



environment southwest



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THE ISLAND FOX

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LLOYD INGLES

The island fox, Urocyon littoralis.

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■ A conspicuous member of the fauna of the islands of southern California is a diminutive form of the gray fox, island fox (*Urocyon littoralis*) which inhabits San Clemente, Santa Catalina, San Nicolas, Santa Cruz, Santa Rosa, and San Miguel Islands. The smaller islands of Anacapa and Santa Barbara contain no foxes and there are no records of their existing there in the past.

The island fox appears to be closely related to the gray fox (*Urocyon cinereoargenteus*), which ranges over most of North America, but little other than taxonomic descriptions exist. Its role in relationship to early human inhabitants, i.e., Chumash Indians, is unknown. Remains of fox were found in Indian shell mounds, but whether they were used for food or other purposes is not known.

Island fox is not recognized as a fur-bearer species under the Fish and Game Code or the Fish and Game Commission's Orders, Rules and Regulations (Title 14). At present there is no protection afforded this species as it has never been exploited for its fur as was the gray fox, probably due to the fact that its range is limited to the islands.

■ An inadequate fossil record leaves unanswered the question of the island fox's origin and means of arrival on the islands. Several possibilities have been suggested. It may be related to a small fox that once existed on the mainland and subsequently became isolated on the

islands. Larger forms developed or moved to the mainland areas and were eliminated and only the small forms persisted. Alternatively, larger forms could have been isolated on the islands and then evolved into the present "dwarf" form.

Current investigations on island and mainland populations and work on some of the smaller Central American forms of the gray fox may provide some clues for answers to this question. In general, the gray fox group shows closer affinities with the South American foxes than with the northern hemisphere *Vulpes* group.

Questions also arise when considering the actual dispersal methods that might have permitted the present island fox distribution. It has been suggested they reached their respective islands via various land bridges from the mainland. To allow for the relatively similar status of evolution to exist for these populations, the land bridge theory must have a rather complicated and almost improbable structure. The northern Channel Islands were connected to the mainland during the middle Pleistocene, probably through a peninsula extending from the Santa Monica mountains. This connection was lost in the late Pleistocene.

The southern group of islands had connections that were much older, particularly San Clemente, which may never have had a connection. It is possible that some islands could have been populated by such methods as rafting, but it is unlikely that this was widespread. Another

possibility is that the foxes were transported to each of the islands by the early native human inhabitants (Chumash Indians). Evidence supporting any of these ideas is not available.

Some workers have noticed a trend in some color and anatomical characteristics that corresponds to the geographical locations of islands. Some size gradient may exist with the largest forms found on Santa Catalina.

The California Channel Islands are continental islands, the farthest from the mainland being San Nicolas at 61 miles and the closest being Anacapa at 13 miles. As such, it is reasonable to expect the overall aspect of the vegetation to resemble that of adjacent southern California. Within the limits of the various topographical and climatological factors this is true. The climate is Mediterranean with a strong maritime influence and is quite similar to the adjacent mainland. The interior valley of Santa Cruz Island has a semicontinental climate and often has freezing temperatures during the winter.

Topography and geology vary greatly among the islands. Several have a low, rounded conformation, others, like Santa Catalina and Santa Cruz, have a rugged and diverse landscape. The larger islands have available water year round from springs and a few small streams. Most of the islands have had their native vegetation modified by one or another of the exotic animals introduced by early European visitors. Damage has come primarily from goats, sheep, pigs, and

European hares and rabbits. In recent years these influences have been greatly reduced, particularly on the privately owned islands.

Topographically less diverse areas, and this is sometimes whole islands, have predominately a coastal sage scrub vegetation. Components are: introduced grasses, California sage (*Artemisia*), buckwheats (*Eriogonum*), sea dahlia, (*Coreopsis*), prickly pear cactus (*Opuntia*), and various composites. The larger islands also have chaparral and scrub oak woodland communities, similar to those on the mainland. Species found include: *Ceanothus*, coffeeberry (*Rhamnus*), toyon (*Heteromeles*), manzanita (*Arctostaphylos*), mountain mahogany (*Cercocarpus*), island cherry (*Prunus*), lemonade berry and sugar bush (*Rhus*), and coast live and scrub oaks (*Quercus*). Closed-cone pines (*Pinus muricata*) are found on Santa Rosa and Santa Cruz Islands. Several extensive stands of these trees are found on Santa Cruz Island. Santa Rosa Island has a small grove of Torrey pines (*Pinus torreyana*).

Primarily the plant species are the same or quite similar to those found on the adjacent mainland. Some forms show closer affinities with more northern mainland forms. Most variation that occurs is on a subspecific level. Some genera are found only on these islands, the most distinct and well-known being the island iron wood (*Lyonothamnus*) on Santa Catalina, Santa Cruz, and Santa Rosa.

■ The fauna shows even less divergence from the mainland forms. The greatest difference is in the conspicuous absence of those species that did not make it to the islands. Animals that are most distinct from their mainland relatives are the island night lizard (*Klauberina riversiana*) of San Clemente, San Nicolas, and Santa Barbara Islands; the island jay (*Aphelocoma coerulescens insularis*) of Santa Cruz; and the island foxes.

The terrestrial mammalian fauna is rather attenuated. This results in fewer available prey species for the fox and also fewer competitors. Potential prey are the deer mouse (*Peromyscus maniculatus*) on all the islands, the western harvest mouse (*Reithrodontomys megalotis*) of San Clemente, Santa Catalina, and Santa Cruz, and the meadow mouse (*Microtus californicus*) of San Clemente. Some competition may occur from the spotted skunk (*Spilogale gracilis*) on Santa Cruz and Santa Rosa. They utilize somewhat the same food resources; however, at the present they are quite rare on Santa Cruz and their status on Santa Rosa is unknown. Some competition may occur between the rodents and foxes in regards to the insect food source. The ground squirrel (*Otospermophilus beecheyi*) of Santa Catalina may also provide



Smaller than the mainland gray fox, the island fox is similar in color with shorter legs and tail.

competition over food resources. Competition may occur between various fruit and/or insect eating birds such as mockingbirds, jays, shrikes, and sparrow hawks. Ravens may compete with the fox's scavenging role.

■ My own work and that from which most of the direct observations in this report are drawn concerns the fox population on Santa Cruz Island.

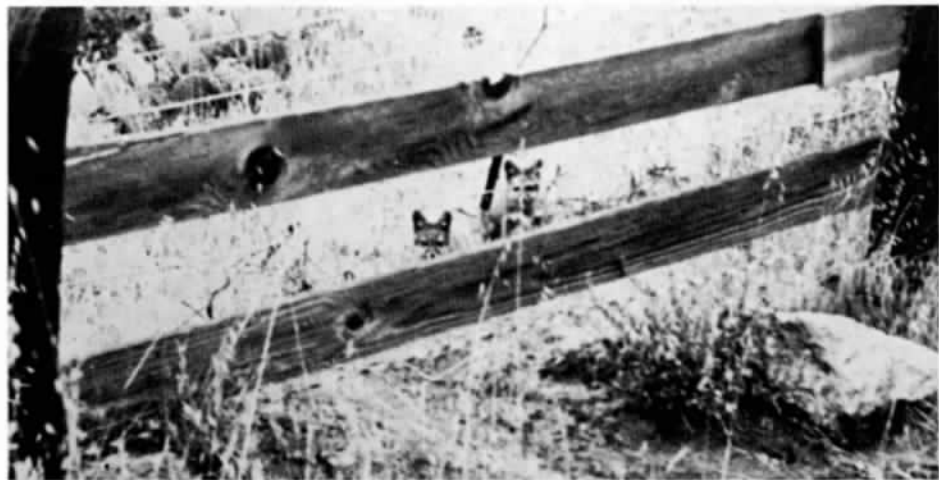
The island fox, like the gray fox, is most active during times of low light intensity. Peaks of activity occur at sunset and sunrise. In general, activity continues throughout the night. During the daylight hours some individuals can usually be found foraging or moving about, particularly during the late spring and early summer when the young need care. Reduced competition and virtually

no predation, except by man, may be factors contributing to a more diurnal existence for this fox as compared to its mainland relative.

Adults in good health average a weight of between 4½ to 5 pounds. This compares to an average weight of 9 pounds for gray fox. Color and color pattern of the island fox and the gray fox are quite similar; greatest differences are in the rufus-cinnamon color and dark color pattern around the muzzle. Skeletal differences exist in the skull and tail vertebrae.

Island fox social behavior is based upon single family units. They can be found singly or in pairs throughout the year except during the reproductive season when the pups are with their parents. Courtship activities may start as early as late January but most copulation occurs in late February and early March. Fol-

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Island foxes, Santa Cruz, on a daylight excursion.

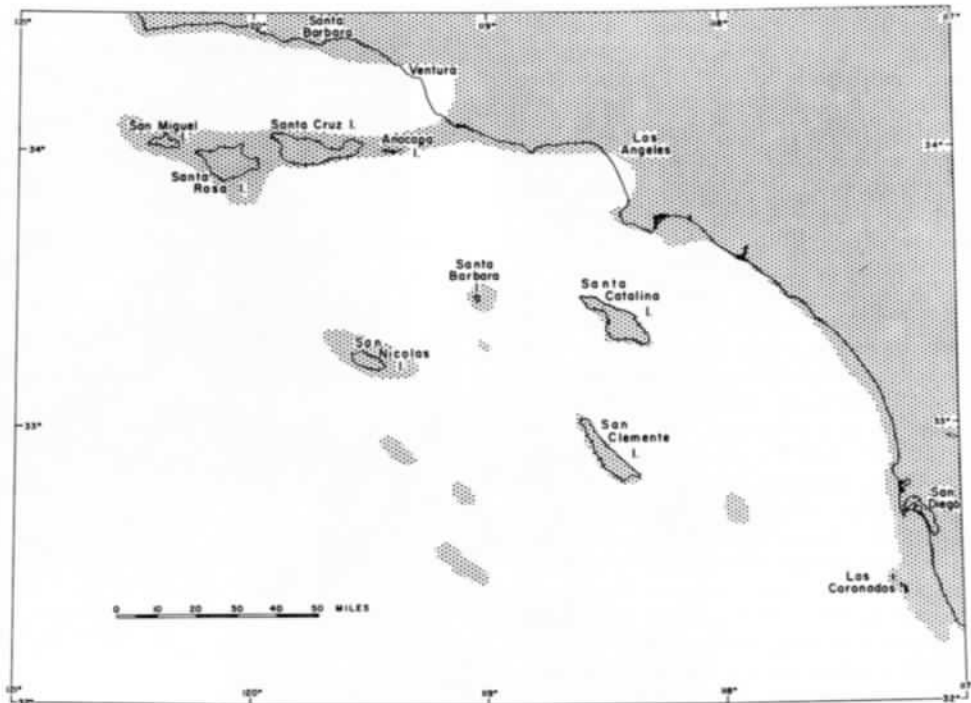
lowing a gestation period of approximately fifty days, the young are born from late April through May with a peak in parturition about the first week in May. Juveniles may remain with their parents throughout the summer. Usually during September the parents will begin forcing the young to become independent. The average number of young raised to maturity is approximately two. Litter size may be as many as five. Young are born in a den, but unlike many other canids, it is usually not excavated by the parents. Island fox, like the gray fox, seems to prefer a site already constructed. This need not even be a den in the ground. More often, island fox will use a brush pile, rock pile, or even man-made structures. This fox is a very agile tree climber and dens have been reported and observed in hollowed limbs or stumps. The den is rather simple in structure, usually at the end of a short tunnel or a depression under a rock or log. Protection is primarily needed only from the weather.

Preliminary work suggests that this fox has a home range, with a possibility of overlapping territories. Movements of marked foxes on Santa Cruz Island indicate their territories are approximately 0.2 mile square. The greatest movement recorded to date has been of just over one mile.

Certain aspects of population dynamics are still under investigation. Normal life span is yet unknown, but is assumed to be somewhat comparable to a dog of similar size. A pair in captivity at the University of California at Santa Barbara in 1971 was at least eight years old. At that time, they showed signs of old age and the female did not reproduce in the preceding year. Recruitment of young and mortality have yet to be assessed. Disease and/or general poor health of older individuals may be the principal mortality factor. Some individuals appear to develop glaucoma to the extent that they are almost completely blind. General condition of such foxes is usually very poor, especially the condition of the fur. Man does not appear to be adversely affecting the fox populations and in most cases the landowners are protecting them.

Redtailed hawks may prey upon unhealthy adults and/or young foxes. Fox fur has been found in hawk castings. It is doubtful that hawks can take healthy adults. Ravens may be in a similar position of influence. In the past, bald eagles may have been a predator but they are no longer present on the Channel Islands. Golden eagles are seen on occasion but none are known to live on the islands. No information is available to account for known fluctuations in the fox populations.

■ Island fox, like the gray fox, has a diet consisting of a high percentage of



California borderland and mainland during Middle Pleistocene.
Dots indicate land areas.

vegetable matter; in fact, this percentage may be even higher for the island fox. This may be partly due to the reduced number of prey species. It was reported that the deer mouse was the mainstay of the island fox's diet. This may have been true for some islands or during the past periods of time. This has certainly not been the case for the Santa Cruz Island population during the past several years. Currently, very little evidence of rodent remains are being found in fox scat. During a two-year study involving the deer mouse population on Santa Cruz Island, their population was found to be quite low and it was speculated that fox predation may be the principal limiting factor. Fox scats were analyzed and the nonvegetable portion of their diet was determined to be less than 10 percent. Only 1.3 percent of the total scats contained rodent remains. Deer mouse populations may have been greater in the past and have contributed more significantly to the fox's diet. The current status of the rodent populations on the other islands is unknown.

Continuing food habit analysis of scat from Santa Cruz Island is showing the island fox to be an opportunistic omnivore, taking advantage of just about every possible food source. Besides plant and insect remains, evidence of rodents, birds, lizards and snakes appear in the scats. Foxes also are seen hunting tree frogs (*Hyla regilla*) during spring and summer. Some of the birds commonly preyed upon are island jay, red-shafted flicker, acorn woodpecker, California quail, mourning dove, and sparrow hawk. Predation upon birds is

greatest during the spring. Feathers are often found around the dens. Birds may be more accessible at this time of year, especially fledglings; also, there will be increased food requirement to feed young foxes.

Insects are a significant food item throughout the year. The Jerusalem cricket (*Stenopelmatus*) appears to be the most important insect component in the diet and is found in scats year round. During the summer months the frequency of grasshoppers and beetles found in the scat increases. Plant material included in island fox diet consists almost exclusively of fruit. Just about every species that has any sort of substantial fleshy and/or abundant fruit will be utilized. Species eaten quite extensively are: manzanita, toyon, island cherry, prickly pear cactus, and summer holly (*Comarostaphylis*). Other items appearing in the scats are nightshade (*Solanum*), rose (*Rosa*), and coffeeberry (*Rhamnus*). Two of these plants, manzanita and toyon, can almost be considered staples in the diets of most of the foxes on Santa Cruz Island. In the summer and fall almost three-fourths of the food eaten is manzanita and in the late fall and winter toyon replaces manzanita.

Carion is included in the diet, primarily from carcasses of pigs, sheep, and marine organisms washed up on the shoreline. Scavenging is also done around human refuse areas.

■ No information is available concerning the current status of fox populations

on any of the islands except Santa Cruz. Reliable historical data are lacking concerning past population estimates for all of the islands. About all that can be found in literature is that populations have fluctuated.

On Santa Cruz Island the fox is found in all habitats. The greatest density occurs in chaparral areas, probably due to the greater concentrations of available food in these areas. Estimates of densities for fox populations for these different habitats are being gathered. Most work to date has been centered on chaparral areas. Estimates of densities range from 20 to 30 foxes per square mile for this habitat. The general population is quite dense, possibly being in the peak portion of its population cycle. This compares to an estimated four foxes per square mile for gray foxes on the mainland.

As of July 1, 1970, 230 island fox were captured in 609 nights of trapping effort representing 198 different individuals. Each individual is marked. Recapture data and direct observations are used to determine movements. Sex ratio is virtually one to one. Trapping has shown that young are out of their dens and active in June. Juveniles can be distinguished from adults through the fall. An accurate total population of island foxes for Santa Cruz Island cannot be determined at this time, but it is unlikely to be greater than 3,000.

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- Von Bloeker, J. 1967. *Land mammals of the southern California islands.* In: *Proceedings of the symposium on the biology of the California islands.*

DeWitt Jones (above) lecturing at the October 20 Members Meeting on John Muir's High Sierra to standing room only in the auditorium (far right).



MUSEUM NOTES:

The Western Society of Naturalists will hold its 1973 meeting Dec. 27-30 on the campus of the University of San Diego. Symposia on Marine Food Webs and the Biology of Macroalgae will be presented in the mornings, with sessions of contributed papers in the afternoons. For information write Prof. David H. Montgomery, Secretary WSN, Biological Sciences Department, California Polytechnic State University, San Luis Obispo, California 93407.

Mr. Carlos Mosca, Director of Education at Sea World, has expressed his regret for the delay members experienced at the Sea World Behind-the-Scenes, Nature Walk September 29. The regular tour guide had not been notified of our visit. Annette Mullins interrupted her day off to lead the tour. She did an excellent job which compensated greatly for the earlier delay.

NEW MUSEUM MEMBERS

Mr. and Mrs. Eugene C. Bailund, Mr. & Mrs. Stewart Benkle, Mrs. Dorothy Benninghoven, Capt. & Mrs. C. B. Bishop, Mr. & Mrs. Myron H. Boyer, Jenifer Burckett, Janis Cadwallader, Mr. & Mrs. Roderick Calverley, Mr. Timothy L. Cass, Miss Laurie Clark, Mr. & Mrs. Leonard Collings, Miss Claudia Crozier, Miss Ethel F. Dredge, Lucy H. Dreher, Mrs. Hannah Elk, Mrs. R. C. Emery, Mrs. Nora M. Fish, Mrs. Marcia Gallup, Mr. & Mrs. James W. Greer, Jr., Miss Stephanie Harper, Mrs. James L. Henderson, Glenda Hightower, Mr. Stephen G. Kahler, Mr. & Mrs. Thomas A. Knotts, Mr. Edwin D. Lindgren, Lisbeth J. Locke, Mr. Loren W. Mitchell, Joan B. McAdams, Mrs. Robert J. Ogden, Miss Pamela J. Pharris, Dr. & Mrs. Robert T. Plumb, Mr. Stephen Wayne Rowell, Mr. Robert D. Ruark, Mildred Smith Sell, Mrs. Paul Sermak, Mr. Gordon E. Shockley, Mr. Joseph J. Silva, Mr. & Mrs. Preston L. Spruance, Jr., Mr. Robert Wadham, Nancy L. Welch, Mrs. Anita Worden.

GUS SCHONEFELD

