

Activity and Movement of the Island Fox, *Urocyon littoralis*, on Santa Cruz Island, California

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close proximity to Los Angeles, one of the major population centers in the U.S. and 3) there is increasing pressure to exploit the California Islands both for natural resources and recreation. For these reasons I began a study to quantify aspects of the behavior of island foxes, emphasizing their activity and movement.

Methods

The study was conducted on Santa Cruz Island, California (34°N, 119°45'W; Fig. 1). From the standpoint of access and logistics Santa Cruz Island was the easiest place to work because the University of California operates a field station on the island. Santa Cruz Island also has the widest variety of habitats and the largest population of foxes of any of the California Islands therefore more variables could be included in the study. The population of foxes was categorized by sex, age and reproductive state. The number of animals tracked by category and season is shown in Table 1.

Island foxes repeatedly can be captured in wire mesh live traps. Folding single-door traps were set under cover of brush to protect captured animals from being overheated by direct solar radiation during the day and from being chilled at night by reradiation to sky temperature and exposure to wind. Traps were placed near obvious animal trails, or in areas where foxes had been seen or trapped previously.

While an animal was in hand standard mammalian measurements were taken to increase our knowledge of the physical characteristics of these seldom studied animals. Results are reported in Fausett (1982). Age was determined by checking wear on the first upper

Abstract – Island foxes (*Urocyon littoralis*) were studied using radio-telemetry and direct observation on Santa Cruz Island, California, to quantify their activity and movement behavior. There were seasonal variations in: 1) time of day for activity (diurnal in winter but crepuscular/nocturnal in summer) and 2) percentage of time active (summer low of 30% to winter high of 46%). The size and type of area covered varied with age, sex and season. Adult males covered 40 ha in winter. In summer, males remained within a 20 ha range as did females in both winter and summer.

Introduction

The island fox (*Urocyon littoralis* Baird, 1857), a small fox found exclusively on the six largest California Islands, historically has been discussed in one of two ways: 1) descriptive/taxonomic (Grey 1858; Merriam 1903; Grinnell & Linsdale 1930; Clutton-Brock *et al.* 1976; Van Gelder 1978) or 2) short natural history expositions (Stephens 1906; Grinnell *et al.* 1937; Von Bloeker 1967). Laughrin (1977, 1980) recently described their population dynamics, food habits and qualitative observations of their behavior.

It generally is accepted that information on an animals activity is a key to understanding the role it has in it's habitat and it's adaptations to changing conditions (*e.g.*, Kavanau & Rischer 1968). It is also essential to know as much as possible about activity and movement of a given species if the impact of humans on the species is to be understood. This is particularly important in the case of the island fox because: 1) it is listed as threatened in California; 2) it lives in

molar (Wood 1959). Each animal had a tag placed in the anterior edge of the pinna – right ear for males, left for females. Tags were coded with different colors of reflective tape so each individual could be identified on sight even at night. Neck circumference was measured to facilitate correct fitting of radio collars to individual subjects.

Radio-telemetry insured that I could find a particular individual under all climatic conditions and at any time of the day or night. The radio transmitters used in the study were crystal controlled, frequency modulated blocking oscillators with a class "C" amplifier stage. Transmission frequency was in the range from 164-165 MHz. Two mercury cells were hooked in series to provide 2.7 v. A transmitter, complete with antenna but without batteries attached, weighed 7.3g. Two battery sizes were used. Large (Eveready E-640) batteries were used on adults, and smaller (Mallory PX-13) ones were used on juveniles. The complete transmitter/battery package on a collar weighed 41g with the larger batteries and 24g with the smaller ones. The E-640's (14mm in diameter x 11mm high) were stacked with the transmitter to produce an overall package 4.7cm long by

1.4cm in diameter. The PX-13's (16mm in diameter x 5mm high) were placed like saddlebags over the transmitter to produce a package 2.5cm long by 3cm wide (thus reducing the lengthwise bulk). As a result, it was possible to tape the shorter package to the strap so the collar could be comfortably buckled around a juveniles' neck. In all cases the weight of the collar with transmitter and batteries was less than 3% of the mass of the animal wearing the radio collar.

Performance of the transmitters varied with regard to distance and time. The greatest distance between transmitter and receiver over which a useable signal was acquired was 1.5km. The average distance was 725m. The distances quoted were determined only for animals which the signal indicated were quiet the entire time from signal acquisition to visual location of the animal. The longest a transmitter functioned on one set of batteries under field conditions was 96 days with the E-640's and 38 days with the PX-13's. The mean time to failure was 60 days and 28 days respectively. All tracking was done with a receiver unit designed and built by Cedar Creek Bioelectronics Laboratory. The receiver was

Table 1. Number of animals tracked while in one of the following categories and season.

Category	Winter	Spring	Summer	Fall
JUVENILES				
Male	*	*	1	1
Female	*	*	1	1
ADULTS				
Males				
With pups	*	—	2	Disperse
Without pups	3	1	1	1
Females				
Pregnant	*	1	—	*
Not pregnant (L)	*	*	1	*
With Pups (NL)	*	*	1	1
Without Pups (NL)	1	—	3	1
POST REPRODUCTIVE				
Males	—	—	—	—
Females	1	—	—	1

* no animals tracked in this category (e.g., no males w/pups in the winter)

— no animals tracked in this category

L = lactating; NL = not lactating.

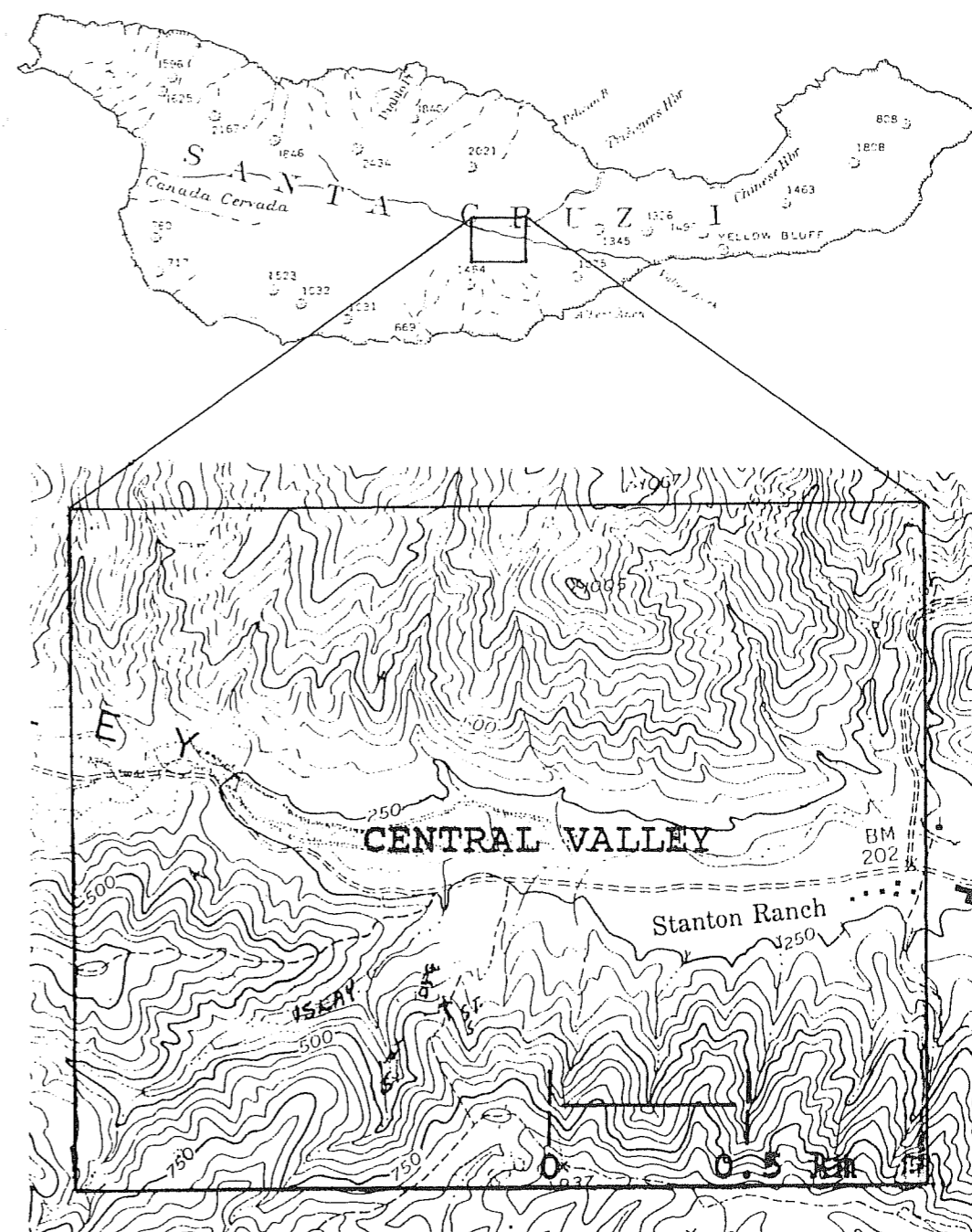


Figure 1. Santa Cruz Island showing topographical details of study area.

connected, with 1.2m of 50 ohm coaxial cable to a 4-element, $1/2 \lambda$, hand-held, Yagi antenna. A Panasonic 1080 portable radio with a 148-176 MHz public service band was used to monitor quiet animals.

Tracking was done in a 3.57km² area between the ridge tops (Fig 1). The valley floor supports a mixture of introduced and native grasses along with scattered oaks. The slopes that form the sides of the Central Valley and the canyons are covered with chaparral. Characteristic differences in species composition and density are seen on north and south facing slopes. Weather measurements were made by recording hygromographs in weather shelters located in the study area. Light level measurements were made by recording pyranographs sitting on top of the weather shelters. Light and weather charts were changed once a week.

Island fox activity and movement behavior was determined primarily by direct observation. Behavior in the categories of resting, moving and moving/foraging was inferred from changing signal characteristics on those occasions when an animal could not be observed. Movements of a collared animal change the orientation of the transmitter antenna. This results in a signal of varying strength. By monitoring these changes while watching foxes I learned that certain behavior patterns reliably could be correlated with signal variations. The signal associated with resting is steady with no change in strength for a period of time ranging from 15 min to more than four hr since the animal hardly moves during that time. When an animal is moving the strength varies constantly with an overall decrease in strength if the animal is moving away from the observer, or an increase if the animal is moving closer. Moving/foraging is characterized by periods of varying signal strength interspersed with periods when the signal is steady. Steady periods occur when an animal is in one place and is, for example, digging, chewing food or waiting to pounce. These periods range from 30 sec-1 min in duration. Changing signal

characteristics were particularly valuable tools in determining nighttime movement and activity. Animals were tracked on a number of moonlit nights when I could observe them in addition to interpreting the radio signals.

Radio-collared foxes were followed upon release for at least 2 hr to determine the most likely area to relocate the animals for subsequent tracking. The animals were then left alone for a period of not less than 8 hr during which time they became accustomed to the collar. Seventy-five percent of the animals exhibited no noticeable reaction to the collar when they were released. They simply moved quietly away from the release point. The other animals moved 5-10m away and either shook or sat down and scratched at the collar for 30 sec or less. Animals without collars were followed for periods that varied from 15 min-3 hr to determine what effect collars might have on the behavior of radio-collared foxes. A control group of 20 foxes were followed after having been handled, ear-tagged and measured in the same way as foxes that had been collared and released.

Whether foxes were collared or not they reacted to the presence of an observer only if they were approached too closely or if the observer made too much noise. The distance that qualified as "too closely" varied with individuals and habitat type. When in chaparral I could get within 5m of all but one animal. In open habitats (*i.e.*, grassland and sandy washes with sparse *Baccharis glutinosa*) 30m was the normal minimum separation with the same individuals. Noise was the other stimulus that caused foxes to move out of my visual contact. Walking through grass or climbing on rocky slopes did not disturb the foxes. However, I had to move slowly and cautiously in chaparral in order to avoid breaking twigs and crunching dried leaves which generated enough noise to interrupt what the foxes were doing or to drive them away.

The foxes were released within 10m of the capture site. Post-release behavior fell into one of two categories: 1) they curled up under

brush to nap or 2) they foraged and then went to a resting place.

Data from field observations of movement was plotted on maps depicting different types of habitat prepared by combining color infrared aerial photographs, topographic maps and field survey information. The same observations were converted into time dependant plots of activity and combined with digitized data from the light and weather instruments to allow graphical analysis of activity.

Forty-nine animals were captured of which 21 were fitted with radio transmitter collars. Two were re-collared in a succeeding season.

Results

The 24 hr activities and corresponding movements of three radio-collared foxes are presented in Figures 2-5. Figures 4 and 5 depict a male that was tracked in both summer and winter. I selected these individuals to portray because they are representative of the activity observed during all clock hours for all male and female foxes that I followed. Data on activity and inactivity by season is presented in Table 2. Individuals tend to be least active during midday in the summer, but exceptions occur. Daytime activity of island foxes peaks in the winter. Combining data in Table 2 by season, foxes were active, on the average, 39.7% of the time tracked during the winter and 31.5% in the summer. Expressed as a function of time of day, winter animals were active 25.4% in daytime and 14.3% at night (total 39.7%). Put another way, in the winter, on average, 64% of a foxes activity in any 24 hr

occurs during the day. During summer foxes were less active during the day (11.6%) than at night (19.9%), therefore 36.8% of activity occurs during the day. By comparing the activity of the tagged foxes with meteorological and light level information, the decrease in activity during summer midday is correlated with an increase in ambient air temperature (Figs. 2 and 4). Air temperature increases with an increase in light level and a decrease in relative humidity. Although winter fluctuations in air temperature and relative humidity were much less than in summer, a decrease in nighttime activity was still seen. *T*-tests for all foxes tracked (Tables 3 and 4) show no statistically significant seasonal difference in activity patterns for males and females, females with pups (whether lactating or not) and females without pups.

The seasonal variation in activity and movement can be illustrated by a description of behavior of the animals during a composite 24 hr day in mid-season. In winter both males and females forage during morning and afternoon hours. Foraging occurred nine times more frequently during the day in winter than at night. Although midday may be spent resting, foxes more commonly were observed moving over extensive areas while frequently depositing small amounts of urine or feces on prominent objects such as rocks, path margins or isolated clumps of grass. The foxes especially marked at the edges of the home range.

Agonistic encounters between members of the same sex occurred during winter daytime. Courtship also occurred primarily during the

Table 2. Seasonal comparisons of active and inactive time in minutes and as a percentage of total time tracked for all foxes.

	Time Active (min)	Time Inactive (min)	Total Time Tracked	% Time Active	% Time Inactive
Summer 1977	2466	5884	8350	29.5	70.5
Summer 1978	3968	7908	11876	33.4	66.6
Fall 1977	919	183	1102	83.4	16.6
Winter 1978	1292	1521	2813	45.9	54.1
Winter 1979	3337	6657	9994	33.4	66.6
Spring 1979	2371	6461	8832	26.8	73.2
Totals	14353	28614	42967	33.4	66.6

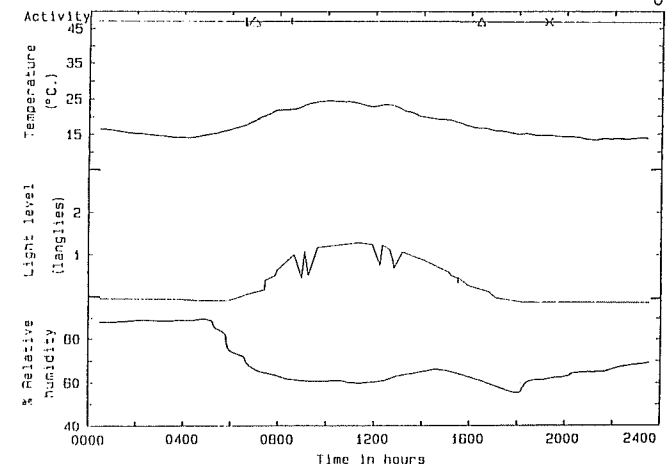
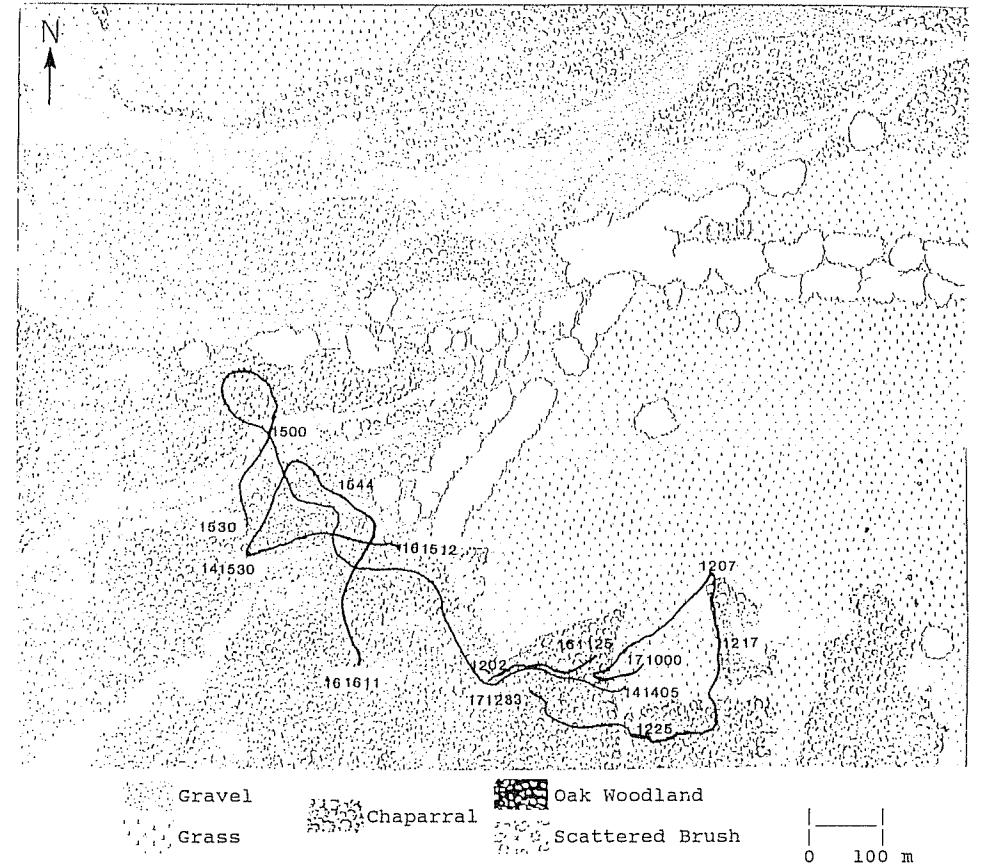
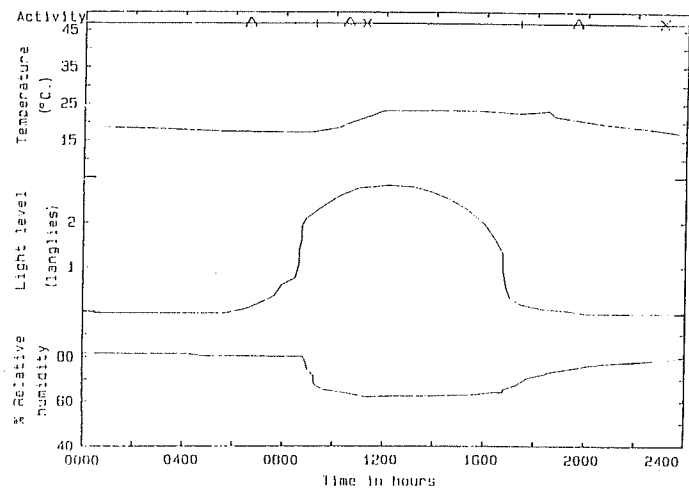
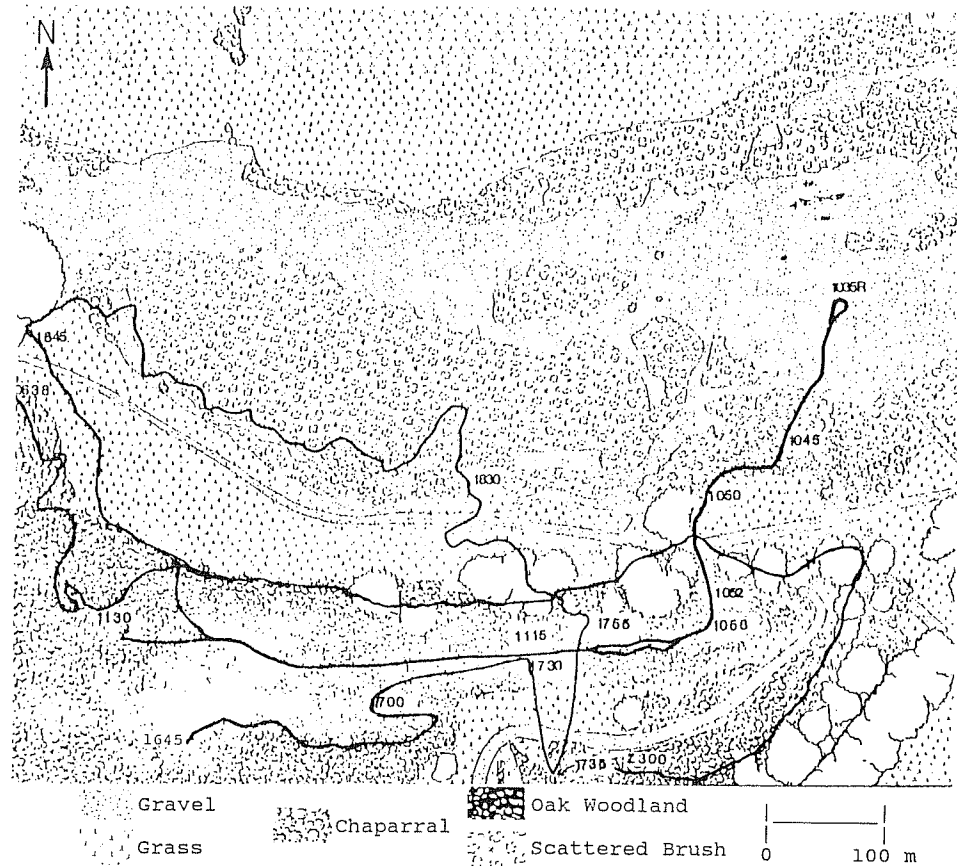


Figure 2. Movements and activities of female island fox (No. 922) observed on 9 July 1978. Habitat type is indicated below each movement map. Activity is depicted along the top line with environmental parameters below. Activity type is indicated by the symbols below. The line through the symbols indicates an observation period. The animal's status, designated by a symbol, continues until another symbol appears on the line. Symbols: X = inactive; | = active; Δ = foraging.

Figure 3. Movements and activities of female island fox (No. 196) observed on 14, 16 and 17 January 1979. See legend for Figure 2 for details of symbols.

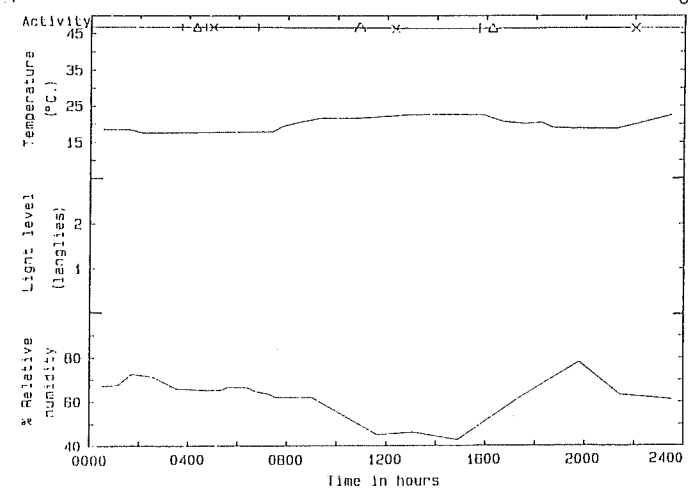
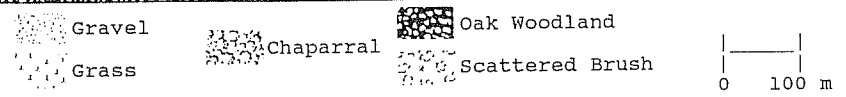
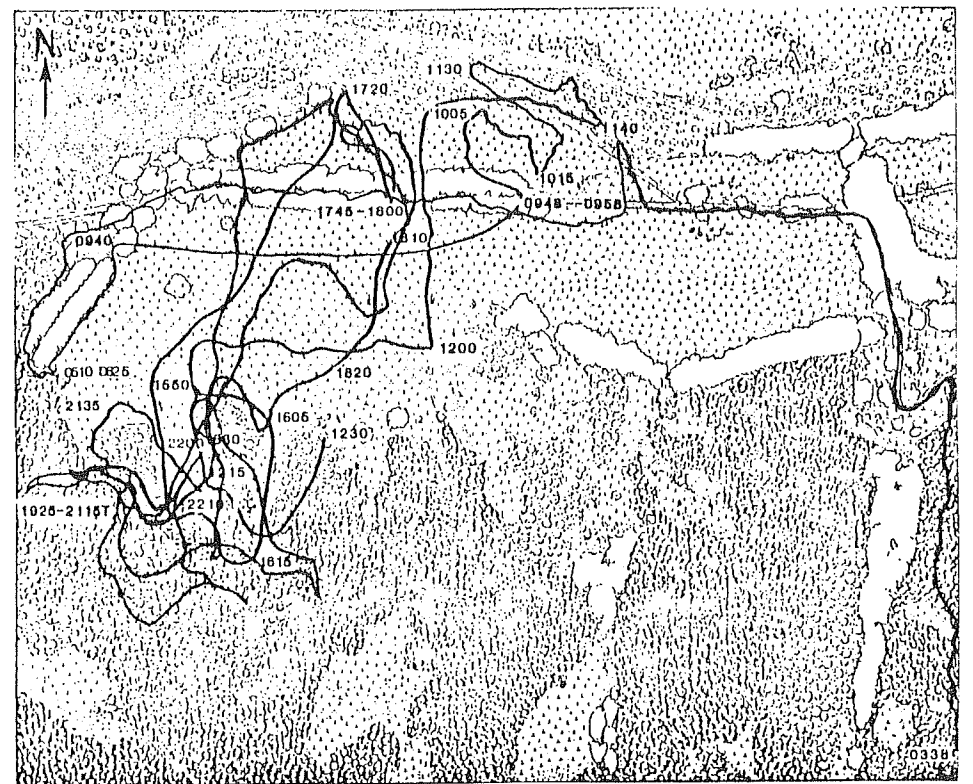
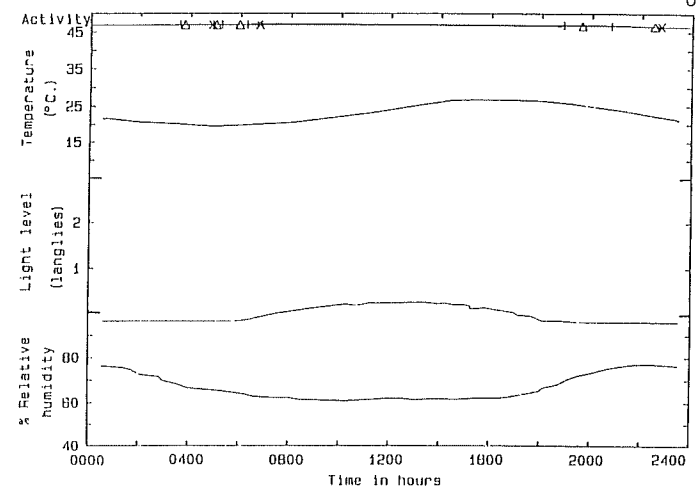
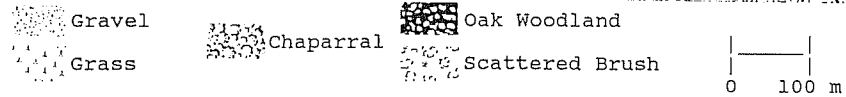
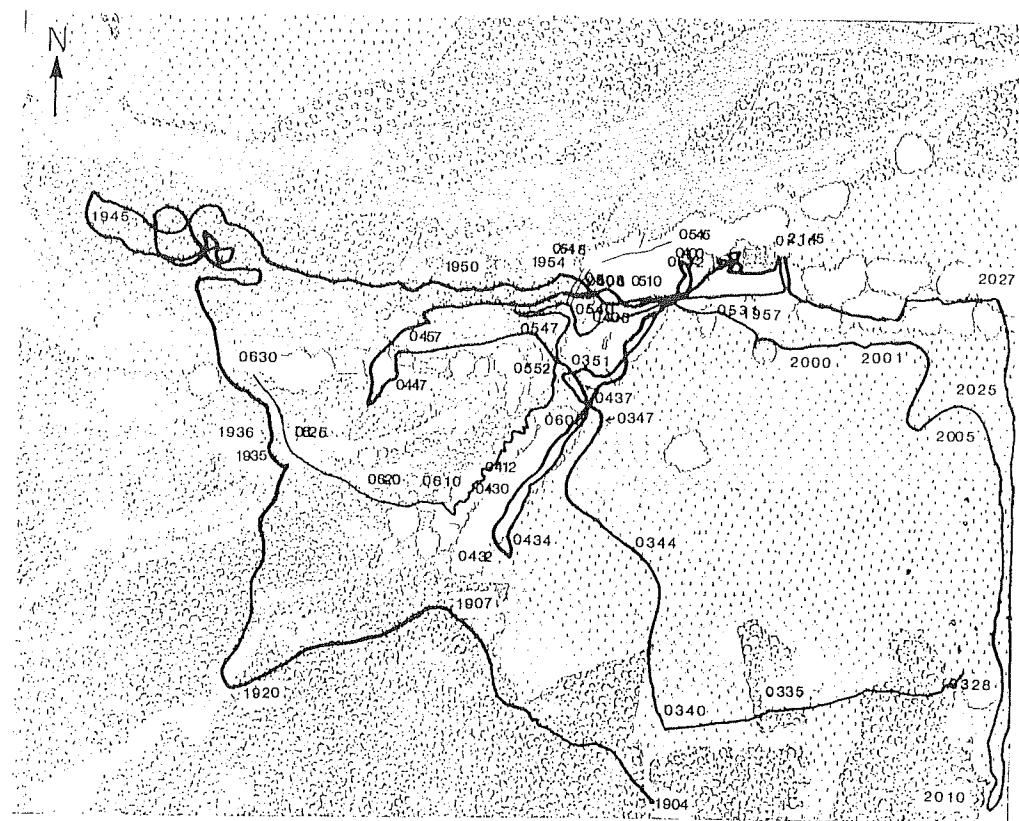


Figure 4. Movements and activities of male island fox (No. 180) observed on 25 August 1978. See legend for Figure 2 for details of symbols.

Figure 5. Movements and activities of male island fox (No. 180) observed on 19 February 1978. See legend for Figure 2 for details of symbols.

Table 3. Seasonal comparison of percentage time active for adult male and female foxes during all clock hours.

Category	Season	Number of Animals	Number of Observation Periods (<i>n</i>)	\bar{x} % Time Active	SD	df	<i>t</i> -test
Females (w/o pups)	Summer	2	29	39	24.0	40	0.396 NS
Females (1 with pup)	Winter	6	13	43	33.2		
Females ¹	Summer	6	45	38	26.8	69	1.041 NS
Males	Summer	5	26	46	32.4		
Females*	Spring	2	11	39	33.8	21	1.949 NS
Males	Spring	2	12	67	32.4		
Females	Winter	6	13	43	33.2	34	0.864 NS
Males	Winter	4	23	52	30.7		
Males	Summer	5	26	46	32.4	47	0.698 NS
Males	Winter	4	23	52	30.7		

* 1 pregnant and 1 with pup.

day and these interactions lasted up to 2 hr. Courtship involved chasing, short periods of feeding together and play behavior. Evening hours are characterized by occasional movement and increased frequency of barking as the season progressed toward spring. Evening movements usually were not foraging bouts; they were more likely to include the same activities engaged in during midday. During the middle of the night, activity was limited and the foxes usually were sheltered under chaparral.

Midday activity decreased during the spring. Male and female pairs that formed during the winter were still together in the spring. In May or June mated females pupped. There did not appear to be an obvious break in the females' foraging frequency on the day of pupping nor a subsequent increase in foraging activity. Females with pups spent more time resting in the natal den than at other seasons, when they rested under any suitable cover.

Lengthy midday activity (*i.e.*, being active for more than 30 min at a time) was only observed on summer days when the air temperature did not go above 22°C. In summer pups emerged from dens when 3-4 wk old. Males did not go into the natal den until the pups emerged when they took a more active role in the pups lives. Although I never observed a male bringing

food to young pups, I have seen 2 month-old pups in the company of a foraging male. Typically foxes foraged for 1-2 hr just before and after dawn, rested in the shade for most of the daylight hours, foraged for 2-3 hr in the evening, rested again, and then on some nights had another short foraging session in the middle of the night.

In the fall, the family still was seen together occasionally but parents spent less time with their pups and ranged more widely. Agonistic encounters were infrequent. Foraging still occurred most often in the cooler part of the day. Toward the end of October the pups still were found in the natal range (the range occupied by the male and female since the preceding winter) but the adults I tracked moved on to new areas. Limited information is available on dispersal since I tracked only two family groups at the appropriate time, and there are gaps in the data. I presume that after a period of wandering the female would occupy a new area of about 20 ha while the male continued to forage and move through an ever widening area that by December encompassed about 40 ha.

The variability of home range sizes of foxes in this study is indicated in Figures 2-5. Particularly apparent in these figures are the complex movements that the animals exhibit in

Table 4. Seasonal comparison of percentage time inactive for adult male and female foxes during all clock hours.

Category	Season	Number of Animals	Number of Observation Periods (<i>n</i>)	\bar{x} % Time Inactive	SD	df	<i>t</i> -test
Females (w/o pups)	Summer	2	32	65	25.5	40	1.159 NS
Females	Winter	6	10	75	12.0		
Females (1 with pup)	Summer	6	47	65	26.2	67	0.217 NS
Males	Summer	5	22	64	24.8		
Females	Winter	6	10	75	12.0	28	1.725 NS
Males	Winter	4	20	60	24.9		
Males	Fall	2	2	28	17.6	9	1.752 NS
Males	Spring	2	9	66	26.4		
Males	Summer	5	22	64	24.8	40	0.527 NS
Males	Winter	4	20	60	24.9		

their routine. Certain areas are traversed repeatedly. Large areas that would be enclosed if the commonly employed minimum polygon method were used to describe their home ranges are not actually utilized.

In February 1978 male 180 was found to be covering a range of 41.2 ha while observed in courtship behavior with three different foxes. Two of the latter were known to be females and the third probably was as well. In August 1978 the range of male 180 (20.4 ha) closely coincided with the range of female 196; in fact, they were seen together many times during August and September. The females that had been seen with male 180 farther east the preceding winter were not seen with him during the summer. The range of female 196 hardly changed in overall outline or in internal pattern of movement between winter and summer. This same general behavior occurred with three other pairs of foxes followed during the winter of 1978-1979. Thus my observations indicate that females occupied essentially the same range during the winter and summer. There is some overlap between female ranges but little contact between individuals, since the overlap areas were used at different times. Conversely, males ranged widely in the winter, their ranges overlapped extensively with those

of other males, and their ranges included two or three entire female ranges. Agonistic encounters between males occurred, especially if a male encountered a male/female pair. Tracked males encountered all females within their range every day. In March males ranged less widely and spent more time within the range of one female. This process continued until April when the males spent all of their time within the range of one female and they often accompanied each other while foraging.

Discussion

Activity: In studies of free-ranging foxes and in a recent review of their ecology (Trapp & Hallberg 1975), gray foxes (*Urocyon cinereo-argenteus*) typically are reported to be nocturnal or rarely crepuscular (active during early morning and late afternoon). My data show that island foxes frequently are active during daylight hours, particularly during the winter, but that during the summer they more nearly follow the pattern observed for foxes on the mainland. Laughrin (1977) also remarked on the frequent daytime activity of the island fox.

Foxes which forage during the day in winter benefit from the increased likelihood of finding food. Scat analysis of the diet of island foxes in winter reveals it to be composed of roughly

70% fruits of common chaparral plants and 22% insects (Laughrin 1977). The fruit is almost without exception bright red. Toyon (*Heteromeles arbutifolia*), a winter fruiting plant, has red fruit. Others include *Atriplex semibaccata* and *Opuntia littoralis*. These plants easily can be seen on a chaparral-covered hillside from a considerable distance during the day. The types of insects that foxes eat (e.g., Coleoptera and Orthoptera) are more active and easily found during the day. Thus, even though the cost of moving per unit time is the same, the increased efficiency of foraging during the day should reduce the time an animal is active. By comparison with foraging at night, a net reduction in cost to the animal should result during winter.

Mech (1970) reported that the activity patterns of wolves (*Canis lupus*) shifts on a seasonal basis from nocturnal in the summer to arrhythmic in the winter. He attributed the winter activity pattern to prey scarcity, a situation that the island foxes also face because of reduced density of insects during that season of the year. In a study by Kavanau & Ramos (1975) on the activity and phasing of carnivores in relation to the adaptation of their visual system, information is included on *Urocyon cinereoargenteus* which points up the behavioral plasticity of these foxes. Kavanau & Ramos found adult foxes to be strongly nocturnal in some tests but practically uninfluenced in other tests employing illuminance levels above 0.1 lux (about 50% of the light of full moon). They concluded that gray foxes' vision is "well suited for both day and night activity but there appear to be limitations in dim light." Kavanau & Ramos (1975) also reported that all four juvenile gray foxes tested were arrhythmic in every test, an intriguing result that suggests either developmental change in the visual system or learned responses by adults. Island foxes have no significant predators and a long history of little or no human harassment. The adaptability of their visual system and inherent behavioral plasticity has allowed

them to take advantage of the opportunities afforded to animals that can be active both by day and by night.

Movement: Of particular interest is the variation in movement by male foxes on a seasonal basis, in contrast to that of females. The results are similar to findings for bobcats (*Felis rufus*) in Minnesota (Fuller *et al.* 1985). The adaptive value of females staying within the same area from winter through fall while males decrease the area they traverse from winter to early spring and then stay within a stable area with one female until the next fall, is hard to understand, except in terms of sexual selection. It cannot be attributed to seasonal differences in foraging requirements since the foraging areas of females remain approximately the same through the year and there is no evidence that males require more food than females during the winter. Indeed, the actions of both sexes in January and February lead me to conclude that males are vying for various females, with limited aggression between males. The competition seems to be by means of increased activity; including movement, scent marking and vocalizations.

Island foxes can be considered to have a home range or maintain a territory, if occasional agonistic encounters and, more importantly, scent marking and vocalizations are viewed as defense of an area (for definitions see Burt 1943; Noble 1939). Burt (1943) mapped the ranges of individuals and "found that the area of each of the breeding females is separate...and they seldom overlap," a condition he equated with territoriality. Breeding island fox females have areas that seldom overlap spatially or temporally.

Pitelka (1959), on the other hand, defined territory as an "area of exclusive use." There are areas, especially after pupping and during the summer, which normally are traversed only by a mated pair and their offspring. Other foxes occasionally move through a mated pair's range. These foxes include animals of reproductive age that failed to reproduce that season as well as animals beyond reproductive

age. These animals have been observed to forage in the areas in question but they do not stay long and probably have no significant impact on the resource base. Strictly speaking, if Pitelka's definition is used, island foxes do not have territories.

In the broader sense, I believe that island foxes do exhibit territoriality, at least on a seasonal basis. It could be too energetically expensive to chase or fight every fox that wandered through a resident's territory, therefore the vocalizations and scent marking during foraging movements serve to advertise the presence (and perhaps physical condition) of the residents thereby reducing agonistic encounters. Based on three encounters I observed, if two individuals meet in spite of the advertising, physical contact is avoided if possible. The most likely outcome is that the resident will chase the interloper for a short distance, and the interloper will leave the mated pair's territory.

Dispersal: The dispersal movements that I observed provide pups with two advantages. In the first case, they spend their early life alone in an area with which they are familiar, and where the sources of food and dangers are known. Having survived the first period of life when mortality is high (Laughrin 1977) they presumably are much better equipped to succeed when they move into unknown areas as they grow older. The second advantage relates to the fires in chaparral areas which usually occur in late summer and early fall (Hanes 1971). The fire season occurs precisely at the same time that the family breaks up which also has been reported for other foxes (Lord 1961). Pups are better off when confronted by fire in a familiar area than in an unfamiliar one. Gray foxes as well as island foxes have a long history of living in semi-arid and chaparral areas both of which are noted for frequent fires that vary widely in intensity and destruction of habitat. It is reasonable to assume that the reproductive cycle of these animals might be adjusted to this potentially devastating factor. None of the literature on gray foxes mentions dispersal in sufficient detail to determine which members

of mainland populations actually leave the natal area. This type of information easily could be acquired by use of telemetry. A study of both island and mainland populations should be undertaken to determine "dispersal patterns" (Brown 1975), that is, which individuals move and when they move. When viewed in light of similarities and differences in the two habitats, an answer to the question of how a particular pattern has evolved or what forces have played a role in that evolution may be answered.

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New Information on the Prehistoric Fauna of San Miguel Island, California

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Abstract – The geology and fauna of the terrestrial late Pleistocene deposits on San Miguel Island is described. These deposits date 12,020-40,000 B.P. New records for San Miguel from these deposits include: pacific rattlesnake, crested caracara, an extinct species of owl, and new species of extinct puffin *Fratercula* and vole (*Microtus*). The remains of nesting colonies of two species of alcids and the extinct flightless goose (*Chendytes*) also were discovered. Faunal discoveries resulting from new work at SMI - 261, the Daisy Cave archeological site, also are listed. This material provides the earliest date for human occupation on San Miguel at 10,700 B.P. The time and causes of extinction of the various elements of the San Miguel fauna are discussed and evidence for decrease in size of small mammals on San Miguel during the last 9,000 years is presented.

Introduction

The 1978 California Islands Symposium (Power 1980) contained two papers on faunal discoveries from Daisy Cave, an archeological site at the eastern end of San Miguel Island. These papers (Guthrie 1980; Walker 1980) reported the past existence on San Miguel of now extinct species of vampire bat, flightless goose, and giant mouse as well as the first records of extant ornate shrew and spotted skunk. A report in 1980 that bones, including what looked like snake vertebrae, had been observed weathering out of sandstone below the earliest archeological sites on San Miguel indicated that more might be learned of the prehistory of this island and prompted the

author to begin a survey of late Pleistocene deposits on the island. This reconnaissance, conducted during the summers of 1984 and 1985, was designed to examine the whole of San Miguel Island for fossil bearing deposits of late Pleistocene age as well as to reexamine Daisy Cave with a view to obtaining better stratigraphic information about the age of the material already recovered from that site. The following paper consists of two parts. The first will describe the geology of the late Pleistocene deposits on San Miguel Island and summarize information on the faunal material from them. The second section will present the results of the reopening of Daisy Cave. There follows a general discussion of the current state of knowledge of the prehistoric fauna of San Miguel Island.

Part I. Late Pleistocene Deposits

In his geology of San Miguel Island, Bremner (1933) indicated that the basement of the island is composed of volcanics and consolidated marine sediments of Eocene and Miocene age, most of which are covered with a layer of Quaternary unconsolidated sediments. Over much of the surface of San Miguel Island these Quaternary sediments are covered with well developed vegetation and a considerable thickness of soil. However, on the northwest facing slopes of the island there are several pockets where aeolian erosion has uncovered sands of late Pleistocene age. These areas were surveyed during the summers of 1984 and 1985 and surface collections were made wherever vertebrate remains were discovered. In addition, some sieving was done in the more unconsolidated sands to recover smaller members of the fauna. The locations of the