



Biology, Policy and Law in Endangered Species Conservation: I. The Case History of the Island Fox on the Northern Channel Islands

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Abstract

Endangered species recovery often requires strategies that are risky, contentious, and difficult to implement. These qualities can lead to recovery actions that result from human dimensions of endangered species conservation instead of biological extent. Here we discuss the recovery actions implemented by the National Park Service in conserving three subspecies of the critically endangered island fox, *Urocyon littoralis*. We present an overview of how these subspecies became endangered, chronicle the existing and future threats to their persistence, and summarize the actions implemented and needed to save the fox from extinction. Similar to other endangered species programs, this recovery program suffers from a bureaucracy that prevents timely implementation of recovery actions and that is risk averse in its strategies to save the fox. Consequently, even though a wealth of biological information now exists on this species and the threats to its existence are well known, necessary recovery actions are being delayed. Bold, aggressive, and controversial actions are likely to be requisites to save the island fox from extinction.

Resumen

La recuperación de especies en peligro muchas veces necesita estrategias arriesgadas, contenciosas, y difíciles de implementar. Estas características pueden derivar en acciones de recuperación que resultan de las dimensiones humanas de la conservación de especies en peligro en lugar de la dimensión biológica. En este artículo, discutimos las acciones de recuperación implementadas por el Servicio de Parques Nacionales en la conservación de tres sub-especies de la críticamente amenazada el zorro isleño, *Urocyon littoralis*. Presentamos una visión de conjunto de como estas sub-especies han llegado a estar en peligro de extinción, describimos las amenazas presentes y futuras, y resumimos las acciones implementadas y las necesarias para salvar al zorro de la extinción. Igual que otros programas de especies amenazadas, este programa de recuperación sufre los efectos de una burocracia que impide la implementación oportuna de acciones de recuperación y que es adversa al riesgo. En consecuencia, aun cuando hoy existe abundante información biológica sobre esta especie y se conocen muy bien las amenazas a su supervivencia, las acciones necesarias para lograr su recuperación no se ejecutan. Para salvar el zorro isleño de la extinción, acciones audaces, agresivas, y controversiales son probablemente las indispensables.

Introduction

A premier and vital piece of endangered species legislation, the U.S. Endangered Species Act (ESA), has been critiqued and often criticized on its efficacy (Clark et al. 1994; NRC 1995; Clark et al. 2002; Kareiva 2002; Roemer & Wayne 2003). Although criticism stems from how the law is worded and its intent (e.g., single species vs. multiple species vs. ecosystem approaches), most censure reflects not an inadequacy in the

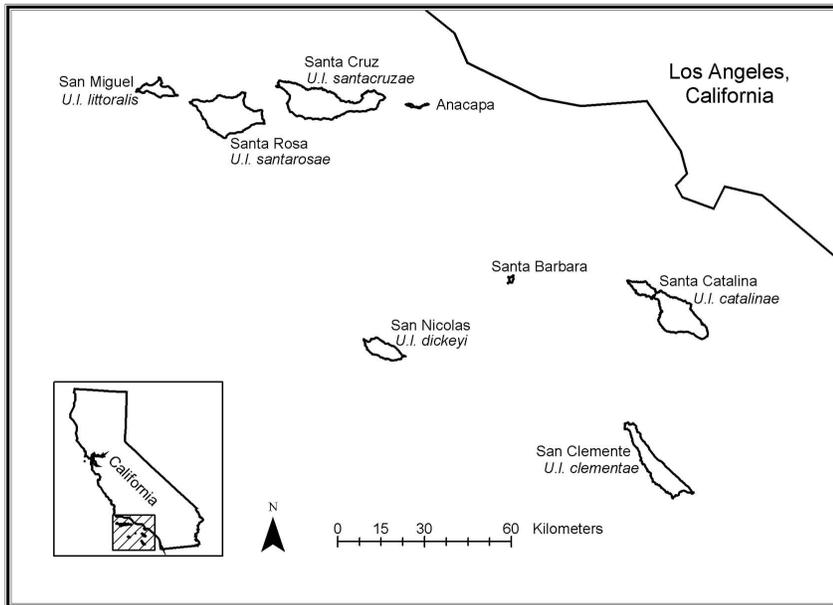


Figure 1. Island foxes (*Urocyon littoralis*) are distributed as six insular populations, each recognized as a separate subspecies, within the California Channel Islands. An archipelago located off the southwestern coast of the United States.

structure of the law itself, but rather in its implementation. Endangered species recovery plans frequently lack detailed biological information on the species at risk, and the threats to the species persistence are often not the primary focus (Tear et al. 1995; Clark et al. 2002; Lawler et al. 2002). Even when sound decisions based on the biology of the species at risk can be reached and implemented, the legal, political, and financial realities of endangered species conservation can take precedence. Because "the ultimate causes of most species' endangerment lie in human values that are manifest in varying social, economic, and political institutions and activities" (Clark et al. 1994: 419), such institutions must be engaged for recovery to elude failure (Clark and Wallace 1998). Here we summarize the evolution of a current endangered species issue that concerns the decline and conservation of the island fox (*Urocyon littoralis*), a carnivore

endemic to the California Channel Islands. This first essay describes the conservation scenario of the island fox on the northern Channel Islands; future essays portray the conservation of fox populations on the southern Channel Islands (Figure 1). Our focus is to present the biological issues that should be paramount and discuss the real world issues that are.

One of only two species of the genus *Urocyon*, the island fox is a dwarf form and direct descendant of the mainland gray fox (*U. cinereoargenteus*). It is restricted to the six largest of the eight California Channel Islands (Figure 1; Moore and Collins 1995). Each island fox population is recognized as a separate subspecies (Collins 1982, 1993; Wayne et al. 1991; Goldstein et al. 1999). It is hypothesized that over 20,000 years ago, gray foxes colonized the northern Channel Islands when the three islands were connected as one large island (Santa Rosae), a land mass located only six kilometers from the North American continent (Collins 1993). At the end of the Pleistocene era sea levels increased, splitting Santa Rosae into the northern Channel Islands and creating three island fox populations (Figure 1). Approximately 10,000 years ago, Native Americans colonized the Channel Islands and then transported foxes from the northern Channel Islands to the southern Channel Islands (Santa Catalina, San Clemente and San Nicolas) as either pets or semi-domesticates (Collins 1991a, 1991b). Thus, the island fox's association with humans is a deep one that historically contributed to their biogeographical distribution and differentiation, and one that today has brought the species to the brink of extinction.

Currently, the three northern island fox subspecies are critically endangered owing to heightened predation by a novel apex predator, the golden eagle (*Aquila chrysaetos*), whose presence was facilitated by an exotic prey, feral pigs (*Sus scrofa*; Roemer et al. 2001, 2002). The subspecies on San Miguel (*U. l. littoralis*) and Santa Rosa Islands (*U. l. santarosae*) are extinct in the wild and the subspecies on Santa Cruz Island (*U. l. santacruzae*) has declined from approximately 1500 adults in 1994 to less than 100 in 2003 (Roemer et al. in

press). These three subspecies, along with a fourth on Santa Catalina Island (*U. l. catalinae*), are currently being considered for protection under the ESA (USDI 2001).

In response to the decline of the island fox on the northern Channel Islands, the National Park Service (NPS) in collaboration with The Nature Conservancy (TNC) developed a recovery plan for the island fox (Coonan 2003a) and a restoration plan for Santa Cruz Island (USDI 2002). The ownership and management of Santa Cruz Island is split between the NPS and TNC. Both plans employ an ecosystem approach that includes: 1) captive breeding and eventual release of island foxes to the wild, 2) monitoring of the wild fox population remaining on Santa Cruz Island, 3) live-capture and removal of golden eagles, 4) reintroduction of bald eagles (*Haliaeetus leucocephalus*) as a potential deterrent to nesting golden eagles, 5) eradication of feral pigs, and 6) control of invasive plants such as fennel (*Foeniculum vulgare*). An ad hoc group of experts from academia, non-governmental organizations, and federal and state resource agencies was also established to guide the fox recovery effort (Island Fox Conservation Working Group; Coonan 2003a).

Despite this holistic approach, which includes the recovery of the fox as a focal point, the plan suffers not in concept, but in timing and implementation. These deficiencies result from a bureaucracy that prevents timely implementation of recovery actions (Miller et al. 1996), an organizational policy that is conservative and risk averse, and an authority and control structure that places key decisions in the hands of administrators rather than scientists and managers that are advising and implementing the actions on the ground. A brief chronology of events may help to elucidate these points.

The Chronology of a Decline and the Creation of an Endangered Species

Prior to the decline of the island fox on the northern Channel Islands, a monitoring program was established on several islands to track their demography (Roemer et al. 1994; Coonan

et al. 2000). The establishment of a monitoring program within Channel Islands National Park was initially opposed by some staff due to differing opinions and attitudes toward its usefulness (e.g., previous trapping has made foxes "skittish"), as well as politics with past landowners from whom Santa Rosa Island was purchased (Coonan and Schwemm 1995). Despite this opposition, monitoring programs were established on San Miguel and Santa Cruz islands; these programs would later prove instrumental in a viability analysis that formed the biological basis for the fox recovery plan (Roemer 1999; Roemer et al. 2000b; Coonan 2003a).

On Santa Cruz, additional facets of island fox biology were intensively studied, including demography, social organization, foraging ecology, and disease ecology (Roemer 1999). As island fox research progressed, fox survival began declining rapidly. Monitored populations were plummeting, and the agent(s) of the decline were unknown. Disease, in particular heartworm (*Dirofilaria immitis*), was initially suspected in playing a role in the island fox decline (Crooks et al. 2001). However, further study implicated predation by golden eagles as the primary agent of decline (Roemer et al. 2000a, 2001, 2002). Golden eagles colonized the northern Channel Islands in 1994 and began to prey heavily on foxes. In the first nine months of the Santa Cruz study, none of the 32 radio-collared foxes had died; 17 months later, cumulative survival dropped to 0.21 and by 1998 the study population was extirpated. The decline in foxes on Santa Cruz was linked to the presence of feral pigs. Pigs, by acting as an alternative, abundant food source, allowed golden eagles to colonize the island and through the process of apparent competition drove the foxes toward extinction. This dynamic also had community-level implications: the decrease in foxes allowed its only competitor, the island spotted skunk (*Spilogale gracilis amphiala*), to increase in numbers. The interaction between the native, introduced, and colonizing species caused apparent competition to replace resource competition as a dominant force structuring the vertebrate community on Santa Cruz Island (Roemer et al. 2002).

During this same period (1993 – 1996), the NPS documented a coincident decline in foxes on nearby San Miguel Island. The monitoring program revealed that the fox population had dropped from an estimated 300 adults in 1993 to less than 100 by 1996 (Coonan et al. 2000; Roemer et al. 2001). Estimated fox density on one grid dropped from 15.9 foxes/km² in 1994 to 0.9 foxes/km² in 1996; this study population was extirpated the following year. To investigate whether golden eagles were also the agent of decline on San Miguel, the Resources Management division requested \$40,000 from the National Park Service Western Region in 1996 to implement a survival study using radio telemetry. The request for funds was denied (T. Coonan, pers. comm.). Research funds were eventually obtained in the fall of 1998. Seven of the 15 radio-collared San Miguel foxes died between November 1998 and July 1999, five as a result of eagle predation (Roemer et al. 2001). By summer 1999, five years after golden eagle predation had been identified as the principal mortality factor for foxes on Santa Cruz, only 15 foxes were known to be alive on San Miguel.

During the same period that fox populations on San Miguel and Santa Cruz were rapidly declining, there was concern that the population on Santa Rosa, where monitoring had been thwarted, was also declining. In 1998, trapping efforts on Santa Rosa validated the concern; only 9 foxes were captured in 132 trap nights (Roemer et al. 2001). Foxes had declined precipitously on all three northern Channel Islands and were in danger of extinction.

The decline of the fox populations on Santa Cruz and San Miguel was documented because monitoring programs were in place. Further, the agent of the decline, golden eagles, was elucidated due to the in-depth study on Santa Cruz, albeit somewhat serendipitously. In response to these declines, 14 of the remaining 15 foxes on San Miguel were taken into captivity under what was termed “protective custody” and a captive breeding program initiated in 1999 (Coonan 2003a). While a captive facility was also needed on Santa Rosa where only 9 foxes

had been captured the previous year, the establishment of a second facility was delayed because of funding restrictions and prohibitive logistical considerations. Eventually, due to local public sentiment spearheaded by local media coverage (Johnson 1999) and insistent support from the scientific community, additional funds were supplied by the NPS and a captive facility for island foxes on Santa Rosa was established in 2000. Only 14 foxes could be found to initiate this second captive facility (Coonan 2003a). Island foxes are now extinct in the wild on San Miguel and Santa Rosa islands, with a total of 38 and 56 foxes currently in captivity, respectively (Coonan 2003a). If these facilities had not been established, it is likely that these subspecies would have gone extinct.

The Next Step: The Complete Removal of Golden Eagles

Given the impact of golden eagle predation on fox survival and population dynamics, it was clear that reducing the number of golden eagles on the islands would be necessary if foxes were to recover. In 1999, the first confirmed golden eagle nest was located on Santa Cruz Island (Roemer et al. 2001), with subsequent nests located on Santa Cruz and nearby Santa Rosa (Coonan 2003a). In November 1999, the Santa Cruz Predatory Bird Research Group under contract by the NPS captured the first golden eagle on Santa Cruz (Coonan et al. in press). Through June 2003, a total of 31 golden eagles were translocated (26 juveniles, sub-adults and adults, and 5 nestlings; Coonan 2003a). Despite the success of the live-capture program, golden eagles still remain and continue to prey on wild foxes. Four to five golden eagles are thought to remain on Santa Cruz with 1-3 eagles on Santa Rosa (Coonan 2003a, 2003b). After eagle removal was initiated, continued monitoring of wild foxes on Santa Cruz revealed that eagles killed 16 of 19 radio-collared foxes found dead between 2001 and 2003 (Coonan et al. in press).

Although golden eagle removal efforts have been successful, the inability to remove all resident eagles from the northern Channel Islands is preventing fox recovery. An additional step in fox

recovery and island restoration includes a plan to eradicate feral pigs from Santa Cruz (USDI 2002). This action will help restore vegetation on the island and should remove the eagles' prey base thereby leading to eagle disappearance. A recent modeling exercise suggests caution in the implementation of such a strategy while eagles remain (Courchamp et al. 2003). Given the susceptibility of foxes to golden eagle predation (e.g., of 47 radio-collared foxes found dead since 1994, 40 were killed by eagles), removal of pigs, a key prey item, could increase predation pressure on foxes. This would drive the remaining wild foxes on Santa Cruz further towards extinction.

While live-capture efforts of golden eagles are continuing, certain eagles have proved difficult, if not impossible to capture. Such individuals may require lethal removal (Courchamp et al. 2003). Lethal removal of an emblematic bird like the golden eagle is, by necessity, emotionally charged, politically unsavory and legally challenging. Resource agencies are necessarily wary of instituting such a policy owing to public sentiment and perception of the agency's role as protectors of our natural heritage. Membership organizations such as TNC are also likely to be wary of such aggressive actions that may reduce their donations and consequently constrict their funding base. In addition to the political obstacles, golden eagles are protected in the United States by two federal laws, the Migratory Bird Treaty Act (1918) and the Bald Eagle and Golden Eagle Protection Act (BEGEPA; as amended in 1962). While both acts prevent "take" of golden eagles, the Secretary of the Interior can grant exemptions. For example, in the 1962 amendment, the Secretary, on request from a state governor, can authorize the taking of golden eagles "for the purpose of seasonally protecting domesticated flocks and herds in such State,...in such part or parts of such State and for such periods as the Secretary determines to be necessary to protect such interests" (16 U.S.C. § 668a). If domesticated flocks are worthy of eagle protection, surely nearly extinct endemic taxa are as well. Moreover, golden eagles have a Holarctic distribution and are not threatened with

extinction in North America. Recent population surveys within the Intermountain West suggest that golden eagles exhibit regular population cycles coupled to their prey, and, although the most recent trends suggest a decrease in numbers in the western U.S., eagle numbers are generally stable or increasing particularly at high latitudes (Hoffman and Smith 2003). The BEGEPA was further amended in 1978 authorizing the Secretary to permit "the taking of golden eagle nests which interfere with resource development or recovery operations." This additional non-lethal approach to reducing golden eagle breeding attempts has not been pursued. There is no legal precedence for not pursuing lethal removal. Public perception and financial burden also should be viewed in light of the critical state of the island fox; averting extinction should be paramount. The lack of action on the development of lethal removal options by the NPS and the U.S. Fish and Wildlife Service represent risk averse strategies to endangered species recovery that places political and financial considerations above biological ones, and which ultimately ignores the main impediment to fox recovery (Clark et al. 2002). Certainly no resource organization wants to see golden eagles shot or the fox go extinct, yet the resource agencies involved appear unwilling to pursue controversial actions that could possibly ensure recovery and would certainly speed implementation of recovery actions (e.g., successful release of captive-borne foxes). Unfortunately, politics continues to precede biology in the recovery of the fox.

The Release of Captive-Reared Island Foxes in the Presence of Golden Eagles

In response to the overwhelming evidence that golden eagle predation caused the decline in foxes and is preventing their recovery, both the Island Fox Conservation Working Group and the IUCN/SSC Canid Specialists Group support the maintenance of the captive breeding facilities and the retention of foxes within until the threat of golden eagle predation can be completely mitigated (Coonan 2003a,b; <http://www.canids.org>). Despite this advice, the NPS unilaterally released six

captive-borne foxes on Santa Rosa and three captive-borne foxes on Santa Cruz on November 20 and 21, 2003, respectively (Coonan 2003c). More releases were planned for December 10, 2003. The NPS suggested that these releases were conducted for three reasons: 1) begin the recovery of the wild fox populations, 2) evaluate survivorship of the released foxes, and 3) evaluate alternative release methods. These motives are flawed on several fronts. First, with eagles still present on the islands, there is little hope that recovery of wild populations can occur. Since the initiation of golden eagle removal on Santa Cruz, the wild fox population has declined from an estimated 133 individuals to less than 70. Annual measures of survival are still too low to allow recovery (Roemer et al. 2000b, 2001; Coonan 2003a). Other factors related to small population size, such as Allee effects, demographic and environmental stochasticity or disease also could doom the remaining foxes (Roemer et al. 2000b, 2001; Timm et al. 2002). Second, the survival of released foxes would most likely be lower than the survival of wild foxes (Breitenmoser et al. 2001). Wild foxes on Santa Cruz have been experiencing predation pressure from golden eagles for nearly a decade and may have responded to such intense selection by becoming more nocturnal (Roemer et al. 2002). There is no reason to expect that captive-borne foxes that have not experienced predation nor have been conditioned to avoid predation would have a higher survivorship than wild foxes. Moreover, in 2002, NPS released three captive-borne foxes on Santa Cruz and two were killed by golden eagles (Coonan 2003a). Finally, the small sample size of foxes being released, their make-up (on Santa Rosa one mated pair and four juvenile females and on Santa Cruz one mated pair and one adult male were released), and the similar manner of release would preclude a valid comparison of "alternative release methods." In sum, the release of island foxes was, at the least, a poor attempt to rigorously evaluate the efficacy of fox recovery, and was most likely a response to the fact that captive breeding facilities were either at capacity or have exceeded

capacity and the NPS lacked funds to sustain such captive populations (Coonan 2003b).

Conclusions and Recommendations

In March 2004, four of the six fox subspecies will likely be granted protection under the ESA. A strategy has been formulated that lists actions needed for recovery, including objective criteria for defining a successful recovery and the costs of such an effort (Coonan 2003a). These objectives are requirements of a recovery plan structured under the ESA (Clark et al. 2002). The current recovery strategy also has taken advantage of information amassed on the evolutionary biology and ecology of the island fox over the past two decades. This information has identified the primary threats to the persistence of fox populations, and has provided the biological foundation necessary for the development of a sound recovery plan. Nevertheless, the current approach to saving the fox has suffered from delays (e.g., establishing the San Miguel and Santa Rosa captive breeding facilities), conservative risk-averse actions (e.g., lack of pursuit of lethal removal of golden eagles or non-lethal destruction of nests), and unilateral decisions that have led to actions based on agency agenda and constraints rather than on sound science (e.g., release of captive-borne foxes in the presence of golden eagles). Further, research projects suggested by Working Group members that could improve fox recovery, such as a comparison of activity patterns in captive versus wild foxes on Santa Cruz and mate choice studies of captive foxes, have also not been pursued.

The lethal removal of golden eagles is a valid and sound management option. And the legal, public, and political obstacles are surmountable. In stark contrast to killing a few golden eagles on Santa Cruz Island, a wind farm in the Altamont Pass of California has resulted in an annual take of 40 - 60 golden eagles and an estimated total take of between 600 - 1,000 eagles (Center for Biological Diversity 2003). It seems ironic that the USFWS has not prevented take of golden eagles at Altamont Pass but at the same time, has failed to initiate lethal removal on Santa Cruz Island to save the fox.

While certain progressive long-term approaches, such as the reintroduction of bald eagles, are underway that may contribute to fox and ecosystem restoration, the necessary immediate and aggressive actions needed to save the fox have not been pursued. Politically based, risk-averse decisions that have plagued other endangered species recovery programs (Clark et al. 1994; Miller et al. 1996) are influencing the recovery of the island fox, and the species has yet to receive protection under the ESA.

The ESA is promulgated under the concept that sound science will prevail over alternative actions that could negatively influence the recovery of endangered or threatened species. Biology is the foundation upon which species at risk are identified and upon which recovery programs must rest. Nevertheless, the realities of endangered species conservation all too often go well beyond biology, in fact, the issues surrounding the laws, organizational policy, funding constraints, and even personal gain may influence recovery trajectory more than species biology does (Miller et al. 1996). The structure of the ESA may not be flawed, but often implementation of the law is. There are ways in which it may be improved. Echoing others who have proposed similar action (Clark et al. 1989; Tear et al. 1995; Clark et al. 2002), we believe the constituency of recovery teams and the authority invested therein is a critical component that could be improved (Miller et al. 1996; Gerber & Schultz 2001). All too often members of recovery teams stand to gain from the selected course of action or are constrained to support an agency agenda. We recommend that alternative members including individuals who guide the process but do not gain from it, similar to a National Science Foundation review panel, should be established. This governing body also should wield legal authority under the ESA to enforce recovery actions and prevent misguided management actions that are based on factors other than biology. For the recovery of our endangered species, biology must be foundational and our policies bold.

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