

GOLDEN EAGLE MANAGEMENT STRATEGY

Summary

This strategy fulfills a requirement for delisting island foxes, namely that management agencies have in place an effective strategy for monitoring golden eagles and eagle predation on foxes, and for mitigating such predation should it occur in the future. Under this strategy, significant predation (due to adult eagles attempting to breed, or multiple mortalities clustered in time or space), will be mitigated by ground or helicopter-based capture attempts, using methods proven in the successful removal of golden eagles from the northern Channel Islands. Monitoring for eagle predation will be via weekly mortality monitoring of a sample of radiocollared foxes on each island, with predation mortality identified in the field by known characteristics of golden eagle predation on foxes (such as evisceration and degloving). The probability of future golden eagles successfully breeding on the islands will be minimized by the removal of nonnative ungulate prey and the reintroduction of bald eagles, both now complete, as well as active engagement (harassment) with any eagles attempting to breed. Should mitigation of significant predation fail, and fox populations fall below a predetermined level, island foxes will be brought into captivity (pens and capture equipment currently remain on the islands).

Background

Predation by golden eagles in the mid-1990s nearly drove the three northern Channel Islands subspecies of island foxes to extinction (Coonan et al. 2010). Extinction was avoided and island fox populations recovered due to the success of recovery actions such as island fox captive breeding and reintroduction, and the capture and relocation of golden eagles from the islands. A total of 44 golden eagles were removed from Santa Cruz and Santa Rosa Islands, the bulk captured by bownet traps, one by a dho-gaza trap, and two via netgunning from a helicopter (Coonan et al. 2010). Island fox reintroduction to the wild began while some golden eagles remained on the islands, and other transient eagles have appeared on the islands in recent years and have been responsible for predation (Coonan and Guglielmino 2012). Recent predation has been detected primarily by mortality monitoring of radiocollared island foxes, because golden eagles are surprisingly stealthy, and golden eagle predation on a fox carcass is easily identified in the field.

Island foxes will always exist at small population sizes (500-1500 individuals) and will remain vulnerable to catastrophic mortality sources, such as disease and predation. It has long been the consensus that long-term vigilance and the capability of responding to future diseases and predation are necessary for island fox persistence; hence the inclusion of epidemic response plans and eagle management strategy in the island fox recovery plan (USFWS 2015). Fortunately, the tools for dealing with predation, as well as disease, are well-established and the management agencies have recent experience successfully using them to recover island foxes. In 2004, the Island Fox Recovery Coordination Group assigned a task force to evaluate the efficacy of golden eagle removal efforts and methods. The resulting analysis, Analysis 4.1, Assessment of Golden Eagle Removal Efforts and Suggestions for Future Directions,

describes each method and its track record or likelihood of success, and remains a valuable resource for eagle management.

Guidance from the Recovery Plan

Recovery Objective 2 in the draft island fox recovery plan (USFWS 2015) requires land managers to address the threat of future golden eagle predation before island foxes can be delisted:

Land managers are able to respond in a timely fashion to predation by nesting golden eagles or significant predation rates by transient golden eagles, to potential or incipient disease outbreaks, and to other identified threats using the best available technology.

C/1: Golden eagle predation:

To reduce the threat of extinction to the San Miguel Island fox, the Santa Rosa Island fox, and the Santa Cruz Island fox from golden eagle predation:

1. *A golden eagle management strategy is developed and approved by the land manager(s) in collaboration with the FWS, including review by the appropriate Integrated Island Fox Recovery Team (IRT) Technical Expertise Group (TEG) or the equivalent. This strategy must include:*
 - *Response tactics (including the use of helicopters and net-guns) to capture nesting golden eagles and any transient golden eagle responsible for significant island fox predation per the golden eagle response strategy;*
 - *Tactics to minimize the establishment of successful nesting golden eagles;*
 - *An established island fox monitoring program for each subspecies that is able to detect an annual island fox predation rate caused by golden eagles of 2.5 percent or greater, averaged over 3 years; and*
 - *An established mortality rate or population size threshold for each subspecies of island fox that, if reached due to golden eagle predation, would require the land manager(s) to bring island foxes into captivity for safety.*

2. *The golden eagle prey base of deer and elk is removed from Santa Rosa Island.*

Criterion C/2 has been met. As of 2015, all elk and all but a few sentinel mule deer have been removed from Santa Rosa Island, completing the removal of non-native ungulate prey from the northern Channel Islands.

This golden eagle management strategy fulfills Criterion C/1 by formulating a general approach for monitoring eagle predation on foxes and the presence of eagles on the islands, responding to predation, preventing future golden eagle breeding, and setting a threshold for reestablishing captive breeding.

Strategy

Some or all of the following actions will be employed to monitor and mitigate future eagle predation on island foxes on the northern Channel Islands. All of the methods have been used previously on the northern Channel Islands, during the successful mitigation of eagle predation in the early 2000s.

Response Tactics

If predation triggers are reached, appropriate measures will be taken to mitigate golden eagle predation. The triggers that elicit response are:

- Evidence of predation on foxes by adult golden eagles attempting to breed on the northern Channel Islands
- A temporal or spatial cluster of predation mortalities: three or more predation mortalities in one month or in one area of an island

The following methods will be used to mitigate documented, unacceptable golden eagle predation on island foxes:

- Helicopter survey and, if necessary, net-gun operation to capture eagles
- Implementation of bow-net trapping, at-nest capture methods, and other ground-based capture efforts

Current Status: The National Park Service (NPS) and The Nature Conservancy (TNC) have responded to predation events in recent years, and continue to have the capability to do so. In 2006 a breeding pair of golden eagles was captured in a net-gun operation on Santa Cruz Island, proving the efficiency of that method, and underscoring the importance of targeting golden eagles attempting to breed; the remains of 13 island foxes were found in the eagle nest, after capture.

The last significant predation event was in 2010 on Santa Rosa, when 7 radiocollared foxes died from predation in February-April of that year. NPS coordinated a helicopter survey in March of that year. Evidence from carcass sites later identified the offending eagles as sub-adults, which subsequently left the island.

Two non-profit organizations, Institute for Wildlife Studies and Native Range, have recent experience in and continued capability to perform helicopter survey and net-gun capture operations on the Channel Islands.

Tactics to Minimize Golden Eagle Breeding

The following tactics, some ongoing or completed, will be used to minimize the future possibility of golden eagles breeding on the northern Channel Islands:

- Reintroduction of bald eagles
- Removal of nonnative ungulate prey

- Active engagement with adult golden eagles attempting to breed

Current Status: Significant, ecosystem-wide management actions have been completed, making the northern Channel Islands far less attractive to potentially breeding golden eagles. The nonnative ungulate prey that previously supported golden eagle breeding in the late 1990s is effectively gone from the islands. Feral pigs were removed from Santa Rosa in 1993 and from Santa Cruz in 2006. Elk removal from Santa Rosa Island was completed in 2011, and there are less than half a dozen mule deer left on that island, all sentinel (radiocollared) animals. Mule deer removal will be completed in 2015. Bald eagles were successfully reintroduced to the northern Channel Islands in the 2000s, and as of 2015 there were over 40 resident bald eagles; their territorial presence may discourage golden eagles from breeding. The management policy of surveying for and attempting capture of adult eagles via helicopter comprises a form of harassment that likely serves to dissuade eagles from breeding.

Monitoring

Because golden eagles are notoriously difficult to detect, golden eagle predation on island foxes is best detected via mortality monitoring of radiocollared island foxes. Thus, a sample of radiocollared island foxes will be maintained on each island, and mortality checks will be conducted weekly, either by ground-based personnel or by aircraft. Collars will be equipped with mortality sensors, which double the collar transmit signal rate if the collar is motionless for more than six hours. Staff will recover carcasses which transmit mortality signals, and will determine if predation is a mortality cause. Although other mortality causes (such as disease) require necropsy and tissue sampling, golden eagle predation is easily determined in the field by the presence of characteristic marks of golden eagle predation: evisceration, de-gloving, severing of the spinal cord, and presence of feathers and whitewash.

The number of radiocollared foxes necessary to adequately detect eagle predation has been determined (see “Number of Radiocollared Individuals Required to Detect Eagle Mortality”, Appendix N in Rubin et al. 2007). To adequately detect an average annual predation mortality rate of 2.5%, 40 radiocollars are required.

If radiotelemetry reveals significant predation, monitoring will be conducted to determine if the predation is due to adult golden eagles which are attempting to breed (such eagles have higher energetic requirements which need to be satisfied by predation on small, live prey, as opposed to carrion, and represent a greater threat to island foxes). Monitoring for eagles will comprise:

- Increased vigilance by ground-based staff, focusing on known golden eagle breeding sites on Santa Rosa and Santa Cruz Islands
- Helicopter surveys for eagles and nests
- Genetic analysis of eagle feathers found at carcass sites

Current Status: Island foxes have been monitored via radiotelemetry since foxes were released back to the wild in 2003-2004, with sample sizes above 40 since 2004-2005. Radiotelemetry detected significant predation events in 2003 and 2010, which were subsequently acted upon (Coonan et al. 2010, Coonan

and Guglielmino 2012). Helicopter surveys were conducted on Santa Rosa in 2010 in response to predation, and genetic analysis of eagle feathers found at kills kites identified the predating eagles as three related golden eagles, likely sub-adult siblings (and thus not adults attempting to breed) (Coonan and Guglielmino 2012, Talbot et al., in review). Radiocollar monitoring also fulfills part of the island fox epidemic response plan (Hudgens et al. 2011), which calls for radiocollar sentinel monitoring to detect disease. Radiocollar monitoring of sentinels (unvaccinated foxes) is conducted on all three northern islands.

Threshold for Reestablishment of Captive Breeding

Should eagle predation mitigation measures fail, foxes may have to be brought into captivity to prevent extinction, or from reaching quasi-extinction, the low population level at which extinction is all but assured (determined to be 30 individuals for island fox populations [Bakker and Doak 2009]). In order for captive breeding to be successful, there must be an adequate number of captive foxes to ensure breeding success of founders, retention of sufficient genetic variation, and growth of the captive colony. This issue was explored for island foxes in the Integrated Island Fox Recovery Team's work on Technical Analysis Request 3.6, Assessment of the Potential Benefits and Costs of Long-term Captive Populations on the Mainland or Islands. The assessment concluded the highest benefit would be derived from a captive breeding program of at least 100 individuals, so a captive population of 75-100 was recommended. To allow for inefficiency of capture, island foxes should be trapped for captivity when estimated populations fall to 150 individuals

Current Status: The captive breeding pens that were used during the 10-year period of captive breeding on the northern Channel Islands (1999-2008) are still intact, and could be used to house foxes brought back into captivity should predation (or another catastrophic mortality event) cause island fox populations to decrease to the low threshold level. Moreover, island fox trapping for population monitoring is conducted annually on each island, so trapping equipment (live traps, etc.) is available on each island for such an effort.

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