

SURVEY OF CARNIVORES IN ARCHES NATIONAL PARK, UTAH

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by

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INTRODUCTION

Among park resource managers there is increasing concern for the survival of wildlife in national parks. As parks become more and more isolated by human development activities around their periphery, they more closely resemble islands of habitat. And, as these islands shrink in size, they are able to accomodate fewer and fewer species (Newmark 1986). National parks face the very real potential of losing many of their native faunal elements if they become totally isolated.

Of special concern in this regard are the terrestrial carnivores. Because of their relatively extensive area requirements, low natural population densities, and susceptibility to human exploitation (e.g., hunting, trapping, poisoning), they may be the first to disappear from many parks. To prevent this it is crucial for park managers to know: (1) which carnivore species occur in their parks; (2) the species' approximate distribution (geographically and by habitat) and abundance; and (3) trends in their abundance.

Very little is known about the carnivores of Arches National Park. Incidental observations are reported through the submission of observation cards, but these are generally associated with areas where people traditionally travel along trail and road corridors, and primarily involve only unusual sightings. Little is known of carnivore species' presence, distribution by habitat, or abundance within the park. One management concern related to these species is the impact of human activities, both inside and outside the park, on their distribution, survival, and ecological interactions.

Carnivore species known or suspected to occur in Arches National Park are listed, by family, in Table 1. They range in size from the 150 gm long-tailed weasel (Mustela frenata) to the 120 kg black bear (Ursus americanus). Of the 15 species listed, the mink (Mustela vison), long-tailed weasel, red fox (Vulpes vulpes), and river otter (Lutra canadensis) have not been documented in Arches National Park, and, therefore must be considered to be extremely rare. The mountain lion (Felis concolor) and black bear probably occur as transients. This leaves 9 species that could be considered as common "residents" of Arches National Park, and 11 "potential" species that might be encountered in a carnivore survey (residents plus transients). A brief summary of the natural history of representative species is included in Appendix 1.

OBJECTIVES

During March and April 1988 a survey of carnivores was conducted within Arches National Park. Objectives of the survey were to:

1. consolidate, summarize, and evaluate all existing information on carnivores in Arches National Park;
2. determine the presence/absence of above-listed carnivores within Arches N.P., and their general distribution by habitat type;
3. test a variety of survey techniques within the various habitats of Arches N.P. to determine which are most effective, least costly, least time consumptive, and most easily replicated on

a year-to-year basis;

4. make recommendations on a long-term monitoring program for carnivores in Arches N.P.;
5. make recommendations on priorities for future research on carnivores in Arches N.P.

METHODS

A computer printout of observation records for Arches National Park was obtained from the Resources Management Division, Southeast Utah Parks Group. Observations since 1975 were summarized by species and compared to results of the field surveys.

Field techniques used to survey carnivores in Arches National Park were: (1) scent station lines; and (2) ground tracking surveys. Scent station methodology was developed by the U.S. Fish and Wildlife Service as a simple, inexpensive way of obtaining data on trends in predator numbers on western rangelands (Linhart and Knowlton 1975). In this technique, a fixed number (usually 10) of scent stations are placed at regular intervals (usually .3 mile on alternate sides) along randomly-selected roads (Roughton and Sweeny 1982). Each station consists of a 1 m diameter circle cleared of all vegetation, footprints, rocks, and debris, and covered with .25 inch of sifted earth. A small, plaster disk impregnated with a scent attractive to carnivores (FAS scent; Roughton 1982) is placed at the center of the station.

Table 1. Carnivore species known or suspected to occur in Arches National Park. Based on Armstrong (1982) and Durrant (1952).

<u>Common Name</u>	<u>Scientific Name</u>
CANIDAE	
kit fox	(<u>Vulpes macrotis</u>)
gray fox	(<u>Urocyon cinereoargenteus</u>)
red fox	(<u>Vulpes vulpes</u>)
coyote	(<u>Canis latrans</u>)
FELIDAE	
mountain lion	(<u>Felis concolor</u>)
bobcat	(<u>Felis rufus</u>)
MUSTELIDAE	
long-tailed weasel	(<u>Mustela frenata</u>)
striped skunk	(<u>Mephitis mephitis</u>)
spotted skunk	(<u>Spilogale gracilis</u>)
badger	(<u>Taxidea taxus</u>)
mink	(<u>Mustela vison</u>)
river otter	(<u>Lutra canadensis</u>)
PROCYONIDAE	
ringtail	(<u>Bassariscus astutus</u>)
raccoon	(<u>Procyon lotor</u>)
URSIDAE	
black bear	(<u>Ursus americanus</u>)

When animals investigate the scent, they leave footprints in the cleared soil area. The stations are checked each morning for a specified number of days (ranging from 1 to 3), and the tracks recorded. After each check, the soil is smoothed out to remove the existing tracks. Obviously, special care must be taken to place stations in sites where the soil will allow the establishment of a clear, distinguishable footprint. The ability to unambiguously determine tracks is the key to success with this method.

Study Sites in Arches N.P. Six scent station lines were used in the present study; each utilized a variation of the standard protocol. A description of each line's protocol is included in Appendix 2. Locations for scent station lines were chosen to sample the principal vegetation types in the park and in order to allow a variety of protocols to be tested. A description of the habitat traversed by each line is also included in Appendix 2. Scent station lines were in the following areas:

- SSL-1. Willow Flats/Willow Springs Road
- SSL-2. Eye of the Whale Arch Road
- SSL-3. Upper Salt Valley Road
- SSL-4. Lower Courthouse Wash
- SSL-5. Upper Courthouse Wash
- SSL-6. Devils Garden.

Ground tracking surveys consisted of hiking through areas suspected of being "good" carnivore habitat looking for tracks and other sign. Areas surveyed in this way were:

- GT-1. Upper Courthouse Wash
- GT-2. Lower Courthouse Wash
- GT-3. Anderson Gulch
- GT-4. Lower Salt Wash (to Salt Spring)
- GT-5. Eagle Park
- GT-6. Herdina Park.

Scent station lines and ground tracking survey routes are illustrated in Figure 1 (study area map attached).

RESULTS

Observation records. Observation records since 1975 are summarized in Table 2. Ten carnivore species have been documented in Arches National Park with these records: kit fox (Vulpes macrotis), gray fox (Urocyon cinereoargenteus), coyote (Canis latrans), bobcat (Felis rufus), mountain lion, badger (Taxidea taxus), striped skunk (Mephitis mephitis), spotted skunk (Spilogale gracilis), raccoon (Procyon lotor), and black bear (the black bear sightings appear to be questionable). This represents 91% (10 of 11) of the species potentially present in the park.

Scent station lines. Results of the scent station lines are summarized in Table 3; raw data are in Appendix 2. Scent stations detected the presence of 4 carnivore species: coyote, gray fox, kit fox, and ringtail (Bassariscus astutus). This represents 36% (4 of 11) of the potential total. A variety of small mammals (kangaroo rats

(Dipodomys sp.), cottontails (Sylvilagus sp.), etc.) and birds also visited the stations.

On lines where both commercial scent lure and FAS scent were used, the commercial scent received 7 visits while the FAS received only 3.

Ground tracking surveys. Results of ground tracking surveys are summarized in Table 4; raw data are in Appendix 3. Ground tracking surveys detected 6 carnivore species: coyote, gray fox, kit fox, raccoon, ringtail, and bobcat. Apparent badger diggings were also seen. This represents 64% (7 of 11) of the potential total. Other interesting species that were detected include: rock squirrel (Spermophilus variegatus), muskrat (Ondatra zibethicus) and porcupine (Erethizon dorsatum).

Table 2. Summary of observation records for carnivores in Arches National Park, 1975-1988.

Common Name	Number of Observations	Date (Year)													
		75	76	77	78	79	80	81	82	83	84	85	86	87	
CANIDAE															
kit fox	65	0	1	0	4	13	11	8	3	10	14	1	0	0	
gray fox	26	0	0	2	3	8	3	2	3	3	2	0	0	0	
coyote	78	8	14	11	8	8	3	1	5	9	11	0	0	0	
FELIDAE															
bobcat	17	4	1	1	3	2	0	2	2	2	0	0	0	0	
mountain lion	6	1	0	4	0	0	0	0	1	0	0	0	0	0	
MUSTELIDAE															
badger	12	0	2	0	0	1	2	3	1	2	1	0	0	0	
spotted skunk	2 (1974)	0	0	0	0	0	0	0	0	0	0	0	0	0	
striped skunk	2	0	0	0	0	0	0	0	0	1	0	1	0	0	
PROCYONIDAE															
raccoon	2	0	1	0	0	0	0	0	0	1	0	0	0	0	
URSIDAE															
black bear	1-2	0	1-2	0	0	0	0	0	0	0	0	0	0	0	

Table 3. Results of scent station surveys in Arches National Park, Spring 1988.

<u>Line Number</u>	<u>Species Detected</u>	<u>Total Visits (all species)</u>	<u>Visitation Rate</u>
SSL-1	coyote kit fox undetermined canid	3	3/45 = 6.67%
SSL-2	none	0	0
SSL-3	possible canid	1	1/18 = 5.55%
SSL-4	none	0	0
SSL-5	fox (gray?) fox (kit?) probable ringtail	9	9/48 = 18.75%
SSL-6	coyote	1	1/60 = 1.67%

Table 4. Results of ground tracking surveys in Arches National Park, Spring 1988.

<u>Ground Tracking Route</u>	<u>Species Detected</u>
Upper Courthouse Wash GT-1	coyote bobcat (porcupine)
Lower Courthouse Wash GT-2	coyote bobcat possible gray fox (porcupine)
Anderson Gulch GT-3	coyote fox (gray?)
Lower Salt Wash GT-4	bobcat coyote raccoon possible gray fox (muskrat, porcupine)
Eagle Park GT-5	coyote possible gray fox possible kit fox possible badger diggings
Herdina Park GT-6	coyote tracks possible kit fox possible gray fox bobcat ringtail

DISCUSSION

Carnivore survey in Arches National Park. The presence of gray fox, kit fox, coyote, bobcat, ringtail, raccoon, and badger were detected during the Spring 1988 carnivore survey. This is only 47% (7 of 15) of the carnivore species known or suspected to occur in Arches National Park and only 70% (7 of 10) of the species documented by observation records. Clearly, the Spring 1988 survey must be regarded as inadequate because it failed to detect 4 species known to occur in the park, as well as 4 additional suspected species.

The survey was inadequate on 2 counts. First, it was inadequate in geographic coverage. Several important areas of the park were not surveyed. Additional survey work in other areas (e.g., Fiery Furnace, Klondike Bluffs, Upper Courthouse Wash near the park boundary, Lower Salt Wash near the Colorado River, Upper Salt Wash, along the Colorado River, in the campground, and in the park housing area) might reveal individuals of the undetected species, including mink and river otter, as well as additional individuals of the already-detected species.

Second, the survey was inadequate in temporal coverage, because it was conducted only 1 time, in the spring. Replication of the survey during different seasons and in future years will be needed to document the transient species (mountain lions and black bears).

Carnivore sign was encountered throughout Arches National Park, but most frequently and abundantly in: (1) washes and stream courses; (2) broken terrain characterized by fins, cliffs, rock outcrops, and canyons (e.g., Herdina Park, Devils Garden). This result is partly a

reflection of habitat utilization. Washes and stream courses are important to carnivores because they are a source of drinking water and because prey animals concentrate there. Broken terrain provides cover for stalking potential prey, hiding from other predators, and birth and rearing of young. The result is also a reflection of the extra effort expended in these areas because of their perceived importance to carnivores.

Habitat use documented by observation records indicates that pinyon/juniper, blackbrush/ricegrass, and tamarisk/willow vegetation types receive most use by carnivores. These results may be biased, however, because most observations occur along roads and trails.

Kit fox observations are concentrated in the Devil's Garden and Fiery Furnace areas, while bobcats have been seen more frequently around Wolfe Ranch and Delicate Arch. Coyote sightings are spread throughout the park.

On the basis of survey results and observation records, it would be tenuous to describe habitat distributions of carnivores in Arches National Park in anything other than the very general terms above.

It would be irresponsible and misleading to speculate on actual numbers of carnivores in Arches National Park based on the results of this survey.

Comparison of survey methods. Of the methods used in this study, observation records detected the highest percentage of potential species, 91% (10 of 11). This is not unexpected, because the record spans 13 years. In any given year, however, observation records are submitted for an average of only 4 species (range = 0-7).

Only the long-tailed weasel and ringtail are not represented by observation records. Long-tailed weasels are undoubtedly extremely rare in Arches National Park, if they occur there at all. Ringtails are secretive, nocturnal animals that live in rough, broken country, all reasons why they are seldom seen by people and, thus, not represented in the record.

Ground tracking surveys detected the second highest percentage of possible species, 64% (7 of 11). Ground tracking did not detect the large, transient species (mountain lion and black bear) nor several of the small mustelids (long-tailed weasel, spotted skunk, striped skunk) which are probably rare and of limited distribution in the park.

Scent stations detected the lowest percentage of species, 36% (4 of 11). Scent station results were heavily skewed toward the canids, a not unexpected result because this technique is designed primarily to detect canids. Large, transient species (black bear and mountain lion), bobcats, and the mustelids were not represented.

Evaluation of carnivore survey methods. Carnivores are unusually difficult to survey because of their large area requirements, naturally low population densities, and secretive nature. Carnivore surveys usually have one of two objectives: (1) to determine the presence of certain species in a defined area; (2) to monitor trends in population levels of certain species in a defined area. These are distinctly different problems, and the most appropriate survey method will depend upon the objectives. What follows is an evaluation of the advantages and disadvantages of the methods used in this study to simply detect presence/absence of carnivores in Arches National Park.

Advantages of observation records. (1) They are simple to implement. (2) They require virtually no investment of time or money. (3) They take advantage of opportunistic observations made by many observers over a long time span. (4) They cover all areas of the park used by people.

Disadvantages of observation records. (1) There is no way to check the accuracy of many sightings. (2) Sightings are concentrated in areas frequented by people (roads and trails); wilderness areas are under-represented. (3) Because they are not collected in a systematic way, they are poor for use as longterm trend indicators.

Advantages of ground tracking surveys. (1) There is no set-up time or equipment cost involved. (2) Routes can be set out in areas where carnivores are likely to travel (stream courses, etc.), and away from areas frequented by people. (3) The entire survey route is scrutinized for tracks rather than only isolated "stations". (4) The route need be walked only once per survey "session". (5) Routes can be walked at times of year when other techniques cannot be utilized (e.g., winter when there is snow cover); (6) Routes can be incorporated into the routine patrol duties of park rangers.

Disadvantages of ground tracking surveys. (1) They are difficult if not impossible to use in areas with poor substrate (e.g., slickrock, heavily vegetated areas). (2) It is difficult to interpret some tracks in poor substrates (e.g., sand), as was the case in the present study. (3) They are more difficult to replicate than more standard schemes such as scent station lines.

Advantages of scent station lines. (1) They are easy to put in

along roads and some trails and therefore can be used to survey a large area rapidly. (2) They are easy to standardize and therefore easy to replicate on a year-to-year basis.

Disadvantages of scent stations lines. (1) It is difficult to interpret tracks in some substrates, as was the case in the present study. (2) For practical reasons they are limited to roads, trails or other areas (e.g., watercourses) where stations can be installed with a minimum of difficulty and then relocated without resorting to large flags, etc. that might scare away wildlife. (3) They require a great deal of time when using a standard protocol of 3 sampling days. (4) They require that an animal be attracted to and step in a small area (i.e., a 1 meter diameter circle or something similar versus the entire length of a road, trail, or watercourse that would be used in ground tracking), thus lowering the probability that any given individual will be detected.

Other carnivore survey methods. Other methods used to survey for carnivores include: photo stations, smoked tracking plates, and spotlighting. Baiting is often used in conjunction with photo stations and tracking plates to attract carnivores. An excellent set-up involving photo stations in conjunction with baiting has been developed by P. Joslin (pers. comm.). Smoked tracking plates were used by Clark and Campbell (1983) to survey for small carnivores in prairie dog colonies. Night spotlighting can be done by vehicle or on foot and can be either very systematic (as in scent station lines) or very opportunistic (as in ground tracking surveys).

RECOMMENDATIONS

Because of staff and financial constraints, future monitoring of carnivores in Arches N.P. should be incorporated, to the greatest extent possible, into existing management activities. The following specific recommendations are designed with this caveat in mind:

1. Effort should be made to increase the quantity and quality of observation records. Better habitat and more-accurate location information are top priorities (Appendix 4). Every effort should be made to verify the accuracy of reports submitted by park visitors. Park staff should be required to record and submit any observations made during their regular duties.
2. Ground tracking surveys should be incorporated into routine trail and backcountry patrols by park staff. This is especially true for Devils Garden and the Fiery Furnace.
3. New ground tracking survey routes should be established and "run" during baseline monitoring programs conducted by the resource management division. Important areas where routes should be established include: Upper and Lower Courthouse Wash, Upper and Lower Salt Wash, Herdina Park, Klondike Bluffs, Eagle Park, Devil's Garden, Fiery Furnace, The Windows, and along the Colorado River. If these routes cannot be walked during regular monitoring programs, they should be run a minimum of twice per year (April and September).

4. Scent station lines should be established and run twice per year (April and September) if the park is interested in monitoring trends of coyotes and, possibly, foxes. Lines should be established along roads in Willow Springs/Willow Flats, upper Salt Valley, and the Anniversary Arch area, and along trails in Eagle Park, Devil's Garden, and the Fiery Furnace. Lines should be established in close proximity to the park boundary to evaluate the potential impact of ADC programs outside the park.

Future carnivore research in Arches National Park might focus on the following, in order of priority:

- a. detailed surveys to determine if river otters and mink are present along the Colorado River within the park;
- b. potential impact of human disturbance on carnivore ecology and behavior;
- c. habitat relations and methods of coexistence of gray and kit foxes;
- d. population dynamics, habitat use, and food habits of bobcats;
- e. carnivore use of and dependence on riparian habitats;
- f. ecology of ringtails.

APPENDIX 1. LITERATURE REVIEW

Species Accounts

Gray fox (Urocyon cinereoargenteus). Gray fox habitat includes shrublands and brushy woodlands in rugged, broken, or hilly terrain. In the western U.S., the gray fox favors chaparral, pinyon-juniper woodlands, or oak woodlands along rocky hillsides, mountainsides, or washes. In a study in Zion N.P., gray foxes were found to be abundant in blackbrush, brushy meadows, open meadows, pinyon-juniper, and ponderosa pine at lower elevations (Trapp and Hallberg 1975). Gray foxes climb well and use trees for foraging and as escape routes (Armstrong 1982).

The home range of the gray fox is 300 to 500 ha (Armstrong 1982). Hollow logs, brush piles, or rock slides are used as natal "dens" (Armstrong 1982).

In Zion N.P. gray foxes were more omnivorous in diet rather than strictly carnivorous. Juniper berries were an important food in winter, mule deer carrion in late winter, and prickly pear fruit during autumn. Similar food habits were documented during a food habits study in Arizona ponderosa pine forest (Turkowski 1980).

Kit fox (Vulpes macrotis). The kit fox is the most specialized of the North American canids for a desert existence. It prefers fairly open, flat, sandy areas with low desert vegetation. Egoscue (1962) studied kit foxes in the western Utah desert that contained three plant communities: vegetated or stabilized dunes, greasewood

flats, and shadscale. The majority of dens were located in the greasewood community, which included, in addition to greasewood, four-wing saltbush, rabbitbrush, horsebrush, and shrubby buckwheat.

Black-tailed jackrabbits composed 90 to 95% of kit fox diet during the pup-rearing season in western Utah (Egoscue 1962). Mice, kangaroo rats, cottontails, and birds are also eaten (Armstrong 1982).

Bobcat (*Felis rufus*). Bobcats use a wide range of habitats in the western U.S. Heaviest use appears to be in rocky canyons at elevations between 1,400 and 2,100 m with ledges and areas of dense vegetation (Young 1958, Gashwiler et al. 1961, McCord and Cardoza 1982). Common vegetation types utilized include mountain mahogany, pinyon-juniper, sagebrush. In the southwestern and western U.S. bobcats have adapted to living in even the driest deserts (Jones and Smith 1979). Females use an unimproved den in a rocky crevice, hollow log, or rockpile to give birth.

Prey abundance, topography, and vegetation structure affect bobcat social structure and home range size (Bailey 1974, Beason and Moore 1977). In turn, social organization profoundly affects population density and the ways bobcats use their environment.

Staple food items for bobcats are rabbits and hares; in most studies these two make up around half the diet. Other important foods are mice, ground squirrels, porcupines, woodrats, and birds.

Mountain Lion (*Felis concolor*). In western North America, mountain lions are generally associated with mountainous terrain,

canyons and rimrock, and feed primarily on mule deer (literature review by Anderson 1983, Ackerman et al. 1984).

In southern Utah, mountain lion habitat is vegetatively and topographically diverse (Ackerman 1982, Hemker 1982). They utilize everything from low altitude (1,350 to 1,800 m) desert shrub and sagebrush-steppe communities through mid-elevation (1,800 to 2,000 m) pinyon-juniper and ponderosa pine types through high elevation (above 2,700 m) aspen and spruce-fir forests.

Within western habitats, stream courses and ridgetops are frequently used as travel lanes and hunting routes by lions (Barnes 1960). Riparian vegetation along streams provides cover for lions traveling in open areas, and ridgetops with cover allow undetected surveillance of lower terrain for potential prey.

Although mule deer is the primary food item, porcupines, rabbits, hares, and unguarded livestock are also taken.

Badger (*Taxidea taxus*). Badgers occur in almost all western U.S. plant communities from sea level to alpine meadows and from deserts to coniferous forests. (Long 1973, Long and Killingley 1983). Badgers are opportunistic feeders; they will eat almost any species of vertebrate or invertebrate they can capture, but especially rodents captured underground (Messick and Hornocker 1981, Lampe 1982). They are most numerous in sagebrush-steppe where pocket gophers and ground squirrels are abundant.

Badger home range size varies dramatically with the season (Sargent and Warner 1972) and sex (Lindzey 1978). It is smallest in

winter, when they enter a state of torpor and reduce their aboveground time by 93% (Harlow 1981). Lindzey (1978) tracked two male badgers whose home range averaged 583 ha. Mean home ranges of three females were less than half that large.

Raccoon (*Procyon lotor*). Raccoons are common in forests of the western U.S. at low to middle elevations, where they greatly depend on riparian areas (Lotze and Anderson 1979, Hart 1982). They prefer deciduous stands over coniferous, but even inhabit basaltic outcroppings in sagebrush ecosystems. They are, however, absent from deserts. Their habitat must include den sites; hollow branches are preferred, but hollow trunks and logs, caves or crevices are also used (Berner and Gysel 1967, Lynch 1974). Raccoons den up (in the same manner as bears) and sleep through the coldest winter months. During warm or clear winter weather they may arouse to forage (Armstrong 1982).

Raccoons are probably the most omnivorous native carnivores in the western U.S., feeding on whatever foods are available: fruit, fish, birds and their eggs, carrion, crayfish, and frogs. They forage extensively in farmyards and wetlands (Fritzell 1978, Greenwood 1982).

Ringtail (*Bassariscus astutus*). Depending on habitat, ringtails may also be omnivorous. They typically inhabit rocky and brushy canyons and talus areas. They are also common in shinnery oak woodlands and live oak savannas. The den is simple, usually in a tree-hole, beneath a boulder, or in a crevice.

In Colorado, ringtails are usually associated with arid canyon and mesa country in the pinyon-juniper vegetation type. However, they have been reported in a wide variety of habitats, including an Engelmann spruce-lodgepole pine-aspen community (Rutherford 1954). Similarly, in southern Nevada, Bradley and Hansen reported ringtails in many habitat types and concluded that ringtails were present in all habitats except the most arid lower deserts.

Spotted skunk (Spilogale putorius). Spotted skunks are less common than striped skunks and less widely distributed. In the southwestern U.S. spotted skunks inhabit rough, broken country below 2,400 m. They can survive in deserts and drier regions of Nevada, New Mexico, and Arizona where the striped skunk cannot (Haley 1975). However, they depend on riparian areas in arid country (Larrison and Johnson 1981).

Spotted skunks are omnivorous, feeding on mice, birds, insects, carrion, eggs, and fruit (Armstrong 1982).

Spotted skunks den under rockpiles, in old woodrat nests, in burrows abandoned by ground squirrels or pocket gophers, or in hollow logs or brush piles.

APPENDIX 2. SCENT STATION LINES — RAW DATA.

Scent Station Line #1 (SSL-1 on map) — Willow Flats/Willow Springs Rd.

PROTOCOL: 15 stations; FAS scent only; .25 mile interval, alternate sides; 3 nights

HABITAT: blackbrush

<u>Station Number</u>	<u>Day 1</u>	<u>Day 2</u>	<u>Day 3</u>
1	0	0	0
2	0	coyote	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	canid (species undetermined)
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	kit fox	0	0

Scent Station Line #2 (SSL-2 on map) — Eye of the Whale Arch Rd.

PROTOCOL: 10 stations; FAS scent only; approx. .25 mile interval,
alternate sides; 3 nights

HABITAT: blackbrush, pinyon/juniper

<u>Station Number</u>	<u>Day 1</u>	<u>Day 2</u>	<u>Day 3</u>
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0

Scent Station Line #3 (SSL-3 on map) — Upper Courthouse Wash

PROTOCOL: 6 stations; FAS scent only; opportunistic spacing; 3 nights

HABITAT: riparian, stream bed

<u>Station Number</u>	<u>Day 1</u>	<u>Day 2</u>	<u>Day 3</u>
1	0	possible canid	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0

Scent Station Line #4 (SSL-4 on map) — Lower Courthouse Wash

PROTOCOL: 8 stations; FAS scent only; opportunistic spacing; 2 nights

HABITAT: riparian, stream bed

<u>Station Number</u>	<u>Day 1</u>
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0

Scent Station Line #5 (SSL-5 on map) — Devils Garden

PROTOCOL: 11 stations; FAS=a commercial scent lure=b; opportunistic spacing; 3 nights

HABITAT: pinyon/juniper, blackbrush

<u>Station Number</u>	<u>Day 1</u>	<u>Day 2</u>	<u>Day 3</u>
1a	0	0	0
b	0	fox	0
2a	fox(gray?)	0	possible fox
b	fox(gray?)	0	possible fox
3a	fox(kit?)	0	0
b	0	0	0
4	0	0	probable ringtail
5a	-	-	-
b	0	0	0
6a	0	0	0
b	0	0	0
7	0	0	0
8	0	0	0
9a	-	-	-
b	0	0	fox(gray?)
10a	0	0	0
b	-	0	fox(kit?)
11	0	0	0

Scent Station Line #6 (SSL-6 on map) — Upper Salt Valley Rd.

PROTOCOL: 10 stations; FAS=a commercial scent lure=b; .3 mile spacing; 3 nights

HABITAT: ricegrass/galleta

<u>Station Number</u>	<u>Day 1</u>	<u>Day 2</u>	<u>Day 3</u>
1a	0	0	0
b	0	0	coyote
2a	0	0	0
b	0	0	0
3a	0	0	0
b	0	0	0
4a	0	0	0
b	0	0	0
5a	0	0	0
b	0	0	0
6a	0	0	0
b	0	0	0
7a	0	0	0
b	0	0	0
8a	0	0	0
b	0	0	0
9a	0	0	0
b	0	0	0
10a	0	0	0
b	0	0	0

APPENDIX 3. GROUND TRACKING SURVEYS — RAW DATA.

GT-1 — Upper Courthouse Wash (NOTE: The numbers below correspond to locations on the study area map)

1. coyote tracks and scat
2. porcupine
3. coyote tracks
4. coyote track
5. coyote track
6. coyote track
7. bobcat tracks
8. porcupine tracks
9. bobcat tracks

GT-2 — Lower Courthouse Wash

1. porcupine tracks
2. coyote tracks
3. bobcat tracks
4. coyote scat
5. porcupine trail
6. bobcat tracks
7. possible fox (gray?) tracks

GT-3 — Anderson Gulch

1. coyote scats, fox (gray?) tracks
2. coyote tracks

GT-4 — Lower Salt Wash

1. muskrat tracks and scat
2. muskrat tracks
3. bobcat tracks
4. bobcat tracks, coyote tracks, porcupine quills
5. raccoon
6. raccoon tracks, coyote tracks
7. bobcat tracks
8. bobcat tracks
9. coyote tracks
10. bobcat tracks
11. raccoon tracks, possible gray fox tracks

GT-5 -- Eagle Park

1. coyote tracks
2. coyote tracks, possible gray fox tracks
3. coyote track
4. possible bobcat track
5. canid track (believed to be kit fox)
6. diggings of either badger or kit fox

GT-6 -- Herdina Park

1. coyote tracks
2. coyote tracks
3. canid tracks (believed to be kit fox)
4. ringtail tracks
5. coyote tracks, other canid tracks (possibly both kit and grey fox)
6. canid track (possibly gray fox)
7. possible ringtail tracks

APPENDIX 4. RECOMMENDED FORM FOR OBSERVATION RECORDS

Park: _____

Species observed: _____ Observer: _____

Date: ____/____/____ Time: _____ Weather: _____
mo. day yr. (24-hr.) temp. / clouds / wind

Location: _____ UTM Coord.: _____

Habitat: _____

Behavior: _____

NOTES:

Repeat same form 2 more times in space below, and 3 times on reverse side if you desire. That would allow up to 6 entries per sheet of paper.

You could assign numbers to species (e.g., 1 = bobcat, 2 = coyote, etc.), locations (e.g., 1 = Courthouse Wash, 2 = Devil's Garden, etc.), and habitats (e.g., 1 = pinyon/juniper, 2 = tamarisk/willow, etc.) to facilitate entry of data into computer. This would also save space on the above form and allow more forms per page.

Use only 100% rag paper for these data forms. That way they will not be destroyed by contact with water.

Record data only in #3 pencil or indelible ink.

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