Bald Eagle Restoration on the Northern Channel Islands, California

May 2002—April 2003

1st Annual Report

MONTROSE SETTLEMENTS RESTORATION PROGRAM

MSRP

Restoring Natural Resources
harmed by DDTs and PCBs

Bald Eagle Restoration on the Northern Channel Islands, California

May 2002—April 2003

1st Annual Report

Prepared by:

Peter B. Sharpe
Jessica Dooley
David K. Garcelon
Institute for Wildlife Studies
Post Office Box 1104
Arcata, California 95518

Prepared for:

National Park Service
Channel Islands National Park
1901 Spinnaker Drive
Ventura, CA 93001

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EXECUTIVE SUMMARY

Bald eagles (*Haliaeetus leucocephalus*) once nested on all the California Channel Islands off the coast of southern California, but disappeared by the early 1960's. Human persecution contributed to the population decline, but the introduction of DDT into the Southern California Bight, starting in the late 1940s, is thought to have led to their ultimate extirpation from Southern California.

Litigation brought by state and federal agencies against the Montrose Chemical Corporation, the DDT manufacturer responsible for the majority of DDT contamination in the Southern California Bight, resulted in a large settlement in December 2000 that provided monies for natural resource restoration through the Montrose Settlements Restoration Program. A portion of the settlement money was targeted for bald eagle restoration on the Channel Islands.

In 2002, the Trustee Council approved funding to study the feasibility of reintroducing bald eagles to the Northern Channel Islands. Administered through the Channel Islands National Park, IWS was contracted to conduct a 5-year feasibility study on Santa Cruz Island. The project called for IWS to release 12 bald eagles per year through a technique called “hacking” and monitor the population to determine how well they adapted to the new environment and whether they accumulated body burdens of organochlorine contaminants that would prohibit successful breeding.

Hacking towers were constructed in May and June 2002 and 12 young bald eagles produced by captive-breeding eagles at the San Francisco Zoo, or removed from wild nests in Alaska, were released from the towers from June to September 2002. Each bird was equipped with a GPS/VHF telemetry package to allow post-release monitoring.

As of the end of April 2003, seven eagles are still on the Northern Channel Islands. Three birds have died in attempts to fly to Anacapa Island or the mainland, instead ending up in the ocean. Two live eagles were recovered (one from the ocean) and taken to raptor rehabilitation centers before being returned to Santa Cruz Island (these are still on the islands). One bird has traveled over 5000 km, flying as far as Montana, and has not returned to the Channel Islands. Finally, one bird disappeared and is assumed to be dead. First-year survival is in line with that reported for bald eagles in other areas and we expect survival to be higher as the birds mature.

IWS believes that the releases on Santa Cruz Island could successfully restore a bald eagle population on all the Northern Channel Islands, as the birds have been located on all four islands during the past year. It is unknown whether bald eagles on the Northern Channel Islands will ingest enough DDT-contaminated food to affect their breeding in the future, but during the next year IWS will continue to monitor the forage use of the eagles and conduct analyses of forage samples and blood collected from the eagles to evaluate potential and actual DDT loads carried by the birds.

ACKNOWLEDGMENTS

IWS thanks the National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), California Department of Fish and Game, National Oceanic and Atmospheric Administration (NOAA), The Nature Conservancy, Alaska Department of Fish and Game, U.S. Forest Service, and the Avian Conservation Center (ACC) at the San Francisco Zoo. We give special thanks to Kate Faulkner (NPS) for her assistance and support, and Kathy Hobson at the ACC for all her work to provide young eagles for our hacking activities. Funding for the project was made available by the Montrose Settlement Restoration Program. Phil Schempf (FWS, Juneau) and Jim Spickler (Eco-Ascension Research and Consulting, Arcata, California) greatly assisted with finding and removing eaglets from wild nests in Alaska. We thank the Ojai Raptor Center and the Coachella Valley Wild Bird Center for rehabilitating two wayward eagles, and veterinarians Dr. Scott Weldy, Dr. Mark Willet, and Dr. Ron Dalzell for their consultations regarding eagle health concerns. We also thank NPS employees Tim Jones, Earl Whetsell, and Kent Bullard for their assistance in erecting the utility poles for the hack towers. Finally, we thank Lenny Altherr of the Santa Catalina Island Conservancy for arranging the purchase and shipping of the lumber and utility poles necessary for the hacking tower construction.

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INTRODUCTION

Bald eagles (*Haliaeetus leucocephalus*) once nested on all the California Channel Islands off the coast of southern California (Fig. 1). Kiff (1980) estimated that there were once a minimum of 24 pairs nesting on the Channel Islands, including five pairs on Santa Cruz Island, three pairs on Santa Rosa Island, three pairs on San Miguel Island, and three pairs on Anacapa

Figure 1. Satellite photo of the California Channel Islands showing the locations of the four Northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa Islands) and the four Southern Channel Islands.

Island. Grinnell and Miller (1944) referred to the Channel Islands as one of two "breeding metropolises" in California, the other being the northeastern section of the state.

Bald eagle numbers began declining on the Channel Islands in the late 19th Century, largely due to human persecution. Tourists and sheep herders shot bald eagles until they were "not quite so abundant" (Howell 1917), the latter because of the belief that eagles were killing lambs. A caretaker on San Miguel Island reportedly shot or poisoned over 20 bald eagles in a single year (field notes of A. J. Van Rossem from 1930; reported by Kiff 1980). At least 82 sets

of eggs were collected from bald eagle nests on the Channels Islands between 1875 and 1949, but this collecting is thought to have had a negligible impact on the eagle populations on most islands (Kiff 1980). However, between 1916 and 1922 egg-hunters apparently collected at least 30 sets of eggs from Anacapa and Santa Cruz Islands, which may have caused a population decline (Kiff 1980). On a trip to Santa Cruz Island in the spring of 1926, Ross (1926) "was impressed by the abundance of Ravens [*Corvus corax*] and the scarcity of Bald Eagles."

Although human persecution impacted bald eagle populations, the ultimate cause of bald eagle extirpation from the Channel Islands was likely the introduction of the organochlorine pesticide DDT into the Southern California Bight. DDE (a metabolite of DDT) levels have been found to be inversely correlated with eggshell thickness and productivity in bald eagles (Hickey and Anderson 1969, Wiemeyer et al. 1984). DDE levels of 3-5 ppm wet weight in bald eagle eggs have been associated with reduced productivity, with reproductive failure approaching 100% with DDE levels of >15 ppm (Wiemeyer et al. 1984). The last confirmed successful nesting of bald eagles on the Channel Islands was on Anacapa Island in 1949 (Kiff 1980). The decline in bald eagle populations in southern California was concurrent with declines in seabird breeding success in the Southern California Bight and with continent-wide declines in bald eagle populations, much of which was also attributed to the impacts of DDT (Risebrough et al. 1971, Anderson et al. 1975, Grier 1982, Wiemeyer et al. 1984).

By 1963, bald eagle populations in the lower 48 states had dropped to an estimated 417 breeding pairs (U.S. Department of the Interior 1994) and there were no bald eagles remaining on the Channel Islands. Bald eagles were declared endangered under the Endangered Species Protection Act in 1967 and then under the Endangered Species Act of 1973. Restrictions on organochlorine pesticide usage and efforts to stop persecution and protect habitat allowed bald eagle populations to recover over a large portion of their range, resulting in their downlisting from endangered to threatened in 1995 (Elliott and Norstrom 1998).

Efforts to restore bald eagles on the California Channel Islands began in 1980 when the Institute for Wildlife Studies (IWS), in cooperation with the United States Fish and Wildlife Service and the California Department of Fish and Game, initiated a program to reintroduce bald eagles to Santa Catalina Island, California (Fig. 1). Between 1980 and 1986, 33 eagles were released on the island from three artificial nest or "hacking" platforms (Garcelon 1988). Many of

these birds matured and formed breeding pairs on the island, but all the eggs produced broke in the nest. Concentrations of DDE in the remains of eggs removed from failed nests implicated this contaminant as the causal agent of the lack of productivity (Garcelon et al. 1989). Eggs removed from nests on Santa Catalina Island exhibited little thinning of the shell, but exhibited areas of gross structural abnormalities of the eggshell that resulted in rapid water loss and a weakening of the eggshell (Risebrough 1998). Mean levels of DDE in egg remains removed from nests in 1987 and 1988 were twice as high as that which has been shown to cause complete reproductive failure (Wiemeyer et al. 1984), indicating that there was still a large amount of DDE in the food chain.

Around 1970 it had been discovered that DDT was entering the Southern California Bight through sewer systems emptying into the ocean at White's Point on the Palos Verdes Peninsula (Fig. 2). The source of the pollution was eventually traced to a company in Torrance, California. In 1990, the U.S. Department of Justice and the California Attorney General filed a lawsuit against this company, Montrose Chemical Corporation, alleging that they were responsible for releasing DDT and other hazardous chemicals into the environment. Montrose Chemical Corporation was once the largest DDT manufacturer in the world and is believed to have dumped DDT through the sewer systems from 1947 to the early 1970s (Fig. 2), as well as dumping DDT-contaminated waste into the ocean near Santa Catalina Island. In December 2000 a settlement was reached that provided $30 million for natural resource restoration in the Southern California Bight, including bald eagles (Department of Justice press release, 12/19/00).

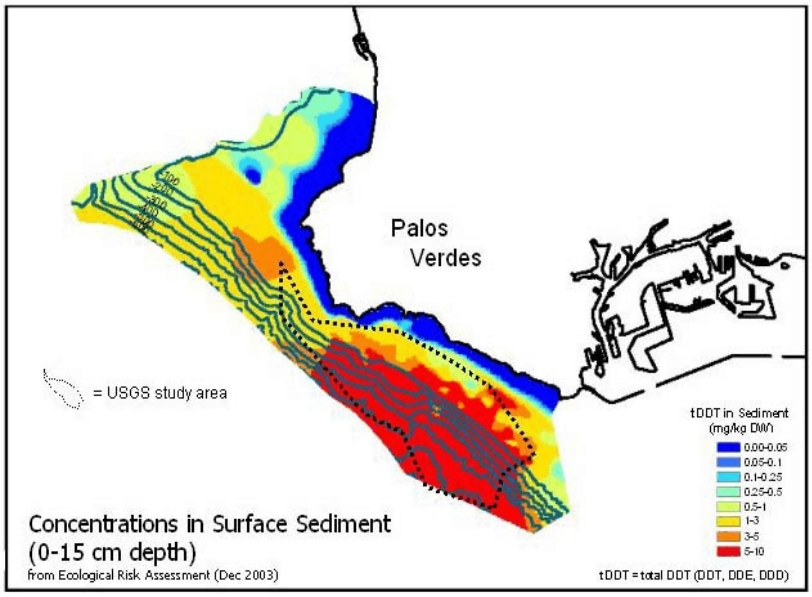

Figure 2. Area of contamination off the Palos Verdes Peninsula, CA where DDT was dumped from 1947 through the early 1970s.

The Montrose Settlements Restoration Program was developed to oversee the settlement monies set aside for natural resource restoration. The Trustee Council that oversees the program is composed of representatives of federal and state agencies that have interests in the Southern California Bight, including the National Oceanic and Atmospheric Administration, U. S. Fish and Wildlife Service , National Park Service (NPS), California Department of Fish and Game, California State Lands Commission, and the California Department of Parks and Recreation.

In late April 2002, the Trustee Council approved funding to study the feasibility of reintroducing bald eagles to the Northern Channel Islands. The project called for IWS to release 12 bald eagles per year on Santa Cruz Island using the "hacking" technique. Careful monitoring of the population would help determine how well they adapted to the new environment and whether they accumulated body burdens of organochlorine contaminants that would prohibit successful breeding. Reintroduction through hacking has been a successful tool in reestablishing bald eagles and other raptor species into formerly occupied habitat (Newton 1988, Nye 1988, Cade 2000) and IWS has already reintroduced bald eagles as a nesting population on Santa Catalina Island, showing that the technique could be successful on the Channel Islands (Garcelon 1988).

This report covers the period from May 2002 - April 2003 and summarizes the first season of eagle releases on Santa Cruz Island and the subsequent follow-up of the released eagles.

STUDY AREA

Santa Cruz Island is located approximately 20 miles off the coast of Ventura and Santa Barbara counties. Santa Cruz Island is the largest of the eight California Channel Islands, measuring about 38 km in length and 12 km wide at its widest point (Fig. 3). The land area is approximately 249 km^2 with 124 km of shoreline and a maximum elevation of 753 meters. Santa Cruz Island is the most rugged and topographically diverse of the Northern Channel Islands and has a Mediterranean climate, with mean monthly temperatures ranging from 11.7 - 20.9° C and a mean annual rainfall of 50 cm (Junak et al. 1995). The NPS owns and manages the eastern 24%

of the island and The Nature Conservancy (TNC) owns and manages the western 76% of the island.

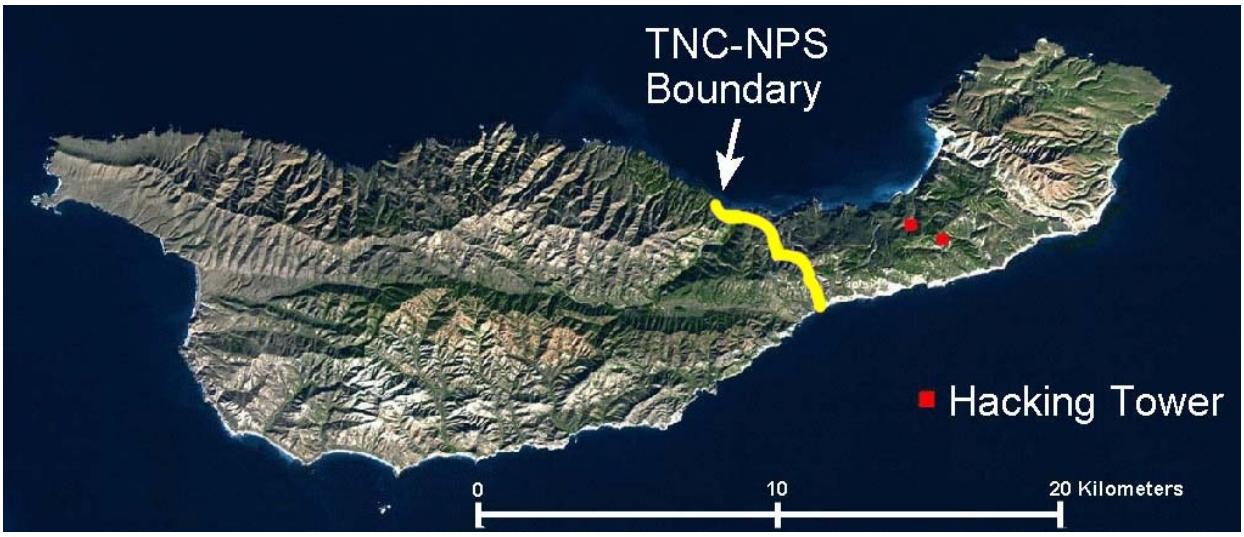

Figure 3. Map of Santa Cruz Island, California indicating placement of two hacking towers. Boundary between The Nature Conservancy (TNC) and National Park Service (NPS) land is shown in yellow.

METHODS

Permitting

In order to conduct the eagle restoration work, IWS had to acquire several state and federal permits or authorization letters. At the federal level, IWS's current Federal Fish and Wildlife Permit (Permit TE744878-8), which covers our work with bald eagles on Santa Catalina Island, was amended to 1) include activities on Santa Cruz, Santa Rosa, San Miguel, Anacapa and Santa Barbara Islands, 2) allow collection of bald eagles from nests in Alaska, Oregon, Washington, and California, and 3) allow the collection of bald eagle feathers for stable isotope analyses. IWS also received a Letter of Authorization from the National Oceanic and Atmospheric Administration that allows us to collect and possess biological samples from dead marine mammals on the Northern Channel Islands for contaminant and stable isotope analyses. In order to remove eaglets from Alaska, IWS also has a Letter of Authorization from the United

States Forest Service, the agency managing the area from which eaglets were to be collected. Also, IWS has a banding permit from the United States Geological Survey's Bird Banding Laboratory to allow us to band the eaglets.

At the state level, IWS signed a Memorandum of Understanding with the California Department of Fish and Game (DFG) to allow us to conduct the bald eagle restoration work on the Northern Channel Islands and to bring eaglets into California from Alaska. The project directors each also have a Scientific Collecting Permit from the DFG. Finally, IWS has a Scientific or Educational Permit from the Alaska Department of Fish and Game, which is renewed annually, to allow us to remove eaglets from Alaska.

Construction of Hacking Towers

In May 2002, IWS constructed two hacking towers on Santa Cruz Island. Construction materials were shipped to Prisoner's Harbor on a NPS landing craft on 6 May (Fig. 4) and then moved to our construction sites via truck. Our criteria for tower locations included 1) good road access to facilitate tower construction and care of the young eagles, 2) areas that would provide views of the island and ocean for the birds while in the towers, and 3) sites that were located so as to reduce that chance of a catastrophic event (e.g. fire or wind storm) destroying both towers. Two flat sites were selected east of the Navy station located on the NPS portion of Santa Cruz Island (Fig. 3). Both sites were in view of the Navy station to allow transmission of video signals (see below); one on the north side (North Tower) of the main east-west ridge and one on the south side (South Tower). Each site was examined by a NPS archaeologist prior to construction so that no archaeologically

Figure 4. Unloading hacking tower construction materials from a NPS landing craft at Prisoner's Harbor, Santa Cruz Island, California.

important sites were disturbed. Each tower consists of a platform (3.65 x 4.88 meters) raised approximately 4-5 meters above the ground on four utility poles (Fig. 5). The utility poles were placed into 1-2 meter deep holes that were drilled into the ground with a tractor-mounted power auger. Each platform supports a box separated into three sections: two separate nest

Figure 5. South hacking tower located on Santa Cruz Island, California.

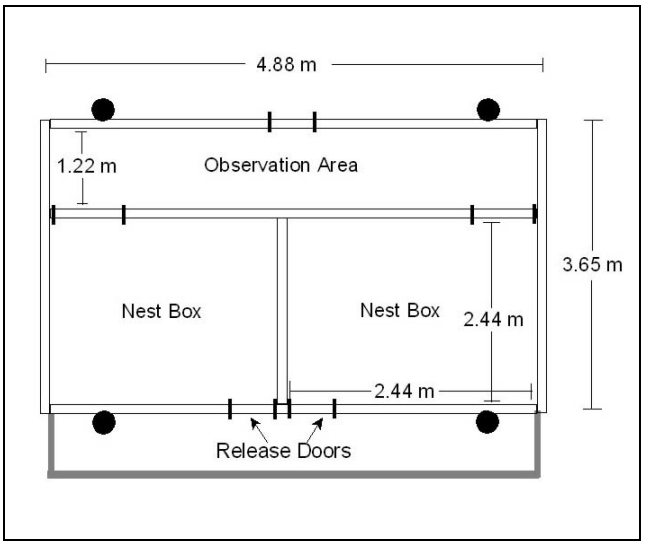

Figure 6. Diagram of hacking tower layout, Santa Cruz Island, California.

boxes and one observation area (Fig. 6). The solid wall separating the observation area and the nest boxes contains feeding doors to add and remove food items and a one-way glass window for watching the eaglets. Each cage also has a solid roof (2.4 meters high) and a solid wall separating it from the adjacent cage. The rear half of the outside wall is solid, whereas the front half of the wall and the entire front of the cage are made of vertical metal bars (Fig. 5). The front also has a release door that can be opened with ropes from outside the tower (Figs. 5 and 6).

We built nests (Fig. 7) and perches in each box prior to acquiring the eagles. Each box was also equipped with a weatherproof bullet-style security camera (black and white video) to monitor the birds' activity. The cameras were connected to a video sequencer that switched

between the cameras in each box once a minute. The video was than transmitted to the Navy station using Trango Eagle Plus (Trango Systems, Inc., San Diego, California) 2.4 Ghz wireless video systems. The video could then be either viewed directly on a video monitor, or recorded on a 24 hour time-lapse VCR for viewing at a later time. The camera systems are solar-powered and turn on and off at dawn and dusk, respectively.

Figure 7. Building a nest in the hacking tower on Santa Cruz Island, California.

Bald Eagle Acquisition

Young bald eagles approximately 8 weeks old were acquired from two different sources: the Avian Conservation Center (ACC) at the San Francisco Zoo and from wild nests near Juneau, Alaska (Fig. 8). Eagle chicks from the ACC were produced by some of their seven pairs

Figure 8. Two 7-8 week-old bald eagles in a nest outside Juneau, Alaska. Photo by Jim Spickler.

Figure 9. Descending from a bald eagle's nest near Juneau, Alaska with two young eagles in orange carrying bags.

of captive-breeding eagles. To find active wild nests we flew helicopter surveys with Coastal Helicopters, Inc., Juneau, Alaska, accompanied by Phil Schempf (FWS, Juneau) and then traveled to the collection area by boat. Jim Spickler of Eco-Ascension Research and Consulting, Arcata, California climbed the nest trees and removed the eaglets by placing the birds into a padded nylon bag and carrying them to the ground (Fig. 9). We examined each bird to make sure it was healthy and then transported it back to the charter boat, where it was placed into a dog kennel (56 cm x 81 cm x 58 cm; W x D x H). We fed fish to each bird by hand 2-3 times per day. The birds were flown by Alaska Airlines from Juneau to Los Angeles, California, transported by van to Ventura, California, and then transported to Santa Cruz Island by either NPS boat or charter airplane (Channel Islands Aviation, Camarillo, California).

Bald Eagle Hacking

The eagles were placed in the hacking towers upon arrival on Santa Cruz Island. Two birds were placed in each cage (Fig. 10) and fed fish and feral pig (*Sus scrofa*) until their release 2-6 weeks later at approximately 12 weeks of age. Each cage was monitored using the video system to insure that all birds were eating and healthy. We also kept daily records of how much food was placed in and removed from each

Figure 10. Two 8-week-old bald eagles in a hacking tower on Santa Cruz Island, California.

cage, as well as of the general behavior and appearance of each bird. When they were approximately 11 weeks old, we fit each bird with a combination 70 g PTT GPS unit (Microwave Telemetry, Inc., Columbia, MD) and VHF transmitter (Advanced Telemetry Systems, Isanti, MN), blue patagial wing markers with a unique letter/number combination, and a FWS leg band (Fig. 11). The satellite transmitters record GPS locations of the bird approximately once per hour and then upload the locations to a satellite approximately once every three days. This allowed us to relocate birds that we were unable to find using traditional VHF telemetry. We also collected ~10 cc of blood from each bird to provide for baseline contaminant and stable isotope analyses.

Figure 11. A 12-week-old bald eagle with blue patagial markers and GPS/VHF transmitter (middle of back).

When the birds were approximately 12 weeks old, we opened the release doors on each cage. We continued to place food items in and around the towers to provide a known food source for the birds while they developed their flight/scavenging skills. These food sources were eventually moved farther from the towers to encourage the birds to search for their food.

Post-Release Monitoring

Following the release of each eagle, IWS biologists closely monitored each bird to insure that they were finding food and remaining healthy. During observations we also noted any interactions with other bald and golden eagles. We usually were able to locate the birds for visual monitoring using a VHF telemetry receiver (Communications Specialists, Inc., Orange,

California). Eagles that we were unable to locate using telemetry could usually be relocated using the GPS data that we retrieved via computer from Argos, Inc. (Largo, MD). We attempted to locate each bird 2-3 times per week throughout the period covered by this report.

RESULTS

Bald Eagle Acquisition

On 19 May, four young bald eagles were shipped from the San Francisco Zoo to Ventura, California via cargo van. These birds were flown to Santa Cruz Island on the morning of 20 May and placed in the North Tower. A fifth eaglet from the San Francisco Zoo was flown to Los Angeles on 21 July and taken to Santa Cruz Island, along with four birds from Alaska, on 22 July (see below).

In mid-July, we traveled to Juneau, Alaska to collect seven young eaglets. On 18 July we flew a helicopter survey of the Couverden area (Fig. 12) between 1000 hr and 1300 hr, locating only two potential donor nests. At approximately 1700 hr on 18 July we were asked by the FWS to remove two bald eagle chicks that were in a nest on the north end of Douglas Island (Fig. 12). The nest tree was at the top of a recent land slide and there were concerns that the tree would fall before the nestlings fledged. Two eaglets approximately 9-10 weeks of age were successfully removed.

A second aerial survey was flown

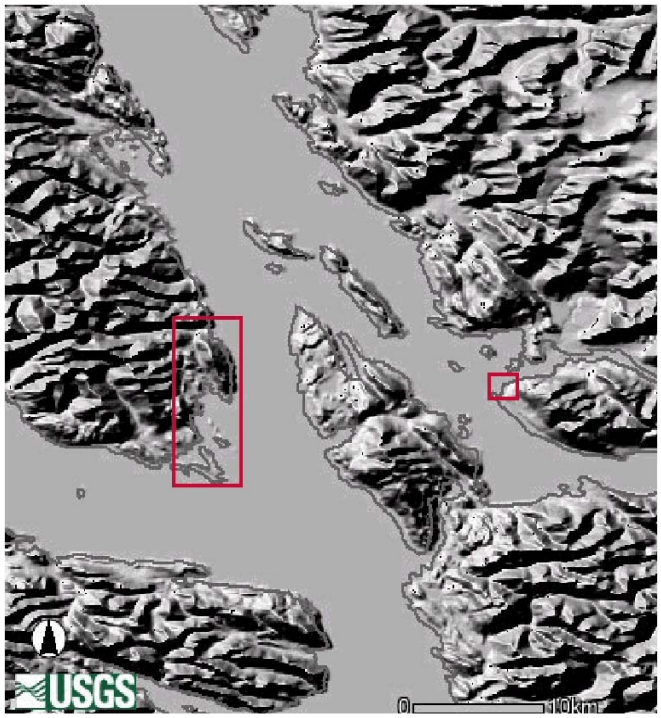

Figure 12. Two areas near Juneau, Alaska where we removed bald eagles from wild nests. The small box is the tip of Douglas Island and the larger box encompasses the Couverden area.

of the Couverden area between 0700 hr and 0900 hr on 19 July and we found a sufficient number of donor nests to supply the five remaining eaglets needed. We boated to the Couverden area on the afternoon of 19 July and removed five eaglets from three different nests on 20 July.

On 21 July we shipped the first four eaglets collected to Los Angeles, California via air cargo. These birds were picked up on the evening of 21 July and taken by boat to Santa Cruz Island, California on the morning of 22 July. The remaining three eaglets were flown to Los Angeles on 23 July and flown to Santa Cruz Island on the morning of 24 July.

Bald Eagle Hacking

The first four birds from the San Francisco Zoo were banded on 18 June (Table 1) and the release doors were opened on 25 June. It took a few days for the eaglets to fledge, but all had taken their first flight by 30 June.

The eagles that arrived from Alaska (7 birds) and the last eagle from the San Francisco Zoo varied widely in age. The two older pairs of eaglets were placed in the North Tower and the two younger pairs in the South Tower. Because of the age differences, the banding and release dates were staggered through August and September (Table 1). The oldest two eaglets were released on 15 August and both eaglets fledged that day. The next oldest two eaglets were released on 17 and 19 August, respectively. Due to thick and persistent fog during and following release, fledging was not witnessed, but both birds had fledged by 20 August. The oldest two eaglets in the South Tower were released on 26 August and fledged on 27 August. The final two birds were released on 7 September, fledging on 9 September and 10 September.

Post-Release Monitoring

The bald eagles released in 2002 have moved between the four Northern Channel Islands, as well as to the mainland. Below is a brief summary of the movements and status of each eagle released. Each bird is referred to by its patagial tag number (see Table 1).

Table 1. Identification, release information, and status of bald eagles released on Santa Cruz Island, California in 2002.

FWS Leg Band	Sex[a]	Patagial Marker	Source[b]	Release Point	Release Date	Status/Latest Location[c]
629-02795	M	A-00	Zoo	North Tower, Box	6/25/02	Alive, Santa Rosa Is.
629-02796	F	A-01	Zoo	North Tower, Box	6/25/02	Alive, Santa Rosa Is.
629-02798	F	A-02	Zoo	North Tower, Box	6/25/02	Alive, Santa Cruz Is.
629-02797	F	A-03	Zoo	North Tower, Box	6/25/02	Assumed dead
629-14042	F	A-04	Alaska	North Tower, Box	8/15/02	Alive, Santa Cruz Is.
629-14041	F	A-05	Alaska	North Tower, Box	8/15/02	Assumed dead
629-14043	M	A-06	Zoo	North Tower, Box	8/19/02	Unknown, last signal on 9/3
629-14044	M	A-07	Alaska	North Tower, Box	8/17/02	Alive, eastern California
629-14045	M	A-08	Alaska	South Tower, Box	8/26/02	Alive, Santa Rosa Is.
629-14046	F	A-09	Alaska	South Tower, Box	8/26/02	Dead, found on mainland 9/22
629-14047	F	A-10	Alaska	South Tower, Box	9/7/02	Alive, Santa Cruz Is.
629-14048	F	A-11	Alaska	South Tower, Box	9/7/02	Alive, Santa Cruz Is.

[a] Determined by karyotyping for birds from San Francisco Zoo and morphometrics for Alaskan birds.

[b] Eagles from the Avian Conservation Center, San Francisco Zoo, California (Zoo) and nests near Juneau, Alaska.

[c] As of 4/30/2003

A-00 Movements

Eagle A-00 has visited all four of the Northern Channel Islands during the year following its release (Fig. 13). Its first flight was to San Miguel Island on 30 August 2002. It stayed on the island for two days and then flew to Santa Rosa Island for a week before returning to Santa Cruz Island on 8 September. A-00

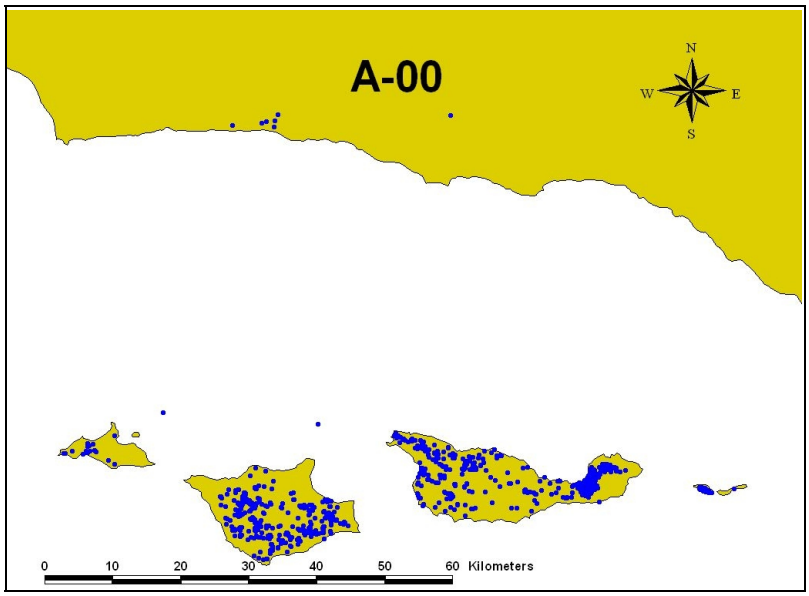

Figure 13. Locations for bald eagle A-00 on and around the Northern Channel Islands, California from June 2002 through April 2003.

spent most of October 2002 through February 2003 on Santa Rosa Island, with 2-day visits to San Miguel and Santa Cruz Islands during October and November, respectively. The bird spent 25 February through 27 March on Santa Cruz Island, flew to Santa Rosa Island on 28 March, and then returned to Santa Cruz Island on 29 March. The first trip to Anacapa Island was on 1-11 April 2003. The bird made a successful flight to the mainland on 12 April, returned to Santa Cruz Island on 14 April and spent the rest of the month flying back and forth between Santa Cruz and Anacapa Islands, staying 1-5 days on each island.

A-01 Movements

Bird A-01 left Santa Cruz Island for the first time approximately 2 weeks after it was released. On 14 July 2002, it made its first flight to Anacapa Island, returning to Santa Cruz on 5 August 2002 (Fig. 14). Its second visit to Anacapa Island was from 20-26 August. On 28 August it flew from Santa Cruz to Santa Rosa Island, and then on to San Miguel Island, where it stayed for several days. A-01 returned to Santa Rosa Island around 2 September and spent all of September through March 2003 on that island, with the exception of three short (less than 6 day) visits back to San Miguel Island. On 1 April it returned to Santa Cruz Island and remained there through the rest of the month.

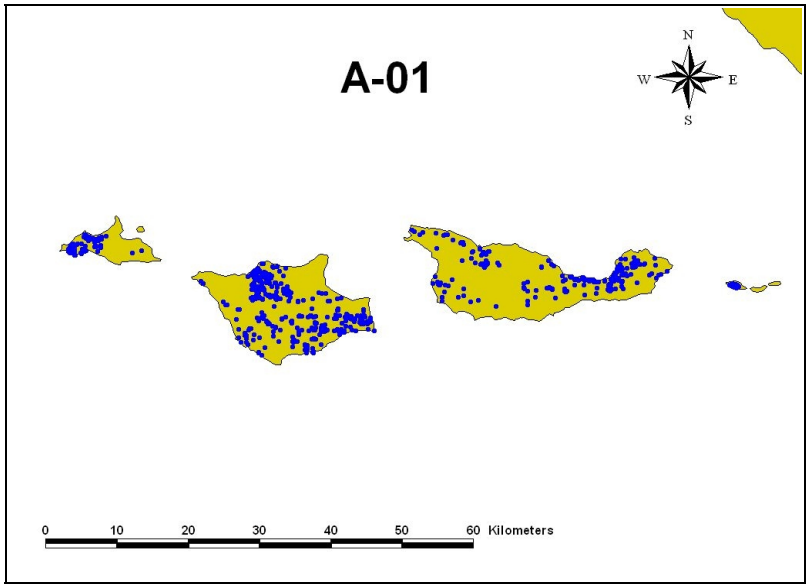

Figure 14. Locations for bald eagle A-01 on the Northern Channel Islands, California from June 2002 through April 2003.

A-02 Movements

A-02 has remained on Santa Cruz Island since its release (Fig. 15). Its GPS transmitter stopped functioning during mid-September 2002, but we have continued to relocate the bird using VHF telemetry. The majority of sightings of this bird are in the Chinese Harbor area.

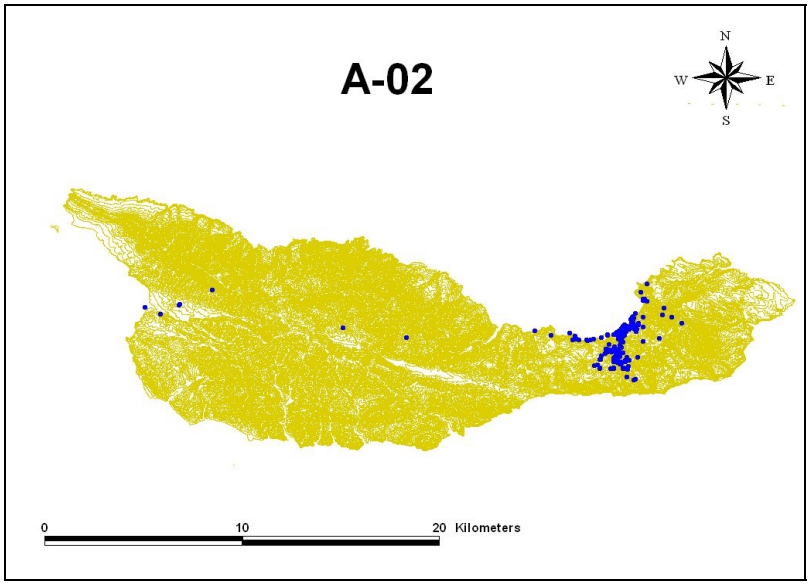

Figure 15. Locations for bald eagle A-02 on Santa Cruz Island, California from June through September 2002.

A-03 Movements

A-03 remained on Santa Cruz Island from the time of its release until 12 July 2002. On that day it apparently made an attempt to fly to Anacapa Island, a distance of approximately 8 km. The GPS data indicate that the bird went into the ocean about 1 km short of the island, whereupon it floated towards San Nicolas Island until the signal disappeared on 22 July (Fig. 16).

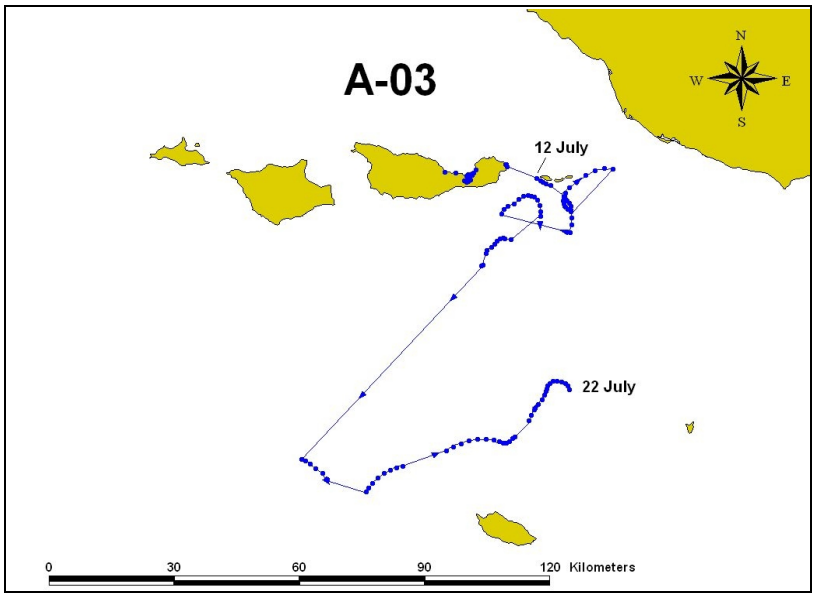

Figure 16. Locations for bald eagle A-03 on and around the Northern Channel Islands, California from June 2002 until its signal disappeared in July 2003.

A-04 Movements

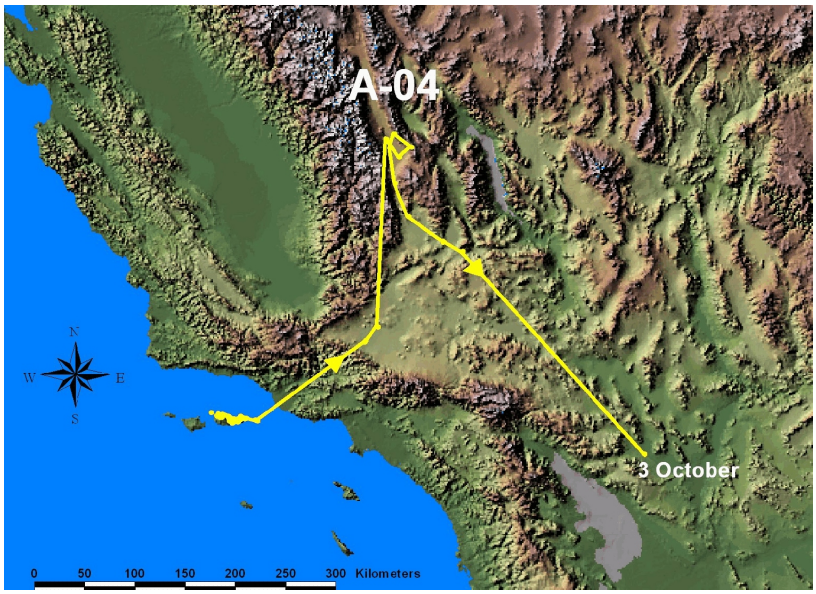

Figure 17. Locations of A-04 through 3 October 2002, when its signal first disappeared near Indio, California.

A-04, released on 15 August, made its first flight to Anacapa Island around 16 September. It returned to Santa Cruz Island on 16 September and then flew to the mainland around 30 September (Fig. 17). A-04 first moved up into east-central California before turning around and flying out into the desert near Indio, California, where we lost the signal on 3 October. Near the end of October we received a call from the Coachella Valley Wild Bird Center saying they had received the eagle a month earlier in an emaciated/dehydrated state. The eagle had been returned to a healthy weight and we picked it up and returned it by boat to Santa Cruz Island on 4 November. After spending a few days in a hacking tower, A-04 was again released. The GPS transmitter failed, but we were able to relocate the bird using VHF telemetry and it stayed on Santa Cruz Island. On 6 March 2003 the GPS transmitter began functioning again, giving us more information on the birds movements around Santa Cruz Island (Fig. 18)

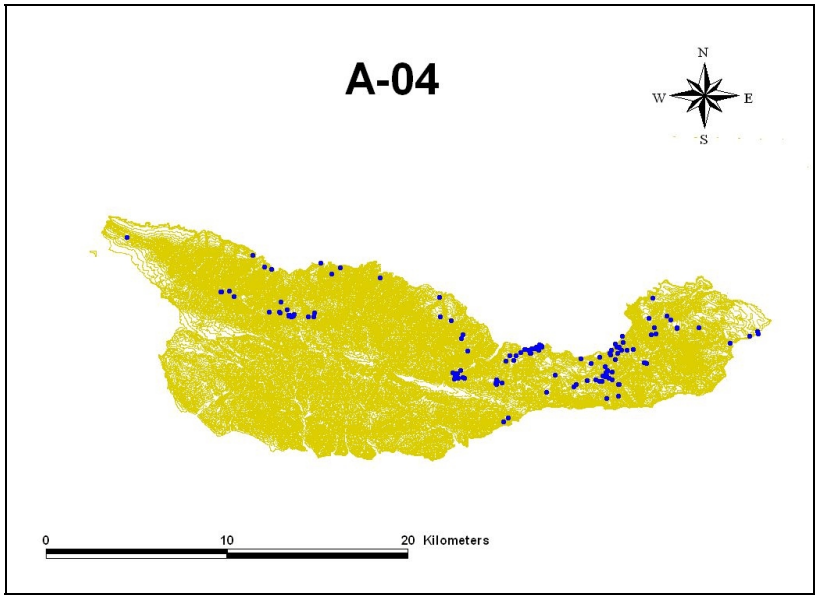

Figure 18. Locations for bald eagle A-04 on Santa Cruz Island, California from August 2002 through April 2003.

A-05 Movements

A-05 was released on 15 August and only survived about one week. It made some movements around Santa Cruz Island and then apparently tried to fly to Anacapa Island on 23 August. As happened with A-03, A-05 went into the ocean about 3.6 km from the tip of Anacapa Island (Fig. 19). The bird seems to have floated for five days before its last signal was sent from near the eastern tip of East Anacapa on 28 August. On 2 October we got a faint VHF signal from A-05's transmitter towards the mainland. We tracked the signal to a boat in the Channel Islands Harbor. The boat captain indicated that the transmitter was found on the ocean floor during a dive off of East Anacapa Island, although no carcass was found.

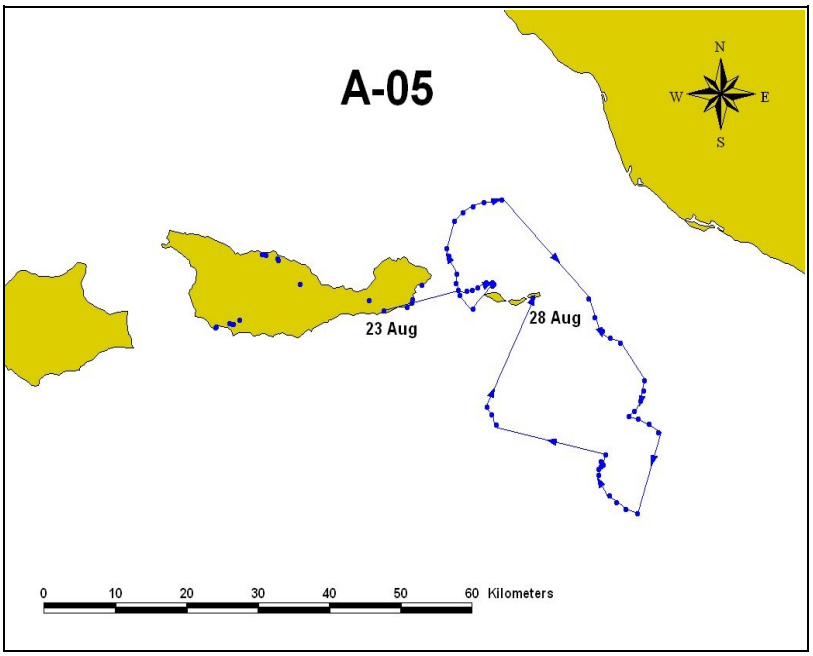

Figure 19. Locations for bald eagle A-05 on and around Santa Cruz Island, California during August 2002.

A-06 Movements

A-06 was brought to the island on 22 July 2002. Once the bird was in the hacking tower we noticed that it was keeping its left eye closed more than normal. According to Kathy Hobson at the San Francisco Zoo, the bird had had an eye problem as a young chick, but the veterinarian had noted no problems prior to transport. On 23 July, Mark Willet, DVM made a visual inspection of the bird while in the tower. We banded the bird on 10 August and still noted the eye problem. Because we wanted to have the bird examined prior to release, we removed the bird from the tower on 13 August and transported it to veterinarian Ron Dalzell on the mainland. Dr. Dalzell diagnosed the bird as having a missing nictitating membrane and having scratches on

the cornea. We returned A-06 to the island, treated it with eye drops for several days, and then placed it back into the hacking tower on 17 August. Drs. Dalzell and Scott Weldy (Orange County Birds of Prey Center) agreed that the bird was releasable, so we opened the cage door on 19 August and the bird fledged on 20 August. A-06 remained on Santa Cruz Island until its signal, both GPS and VHF, were lost on 3 and 4 September, respectively (Fig. 20). We assume that the bird is dead.

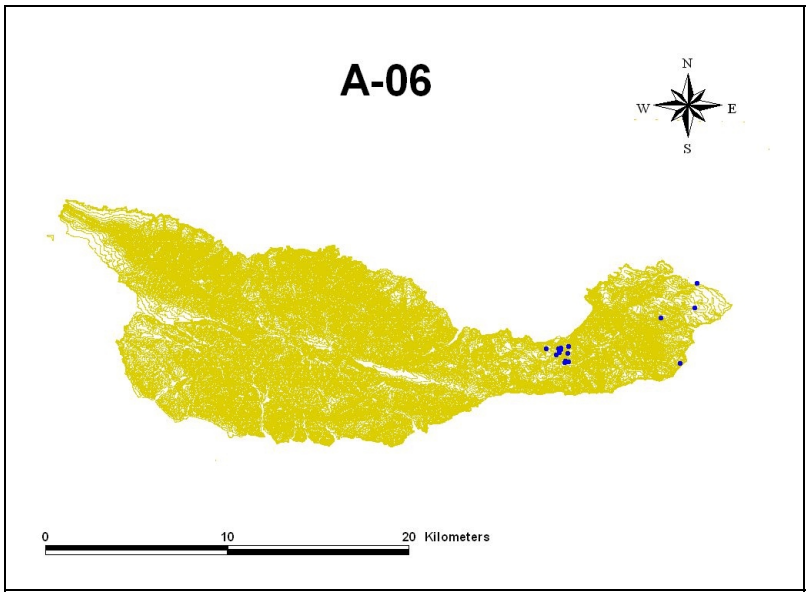

Figure 20. Locations for bald eagle A-06 on Santa Cruz Island, California from 23 August to 3 September 2002.

A-07 Movements

A-07 has moved farther than any of the other released birds. As of 30 April 2003, this bird has flown approximately 5000 km since its release, traveling as far as western Wyoming (Fig. 21). A-07 left Santa Cruz Island on 15 September 2002, flying to Anacapa Island and then to the mainland. It crossed into Nevada on 17 September, Utah on 20 September, and

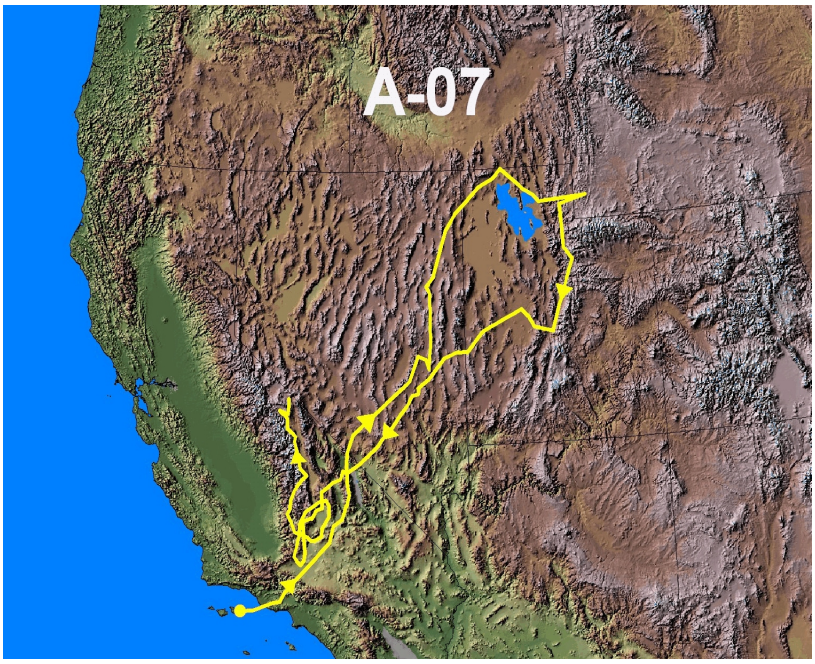

Figure 21. Locations for bald eagle A-07 from August 2002 through April 2003.

Wyoming on 22 September. After spending about a month in western Wyoming, the bird returned to Utah on 19 October and spent nearly three months in central Utah. On 20 January 2003, A-07 crossed back into Nevada and arrived in California on 9 February. The bird flew to within about 150 km of Santa Cruz Island, spending a month in and around Rosamond, California. In mid-March, A-07 moved north and spent the remainder of March and April near Lake Crowley in Mono County, California.

A-08 Movements

A-08 remained on the islands throughout the year (Fig. 22). Following its release it spent a month on Santa Cruz Island, before flying to Santa Rosa Island on 29 September. On 11 October the bird flew to San Miguel Island, but returned to Santa Rosa after a few hours. A-08 spent most of October through April 2003 on Santa Rosa, except for five separate trips of 1-12 days to Santa Cruz Island, starting on 10 February 2003.

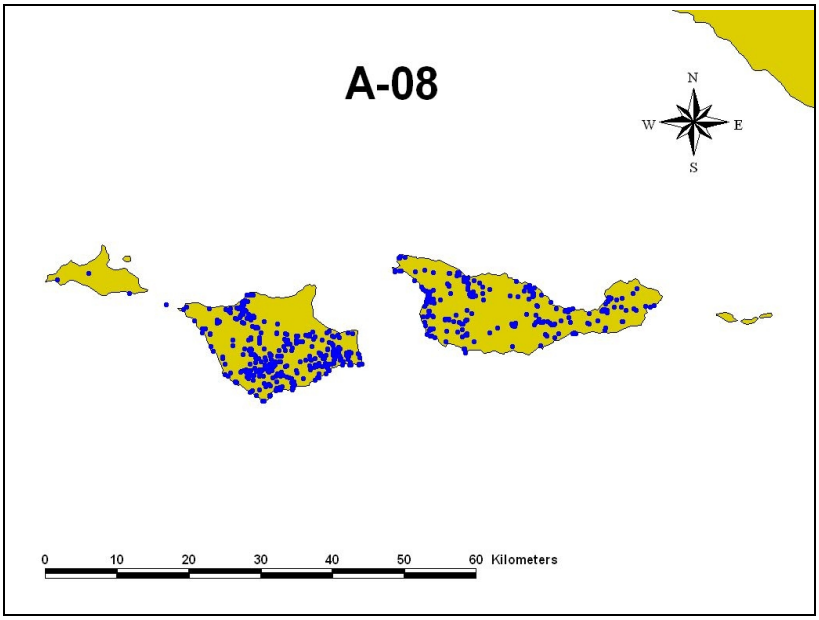

Figure 22. Locations for bald eagle A-08 on the Northern Channel Islands, California from August 2002 through April 2003.

A-09 Movements

A-09 also ended up in the ocean within a month of its release. It remained on Santa Cruz Island until 15 September, when it flew to Anacapa Island. On 16 September the bird attempted

to fly to the mainland, but went into the ocean about 1 km from the mainland (Figure 23). It floated for 3-4 days before washing up on shore at Point Mugu. We were able to recover the carcass on 22 September.

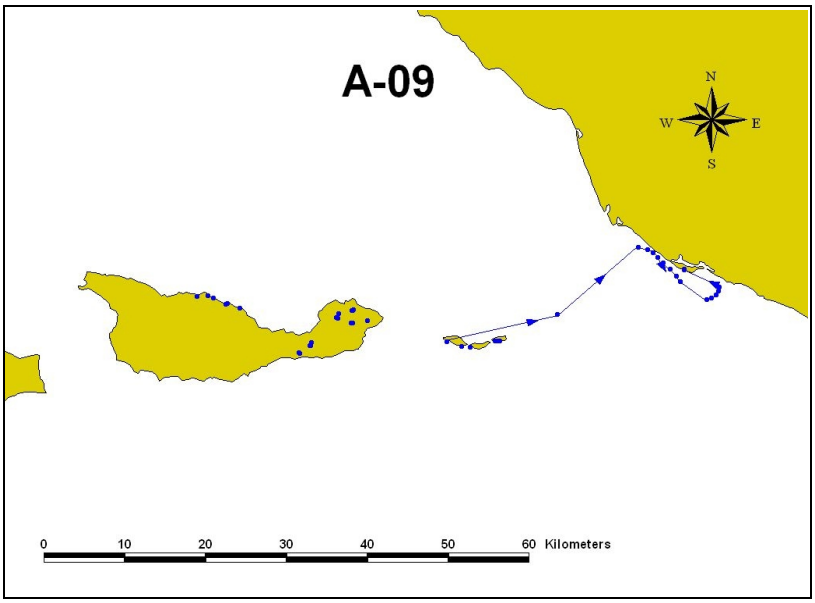

Figure 23. Locations for bald eagle A-09 on and around Santa Cruz Island, California during September 2002.

A-10 Movements

A-10 remained on Santa Cruz Island throughout most of its first year. Its GPS unit stopped functioning on 13 December 2002, but at that time it had not left Santa Cruz (Fig. 24). On 9 March, while the golden eagle crew was attempting to trap golden eagles (*Aquila chrysaetos*), a trap went off accidentally and trapped A-10. We happened to be accompanying the trappers that day and saw that the antenna for the GPS unit had been torn off. The bird was released on the spot because we did not have a replacement transmitter at the time. We were able to continue tracking the bird using VHF telemetry and it remained on Santa Cruz until mid-April 2003, at which time its signal appeared to be originating on Anacapa Island.

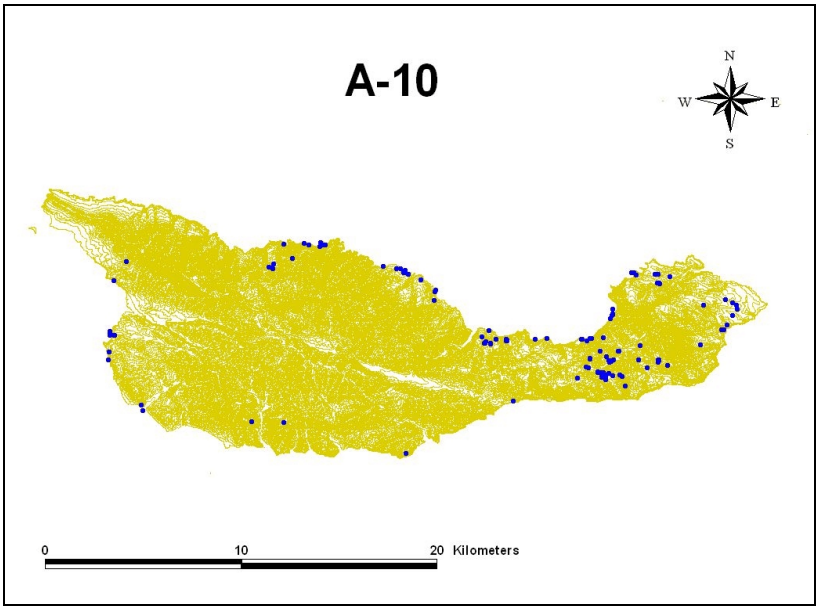

Figure 24. Locations for bald eagle A-10 on Santa Cruz Island, California from September through December 2002.

A-11 Movements

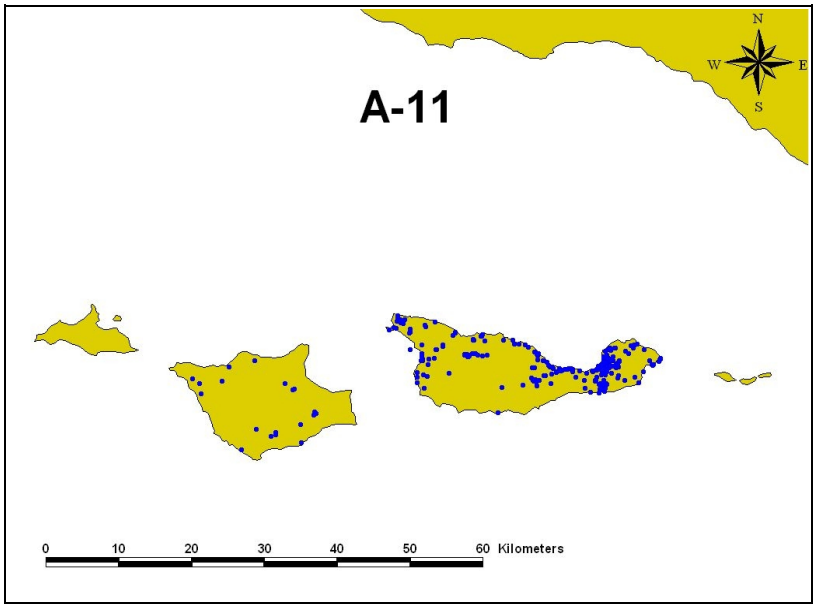

Figure 25. Locations for bald eagle A-11 on the Northern Channel Islands, California from September 2002 through April 2003.

The last bird released, A-11, also went into the ocean, but was fortunate to be picked up by a passing boat on 9 October. The bird was taken to the Ojai Raptor Center, where it recovered and then returned to Santa Cruz Island on 25 October. She was placed into a hacking tower and then released again on 31 October. Following its second release, the bird remained on Santa Cruz Island, except for a 6-day visit to Santa Rosa Island on 14-20 January 2003 (Fig. 25).

Other Eagle Sightings

During monitoring of released eagles we also recorded an incidence of a Santa Catalina Island bald eagle on Santa Cruz Island. On 4 March 2003, J. Dooley observed K-02 in the vicinity of Prisoner's Harbor. This bird was captive-bred at the San Francisco Zoo and fostered into a wild nest on Santa Catalina Island in 2000. It was seen near Klamath Falls, OR on 15 January 2001 and back on Santa Catalina Island in March and April 2002.

Foraging Activity

We provided carcasses of feral pigs for the released eagles throughout the year. Most carcasses were provided near the hacking towers during the 1-2 month period following the

releases (June - September) and then placed in a variety of locations island-wide at a rate of 1-2 carcasses per week during the rest of the year (Table 2). The eagles have readily fed upon the pigs, which has been confirmed by visual observations (direct and through video-monitoring). Our telemetry and GPS data also confirm that the eagles are regularly found in the vicinity of fresh pig carcasses.

Table 2. Number of pig carcasses provided for released bald eagles on Santa Cruz Island, California from July 2002 through April 2003.

	Month									
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Number of Pigs Provided	23	16	48	20	19	8	3	4	7	9

Although we have not observed any fishing attempts by the eagles, they do find other sources of food besides the carcasses we provide. We have observed six eagles feeding on or perched near six different marine mammal carcasses between September 2002 and April 2003 (Table 3). Most observations of marine mammal carcasses have been made at Chinese Harbor,

Table 3. Observations of bald eagles feeding on or perched near marine mammal carcasses on Santa Cruz Island, California from September 2002 through April 2003.

Prey Species/Location	Date	Eagles Present
Harbor Seal (*Phoca vitulina*)		
Chinese Harbor	11/20/2002	A-10
Chinese Harbor	12/05/2002	A-00, A-01, A-04, A-08, A-10, A-11
Unidentified Marine Mammal		
Christy Beach	09/05/2002	A-08
Canada del Agua	10/16/2002 and 10/18/2002	A-10
Chinese Harbor	01/30/2003	A-04. A-10. A-11
Chinese Harbor	04/14/2003	A-11

but eagles have been observed feeding on these carcasses during only about 2% of the 47 hours of bald eagle observations made in that area. A-01 was also seen flying with what appeared to be a snake in her talons on 2 April 2003 above Agua Escondido. NPS technicians working on the fox project on Santa Rosa Island reported at least one instance of a bald eagle at a gut pile remaining from deer and elk hunting activities that occurred during winter of 2002.

Bald Eagle/Bald Eagle Interactions

The released bald eagles often are observed soaring and perching together, especially in the Chinese Harbor area. There have been antagonistic encounters between bald eagles at carcasses, but they are often seen feeding together too. The larger females tend to dominate feeding at carcasses, as has been observed with bald eagles on Santa Catalina Island (Garcelon 1990). When an eagle released on Santa Catalina Island in 2000 was observed on Santa Cruz Island in March 2003, there were no observed interactions with the Santa Cruz eagles.

Bald Eagle/Golden Eagle Interactions

We observed interactions between bald eagles and golden eagles on several occasions on Santa Cruz Island between November 2002 and March 2003. The bald and golden eagles often appear to tolerate each others' presence. For instance, A-02 was perched about 5 meters from an immature golden eagle in a dead tree on 29 November 2002 and A-11 fed on a pig carcass while a golden eagle perched about 50 meters away on 11 December 2002. On 11 February 2003, an immature golden eagle fed on a pig carcass alongside a bald eagle, while two other bald eagles perched about 10 meters away. On 6 March 2003 an immature golden eagle was soaring with two immature bald eagles above Montanon.

On other occasions bald eagles appeared to preclude golden eagles from feeding at carcasses. For instance, golden eagles flew over carcasses upon which one or more bald eagles were feeding on 10 and 31 December 2002 and 8 February 2003, but did not attempt to feed. On

9 February 2003, a juvenile golden eagle landed on a snag about 100 meters from A-04, which was feeding on a pig carcass. About an hour later the golden eagle landed within 10 meters of A-04, who stopped feeding and walked towards the golden eagle, which flew away. Later in the day, when there were no bald eagles present, the golden eagle fed on the carcass while two adult golden eagles flew overhead. On 20 February 2003, a golden eagle landed near a pig carcass while A-10 and A-11 perched nearby. The golden eagle flew off almost immediately.

Bald Eagle Sightings on Other Islands

Bald eagles that traveled to other of the Northern Channel Islands were occasionally reported by people working/visiting on the islands. A hunter reported A-00 perched on a fencepost in October 2002 on Santa Rosa Island. A-01 was seen soaring by a NPS fox technician on San Miguel Island in late summer/early fall 2002. On Anacapa Island, there were several reports of bald eagles perching or flying in the summer/fall 2002.

Jessica Dooley traveled to Santa Rosa Island in January 2003 to check on three eagles (A-00, A-01, and A-08) that had spent most of the fall/winter on the island. Each bird was seen at least once from 23 - 28 January 2003. A-00 was observed flying and being harassed by two peregrine falcons (*Falco peregrinus*) and perching in several locations. A-01 was seen perched in trees and A-08 was seen flying and perching at the southeast portion of the island and landing near a pig carcass that had been brought from Santa Cruz Island as bait for the golden eagle trappers working on Santa Rosa Island.

DISCUSSION

The first season of bald eagle releases on Santa Cruz Island went well. Eight of 12 birds released are known to be alive and seven have remained on the Northern Channel Islands. We would not expect these birds to leave the islands after remaining through their first fall/winter. The movements of the birds among all four of the Northern Channel Islands gives us hope that

bald eagle releases conducted solely on Santa Cruz Island can restore populations on all four islands. In addition, the presence of bald eagles on the Northern Channel Islands may attract bald eagles from other areas, including Santa Catalina Island, further increasing the population size and genetic diversity.

The birds that moved to Santa Rosa Island for much of the fall and winter were likely feeding on mule deer (*Odocoileus hemionus*) and Roosevelt elk (*Cervus canadensis*) carcasses or gut piles left from hunting and culling activities. We have some concern about the potential threat of lead bullets used in these activities being ingested by the eagles, although there is no evidence that any of this year's eagles suffered from lead poisoning. However, the deaths of one or two eagles due to lead poisoning would be a loss of 10-20% of the birds released. We would suggest that the NPS consider implementing practices that would minimize the risk of lead poisoning, such as the burying of carcasses or gut piles, or preferably, switching to non-lead ammunition for hunting/culling activities on Santa Rosa Island.

Because four birds ended up in the ocean (25% of those released) we were initially concerned that the transmitter package we used may have been too heavy. The transmitter package weighed approximately 130 g, which is within the Bird Banding Laboratory guidelines that prohibit transmitters from weighing more than 3% of the birds' total weight. All four birds that ended up in the ocean were females, which can be 25% larger than males. We would expect males to be more impacted by transmitter weight than females, because of their smaller size, so we do not think that the bird losses in the ocean were directly related to the transmitters. Instead, the casualties were more likely a result of a lack of flying experience and/or stamina. All three birds that died in the ocean had been released less than a month prior to their death, and A-11 went into the ocean just over a month after it started flying. On Santa Catalina Island, young eagles that leave the island usually do not attempt to fly to the mainland until about two months after fledging (unpublished data). However, to reduce the likelihood that the transmitter package will negatively impact the birds in the future, we have switched to a transmitter package with a different configuration that weighs about 100 g for the 2003-2004 season. Several eagles from the Santa Catalina Island releases have been found dead at sea or on beaches, so it is possible that this is a relatively common source of mortality that has come to light because of the use of GPS transmitters.

We had several problems with the GPS transmitters used during the 2002-2003 season, which resulted in temporary or permanent data loss. The units are recharged by small solar panels, which may occasionally get covered by feathers or produce little charge during foggy or cloudy conditions, resulting in temporary data loss. The transmitters that completely failed usually had lost the antenna, probably because the bird pulled it off. The GPS packages for the next season will have a reinforced antenna attachment, which should reduce the rate of GPS failure due to antenna loss.

First year survival for the Santa Cruz bald eagles was 66% (assuming that A-06 is dead), which is similar to the first-year survival of 70-75% for eagles released on Santa Catalina Island (unpublished data), 63% in Florida (Wood 1992), 71% in Alaska (Bowman et al. 1995), and 77% in northern California (Jenkins et al. 1999). Highest mortality generally occurs during the first year for bald eagles and we expect that survival rates for the 2002 cohort will increase as they mature.

One concern that was raised about restoring bald eagles to the Northern Channel Islands was the potential negative impact upon breeding sea birds, especially on Anacapa Island. Because it is difficult to get any direct observations of the eagles on Anacapa Island because of restricted access throughout most of the year, we have had to rely solely on the GPS data to determine any possible impact on breeding sea birds. Several eagles have flown to Anacapa Island, but they rarely spent much time there. Most of these trips occurred within a couple of months of fledging, when the sea bird breeding season was drawing to a close and before we would expect the eagles to begin taking live prey. One eagle, A-00, did spend much of April 2003 on Anacapa Island, but the frequent trips back to Santa Cruz Island suggest that the eagle may not have been finding much food on Anacapa Island. Because of the infrequent use of Anacapa Island by bald eagles, especially during the breeding season, we do not believe that bald eagles had a measurable impact on the breeding sea birds during this first season of releases.

A suggested possible benefit of bald eagle restoration on the Northern Channel Islands is that the golden eagles will be driven away by adult bald eagles defending breeding territories. Although we did not observe any physical contact between bald eagles and golden eagles, bald eagles do seem to be dominant over golden eagles at carcasses. As the bald eagles from this first

year of releases mature and form territories we will be able to see what, if any, effects bald eagles have on golden eagle occurrences on the Northern Channel Islands.

One of the main questions now is whether the bald eagles will be able to reproduce once they mature, or whether DDE contamination will preclude egg hatching. During the next couple years we will be collecting prey samples and blood samples from bald eagles for analyses to calculate actual and potential contaminant loads for the bald eagles to start to address this question before this year's birds reach breeding age. Even though residues of DDT in the marine ecosystem have prevented the Santa Catalina Island eagle population from successfully hatching their own eggs (Garcelon 1997, Sharpe and Dooley 2001), the birds are successfully surviving on the island and serving an important ecological niche, which at the very least should be the outcome of bald eagle restoration on the Northern Channel Islands.

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