

State of California
The Resources Agency
Department of Fish and Game

Informational Report

NONNATIVE RED FOXES IN CALIFORNIA

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Threatened and Endangered Birds and Mammals
Nongame Bird and Mammal Section

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ABSTRACT

Non-native varieties of red foxes, *Vulpes vulpes*, that were imported into California have populated lowland areas in much of the State. They are common in many natural environments and are thriving in several urban areas. The range of this now widespread and abundant predator has been expanding because of natural propagation and dispersal and because of illegal relocation by people. In recent decades, the non-native red fox has become a significant threat to many endangered species and other vulnerable native animals. To protect endangered wildlife, agencies have had to implement localized fox control by trapping and euthanasia, as well as by fencing and other nonlethal predator control methods. Some fox control efforts at wildlife refuges have been challenged in courts. The Department of Fish and Game has been cooperating with other agencies to determine the current population status of the non-native red fox, to assess the damage this introduced predator causes to wildlife, and to take effective action to protect the public and wildlife. Other efforts include informing the public about the threats these foxes pose and about the nature of agency control programs.

INTRODUCTION

Red foxes imported from other states have become established in the lowlands in much of California, including wildlands, rural areas, and cities, and they are spreading into new areas. This non-native predator is now a significant threat to California's native wildlife.

The advance of the alien red fox presents land and wildlife managers with formidable problems. The foxes can be devastating to wild animals if not restrained by natural or artificial controls. Several agencies have begun fox population control by lethal and nonlethal means where red foxes threaten endangered species, vulnerable ground-nesting birds, and other wildlife in nature reserves and other key wildlife habitats. Additionally, private citizens and organizations have needed help in controlling these foxes for protection of property and for public safety. California Department of Fish and Game and other agencies have been attempting to stop the spread of this introduced fox by enforcing restrictions on possessing and transporting them in the State.

One organization brought legal action against the State and the federal government over fox control efforts at two southern California wildlife refuges, but its efforts to halt lethal fox control in those areas have been unsuccessful. Recently, animal rights advocates have actively criticized fox control efforts through the news media, public demonstration, and letters to governmental leaders. Many conservation groups, on the other hand, have supported vigorous fox control measures to protect wildlife.

This report is intended to address the common questions and concerns that have surfaced recently over the status of non-native red foxes, their effects on the environment, and the nature of State and federal agency control actions.

ACKNOWLEDGMENTS

Many people from state and federal agencies and the public provided me with valuable review comments during the preparation of this informational report. I especially appreciate the assistance of the following: Ms. Esther Burkett, Mr. Jerry Clark, Ms. Leora Feeney, Dr. Richard Golightly, Ms. Gretchen Jurek, Mr. Paul Kelly, Mr. Alan Sargeant, Ms. Jean Takekawa, Mr. Ron Thompson, and Dr. Roy Woodward. Other reviewers who provided valuable comments included Mr. Bill Brownlee, Mr. Bruce Elliott, Dr. John Gustafson, Chief Dwayne Johnston, Mr. Lloyd Kiff, Captain Phil Nelms, Chief Christopher Patin, Ms. Colleen Pelles, Dr. Katherine Ralls, Dr. Kevin Reilly, Mr. Kevin Sallee, Mr. Ron Schlorff, Mr. Carl Wilcox, Dr. Daniel Williams, and Mr. Richard Zembal. Also, I appreciate the advice and information provided by many others.

Is the red fox native to California?

Many subspecies of red foxes exist in the wild in various geographic areas of North America, but the only region in California where red foxes are native is in the high elevations of the Sierra Nevada and Cascade ranges. This indigenous subspecies is the Sierra Nevada red fox (*Vulpes vulpes necator*). It lives in coniferous forests and above timberline from about 4,000 to nearly 12,000 feet in elevation, chiefly above 7,000 feet. It became so rare that the California Fish and Game Commission declared it *threatened* in 1980.

Other populations of wild red foxes in California are derived from imported stock and are therefore not native. These foxes are descendants of ones that escaped or were released from captivity from time to time since the late 1800s. Red foxes were imported from many parts of North America, so various subspecies and mixed strains of non-native red foxes have been introduced into California. For example, the red foxes now found in the Sacramento Valley appear to be descended mainly from individuals imported from the great plains, the range of the subspecies *Vulpes vulpes regalis*.

Bones from the Rancho La Brea tar pits of southern California represent the period from about 10,000 to 40,000 years ago and include many remains of wolves, coyotes, gray foxes, and domestic dogs, but not red foxes. Also, there is no evidence of naturally occurring populations of red foxes in southern California and other lowlands in the State, based on numerous animal surveys in the first half of this century.

Wildlife inventories of the coastal wetlands of California during the 1970s and 1980s clearly show that red foxes appeared in these wildlife habitats since the mid 1970s. Perhaps they were released there by people or came in from surrounding urban areas where recently established red fox populations were thriving.

What is a native species?

A species, subspecies, or variety of life is native or indigenous to a particular area if it originated in that area or came to the area under natural conditions. These are the natural conditions of climate, soil, and topography that prevailed before human activity became important in changing them. Our knowledge of what kinds of plants and animals are native to a locale is based on historical reports, museum records, natural history surveys, and paleontological and archeological studies. The Department of Fish and Game, California Fish and Game Commission, and Department of Food and Agriculture use such reputable scientific sources to ascertain which species are native.

Species or subspecies that are not native to California are considered to be exotics. Wild-bred offspring of exotic plant and animal species are not considered to be native, since they originated from imported genetic stock of non-natives. The State does not classify naturalized plant and animal species as natives.

Non-native species become established as breeding populations in new lands because of introductions by humans. Some introductions have been purposeful, others inadvertent. Unintentionally, people create conditions that favor the spread of adaptable exotic plants and animals. Human-caused changes to natural habitats, which are detrimental to many native species, are beneficial to many nonindigenous plants and animals.

How did these non-native red foxes get to California?

Various subspecies of the red fox were imported into California for fox hunting - mainly in the late 1800s and early 1900s - and for fur farming since World War I. Also, red foxes have been imported for live exhibition and for use in films.

The earliest known introduced population formed in the southern Sacramento Valley, where early settlers possibly imported eastern foxes by train soon after the railroad connection with eastern states was established in the 1870s. Many more foxes were released or escaped in subsequent years, and some of them formed breeding populations in the wild in various parts of the State. By the 1970s, the alien red fox population was well-established in northern California in the Sacramento Valley, and it was expanding into the central part of the State. Also, some other small, isolated breeding populations had formed elsewhere, including the vicinity of Los Angeles.

What is the status of the red fox?

The red fox (*Vulpes vulpes*) is one of the most widespread and abundant land mammal species in the world. This carnivore is common in its native range in Canada, the continental United States, Europe, northern Asia, the Middle East, and northern Africa. Also, people have spread them to Australia and elsewhere.

In California, the native Sierra Nevada red fox is extremely rare and has been protected as a *threatened mammal* since 1980 under the California Endangered Species Act. The non-native red fox has been a *prohibited animal* since 1973. It may not be imported, transported or possessed without State permission. This abundant introduced fox is a well-established exotic species.

All red foxes in the State are classified as *fur-bearing mammals*. They may not be captured, killed or otherwise taken except as permitted by the California Department of Fish and Game. Red foxes may not be taken for profit-making purposes.

How many of these red foxes are in California?

The population of non-native red foxes in California is not known. Red foxes are numerous in the Sacramento Valley, where they have existed for more than a century. They are now becoming common in the San Joaquin Valley. Since the late 1970s, they have become abundant in other parts of the State, especially in the San Francisco Bay area, Monterey Bay area, and southern California coastal counties.

It would be difficult to census red foxes over a large area, but some studies in southern California show how abundant this species can become locally. In an urban area of Orange County where these foxes are being intensively studied, they number in the dozens per square mile. In another area, 128 red foxes were removed in 1988 from the Seal Beach National Wildlife Refuge marshlands and from the adjacent uplands. Such concentrations have been found in numerous locations throughout their range in California, indicating that the statewide population of this alien fox numbers in the thousands.

Why are non-native red foxes doing so well?

Red foxes eat a wide variety of food, including berries, insects, birds, bird eggs, small mammals, and garbage. They are adaptable to a wide range of habitat conditions. Red foxes around the world inhabit places as diverse as deserts, grasslands, tundra, forests, farmlands, and urban areas.

Non-native red foxes are surviving well in many of California's wildlife habitats, from semi-deserts to wetlands. They even swim, hunt, and den in tidal salt marshes. Also, they are thriving in many urban areas.

They have few natural predators, but coyotes will kill them. Where coyotes are abundant, red foxes may survive only in scattered locations at the periphery of coyote territories or in areas with considerable human activity. When coyotes can no longer survive in an area because of urbanization or intensive coyote control, the populations of smaller predators, such as non-native red foxes, raccoons, and skunks, usually increase.

In areas where food is abundant, red foxes are prolific, breeding in their first year and raising litters of usually four to seven pups annually. Pups are born usually in late winter or spring. Generally, juvenile foxes suffer high mortality in the wild. However, many foxes live for several years, and a few live longer than eight years.

These predators soon become abundant in an area. As the local population grows, young foxes disperse in late summer, fall, and winter into new areas and form territories many miles from their birthplace. Older foxes sometimes move into new areas, as well. As this natural dispersal has progressed, augmented by illegal relocations, the population of red foxes has grown.

Red foxes can flourish in urbanized areas. They occupy residential and commercial areas and open spaces, often traveling across roads, through culverts, and along flood control channels. Their dens are typically in open spaces, such as parks, road and creek embankments, and utility yards. Red foxes are typically well fed in urban areas, where garbage is abundant and where people feed them. Feeding wild foxes, however, may violate municipal public health and safety ordinances, as in Los Angeles County. The heaviest red foxes, some weighing up to 16 pounds, have been found in cities. With an abundant and dependable supply of food and lack of competition by coyotes, the urban foxes proliferate. The offspring, as well as adults, often disperse for miles into surrounding areas, to the detriment of native animal populations in wetlands, nature centers, and other wildlife habitats.

Supplemental feeding of red foxes is prodigious at some urban sites, which may become centers of fox dispersal. Thus, a dedicated fox feeder may be inadvertently contributing to major environmental impacts far from where food has been provided.

Well-meaning people have unintentionally expedited the spread of red foxes by translocating them from one area of the State to another and by releasing pet foxes. There are many reports of animal control agencies, wildlife rehabilitators, and other individuals who have trapped or otherwise obtained live red foxes and illegally relocated them to the wild in California.

The Department of Fish and Game has contracted with Humboldt State University to assess the range, movement patterns, food habits, and other aspects of the natural history of this non-native fox in California. This information is important for the development of effective protection programs for endangered species and other native wildlife.

How does the introduced red fox differ from other California foxes and the coyote?

Five species of wild canids (the dog relatives) are found in California - the coyote and four fox species. Foxes fall within the range of weights of domestic cats, and all have long bushy tails.

The **red fox**, *Vulpes vulpes*, is the largest species of fox in the world. Coat colors vary regionally, typically being red or reddish-yellow, with white underparts, black legs, and a white-tipped tail. However, not all red fox individuals have black legs or a noticeable white tail tip. Some ranch-dwelling varieties of this species are nearly white, and some wild red foxes are black. Dark color phases, called "silver" and "cross", appear among wild populations, and pups in the same litter may be of different color phases.

Non-native red foxes in California rarely weigh over 12 pounds, but some well-fed individuals in cities have weighed nearly 16 pounds. In much of the State, introduced red foxes are typically pale red or straw-colored when adult. Probably, representatives of several subspecies and hybrids of red foxes were introduced in the California lowlands, and they are becoming increasingly hybridized as the subpopulations expand and mix.

The native Sierra Nevada red fox, *Vulpes vulpes necator*, is found from about 4,000 to nearly 12,000 feet elevation in the Sierra Nevada and Cascade ranges. Most individuals have been of the typical red color phase. This rarely seen fox is a State *threatened* species. The range of introduced red foxes probably has not extended into the range of our native fox, but some non-native red foxes have been illegally translocated into that area. The native fox is slightly smaller than the imported one, but they cannot be differentiated by appearance alone.

The **kit fox**, *Vulpes macrotis*, is the size of a small cat, weighing about 3 to 6 pounds. It has a rusty-tinged, pale gray coat. Legs are pale and the tail is noticeably black-tipped. Three subspecies occur from southern to northeastern California. Red foxes are becoming common in the San Joaquin Valley area, the range of the San Joaquin kit fox, *Vulpes macrotis mutica*, a subspecies that is State-listed *threatened* and federally listed *endangered*.

The common fox of the tree- and brush-covered lands throughout California is the **gray fox**, *Urocyon cinereoargenteus*. It weighs about 9 pounds and has a grizzled gray coat and white underparts, with yellowish-red fur on the sides. The coat is darkest along the back, and a black streak is quite noticeable along the top of the tail. Alien red foxes occur in the gray fox range. Compared with a gray fox, the red fox appears larger and its muzzle, legs, and ears are proportionally longer. The red fox has black legs and a white tail tip; the gray fox has gray or rust-colored legs and a black tail tip.

The **island fox**, *Urocyon littoralis*, is similar in appearance to a gray fox but weighs about 5 pounds. This State-listed *threatened* species is found only on several of the Channel Islands off southern California, each island with its own endemic subspecies. Red foxes have not become established on the islands.

The **coyote**, *Canis latrans*, a common species found statewide, is the size of a medium-sized dog, weighing from about 20 to over 40 pounds. It is tawny, gray, or reddish gray. Legs are pale-colored, and the tail is typically black-tipped, but sometimes white-tipped. When running, coyotes hold the tail down, whereas foxes hold it straight out.

What are non-native red foxes doing that is harmful to wildlife in California?

Non-native red foxes in California have become a significant threat to the survival of many endangered animals and are detrimental to local populations of other wildlife, such as waterbirds, ground-nesting birds, and rodents.

Red foxes forage generally at night, covering large areas to search for food and to maintain defense of their territories. They leap upon small prey, such as mice, reptiles, and amphibians. They catch small mammals and birds as large as rabbits and pheasants by stalking and rushing at them or outsprinting them. Often, they bury (or cache) their prey for later use. The foxes also feed on carrion, invertebrates, fruits, and berries. They remove wild bird eggs from nests on or near the ground and cache them. Red foxes that discover a concentration of vulnerable prey may kill far more than they can eat and will either leave the surplus or cache it.

Predation is a natural part of a healthy ecosystem, and native predators are important components of California's natural environments. However, introduced predators, such as the red fox, disrupt natural predator-prey relationships.

Many native wildlife, having evolved in natural ecosystems without red foxes, have little defense against this active predator. The problem is particularly serious in isolated, remnant, or degraded natural areas, or in wildlife habitats near urban areas, where native animals are especially vulnerable to disturbances and predation. Thus, the alien fox can become a dominant species in ecosystems already placed under stress by human-caused impacts on habitats.

The seriousness of the problem of red fox predation in California is becoming apparent from many recent biological studies and from discoveries of major destruction of wildlife by these foxes. Here are some examples:

- In the late 1970s and early 1980s, coyotes temporarily disappeared from Mugu Lagoon in Ventura County, and red foxes moved in and became abundant. Electric fencing failed to protect a nesting colony of the *endangered* California least tern. The foxes preyed so heavily in the beach-nesting colony that the terns were unable to raise young annually until 1983, when fox numbers began to decline after coyotes returned. The terns again produced large numbers of young by 1985, by which time the red fox population had been nearly eliminated by coyotes.
- Red foxes were introduced at Los Angeles International Airport in the late 1970s and became a major predator nearby in the remnant natural habitat of the El Segundo Sand Dunes. 'Red fox predation apparently was the chief reason for the catastrophic disappearance by the mid 1980s of nearly all species of small native mammals that had existed at the dunes in 1975.
- Red foxes were first observed at the Seal Beach National Wildlife Refuge in Anaheim Bay, Orange County, in 1979, and they soon became abundant. By 1986 they had nearly eliminated one of California's last remaining large populations of an *endangered* bird, the light-footed clapper rail. Intensive fox control efforts have been implemented since 1986 and have been effective. Fox trapping and rail nest-site enhancements in the marsh have allowed the rail population to rebound. The highest number of these birds ever documented in the refuge (a minimum of 98 rails) was recorded in November 1991. This contrasts with totals ranging from only 2 to 7 rails during comparable counts from 1984 through 1986.

- At Bolsa Chica State Ecological Reserve, also in Orange County, red fox predation was first suspected in 1979. The foxes soon became common. They were a major cause of nesting failures in island-nesting colonies of California least terns from 1985 to 1988, despite attempts to exclude predators by electric fences. Since 1987, when annual fox trapping was initiated, the terns rebounded to record numbers and nesting success.
- At three Orange County nesting colonies of the *endangered* California least tern, red foxes caused the following damage in 1988:
 - at the Seal Beach -National Wildlife Refuge, red foxes penetrated an electric fence around a 3-acre tern nesting area. The foxes took eggs from 44 of the 69 nests in the colony.
 - at the Bolsa Chica Ecological Reserve, red foxes raided the island tern colony three times. Of 159 nests established by the birds, there were 75 nest failures, most of them caused by egg predation by foxes.
 - at the Huntington Beach colony, red foxes entered the chain-link fenced area and destroyed eggs in 45 of the 104 nests established.
- At the Oakland Airport in San Francisco Bay, red foxes appeared for the first time in 1990, threatening the second largest colony of California least terns in the Bay Area. In 1991, the presence of foxes prevented the terns from nesting there for the first time in 10 years.
- Red foxes appeared along a stretch of coast at Monterey Bay in 1985 and increased dramatically. This has been a major nesting area of the western snowy plover, a small, beach-nesting shorebird now being considered for the federal *endangered* list. In 1990, no eggs hatched in up to half of the 205 plover nests owing to fox predation.
- At the Moss Landing Wildlife Area, Monterey County, nesting colonies of black-necked stilts, American avocets, Forster's terns, and western gulls have been unable to nest successfully in recent years because of red fox predation. In 1989, and again in 1990, red foxes temporarily disrupted a harbor seal nursery, causing adult females on the beach to stampede into the water and leave recently born pups behind.
- In 1989-90 studies of nesting snowy plovers in salt ponds in south San Francisco Bay, red foxes were seen throughout the study area and were a dominant predator, accounting for 89% of observations of all mammalian carnivores. The foxes were suspected of preying upon eggs and chicks of the plovers and were observed taking adults of other shorebird species.
- In San Francisco Bay, the invasion by red foxes into the marshlands in recent years has been devastating to the *endangered* California clapper rail, a subspecies now reduced to a few hundred remaining individuals. A radiotelemetry study has documented that the foxes kill adult rails.
- By 1991, the spread of red foxes in San Francisco Bay had reached the Bair Island marshland wildlife preserve. Red foxes that took up residence that year completely destroyed the largest colony of herons and egrets in the Bay Area, comprising hundreds of nests.
- Red foxes are moving into the range of the San Joaquin kit fox, a State-listed *threatened* species. In several areas, the red foxes may have displaced the smaller kit fox, and there is evidence of these non-native foxes killing kit foxes.

Can the problem be solved without killing the foxes?

By fences? The adaptive red fox can get past standard fences by squeezing through small gaps, burrowing, scrambling over 8 foot vertical chain-link sections, and passing through drainage culverts, even those that are hundreds of feet long. Special fence designs and installation procedures can discourage red foxes, but even then, such expensive predator-resistant fences are only partially effective against them. Fencing has helped reduce red fox and other mammal predation in small areas of a few acres in some cases. However, many refuges and wildlife areas are too large to be completely surrounded and effectively protected by special--predator-resistant fences.

Fence maintenance is continually needed in coastal environments. Because of salt and moisture, special coating is needed to extend the life of any metal fence. On beaches, wind-blown sand must be groomed to keep fences from being buried or undermined.

Electric fences have been useful in some situations but have worked poorly in others. Such fences near the ocean are subject to frequent electrical failures from salt corrosion and moisture-caused short circuits. Major predation by foxes could occur during even a short-term power loss.

Large-mesh, predator-resistant fences are being tested around individual snowy plover nests on some sand beaches and dikes to reduce serious red fox predation. This labor-intensive method can help protect eggs if nests can be found and fenced before the foxes discover them. However, chicks quickly leave the small enclosures and become vulnerable to predation. In a 1991 study, colony hatching success improved but fledgling success remained low, possibly owing to fox predation on recently hatched chicks and fledglings outside enclosures.

Fences present problems in marshlands. Special designs would be needed to accommodate tidal action in coastal areas, for example. To bury a fence a foot or two underground to inhibit fox burrowing is expensive where practicable, but in wetlands, such trenching would destroy native vegetation and cause other environmental damage.

Often, fences themselves are detrimental to survival of native wildlife. Fences placed to protect one species may also seriously impede movements of other species through their habitat. In some areas, such as in naturally treeless coastal marshes, fences erected to protect ground-nesting birds also can benefit predatory birds by creating hunting perches. This is detrimental to local prey populations, including the species intended for protection.

By other nonlethal methods? Islands and moats have been constructed to deter mammalian predators from gaining access to bird colonies and other wildlife areas, but red foxes are capable swimmers. Chemical repellents have been used to attempt to deter carnivores, but so far they have been of little value.

Neutering a large proportion of the foxes would be needed long-term and over a large area in order to significantly reduce fox populations in a region, but even if feasible methods could be devised to do this, it would not end the immediate threats to endangered species. Neutering a fox would not prevent it from continuing to kill animals for the rest of its life.

It is expensive to properly house and maintain the foxes in permanent captivity. If foxes were to be routinely live-captured to protect wildlife, facilities adequate to permanently confine red foxes would be filled quickly. This would raise other ethical concerns.

Can coyotes be reintroduced to control the foxes naturally?

Agencies are considering the reintroduction of coyotes to control red foxes in specific areas where coyotes no longer occur. A major concern is whether the habitat is sufficient to again support a population of these larger carnivores over time. Coyotes need a large area to establish a usable territory. The area must lack the factors that caused the coyote to become extirpated from there in the first place. Restoration of suitable coyote habitat would be needed before coyote reintroduction could be contemplated for some areas. Additionally, protecting the coyotes from human-caused disturbance and mortality and protecting the public must be important considerations.

Since coyotes need fairly large feeding territories, reintroduction has little likelihood of being a feasible natural control method in small, remnant wildlands that are isolated from other wildlife habitats.

One way to help protect vulnerable prey species from serious predation by red foxes is to maintain wildlife reserves that are large enough to allow for the continuing existence of coyote populations. Alternatively, fairly small wildlife habitats connected to other wildlands by creeks, greenbelts, or other suitable natural or artificial wildlife corridors can also provide adequate habitat for coyotes.

Why not just relocate the non-native foxes somewhere else in the wild in California?

Relocating red foxes is not an environmentally acceptable solution to any local problem involving this exotic species. Also, under State law, the red fox is classified as a *prohibited species*, which means that this species may not be imported into California, transported, possessed, or released to the wild without the permission of California Department of Fish and Game.

It is the policy of the Department to deny any request to release non-native red foxes anywhere in California. This applies to everybody, including wildlife rehabilitators, pest control operators, animal control officers, and land developers. Relocations would cause detrimental impacts to local wildlife populations and could lead to the proliferation of the foxes in new areas. This would exacerbate the problems we have now. Unfortunately, one of the factors contributing to the spread of this species has been the relocation of red foxes within California by well-meaning people. In 1988 a well-intentioned wildlife rehabilitation group relocated, without authorization, two non-native red foxes from southern California to Sequoia National Park, which is part of the range of the *threatened* Sierra Nevada red fox. Such illegal releases can only further threaten that already rare native subspecies.

Even if red foxes were neutered before relocation, they would still harm wildlife. Each neutered fox would still prey on wildlife for as long as it lived, which might be many years. Also, neutered foxes could still harm native canine species by spreading disease, disrupting local territories, or causing mortality.

Can they be exported to other states where red foxes are native?

No other state wildlife agency wants to import red foxes from California for release to the wild.

In recent years, the Department of Fish and Game has been requiring that anyone desiring to trap-and export red foxes to another state for rehabilitation or release must first obtain written support and approval from the recipient state wildlife agency. The Department wants to avoid having captured foxes held in captivity indefinitely while efforts are under way to locate a possible receiving state. The Department also wants to ensure that support for the importation of red foxes from California would be clearly expressed in writing by the wildlife agency of the receiving state.

In 1989 and 1990, three entities - the U.S. Fish and Wildlife Service and two private firms - attempted to find states willing to receive red foxes from California. Two of these entities contacted all of the other 47 contiguous states; all three contacted Texas. Some southeastern states indicated that importations for purposes of fox hunting in fenced compounds could be arranged. (Such importations are now being stopped because they contributed to the spread of diseases and were a health risk to wild and domestic animals and to humans.) Other states indicated that they allow importations of red foxes for commercial fur farming.

The requesting parties found that no state wildlife agency wanted to import red foxes for release to the wild. However, Texas further indicated a willingness to consider fox importation requests for rehabilitation or propagation and for subsequent release. In 1991, Texas officials changed that position, primarily because of concerns that fox importations could spread diseases.

There are several biologically sound reasons for not exporting red foxes for release into an area where red foxes currently exist. To move the foxes to another state for release to the wild would increase the chance of spreading diseases from one part of the country to another. It would contribute to the nationwide problem of the intermixing of red fox subspecies. Also, it would artificially increase local populations of red foxes, placing the imported foxes into competition for food and territory with the local fox populations.

The non-native red foxes in California are a mixture of various introduced subspecies of wild foxes and of fur farm breeding stocks from around the country. The genetic source of most introductions is unknown, and over the years, there has been sufficient opportunity for extensive hybridization to occur. It would be expensive, if even possible, to prove that an individual non-native red fox is purely representative of specific subspecies. Consequently, it would not be possible to return foxes to their "area of origin". Their areas of origin cannot be determined.

Why did the California Department of Fish and Game originally resist trying to save a family of red foxes from a freeway project in southern California in April 1991?

Red foxes that had a den beside a nearly completed freeway section in Costa Mesa were well acquainted with freeways and other high speed roads. The female raised pups successfully near another freeway the prior year. These foxes were among a number of family groups being studied by a university student under contract with the Department of Fish and Game. The study was undertaken to determine how this species manages to do so well in the urban environment and to assess the threat these animals pose to endangered species and other native wildlife. A radiotransmitter collar was placed on the male in 1990. Studies of that and other radio-collared foxes had shown that urban foxes routinely cross or circumvent highways and freeways throughout their home ranges with surprising success.

Newscasters of a local television station claimed that the foxes were half-starved and were trapped between a fence and the soon-to-open freeway and would be struck by cars. These newscasters intensively criticized the Department of Fish and Game for not rescuing and relocating the foxes and for wanting to euthanize them instead. However, Department staff contended that the imminent opening of the new freeway stretch was not a serious threat to the foxes, that there was no sanction for relocating them, and that they were best left alone. The newscasters encouraged a strong outpouring of public concern for the welfare of the fox family. Over the next two weeks, Department staff handled an overwhelming number of phone calls and letters from outraged citizens and developed a plan for resolving the issue, at a cost of at least \$25,000 in staff time alone. Under this pressure, the Department arranged for the capture of the female and her six pups on April 28, 1991. They are now in permanent captivity in zoos. The radio-collared male could not be captured, and researchers are continuing to monitor his movements and behavior.

Why didn't the Department of Fish and Game allow those red foxes captured in Costa Mesa to be sent to a rehabilitation center in Texas, which had a permit to receive them?

In past years, a small number of exotic red foxes captured in California were imported by Texas, as authorized by the Texas Parks and Wildlife Department. The permits were for the red foxes to be placed at a wildlife rehabilitation facility. Subsequent releases of the foxes to the wild in Texas were to be considered by that state under a separate permit process.

In 1989 and 1990, letters written by Texas wildlife officials stated that importations of red foxes for release to the wild were not desired by that state. However, the issuance of an importation permit by the Texas permit office on April 24, 1991, for the freeway foxes seemed to contradict that State's recently expressed concerns. So, on May 8, 1991, California Department of Fish and Game wrote to the Executive Director of the Texas Parks and Wildlife Department, requesting written clarification of that agency's policy and procedures on red fox importations. This was done to determine whether the April permit had been issued in full accordance with the policies and desires of the State of Texas.

The Texas Parks and Wildlife Department response stated that importations would present serious health risks to Texas wildlife and the public; that Texas will not authorize any further importation of red foxes for release to the wild; and that the terminated April 1991 permit would not be renewed.

What is being done to keep such exotic species from becoming a threat to California's wildlife, domestic animals, crops, and public health?

California expends millions of dollars annually for control or eradication of introduced populations of exotic plants and animals. Past experiences with importations of exotic wildlife (e.g., the red fox of other states, the English sparrow, the South American nutria, and others) have led in recent decades to legal restrictions to avoid unauthorized or accidental introductions. Releases of exotic wildlife into California are not allowed without first obtaining California Fish and Game Commission authorization. Importations of many kinds of foreign wildlife for captivity also require careful evaluation before permits are granted.

The Department of Fish and Game restricts the importation of red foxes into California, transportation within the State, and exportation to other states for the welfare of the foxes themselves, as well as for the protection of native wildlife from fox depredations and from fox-spread diseases.

Although quarantine is used to control the potential spread of diseases, there is no feasible method available to certify that live foxes are free of rabies and alveolar hydatid disease (a red fox tapeworm that infects humans).

Many laws have been passed to protect California's agriculture, property, public health, and native wildlife and vegetation from damage by exotic wildlife. It is the responsibility of the California departments of Fish and Game, Food and Agriculture, and Health Services; U.S. Fish and Wildlife Service; and other agencies to enforce those laws.

The Department of Fish and Game and U.S. Fish and Wildlife Service are increasing efforts to control exotic red foxes, including use of lethal measures. Such control will be necessary to protect native wildlife in more places in the future as the red fox population expands.

Is it the State's policy to eradicate these foxes?

No State or federal governmental agency in California has yet proposed or adopted a policy to eradicate these introduced foxes. The non-native red fox has become so abundant and widespread that any effort to eliminate or even significantly reduce the statewide population would be impractical with currently available methods and resources. The cost likely would be prohibitive.

For red foxes and other well-established non-native species that are detrimental to wildlife and the public, such as Norway rats and starlings, control in localized areas is all that can realistically be undertaken.

Red fox control efforts are not being done on a scale that would reduce the statewide population. However, in some local areas, such as wildlife refuges, foxes are killed for the protection of endangered species or other wildlife where nonlethal methods have failed or are not feasible. Other local fox control efforts have been made when property or human safety are threatened. All of these areas together represent only a small fraction of the statewide range and numbers of introduced red foxes in California.

How does one go about arranging for red fox control?

Anyone desiring to kill or capture a red fox must first obtain a permit from California Department of Fish and Game, except for public health reasons. Non-native red foxes that cause damage to property may be killed by the property owner or a designee under a depredation permit or other permit from California Department of Fish and Game. Property owners may request Animal Damage Control (ADC), a U.S. Department of Food and Agriculture agency, to trap foxes that are causing damage. ADC has State permission to trap them and has the expertise to conduct red fox control measures. This may be done in the 38 counties that contract with ADC for predator control. For example, ADC was called upon to trap red foxes at San Jose International Airport, because the foxes, which were being struck by aircraft on runways, had become a hazard. State and federal wildlife agencies may control foxes on public lands for protection of wildlife or may contract with ADC to do so.

No red foxes may be taken in the range of the Sierra Nevada red fox, unless permitted by the Department of Fish and Game. Although this native subspecies has not been found below 3,900 feet in elevation, the Department should be contacted first about any activity involving the take of any red foxes above 2,000 feet elevation in the Sierra Nevada and Cascade ranges.

Persons wanting to catch and relocate red foxes to another state must first obtain written concurrence from that state's wildlife agency, and an import permit, before California would issue permits for capturing and moving them.

If the red foxes must be killed, are humane methods used?

The main method of lethal control of red foxes for wildlife protection involves live capture and euthanasia, which is done as selectively and humanely as possible. Agencies have made a concerted effort to use humane methods to trap these foxes. Walk-in cage traps are sometimes used, but the preferred trap is the more efficient leg-hold type. Commercial padded traps were too inefficient for endangered species protection efforts in the mid 1980s, when control efforts began, but improvements have been made. In recent years, well-padded traps, such as the "Soft-Catch" trap, have been used that are efficient and greatly reduce injuries to foxes. State and federal red fox control programs do not employ bare steel-jawed traps.

Traps are checked often and trapped foxes are quickly and humanely killed by shooting or, more commonly, by lethal injection. Injection with sodium pentobarbital, commonly used by veterinarians, kills quickly and humanely. Contrary to claims by certain groups, the trapped foxes are not being killed by crushing their chests under foot, and pups in dens are not killed by gas or sharp instruments. Pups are not left in dens to starve but are dug out and removed by hand and are then euthanized by injection.

One group claimed that governmental agents involved in trapping had been illegally using a banned euthanasia agent until they were threatened with a lawsuit. The claim was that the drug, T-61, was an unacceptable euthanasia agent that caused intense pain, extreme convulsions, and agony. Actually, T-61 is a drug that was commonly used by veterinarians and animal shelters in recent decades for mammal euthanasia. It did not cause negative side effects when properly injected by experienced persons. Past use of T-61 for red fox euthanasia was done legally and humanely. The manufacturer of T-61 discontinued its production in recent years. This agent is no longer used for red fox euthanasia only because supplies became exhausted. Use of T-61 for euthanasia was not banned.

Is there a fur trapping season on red foxes?

The taking of any red fox (including all color variations) for profit-making purposes is prohibited by California law. This law was adopted expressly for the protection of the native Sierra Nevada red fox, a State-listed *threatened* mammal. Because the native and non-native red foxes are so similar in appearance, the law was written to protect both from commercial trapping. Anyone who would illegally take a native red fox could not legally sell or export its pelt under pretense of its being the pelt of a non-native red fox.

May red foxes be kept as pets?

California laws require a person to have a permit issued by California Department of Fish and Game before importing, exporting, possessing, transporting, or releasing any red fox. In few instances will such permission be granted, and because of the seriousness of the non-native fox problem statewide, restrictions are being tightened.

Any person who has a pet red fox in California is in violation of State regulations. There are no valid permits for anyone in California to possess a pet red fox.

Red fox pups are charming but do not make good pets. Like other wild predatory animals, young red foxes raised in captivity require a great deal of time and attention. But raised in a household, they soon become unmanageable, causing great damage by their chewing and urinating. Also, they have a strong, somewhat skunk-like odor. Most young foxes raised by people end up either living in a cage; being given to the rare zoo that would want one; being turned over to an animal welfare facility or animal shelter; or being released to the wild or escaping, thus adding to the problem. One of the first red foxes recorded in Los Angeles County (in 1968) was a road-killed individual that was wearing a dog collar.

Few zoos or other animal holding facilities desire to receive red foxes, and even fewer have been authorized to do so. Released hand-reared foxes have a low likelihood of surviving for long in the wild. If they do survive, they do so at the expense of other wild animals, and they might contribute to the establishment of new breeding populations.

Are red foxes a threat to pets and other domestic animals in urban areas?

Red foxes in urban areas do kill domestic animals, as they do in rural areas. For example, when a family of foxes next to a Costa Mesa freeway construction site was being closely monitored, the observers saw the male bring a domestic rabbit to the den from the surrounding densely urbanized area.

Red fox food habits are being investigated by Humboldt State University researchers as part of the Department-contracted fox study in urban Orange county. Carcasses found at red fox dens and cache sites in urban areas have included domestic rabbits, cats, and numerous domestic chickens and ducks, in addition to many wild animals. Researchers and the public in that study area have reported seeing domestic animals being killed by red foxes.

Do red foxes spread diseases?

The greatest public health concern presented by red foxes is the risk of their spreading rabies. Worldwide, this species is well known for being at high risk for carrying rabies and for transmitting it to other mammals. Periodically, rabies spreads through red fox populations, causing significant mortality in areas of the world where the fox rabies virus has become prevalent. It is a major control on red fox populations in those areas. Incidents of fox rabies in California are uncommon; however, fox rabies outbreaks in gray foxes-occurred in southern California in the 1960s and have occurred recently in Texas and Arizona.

Red foxes are capable of carrying and spreading many other kinds of diseases detrimental to their own species, other canines, other wildlife, and to the public. Larval forms of tapeworm found in foxes are infectious and dangerous to many animals, including humans. Red foxes are also quite susceptible to distemper and can pass on the infection to other animals. Sarcoptic mange, an infectious skin disease that is sometimes fatal to red foxes, is fairly common in the non-native population in California. Fleas on foxes could transmit bubonic plague to humans and rodents if the fox previously had been in contact with infected rodents.

FURTHER READING

- Ables, E.D. 1975. Ecology of the red fox in North America. Pages 216-236 in M.W. Fox (ea.), *The wild canids - their systematics, behavioral ecology and evolution*. Behavioral Science Series. Van Nostrand Reinhold Co., New York, 508 pp.
- Anonymous. 1991. Exposition: Freeway foxes. *Terra*, 30(2):46.
- Burkett, E.E., and J.C. Lewis. 1992. The spread of the red fox. *Outdoor California*, 53(2):1-6 (in press).
- California Department of Fish and Game. 1991. 1990 annual report on the status of California's state listed threatened and endangered plant and animals. Fifth annual report. The Resources Agency, Calif. Dep. Fish and Game, Sacramento. 207 pp.
- Culotta, E. 1991. Biological immigrants under fire. *Science*, 254:1444-1447.
- Foerster, K.S., and J.E. Takekawa. 1991. San Francisco Bay National Wildlife Refuge predator management plan and final Environmental Assessment. U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge, Newark, CA. 54 pp.
- Gould, G.I. 1980. Status of the red fox in California. Calif. Dep. Fish and Game, Nongame Wildlife Investigations, Job I-8, Progress Rep. 3 pp.
- Gustaitis, R., and R. McGrath. 1991. Species Wars - Red fox: Urban charmer, alien menace. *California Coast & Ocean*, 7(3):24-26.
- Laycock, G. 1966. The alien animals: The story of imported wildlife. Ballantine Books, Inc., New York. 246 pp.

- Roest, A.I. 1977. Taxonomic status of the red fox in California. Calif. Dep. of Fish and Game, Nongame Wildlife Investigations, Job 11-1.3, Final Rep. 15pp.
- Samuel, D.E., and B.B. Nelson. 1982. Foxes. Pages 475-490 in J.A. Chapman and G.A. Feldhamer (eds.). Wild mammals of North America. The Johns Hopkins Univ. Press, Baltimore. 1147 pp.
- Sargeant, A.B., S.H. Allen, and R.T. Eberhardt. 1984. Red fox predation on breeding ducks in mid continent North America. Wildlife Monographs, 89. 41 pp.
- Soule, M.E., D.T. Bolger, A.C. Alberts, J. Wright, M. Sorice, and S. Hill. 1988. Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. *Conservation Biology*, 2(1):75-92.
- Soule, M.E. 1990. The onslaught of alien species, and other challenges in the coming decades. *Conservation Biology*, 4(3):233-239.
- State of California. 1991. Fish and Game Code of California. Gould Publications, Inc.
- State of California. 1991. California Code of Regulations: Title 14, Natural Resources.
- U.S. Fish and Wildlife Service and U.S. Navy. 1990. Endangered species management and protection plan, Naval Weapons Station - Seal Beach and Seal Beach National Wildlife Refuge. Final Environmental Impact Statement. U.S. Fish and Wildlife Service, Portland, OR.
- Voigt, D.R. 1987. Red Fox. Pages 379-392 M. Novak, J. Baker, M. Obbard, and B. Malloch (eds.), Wild furbearer management and conservation in North America. Ministry of Natural Resources, Ontario, Canada.