with the exception that we measured the distance between the pre-flush position of the animal and our line-of-movement. A range finder was used to measure all distances.

RESULTS

Grassland Ecosystem

Four-hundred sixty-two and 393 trials were run for vesper sparrows and western meadowlarks, respectively. For both species, logistic regression models indicated that treatment and distance to trail (for on-trail) or line of movement (for off-trail) were significant predictors of whether a bird would flush. For both species, the greatest response occurred on off-trail sites. For both on-trail and off-trail, the dog alone activity elicited the least response for both species, whereas a pedestrian alone and dog-on-leash elicited similar responses (Figure 1).

When vesper sparrows flushed, mean flush distance differed significantly between each treatment ($F = 11.75$; 3, 269 df; $P = 0.0001$). Flush distance was significantly greater for off-trail pedestrian alone and off-trail dog-on-leash than any other treatment. There were no significant differences in the distance of flush between the treatments ($F = 1.46$; 5,269 df; P

= 0.2041), however, birds tended to fly further on the off-trail sites as compared to on-trail sites (Table 1).

When meadowlarks flushed, mean flush distance differed significantly between each treatment (F = 8.00; 5,244 df; P = 0.0001). Flush distance was significantly greater for off-trail pedestrian alone and off-trail dog-on-leash than all disturbances occurring on-trail. Flush distance was also significantly greater for off-trail dog alone than on-trail dog-on-leash and on-trail dog alone. Additionally, flush distance was significantly greater for on-trail pedestrian alone and on-trail dog-on-leash than on-trail dog alone. For meadowlarks, distance of flush differed significantly between treatments (F = 3.99; 5,244 df; P = 0.0017). Distance of flush was significantly greater for off-trail pedestrian alone and off-trail dog-on-leash than for on-trail pedestrian alone and on-trail dog-on-leash. Additionally, distance of flush was significantly longer for both on- and off-trail dog alone than on-trail dog-on-leash (Table 1).

For all treatments, meadowlarks flushed at greater distances from the disturbance than vesper sparrows (on-trail pedestrian alone, t = 10.22, 59 df, P = 0.0001; on-trail dog-on-leash, t = 10.21, 54 df, P = 0.0001, on-trail dog alone, t = 2.98, 36 df, P = 0.0051; off-trail pedestrian alone, t = 12.40, 72 df, P = 0.0001; off-trail dog-on-leash, t = 9.27, 82 df, P =0.0001; off-trail dog alone, t = 9.67, 70 df, P = 0.0001) and flew greater distances once flushed (on-trail pedestrian alone, t = 4.22, 72 df, P = 0.0001; on-trail dog-on-leash, t = 3.40, 63 df, P = 0.0012, on-trail dog alone, t = 5.58, 43 df, P = 0.0001; off-trail pedestrian alone, t = 6.40, 72 df, P = 0.0001; off-trail dog-on-leash, t = 5.26, 133 df, P =0 .0001; off-trail dog alone, t = 5.49, 76 df, P = 0.0001) (Table 1).

Forest Ecosystem

Two-hundred twenty-eight trials were run for American robins. Logistic regression models indicated that treatment and distance to trail (for on-trail) or line of movement (for off-trail) were significant predictors of whether a bird would flush. Robins showed the greatest response to disturbances off-trail. Whether robins flush or not did not differ between the pedestrian alone and pedestrian accompanied by a dog (Figure 3).

When robins flushed, mean flush distance differed significantly between treatments (F = 17.92; 3,129; P = 0.0001). Flush distance was significantly greater for off-trail disturbances than on-trail disturbances. Additionally, flush distance was significantly greater for off-trail pedestrian accompanied by a dog than a pedestrian alone. Distance of flush also differed significantly between treatments (F = 3.50; 3, 129 df; P = 0.0174). Distance of flush was significantly greater for off-trail pedestrian accompanied with a dog than any other treatment except on-trail pedestrian accompanied by a dog (Table 2).

Eighty-eight trials were run for mule deer. Logistic regression models indicated that distance to trail (for on-trail) and treatment were significant predictors of whether deer would become alert. On-trail, a pedestrian accompanied by a dog elicited a greater alert response from deer than a pedestrian alone. When deer were disturbed off-trail (regardless of treatment type), they always became alert to the disturbance. Logistic regression models indicated that distance to trail (for on-trail) and line-of-movement (for off-trail) and treatment were significant predictors of whether deer would flush. A pedestrian accompanied by a dog elicited a greater flushing response by deer than a pedestrian alone (Figure 3).

Because many of the deer disturbed moved out of site and because we attempted to simulate typical recreationist behavior (i.e., continuing to proceed along the trail or line of movement without stopping) which caused deer to remain alert to our presence until we moved out of sight of the deer, we were unable to perform further statistical analysis. However, the on-trail pedestrian alone elicited the least response by deer and the off-trail pedestrian accompanied by a dog elicited the greatest response by deer (Table 3).

DISCUSSION

Wildlife may exhibit diverse responses to various types of recreational activities and may be influenced by the spatial context in which the activity occurs (Knight and Cole 1995). Vesper sparrows and western meadowlarks showed the least response to a dog alone and the greatest response when a pedestrian was present. Because dogs closely resemble coyotes (*Canis latrans*) and because coyotes rarely prey on adult birds (Leach and Frazier 1953, Andelt et al. 1987), birds may not perceive dogs as a significant threat. Alternatively, dogs may pose a greater threat than a pedestrian and birds may hold their position until the last moment, attempting to remain undetected. When comparing pedestrian alone and pedestrian accompanied by a dog on-leash, responses were similar, indicating that the presence of a dog with a pedestrian did not have an additive affect on whether wildlife flushed or not. American robins responded similarly, however once flushed, robins tended to fly further when a dog was present.

Responses of birds were magnified when treatments occurred off-trail. Recreational use off-trail occurs but is irregular and dispersed, conversely, recreational use on trails is heavy and constant (City of Boulder Open Space 1996). Because recreational activities occurring on-trail are common and predictable, birds have become habituated to activity in these locations. Off-trail recreation, however, is infrequent and spatially unpredictable, thus birds are not accustomed to these activities, resulting in greater responses. Cooke (1980), Yalden and Yalden (1989), and Burger and Gochfeld (1991) showed that in areas where human activity is common and frequent, birds were more approachable than those in areas where humans were less common.

Western meadowlarks exhibited greater responses than vesper sparrows. Cooke (1980), Holmes et al. (1993), and Skagen et al. (1991) also found that flush response increased with increasing body size. This relationship may be explained by the different energetics of large versus small birds. Small birds have a greater surface to body mass ratio, resulting in increased energy expenditure (Koplin et al. 1980, Wasser 1986). Therefore, small birds may be energetically stressed if repeated avoidance flights to disturbance occurs. However, because our study was conducted during the summer, presumably when food is not a limiting resource (Wiens 1974, 1977), energy expenditure may not be an important consideration. Alternatively, larger birds are more visible and may have historically been exposed to greater human persecution, causing larger birds to be more sensitive to humans (Cooke 1980).

Deer exhibited the greatest response to off-trail treatments and/or when a dog was present. In addition, responses by deer were magnified when treatments occurred off-trail where activities are less frequent and unpredictable. Others have found that large mammals exhibit a greater response when an activity is unpredictable (Schultz and Bailey 1978, MacArthur et al. 1982, Hamr 1988).

A pedestrian accompanied by a dog evoked a greater response from deer than to a pedestrian alone. Others have reported that dogs elicited the greatest response by wildlife (MacArthur et al. 1982, Yalden and Yalden 1990, Keller 1991). Although City of Boulder

Open Space regulations require that dogs be under sight or voice control, there are no leash laws on our study sites and dogs are known to harass and attack deer (pers. obs.). In extreme cases, dogs have been known to kill deer (Bowers 1953, Barick 1969, Lowry and McArthur 1978). Because dogs are common and rarely leashed, one can assume that deer have become sensitized to the presence of dogs, explaining the greater reaction when a pedestrian was accompanied by a dog.

Of the species measured in our study, all appeared to have a threshold of tolerance to treatments based on distance. Our study indicates that there are both intra- and interspecific variation in responses. Additionally, even though all species exhibited a greater response to off-trail disturbances, the type of recreational activity evoked various levels of response from different species.

MANAGEMENT RECOMMENDATIONS

Natural-lands managers can use spatial and behavioral restrictions to ensure the coexistence of wildlife and recreationists (Knight and Temple 1995). Because off-trail disturbances elicited the greatest response by all wildlife in this study, recreational use could be restricted (either through enforcement or education) to designated trails to reduce impacts. Furthermore, because type of recreational activity influences wildlife responses, managers could restrict certain recreational activities in some areas. Partitioning the landscape into recreation zones, allowing certain activities in some zones while restricting them in others, may aid in reducing conflicts with sensitive species or sensitive habitats.

Many people are not aware of how their activities affect wildlife, even if they see animals respond to their actions. Even though a single dog alone elicited the least response by grassland birds in our study, if recreationists allow their dogs to roam freely off of a trail, the "area-of-disturbance" increases, because the dog is no longer on-trail. Additionally, in our study we did not stop and view the subjects for extended periods of time or attempt to move towards them. Behaviors, of which, are common among nature viewers and could lead to added stress on wildlife (Klein 1993).

Recreationists are more likely to support restrictions if they understand how wildlife will benefit (Purdy et al. 1987, Harris et al. 1995). By emphasizing how human activities affect wildlife, people can associate their actions with either benefiting or harming animal populations and begin to develop a conservation ethic. Such an ethic can substantially minimize the increasing number of wildlife/human conflicts occurring in natural areas (Knight and Temple 1995).

Effective visitor education is crucial to developing a conservation ethic. Instructional discussions with natural-lands managers will aid in informing recreationists of how their activities affect wildlife and how they can modify their behavior to minimize impacts. Klein (1993) found that visitors who spoke to wildlife refuge personnel were significantly less likely to disturb wildlife than recreationists who did not.

Because our study was conducted only during the summer season in an urban/wildland matrix where recreational use is extremely heavy and hunting is prohibited, caution should be used when extrapolating our results to areas lacking these characteristics. Furthermore, because there is intra- and interspecific variation in responses of wildlife observed in our study, other species may respond differently. However, our protocol could be used to collect data for other species, habitats, and seasons.

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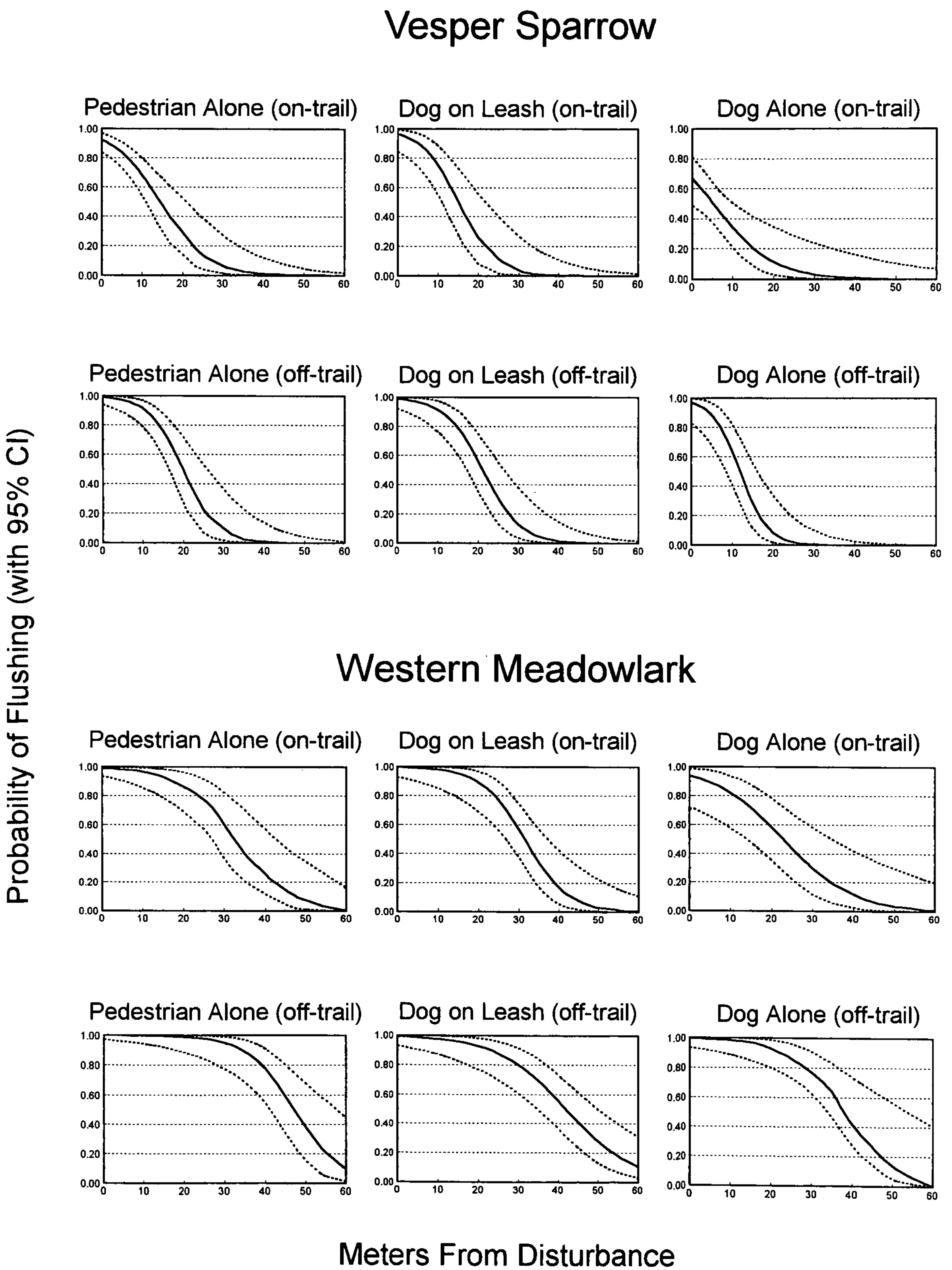
Vesper Sparrow
Pedestrian Alone (on-trail)
Dog on Leash (on-trail)
Dog Alone (on-trail)
Pedestrian Alone (off-trail)
Dog on Leash (off-trail)
Dog Alone (off-trail)
Western Meadowlark
Pedestrian Alone (on-trail)
Dog on Leash (on-trail)
Dog Alone (on-trail)
Pedestrian Alone (off-trail)
Dog on Leash (off-trail)
Dog Alone (off-trail)
Probability of Flushing (with 95% CI)
Meters From Disturbance

Table 1. Mean (SE) flush distance[a] and distance of flush[b] in the grassland ecosystem, City of Boulder Open Space, Boulder, CO, 1996.

	Vesper Sparrow	
Treatment	Flush Distance (m)[c]	Distance of Flush (m)[d]
Pedestrian Alone (on-trail)	9.25 (0.85)[1]	43.06 (3.95)[1]
Dog-On-Leash (on-trail)	10.13 (0.92)[1,2]	39.39 (4.56)[1]
Dog Alone (on-trail)	9.89 (1.85)[1,2]	35.41 (6.52)[1]
Pedestrian Alone (off-trail)	16.95 (0.87)[3]	51.49 (5.44)[1]
Dog-On-Leash (off-trail)	15.11 (0.89)[3]	52.23 (3.99)[1]
Dog Alone (off-trail)	10.87 (1.16)[1,2]	43.43 (5.91)[1]
	Western Meadowlark	
Treatment	Flush Distance (m)[c]	Distance of Flush (m)[d]
Pedestrian Alone (on-trail)	30.63 (1.91)[1]	75.33 (6.55)[1,2]
Dog-On-Leash (on-trail)	28.21 (1.52)[1]	65.68 (6.09)[2]
Dog Alone (on-trail)	18.78 (2.34)	91.50 (7.47)[1,3]
Pedestrian Alone (off-trail)	37.73 (2.07)[2]	95.97 (6.57)[3]
Dog-On-Leash (off-trail)	36.71 (1.50)[2]	102.29 (6.73)[3]
Dog Alone (off-trail)	33.50 (2.03)[1,2]	88.75 (5.38)[1,3]

[a] -- distance between the disturbance and bird when flushed.

[b] -- distance the bird moved after flushing.

[c] -- Values with the same number indicate no significant difference ($P < 0.05$).

[d] -- Values with the same number indicate no significant difference ($P < 0.05$).

American Robin

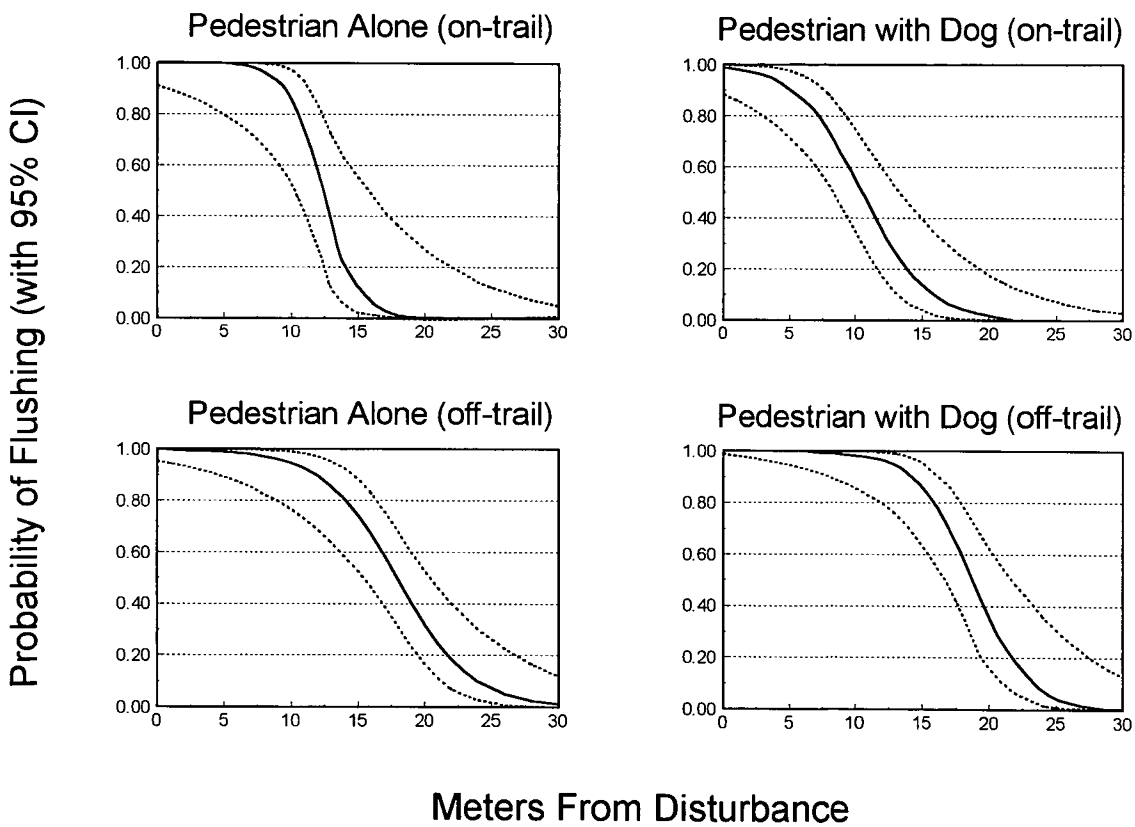

Table 2. Mean (SE) flush distance[a] and distance of flush[b] for American robins in the forest ecosystem, City of Boulder Open Space, Boulder, CO, 1996.

Treatment	Flush Distance (m)[c]	Distance of Flush (m)[d]
Pedestrian Alone (on-trail)	9.61 (0.63)[1]	14.97 (2.19)[1]
Pedestrian with Dog (on-trail)	9.82 (0.55)[1]	20.79 (2.09)[1,2]
Pedestrian Alone (off -trail)	13.74 (1.08)	17.31 (1.85)[1]
Pedestrian with Dog (off-trail)	16.27 (0.60)	23.49 (2.05)[2]

[a] -- distance between the disturbance and bird when flushed.

[b] -- distance the bird moved after flushing.

[c] -- Values with the same number indicate no significant difference ($P < 0.05$).

[d] -- Values with the same number indicate no significant difference ($P < 0.05$).

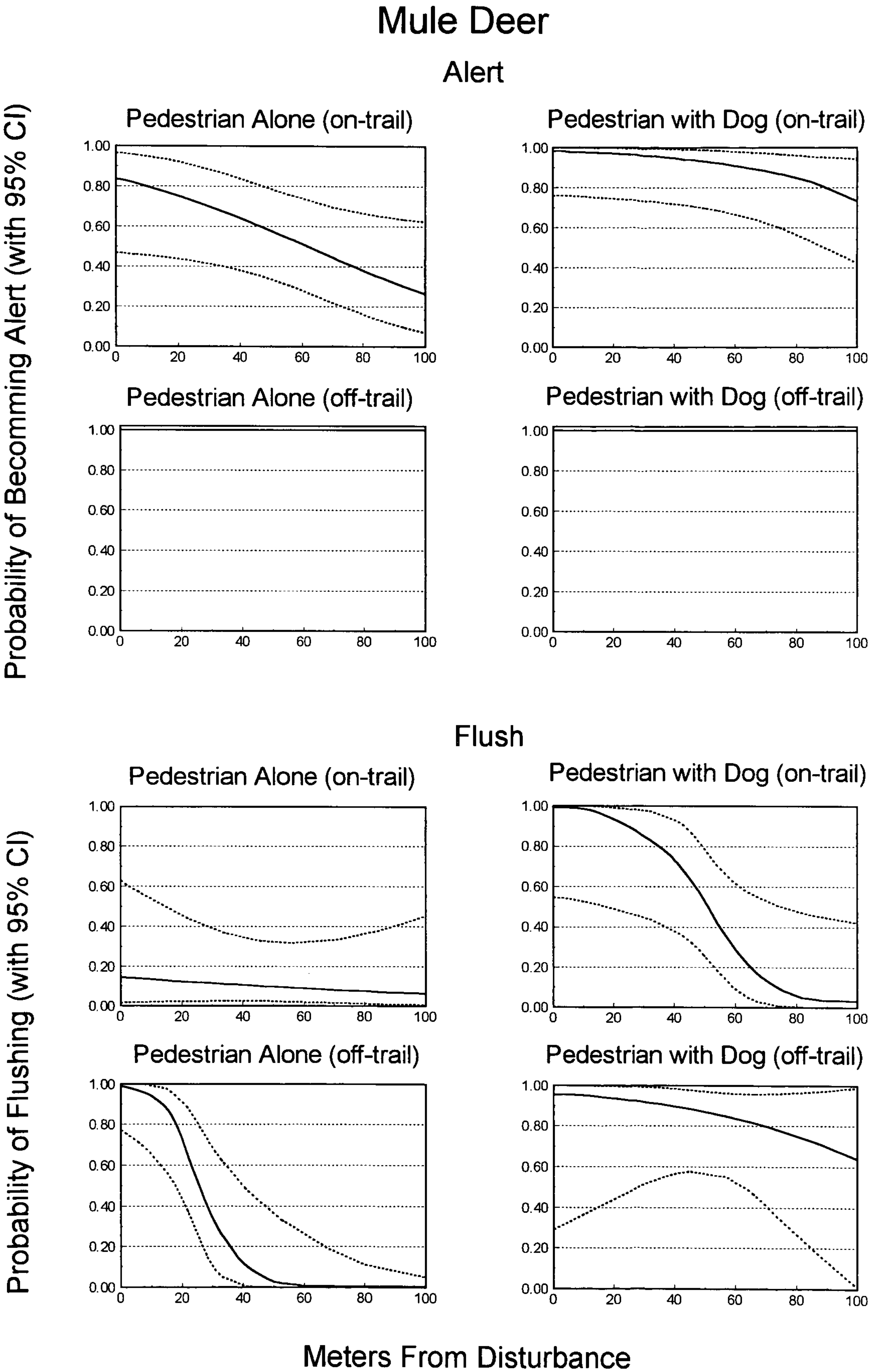
Mule Deer
Alert
Pedestrian Alone (on-trail)
Pedestrian with Dog (on-trail)
Pedestrian Alone (off-trail)
Pedestrian with Dog (off-trail)
Probability of Becomming Alert (with 95% CI)
Flush
Pedestrian Alone (on-trail)
Pedestrian with Dog (on-trail)
Pedestrian Alone (off-trail)
Pedestrian with Dog (off-trail)
Probability of Flushing (with 95% CI)
1.00
0.80
0.60
0.40
0.20
0.00
0
20
40
60
80
100
Meters From Disturbance

Table 3. Response characteristics of mule deer to disturbance, City of Boulder Open Space, Boulder, CO, 1996.

	On-Trail	
	Pedestrian Alone	Pedestrian with Dog
Distance of Flush (m)	(30 - 33)* 100% remained in sight	(33 - 120) 100% remained in sight
Type of Flush	walk = 100% slow run = 0% run = 0%	walk = 0% slow run = 0% run = 100%
Time (secs.) Until Resume Pre-disturbance Activity	(3 - 110) 100% resumed while in sight	(>24 - >309) 11% resumed while in sight
	Off-Trail	
	Pedestrian Alone	Pedestrian with Dog
Distance of Flush (m)	(7 - 113) 100% remained in sight	(>76 - >300) 8% remained in sight
Type of Flush	walk = 29% slow run = 14% run = 57%	walk = 0% slow run = 8% run = 92%
Time (secs.) Until Resume Pre-disturbance Activity	(1 - 247) 80% resumed while in sight	(>9 - >183) 0% resumed while in sight

* -- Indicates range (> indicates response was active until deer was out of sight).

LIST OF TRAILS AND CONTROL SITES USED DURING THE STUDY INVESTIGATING

"WILDLIFE RESPONSES TO PEDESTRIANS AND DOGS"

GRASSLAND TRAILS:	GRASSLAND CONTROL SITES:
GREENBELT PLATEAU	AREAS TO THE N. OF HWY. 128
SOUTH BOULDER CREEK	AREAS W. OF HWY 93 (W. OF GREENBELT PLATEAU)
BIG BLUESTEM	AREAS S. OF FLATIRONS VISTA TRAIL
FLATIRONS VISTA	AREAS S. OF HWY. 170 TOWARDS ELDORADO SPRINGS
FOOTHILLS	AREAS N. OF FOOTHILLS TRAIL
MESA TRAIL	

FOREST TRAILS:	FOREST CONTROL SITES:
S. SHANAHAN	AREAS E. OF MICKEY MOUSE
N. SHANAHAN	AREAS S. OF S. SHANAHAN
MESA TRAIL	AREAS W. OF MESA TRAIL
HOMESTEAD TRAIL	AREAS S. OF FLATIRONS VISTA TRAIL
TOWHEE TRAIL	