

**Bald Eagle Restoration on the Northern Channel Islands,
California
January — December 2006
5th Annual Report**



Restoring Natural Resources
harmful by DDTs and PCBs

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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.

In 2002, the Institute for Wildlife Studies (IWS) initiated a 5-year bald eagle restoration feasibility study on Santa Cruz Island, under contract with the National Park Service. IWS released 15 eagles from hacking towers in 2006, bringing the total number of birds released since 2002 to 61. These eagles were acquired from captive-breeding eagles at the San Francisco Zoo (13 birds) or rehabilitation centers (2 birds). Each bird was equipped with a GPS/VHF telemetry package to allow post-release monitoring. Six of this year's released eagles died: three in the ocean, one at the west end of Santa Cruz Island, one on West Anacapa Island, and one in central California. There were two other known mortalities: a bird released in 2003 died near Tejon Ranch, possibly from electrocution, and a bird released in 2005 died in the ocean north of Santa Cruz Island.

In 2006, we had the first known nesting attempts on the northern Channel Islands since bald eagle restoration began. A pair of eagles that were originally released on Santa Catalina Island in 2001 (male K-10) and 2002 (female K-26) nested in a tree on the northern portion of Santa Cruz Island and successfully hatched one of two eggs. A second nest was found on the ground on the south side of Santa Cruz Island. The male (K-11) was released on Catalina Island in 2001 and the female (A-04) was released on Santa Cruz Island in 2002. This pair also hatched an egg and both nests successfully fledged their chicks. These successful nests were the first known successful bald eagle nests on the Channel Islands since 1949.

As of the end of December 2006, 30 of the 61 bald eagles released are known to be on the northern Channel Islands (five from 2002, four from 2003, six from 2004, eight from 2005, seven from 2006). In addition, four birds are known to be on the mainland (one from 2003, one from 2004, one from 2005, one from 2006). There are also three eagles previously released on Santa Catalina Island that are resident on Santa Cruz Island. With the addition of the two

naturally hatched eagles that have remained on the islands, this brings the total number of bald eagles known to be residing on the northern Channel Islands to 35 birds.

Bald eagles have continued to use Santa Rosa Island, especially from the fall through spring, where they have been seen feeding on carcasses and gut piles of mule deer (*Odocoileus hemionus*) and Roosevelt elk (*Cervus canadensis*) left from the guided hunts and culling activities, and on marine mammal carcasses on the beaches. In 2006, there was a large-scale movement of birds from Santa Rosa Island to West Anacapa Island during the spring, which corresponds with the marine bird breeding season.

The successful breeding of bald eagles on Santa Cruz Island during 2006, coupled with the high survival and retention rates of bald eagles on the northern Channel Islands, are reason for optimism regarding the success of the program. The eagles are moving freely among the islands, which suggests that our releases will eventually repopulate the four northern Channel Islands.

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, U.S. Navy, Alaska Department of Fish and Game, U.S. Forest Service, and the Avian Conservation Center (ACC) at the San Francisco Zoo. Funding for the project was made available by the Montrose Settlements Restoration Program.

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INTRODUCTION

Bald eagles (*Haliaeetus leucocephalus*) were once common residents on the Northern Channel Islands off the coast of Southern California (Fig. 1). A minimum of five pairs nested on Santa Cruz Island, three pairs on Santa Rosa Island, three pairs on San Miguel Island, and three pairs on Anacapa Island in the early 1900's (Kiff 1980, 2000), but they disappeared by the 1960's.



Figure 1. The California Channel Islands off the coast of southern California.

Bald eagle numbers began declining on the Channel Islands in the late 19th Century, largely due to human persecution, but 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 1968, 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 prior to 2006 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).

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 (FWS), 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 different 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. 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, 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).

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 (NOAA), United States Fish and Wildlife Service (FWS), National Park Service (NPS), California Department of Fish and Game (CDF&G), California State Lands Commission, and the California Department of Parks and Recreation.

In April 2002, the Trustee Council approved funding to begin an experimental reintroduction of bald eagles to the northern Channel Islands. The project and funding was administered through the National Park Service, Channel Islands National Park, who contracted with IWS to begin a five-year experimental reintroduction. The project called for IWS to release 12 bald eagles per year on Santa Cruz Island and then carefully 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. 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 summarizes the fifth and final season of planned releases conducted from May through December in 2006.

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. 2). The land area is approximately 249 km² with 124 km of shoreline and a maximum elevation of 753 m. 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.

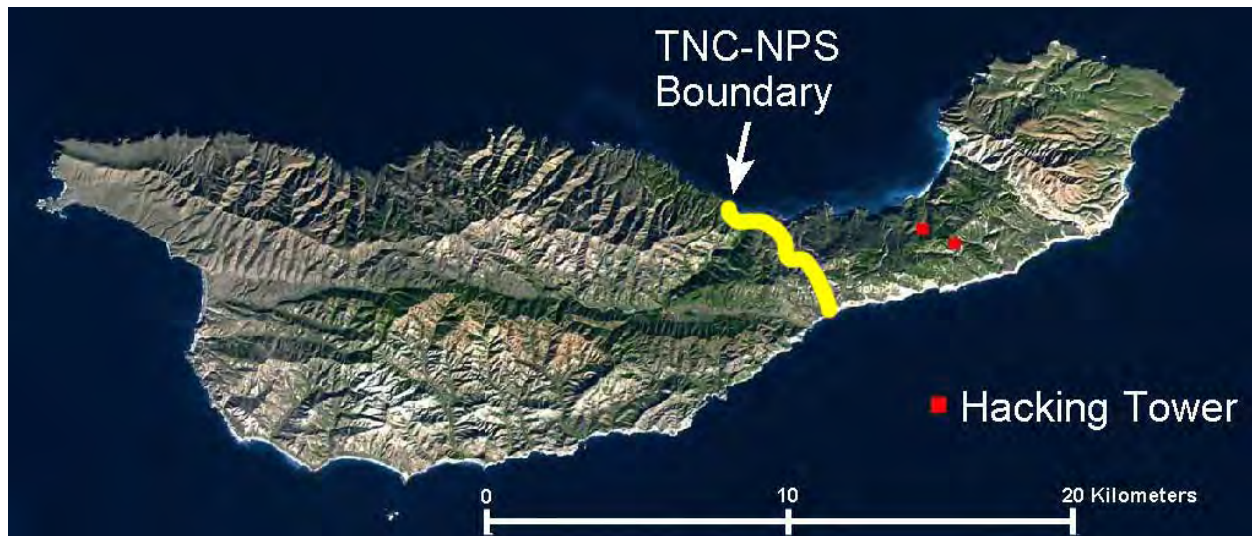


Figure 2. Santa Cruz Island, California with the boundary between The Nature Conservancy (TNC) and National Park Service (NPS) properties.

METHODS

Permitting

IWS has the required Federal Fish and Wildlife Permit (Permit TE744878-8) and a Memorandum of Understanding with the CDF&G to conduct the bald eagle restoration feasibility study on the northern Channel Islands. IWS has a banding permit from the United States Geological Survey's Bird Banding Laboratory allowing banding and radio-tagging the eaglets prior to release and a Letter of Authorization from NOAA that allows collecting and possessing biological samples from dead marine mammals for contaminant and stable isotope analyses.

Surveying and Nest Monitoring

Bald eagles released in 2002 were expected to reach breeding age in 2006, so we conducted surveys of the islands to search for breeding activity. Nests found during the surveys were monitored several times per week to determine the outcome of any breeding attempts.

Bald Eagle Acquisition

In 2006, we acquired 13 young bald eagles that were captive bred at the Avian Conservation Center (ACC) at the San Francisco Zoo, California. Two other eaglets that had been in rehabilitation also were released on Santa Cruz Island.

Bald Eagle Hacking

The approximately 8-week-old eaglets were placed in one of two hacking towers (North or South Tower) upon arrival on Santa Cruz Island (Fig. 2). Two to four birds were placed in each cage and fed fish and feral pig (*Sus scrofa*) until their release. Each cage was monitored remotely using a wireless video system to insure that each bird was eating and healthy. We also kept daily records of how much food was placed in and removed from each 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 satellite/VHF transmitter (Fig. 3), patagial wing markers, and Fish and Wildlife Service leg band. The satellite transmitters record GPS locations of the bird and then upload them to a satellite approximately every three days. This would allow 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 allow for baseline contaminant analyses.

When the birds were approximately 12 weeks old, we opened the release doors on each cage. It took up to six days for the birds to fledge from the towers. 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.



Figure 3. PTT GPS unit with VHF transmitter (gray) attached to the side. The whole unit weighs approximately 100 g.

Post-Release Monitoring

Following the release of each eagle, IWS biologists closely monitored each bird to insure that they were finding food and healthy. We usually were able to locate the birds for visual monitoring using a VHF telemetry receiver (R-1000; 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, Maryland). Data were downloaded daily and any bird that had not moved more than 50 m in a day was immediately located to determine its status. Otherwise, we attempted to locate each bird at least 2-3 times per week during the first 2-3 months following release to insure that they were healthy and finding food.

Trapping

This season we continued efforts to trap older bald eagles to collect follow-up blood and feather samples for contaminants and stable isotope analyses. Trap sites were selected in areas where bald eagles were frequently observed. Prior to trapping efforts we placed pig or deer carcasses at the trap site to attract eagles to the area. A bownet was placed in the ground, covered with dirt and grass, and baited with a pig or deer hindquarters. Traps generally were set before daylight and observed from a blind.

RESULTS

Surveying and Nest Monitoring

A boat survey of Anacapa, Santa Cruz, and Santa Rosa Islands was conducted on 20 and 21 February. Poor weather reduced our ability to survey much of Santa Rosa Island, but Anacapa and Santa Cruz Islands were surveyed sufficiently. A total of 11 eagles from the Santa Cruz and Santa Catalina populations were observed on the islands during the survey (see Appendix I).

Pelican Harbor Nest

During the boat survey on 21 February, two bald eagles originally fostered into nests on Catalina Island were observed perched at a possible nest up-canyon from Pelican Harbor on Santa Cruz Island. The male, K-10, was fostered into the Twin Rocks nest on Catalina Island in 2001. He flew to the mainland in July 2001 and was seen as far north as Oregon. He was seen on Santa Cruz Island in August 2003, Lake Cachuma (Santa Barbara Co.) in January 2004, Santa Cruz Island in February 2004, and northern Oregon in October 2004. We believe he has remained on Santa Cruz Island since returning to the island in 2005. The female, K-26, was fostered into the West End nest on Catalina Island in 2002, left the island in August 2002, and was seen as far north as Monterey, California. She was first seen on Santa Cruz Island in February 2005 and is believed to have remained on the island since that time.

We hiked to the potential nesting area on 23 February and confirmed the presence of a nest, but observed no eggs. On 5 March the birds were observed in incubation posture (Fig. 4) and we later confirmed two eggs in the nest. The eggs were expected to hatch starting around 10 April. On 8 April we placed a high-powered video camera in a tree about 90 m from the nest so that we could monitor the nesting activity without disturbing the birds. On 10 April we could only see one egg in the nest, which successfully hatched on 12 April. This was the first known natural hatch of a bald eagle on the California Channel Islands in about 50 years. The first-time parents did not feed the chick until 14 April, but



Figure 4. An adult male bald eagle incubating the eggs at the Pelican Harbor nest, Santa Cruz Island, California in 2006.

then began regularly bringing prey to the nest. Working with the National Park Service and the Ventura County Office of Education, we established a live web cam of the nest to allow viewers to watch this historic eaglet.

We visited the nest on 7 June to band the 8-week-old eaglet. It was fit with wingmarkers (A-49), a GPS/VHF transmitter, and federal leg bands (Table 1), and we collected blood and feather samples for contaminant and stable isotope analyses. The bird took its first flight on 13 June and remained in its parents' territory for approximately a month before beginning to explore the islands. A-49 remained on Santa Cruz through 22 September. On the morning of 23 September it flew to Santa Rosa Island where it remained through the end of the year (Fig. 5).

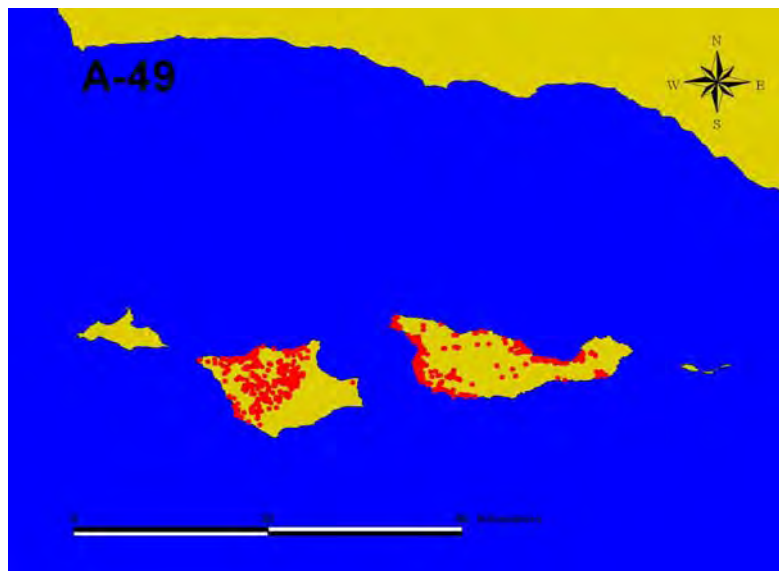


Figure 5. Movements of Bald Eagle A-49 on the northern California Channel Islands in 2006.

Malva Real Nest

On 6 April, the GPS data from a 4-year-old female (A-04) indicated she was spending her nights and about half of the daylight hours at the same location. On 7 April, we confirmed that the bird had a nest on the ground in the middle of a field on the south side of Santa Cruz Island (Fig. 6), one of only a few known ground nests reported outside of the Aleutian Islands. Her mate was K-11, an eagle fostered into the West End nest on Catalina Island in 2001, but for which we had no reported sightings between the time it left Catalina Island in 2001 and when it was found breeding on Santa Cruz Island. We were concerned about the potential impact of feral pigs and foxes on the success of the nesting attempt, but on or around 5 May the behavior of the birds changed, indicating that a chick had hatched. Because of the tall grass around the nest, we did not see the chick until 11 May.



Figure 6. Malva Real adult incubating egg(s) in a ground nest on Santa Cruz Island, California and the location of the nest in relation to the surrounding area (inset).

On 26 June, we visited the “nest” to band the eaglet. The nest consisted of a few sticks laid in the grass and the eaglet had started wandering in the vicinity of the nest several weeks before banding. The eaglet was found near a bush about 20-30 m from the nest. It was fit with wingmarkers (A-60), a GPS/VHF transmitter, and federal leg bands (Table 1). A fledge date was difficult to determine because the bird moved around on the ground so much, but it started moving longer distances around 17 July. It remained on Santa Cruz Island until 20 September and then flew to Santa Rosa Island (Fig. 7). On 21 September, it flew to San Miguel Island, where it stayed for a month before returning to Santa Rosa Island on 20 October.

Except for a two-day visit to Santa Cruz Island on 31 October

– 1 November, A-60 remained on Santa Rosa through the rest of the year.

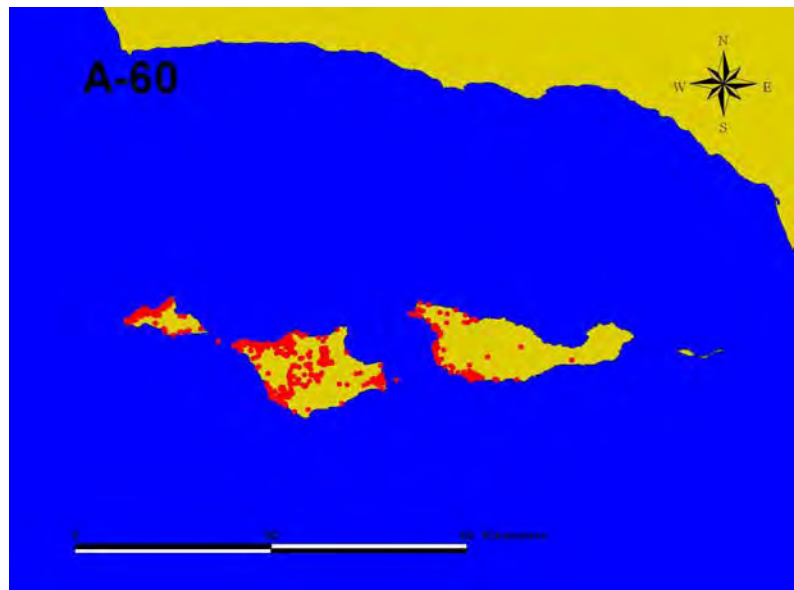


Figure 7. Movements of Bald Eagle A-60 on the northern California Channel Islands in 2006.

Bald Eagle Acquisition

Fifteen bald eagles were released on Santa Cruz Island in 2006: 13 from the San Francisco Zoo, one removed from a Catalina Island nest, and one from a rehabilitation center. On 11 May, three of the bald eagles produced at the Zoo were taken by boat to Santa Cruz Island and placed in the North Tower. On 25 May, six additional Zoo birds were taken by boat to Santa Cruz Island and placed in the South Tower. Five more eaglets, four from the Zoo and one that was removed from the West End nest on Santa Catalina Island with a broken leg, were taken to the island on 6 June. The Zoo birds were placed in the North Tower and the Catalina bird was placed in a quarantine cage until the pins were removed from its leg. It was moved into the North Tower on 14 June. The final bird was flown to Santa Cruz Island from a rehabilitation center in northern California on 5 August and placed in the North Tower.

Bald Eagle Hacking

The first three birds from the ACC that were placed into the North Tower were banded on 3 June and released on 8 June (Table 1). We banded three of the birds in the South Tower on 17 June and the remaining three birds in the South Tower on 23 June. All six birds were released on 25 June. We banded the final four ACC birds in the North Tower on 25 June and released them on 29 June (Table 1). The eagle from Catalina Island was banded on 11 July and released on 17 July. The final bird was banded on 5 August and released on 12 August.

Post-Release Monitoring

IWS personnel began daily post-fledging tracking and monitoring of the eagles as soon as the nest box doors were opened. Food, in the form of feral pig and fish carcasses, was placed on top of and in front of each hack tower initially, and then moved further from the towers to encourage the young birds to search for food.

As of 31 December, 10 of this year's fledglings (8 hacked, 2 from wild nests) are being tracked and monitored on a regular basis. Both the satellite and VHF transmitters stopped

functioning on Eagle A-57 on 8 July, but it was seen alive on 31 July. We had six known mortalities among this year's released birds. As in the past, eagles dying from drowning/hypothermia was our biggest single source of mortality (three birds this season). Three other birds died of unknown causes, one on Santa Cruz Island, one on Anacapa Island, and one in central California (Table 1).

A-46 Movements

Eagle A-46 left the islands on 6 July. It crossed into Oregon on 16 July, into Washington on 21 July, and into British Columbia on Vancouver Island on 11 August (Fig. 8). We stopped receiving data from this bird on 6 November, but we had a report and photo of it at the Vancouver dump on 7 December.

A-47 Movements

Eagle A-47 fledged on 9 June. It remained on the island, but between 1500 and 1600 hours on 22 June it ended up in the water approximately 1.6 km northeast of the easternmost point of Santa Cruz Island. We continued to get its signal floating in the ocean until 1 July, at which time it was about 42 km south southeast of Santa Barbara Island (Fig. 9).

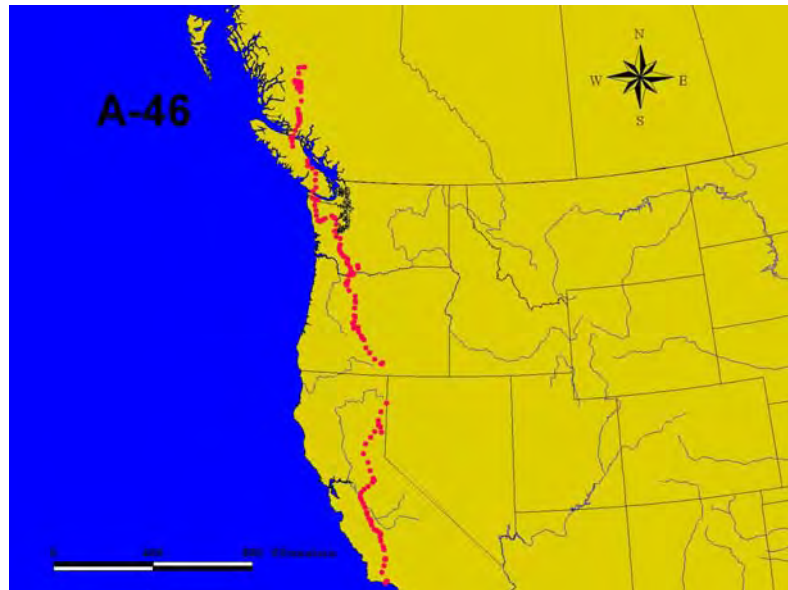


Figure 8. Movements of Bald Eagle A-46 across the western United States and Canada during 2006.

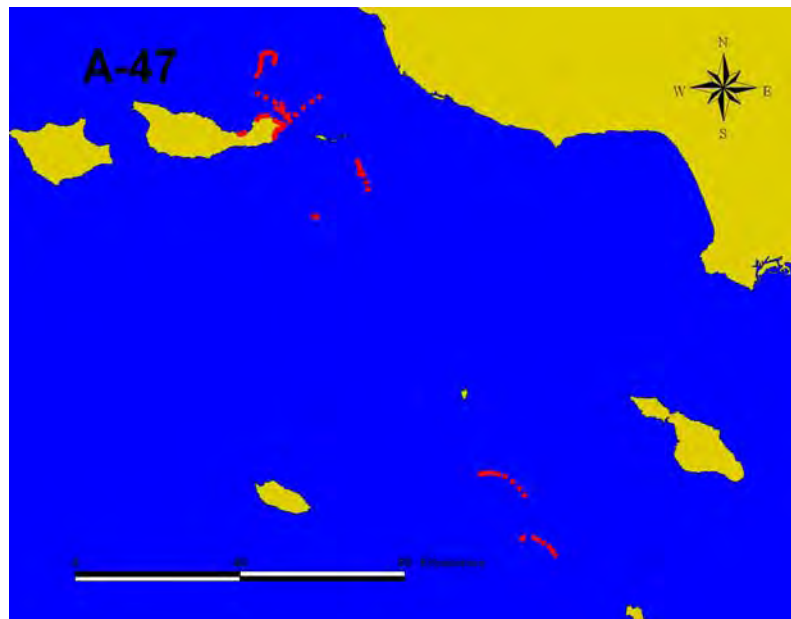


Figure 9. Movements of Bald Eagle A-47 on the California Channel Islands in 2006.

Table 1. Identification, release information, and status of bald eagles fledged on Santa Cruz Island in 2006.

FWS Leg Band	Sex ^a	Patagial Marker	Source ^b	Release/Hatch Location	Fledge Date	Status/Latest Location ^c
629-52404	M	A-46	Zoo	North Tower, Box 1	6/8/06	Alive, Vancouver, B.C.
629-52405	M	A-47	Zoo	North Tower, Box 1	6/9/06	Dead (died in ocean)
629-52406	F	A-48	Zoo	North Tower, Box 1	6/14/06	Alive, Santa Rosa Island
629-52407	F	A-49	Wild	Pelican Harbor Nest	7/13/06	Alive, Santa Rosa Island
629-52409	F	A-50	Zoo	South Tower, Box 4	6/25/06	Dead, w. end of Santa Cruz
629-52410	F	A-51	Zoo	South Tower, Box 4	6/25/06	Alive Santa Rosa Island
629-52411	F	A-52	Zoo	South Tower, Box 4	6/25/06	Alive, Santa Rosa Island
629-52415	F	A-53	Zoo	South Tower, Box 3	6/26/06	Dead, found in central CA
629-52416	M	A-54	Zoo	South Tower, Box 3	6/25/06	Dead (died in ocean)
629-52417	F	A-55	Zoo	South Tower, Box 3	6/28/06	Alive, Santa Cruz Island
629-52418	M	A-56	Zoo	North Tower, Box 2	7/16/06	Dead (died in ocean)
629-52419	F	A-57	Zoo	North Tower, Box 2	6/29/06	Unknown
629-52420	M	A-58	Zoo	North Tower, Box 2	6/29/06	Alive, Santa Rosa Island
629-52421	F	A-59	Zoo	North Tower, Box 2	6/29/06	Alive, Santa Rosa Island
629-52422	M	A-60	Wild	Malva Real Nest		Alive, Santa Rosa Island
629-52423	F	A-61	Catalina	North Tower, Box 1	7/19/06	Dead, w. Anacapa Island
629-52424	F	A-62	N. CA	North Tower, Box 1	8/12/06	Alive, Santa Rosa Island

^a Determined by karyotyping.

^b Bald eagles from the San Francisco Zoo, California (Zoo) or rehabilitated birds from Catalina Island or Northern California

^c Status as of 31 December 2006.

A-48 Movements

Eagle A-48 remained on Santa Cruz Island for about a month before flying to Anacapa Island (Fig. 10). Data were sporadic, but it flew to Anacapa sometime between 13 and 18 July. It remained on Anacapa for a month, returned to Santa Cruz Island on 15 August, then flew

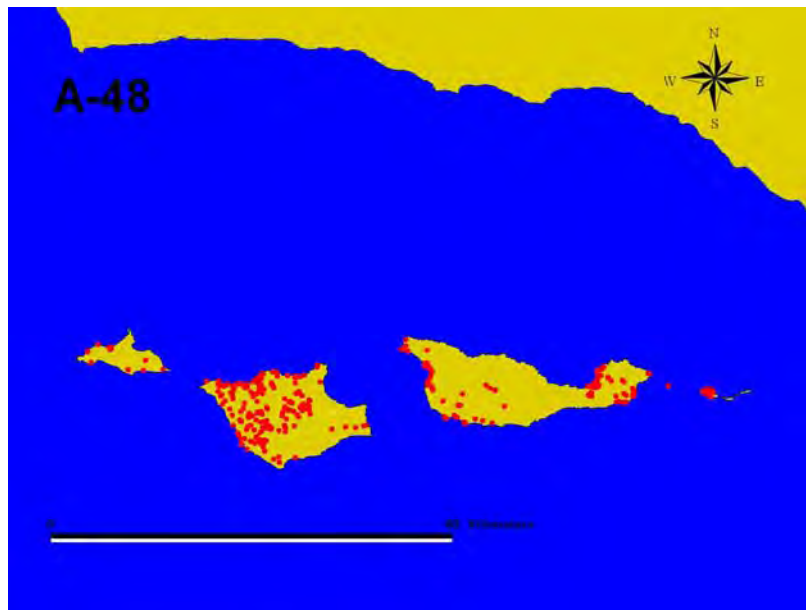


Figure 10. Movements of Bald Eagle A-48 on the California Channel Islands in 2006.

back to Anacapa Island on 20 August, where it remained through 6 September. The bird returned to Santa Cruz Island on 7 September, flew to Santa Rosa Island on 16 September, to San Miguel Island on 22 September, and back to Santa Rosa on 24 September, where it remained through the end of the year.

A-50 Movements

Eagle A-50 spent all of its time on Santa Cruz Island. It moved to the northwestern tip of Santa Cruz Island around 13 July (Fig. 11). GPS data from 30 July showed that the bird was not moving more than 50 m a day.

Because of the three-day delay in receiving data, we were not able to get out to the area until 4 August, at which time the bird's carcass was found tangled in kelp on a small beach near Frasier Point. The bird was seen with a full crop on 22 July, so it seems to have been finding food in the area. The cause of death is unknown.

A-51 Movements

Eagle A-51 remained on Santa Cruz Island until 20 July. It flew to Anacapa Island between 1600 and 1700 hrs on 20 July, where it remained for almost a month (Fig. 12). On 17 August, the bird returned to Santa Cruz Island, but returned to Anacapa on the 20th. It made another trip to

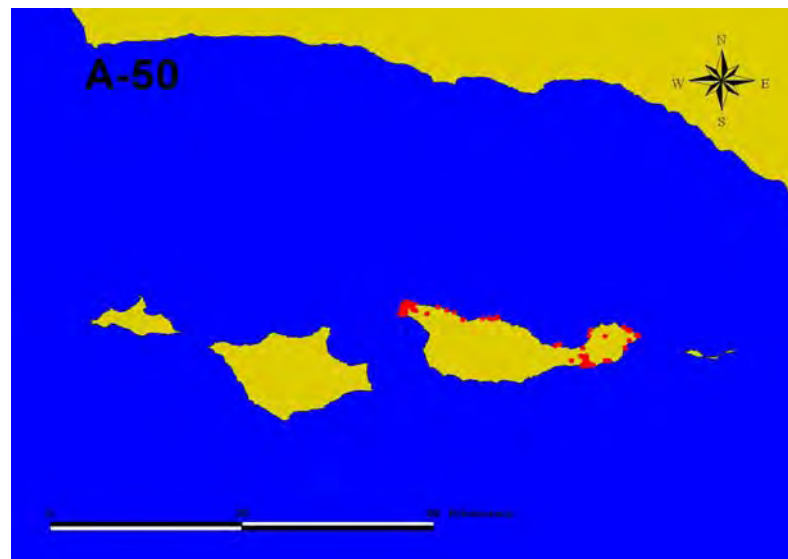


Figure 11. Movements of Bald Eagle A-50 on the California Channel Islands in 2006.

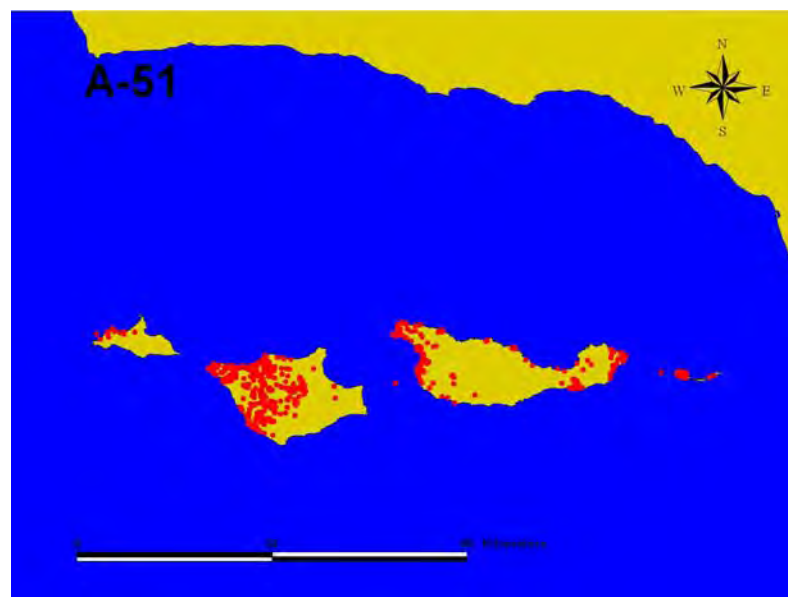


Figure 12. Movements of Bald Eagle A-51 on the California Channel Islands in 2006.

Santa Cruz Island on 6 September, flew back to Anacapa on 18 September and then returned to Santa Cruz on 19 September. On 20 September, A-51 flew to Santa Rosa Island and then moved to San Miguel Island the next day. It returned to Santa Rosa on 24 September and remained there through the end of the year.

A-52 Movements

Eagle A-52 first flew to Santa Rosa Island on 17 July (Fig. 13), but returned to Santa Cruz Island two days later. On 5 August it made a flight to Anacapa Island, flew back to Santa Cruz around 16 August, then returned to Anacapa on 25 August. It flew to Santa Cruz

Island on 2 September, to Santa Rosa Island on 6 September, back to Santa Cruz on 9 September, to Santa Rosa on 20 September, and to San Miguel Island on 21 September, where it stayed for nearly two weeks. On 4 October it flew to Santa Rosa Island, where it remained through the end of the year.

A-53 Movements

Eagle A-53 left the islands on 16 September. It flew through central California to the Nevada border by 22 September before returning to central California. Our data from 8 October indicated that the bird had stopped moving (Fig. 14). It was recovered from a

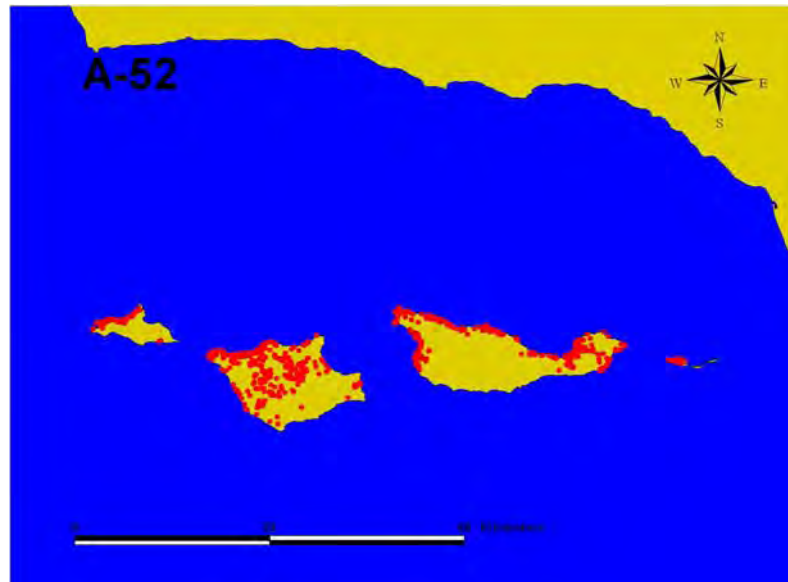


Figure 13. Movements of Bald Eagle A-52 on the California Channel Islands in 2006.

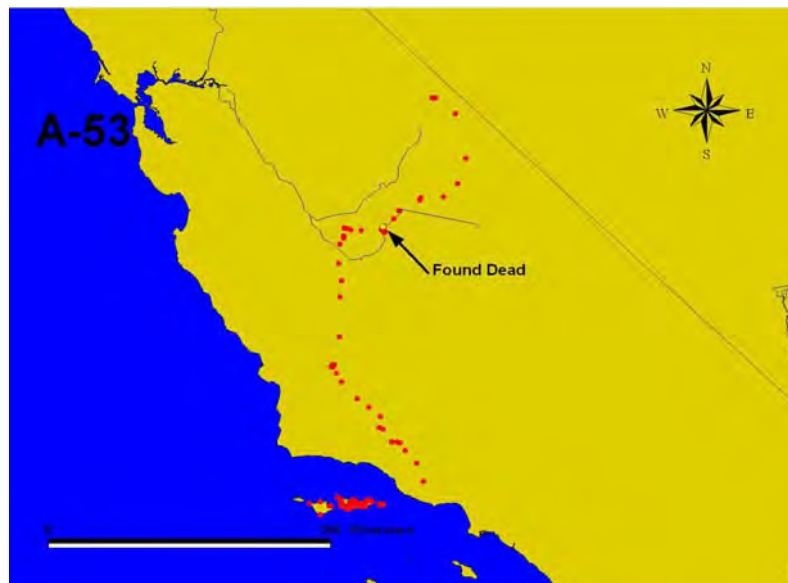


Figure 14. Movements of Bald Eagle A-53 on the California Channel Islands in 2006.

field near Fresno, California on 14 October. There was no indication of the cause of death.

A-54 Movements

Eagle A-54 spent all of its time on Santa Cruz Island following its release (Fig. 15). On 5 August the bird apparently attempted to fly to the mainland from the western tip of the island. It appears to have gone into the water about 20 km northeast of the point from which it left the island.

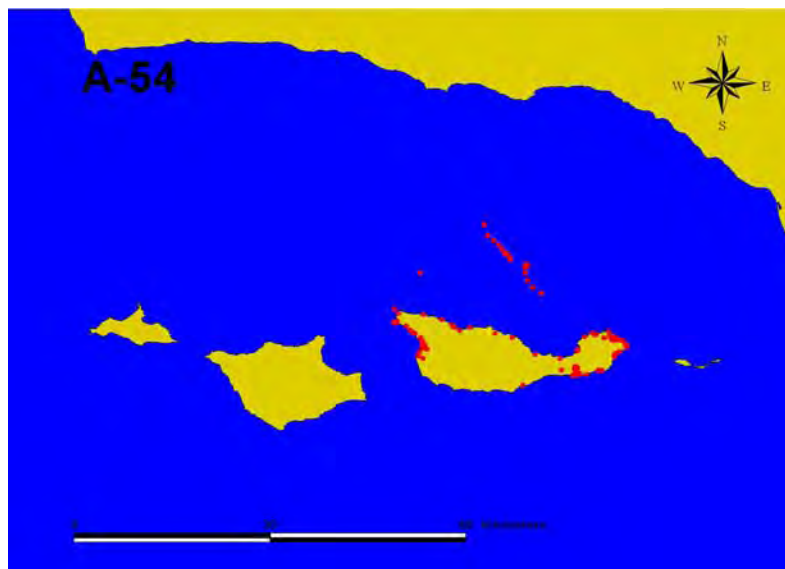


Figure 15. Movements of Bald Eagle A-54 on the California Channel Islands in 2006.

A-55 Movements

Eagle A-55 stayed on Santa Cruz Island until 4 August, at which time it flew to Santa Rosa Island (Fig. 16). The next day it flew to San Miguel Island at around 1000 hours, but it was back on Santa Rosa by 1700 hours. The next day it returned to Santa Cruz Island and stayed on the island until 22 September. It

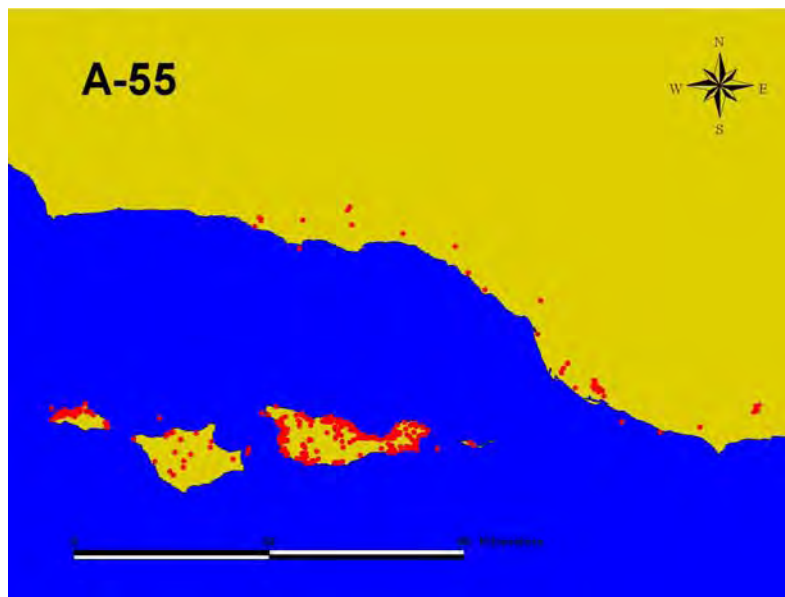


Figure 16. Movements of Bald Eagle A-55 on the California Channel Islands in 2006.

then flew to Santa Rosa around 1100 hours and then on to San Miguel around 1200 hours. It remained on San Miguel until returning to Santa Rosa and then Santa Cruz on 27 November. On 21 December, it flew due east from Santa Cruz to the mainland. It spent time along the mainland coast before returning to Santa Cruz Island on 28 December.

A-56 Movements

Eagle A-56 stayed on Santa Cruz Island until 18 September, at which time it flew to Anacapa Island (Fig. 17). It attempted to return to Santa Cruz Island on the same day, but ended up in the ocean less than 1 km from the easternmost point of Santa Cruz. We continued to get its GPS data from the ocean until 1 October, at which time it was about 75 km west of San Clemente Island.

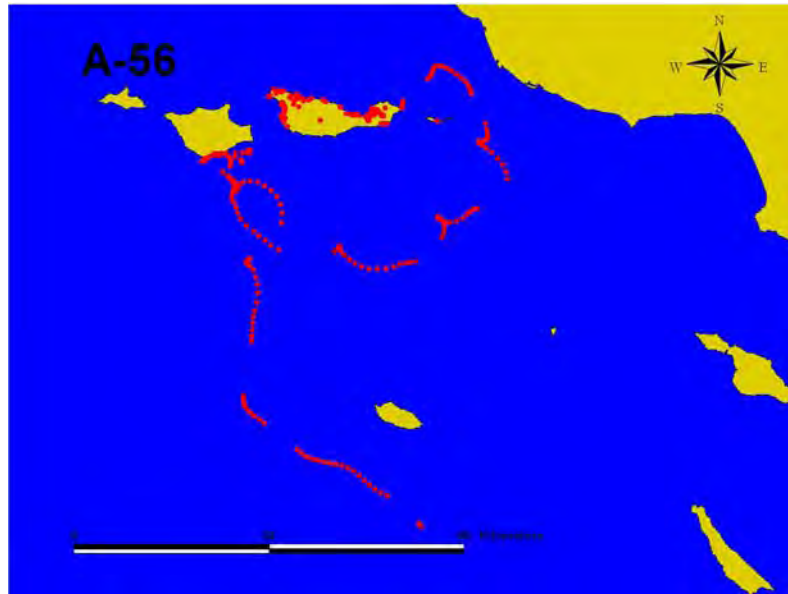


Figure 17. Movements of Bald Eagle A-56 on the California Channel Islands in 2006.

A-57 Movements

Eagle A-57's GPS transmitter malfunctioned on 8 July, about a week after fledging (Fig. 18). The bird was seen on 31 July still wearing both transmitters, but we were unable to receive a signal from either. The current status of the bird is unknown.

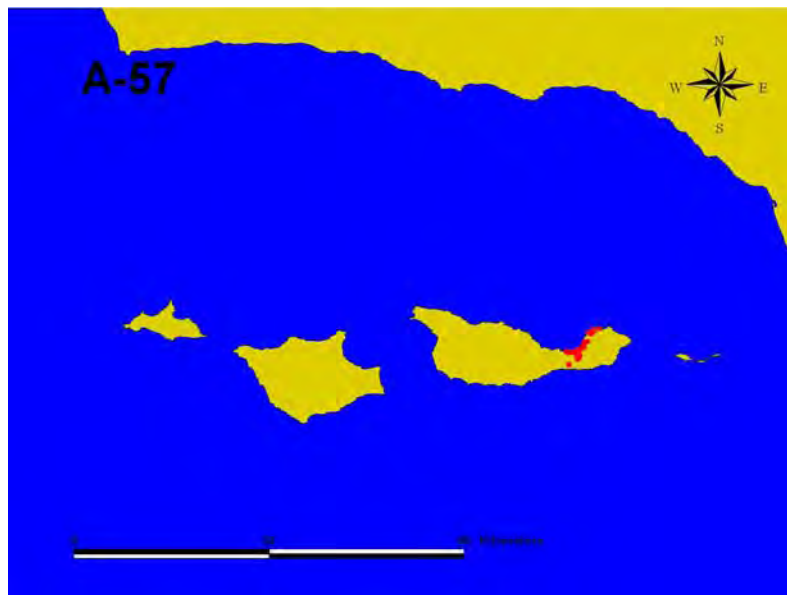


Figure 18. Movements of Bald Eagle A-57 on the California Channel Islands in 2006.

A-58 Movements

Eagle A-58 visited three of the northern Channel Islands during 2006. It flew to Santa Rosa Island on 4 August, but returned to Santa Cruz Island the next day (Fig. 19). On 14 August

it returned to Santa Rosa Island, where it remained for 10 days before moving further west to San Miguel Island. It stayed on San Miguel for a day, flying back to Santa Rosa Island on 25 August, where it remained through the end of the year.

A-59 Movements

Eagle A-59 stayed on Santa Cruz Island until 22 September, at which time it flew to Santa Rosa Island. The next day it moved to San Miguel Island and remained there for over two months (Fig. 20). On 27 November it flew to Santa Rosa Island and then moved east to Santa Cruz Island on 29 November. It returned to Santa Rosa on 2 December and remained on the island through the end of the year.

A-61 Movements

Eagle A-61, the eagle that suffered a broken leg in a nest on Catalina Island, was released from a hacking tower on 19 July and flew to Anacapa Island on 5 August (Fig. 21). We stopped receiving data on the night of 6 August, except for a few sporadic data points on 12-16 August,

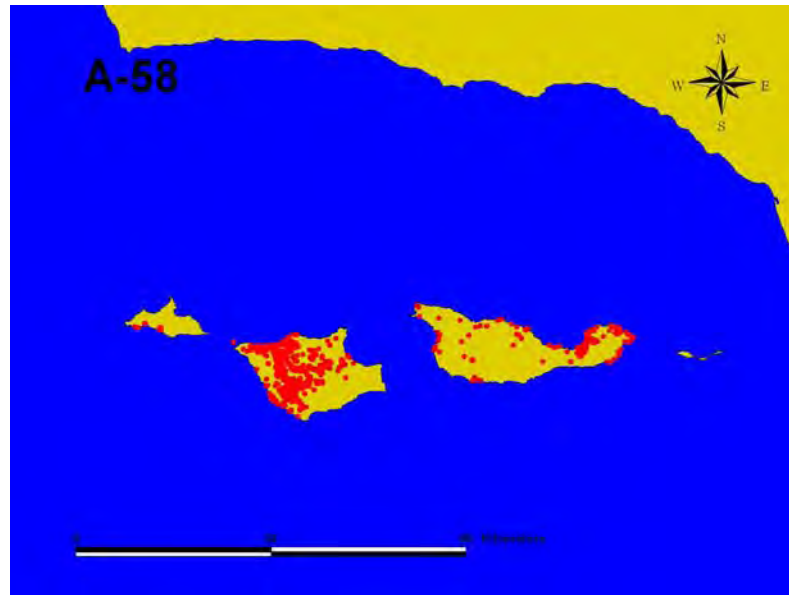


Figure 19. Movements of Bald Eagle A-58 on the California Channel Islands in 2006.

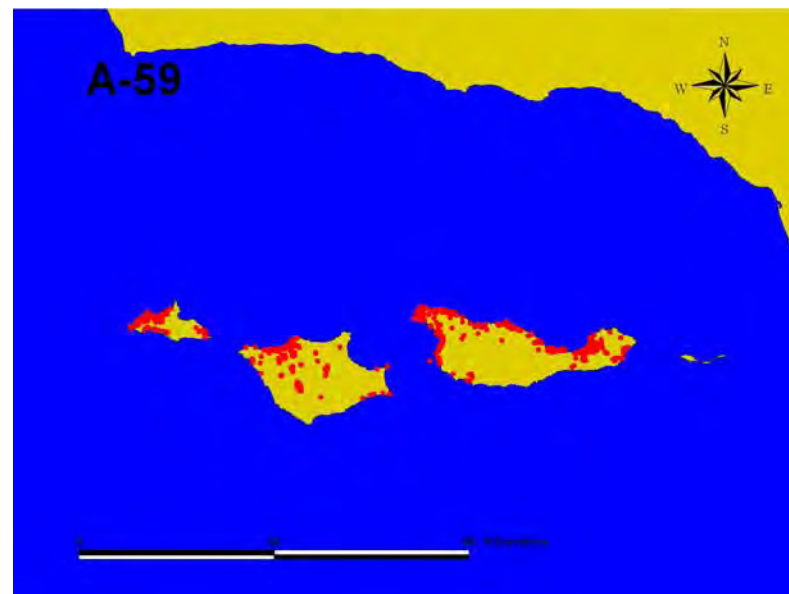


Figure 20. Movements of Bald Eagle A-59 on the California Channel Islands in 2006.

all of which were at the same location. We were unable to access the island until after the sea bird breeding season. In October we boated to Anacapa Island from Santa Cruz and recovered A-61's carcass from a small canyon on the north side of West Anacapa Island.

A-62 Movements

Eagle A-62 had the easiest movements to track from the 2006 releases. It stayed on Santa Cruz Island until 26 October, at which time it flew to Santa Rosa Island. It remained on Santa Rosa through the end of the year (Fig. 22).

Follow-up of Previously Released Eagles

While monitoring the newly released eagles, we continued to monitor the birds released in 2002 through 2005. Below is a brief summary of the movements and status of these birds during 2006. Each bird is referred to by its patagial tag number (Table 2).

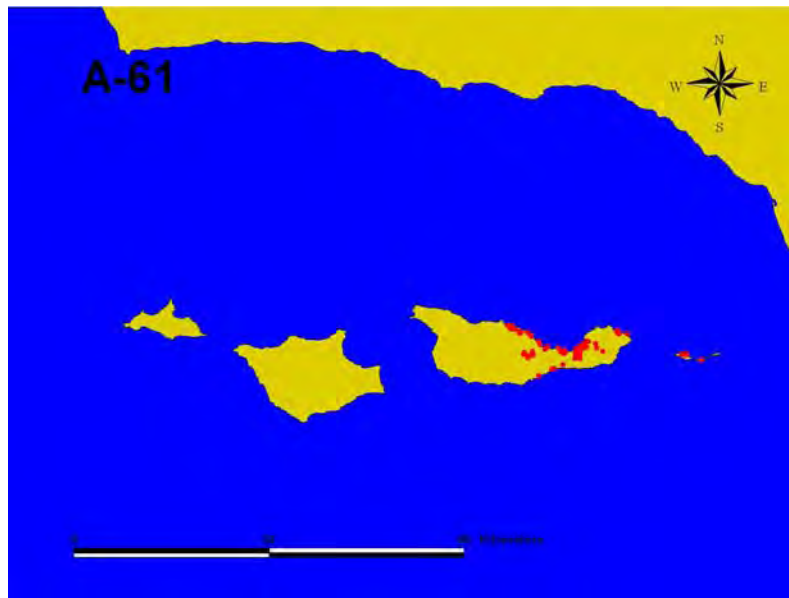


Figure 21. Movements of Bald Eagle A-61 on the California Channel Islands in 2006.

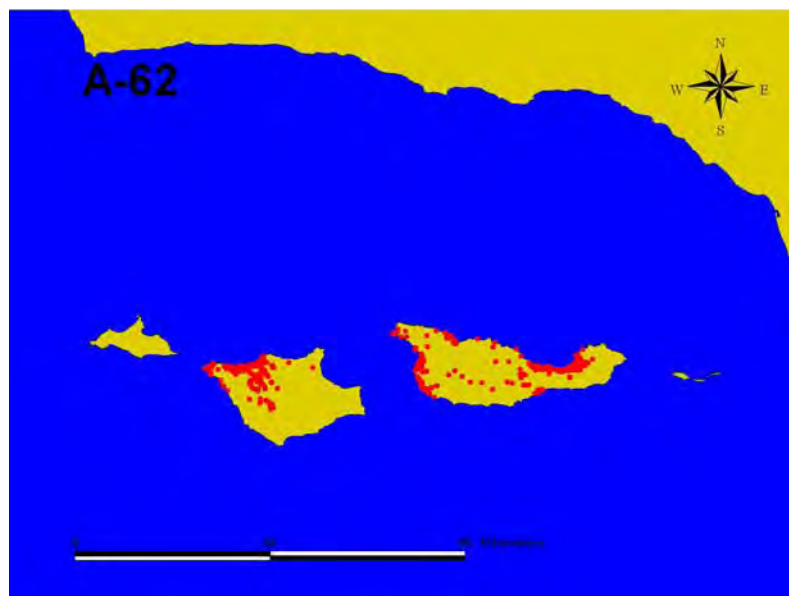


Figure 22. Movements of Bald Eagle A-62 on the California Channel Islands in 2006.

Table 2. Identification, release information, and current status of bald eagles released on Santa Cruz Island, California during 2002-2005.

FWS Leg Band	Sex ¹	Patagial Marker	Source ²	Release Point	Release Date	Status, Latest Location ³
629-02795	M	A-00	Zoo	North Tower, Cage 1	6/25/02	Alive, Santa Cruz Is.
629-02796	F	A-01	Zoo	North Tower, Cage 1	6/25/02	Unknown
629-02798	F	A-02	Zoo	North Tower, Cage 2	6/25/02	Alive, Santa Rosa Is.
629-02797	F	A-03	Zoo	North Tower, Cage 2	6/25/02	Dead
629-14042	F	A-04	Alaska	North Tower, Cage 2	8/15/02	Alive, Santa Cruz Is.
629-14041	F	A-05	Alaska	North Tower, Cage 2	8/15/02	Dead
629-14043	M	A-06	Zoo	North Tower, Cage 1	8/19/02	Alive, Santa Rosa Is.
629-14044	M	A-07	Alaska	North Tower, Cage 1	8/17/02	Dead
629-14045	M	A-08	Alaska	South Tower, Cage 3	8/26/02	Alive, Santa Rosa Is.
629-14046	F	A-09	Alaska	South Tower, Cage 3	8/26/02	Dead
629-14047	F	A-10	Alaska	South Tower, Cage 4	9/7/02	Unknown
629-14048	F	A-11	Alaska	South Tower, Cage 4	9/7/02	Alive, Santa Cruz Is.
629-47354	F	A-12	Zoo	North Tower, Cage 2	6/13/03	Alive, mainland
629-47355	F	A-13	Zoo	North Tower, Cage 2	7/01/03	Dead, mainland
629-47364	M	NA	Zoo	North Tower, Cage 1	7/25/03	Alive, Rehab.
629-47361	F	A-14	Alaska	South Tower, Cage 3	8/21/03	Dead
629-47357	M	A-15	Zoo	North Tower, Cage 1	7/25/03	Dead
629-47359	F	A-16	Alaska	South Tower, Cage 3	8/21/03	Alive, Santa Cruz Is.
629-47360	F	A-17	Alaska	South Tower, Cage 3	8/21/03	Alive, Santa Cruz Is.
629-47362	F	A-18	Alaska	South Tower, Cage 4	8/21/03	Dead
629-47363	F	A-19	Alaska	South Tower, Cage 4	8/21/03	Unknown
629-47358	F	A-20	Alaska	North Tower, Cage 2	8/31/03	Dead
629-47356	M	A-21	Alaska	North Tower, Cage 2	8/31/03	Alive, Santa Rosa Is.
629-47365	F	A-22	Zoo	North Tower, Cage 1	7/09/04	Alive, Santa Rosa Is.
629-47366	F	A-23	Zoo	North Tower, Cage 2	7/26/04	Unknown
629-47372	F	A-24	Alaska	South Tower, Cage 4	8/18/04	Alive, Santa Rosa Is.
629-47373	M	A-25	Alaska	South Tower, Cage 4	8/18/04	Dead
629-47374	M	A-26	Alaska	South Tower, Cage 4	8/18/04	Dead

Table 2. Continued

FWS Leg Band	Sex ¹	Patagial Marker	Source ²	Release Point	Release Date	Status, Latest Location ³
629-47375	F	A-27	Alaska	South Tower, Cage 3	8/19/04	Alive, Mainland
629-47376	M	A-28	Alaska	South Tower, Cage 3	8/19/04	Alive, Santa Cruz Is.
629-47377	M	A-29	Alaska	South Tower, Cage 3	8/19/04	Alive, Santa Rosa Is.
629-47378	F	A-30	Rehab	South Tower, Cage 4	8/19/04	Dead
629-47379	F	A-31	Alaska	North Tower, Cage 1	9/12/04	Unknown
629-47380	F	A-32	Alaska	North Tower, Cage 1	9/12/04	Alive, Santa Cruz Is.
629-47381	M	A-33	Alaska	South Tower, Cage 4	10/9/04	Alive, Santa Rosa Is.
629-47385	F	A-34	Zoo	South Tower, Box 3	7/02/05	Alive, Santa Rosa Is.
629-47386	F	A-35	Zoo	South Tower, Box 3	7/02/05	Alive, Santa Rosa Is.
629-47387	F	A-36	Zoo	South Tower, Box 3	7/02/05	Alive, Santa Rosa Is.
629-47388	F	A-37	Zoo	South Tower, Box 4	7/02/05	Alive, Santa Rosa Is.
629-47389	M	A-38	Zoo	South Tower, Box 4	7/02/05	Dead
629-47390	M	A-39	Zoo	South Tower, Box 4	7/02/05	Alive, mainland
629-47391	M	A-40	Zoo	South Tower, Box 4	7/02/05	Alive, Santa Cruz Is.
629-47392	M	A-41	Alaska	North Tower, Box 2	7/12/05	Dead
629-47393	F	A-42	Zoo	North Tower, Box 2	7/12/05	Dead
629-47399	F	A-43	Zoo	North Tower, Box 1	7/20/05	Alive, Santa Rosa Is.
629-47400	M	A-44	Zoo	North Tower, Box 1	7/20/05	Alive, Santa Cruz Is.
629-02800	M	A-45	Zoo	North Tower, Box 1	7/20/05	Alive, Santa Rosa Is.

¹ Determined by karyotyping for birds from San Francisco Zoo, and morphometrics for Alaskan birds.

² Bald eagles from the Avian Conservation Center, San Francisco Zoo, California (Zoo), wild nests near Juneau, Alaska (Alaska), or Shasta Wildlife Rescue and Rehabilitation Center, Redding, California (Rehab).

³ As of 12/31/06.

A-00 Movements

Eagle A-00, which dropped its transmitter in May 2003, was seen on Santa Rosa Island in January 2006. It is known to have survived through the end of the year (sighted on Santa Cruz in early 2007).

A-02 Movements

Eagle A-02 spent the first part of the year primarily on the northern shore of Santa Cruz Island (Fig. 23). She flew to Santa Rosa Island on 28 February, but returned to the Lady's Harbor area of Santa Cruz on 3 March. She moved about the island, largely along the southwestern coast, until returning to Santa Rosa on 23 September. She flew to Santa Cruz on 7 December, returned to Santa Rosa on 15 December and remained there through the end of the year.

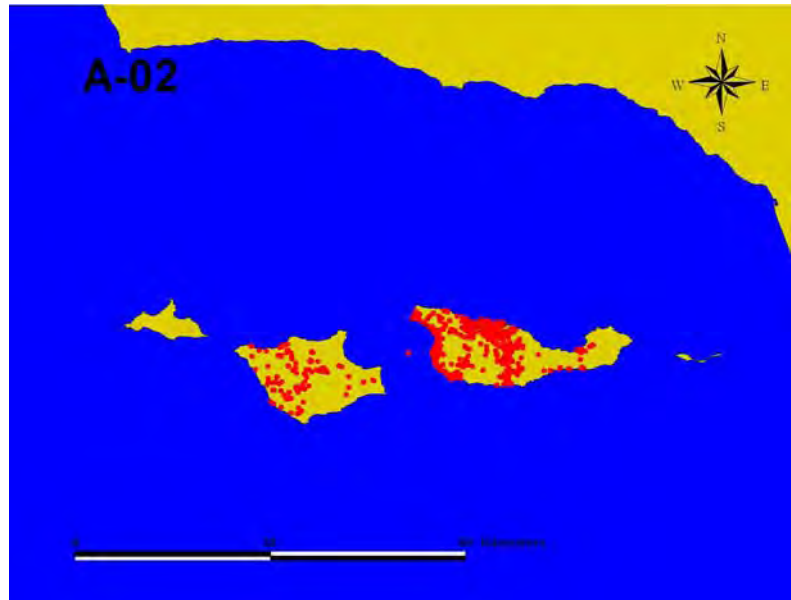


Figure 23. Movements of Bald Eagle A-02 on the California Channel Islands in 2006.

A-04 Movements

Eagle A-04 has a functioning GPS unit, which was crucial in allowing us to find her nest in the field. She generally remained on the southwestern portion of the island through most of the year (Fig. 24). However, later in the year she roamed more widely, making trips to Santa Rosa Island on 10 - 14 October and 18 October - 1 November. She also made a short visit to the eastern portion of Santa Cruz Island on 12-15 December.

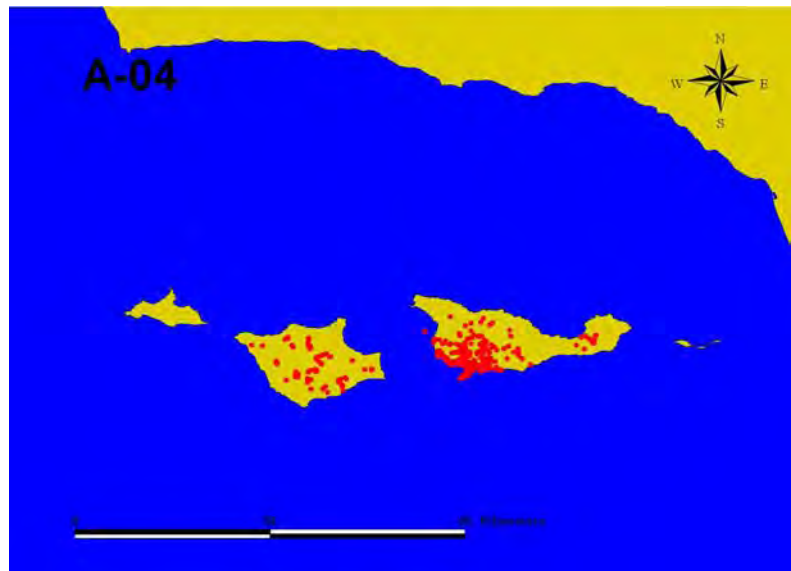


Figure 24. Movements of Bald Eagle A-04 on the California Channel Islands in 2006.

A-06 Movements

Eagle A-06 disappeared soon after his release in 2002. During trapping efforts on Santa Rosa Island in January, we saw this bird flying near China Camp on the south side of the island.

A-08 Movements

Eagle A-08 dropped his transmitter in July 2003. The bird is known to be alive on Santa Rosa Island (seen in early 2007).

A-11 Movements

Eagle A-11 dropped its transmitter in September 2003. This bird has been seen on Santa Cruz Island several times during 2006 (Fig. 25). She was seen in the presence of male A-21 several times, so this is a possible new pair for 2007.



Figure 25. Female A-11 on Santa Cruz Island in 2006. Photo captured using a remote camera at a bait site.

A-12 Movements

Eagle A-12 left the Channel Islands in August 2003 and we stopped receiving data in December 2003. In January 2006, this bird was reported at Bravo Lake in Tulare County, California.

A-13 Movements

Eagle A-13's GPS unit stopped transmitting data in July 2004, at which time it was in Montana. This bird was reported in southern California several times in 2006. It was sighted at

Tejon Ranch in August and at Devereux Slough, Santa Barbara County, California in November. Unfortunately, the bird was found dead below some power lines at Tejon Ranch on 3 December, but it is unclear whether it was electrocuted.

A-16 Movements

Eagle A-16 dropped its transmitter on Santa Rosa Island sometime in late 2005 or early 2006. We began getting data from the transmitter in the Trancion Canyon area of Santa Rosa in March 2006 and were able to recover its transmitter. The bird was seen on Santa Rosa Island on 29 April and is known to still be alive as of the end of 2006 (seen repeatedly on Santa Cruz in early 2007).



Figure 26. One of several photos taken of Eagle A-17 on Santa Cruz Island in 2006 using remote cameras at bait sites.

A-17 Movements

Eagle A-17 dropped its transmitter in 2004. This bird's photo was captured multiple times on Santa Cruz Island during 2006 using our remote cameras (Fig. 26).

A-21 Movements

Eagle A-21 spent time on three of the northern Channel Islands in 2006 and moved between them regularly (Fig. 27). At

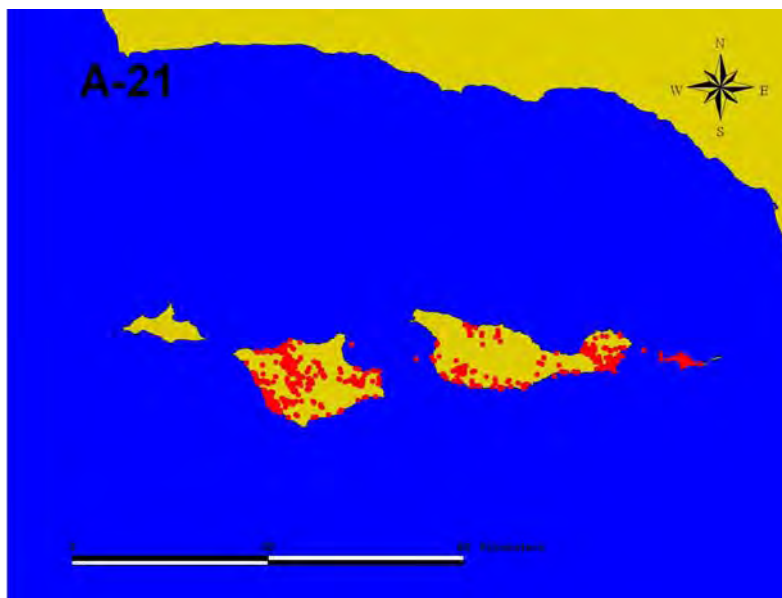


Figure 27. Movements of Bald Eagle A-21 on the California Channel Islands in 2006.

times the GPS data were sporadic and we would miss several days of locations. He flew between Santa Cruz and Santa Rosa Islands three times in January, three times in February, then spent most of March through mid-June on Anacapa Island, with several short trips to Santa Cruz. He spent 13-21 June on Santa Rosa Island, a few days on Santa Cruz, and then returned to Anacapa for most of July (again making several short trips to Santa Cruz). August through December were spent primarily on Santa Rosa Island, although he made short trips to both Santa Cruz and Anacapa Islands during that period.

A-22 Movements

Eagle A-22 was not seen during 2006, but was seen on Santa Rosa Island in early 2007.

A-24 Movements

Eagle A-24 dropped its transmitter in 2005, but was seen on Santa Rosa in January 2006.

A-27 Movements

Eagle A-27 dropped its transmitter on Santa Rosa Island in September 2005. It was seen fishing at Pine Flat Lake near Fresno, California on 1 September and is known to have survived the year (seen on the mainland in early 2007).



Figure 28. Eagle A-28 (right side) on a hacktower roof with two of the eagles released in 2006.

A-28 Movements

Eagle A-28's transmitter stopped functioning in December 2005. It was seen on Santa Cruz Island in August 2006, often at the hacking towers with this year's released birds (Fig. 28).

A-29 Movements

Eagle A-29 spent most of the year along the coast of Santa Cruz Island (Fig. 29). On 26 October it flew to Santa Rosa Island and remained there through the end of the year.

A-32 Movements

Eagle A-32 flew to the mainland on 15 January and was seen several times at Lake Cachuma, Santa Barbara County, California. It returned to Anacapa Island on 12 February and remained there until it flew to Santa Cruz Island on 3 March (Fig. 30). On 13 March it flew to Santa Rosa Island, but returned to Santa Cruz Island on 18 March. It flew to Anacapa Island on 26 March, returned to Santa Cruz on 15 April, flew back to Anacapa on 27 April, back to Santa Cruz on 5 May, and then back to Anacapa on 22 May. On 24 May it dropped its transmitter, but it was seen at Lake Cachuma in October and is known to have survived through the end of the year.

A-33 Movements

Eagle A-33 spent most of January on Santa Cruz Island, flew to Santa Rosa Island on 22 January, and except for a one-day trip back to Santa Cruz, remained there until 7 February (Fig.

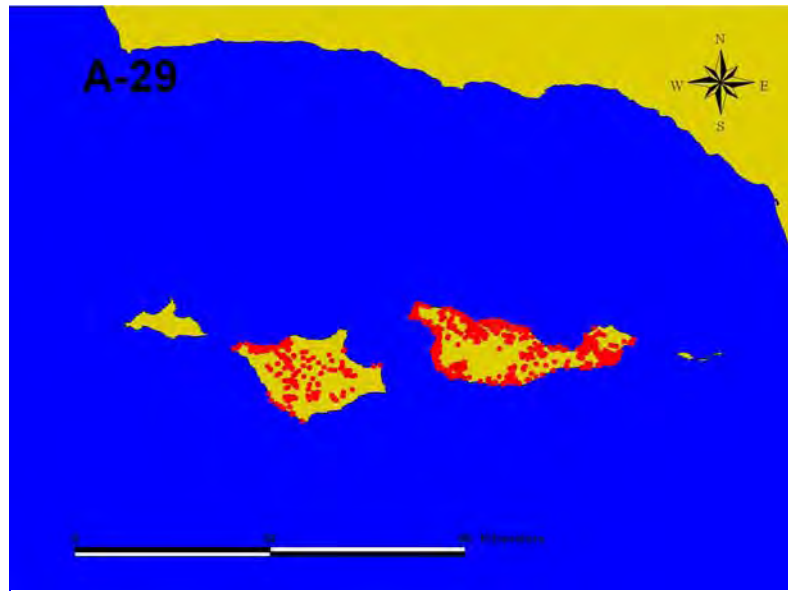


Figure 29. Movements of Bald Eagle A-29 on the California Channel Islands in 2006.

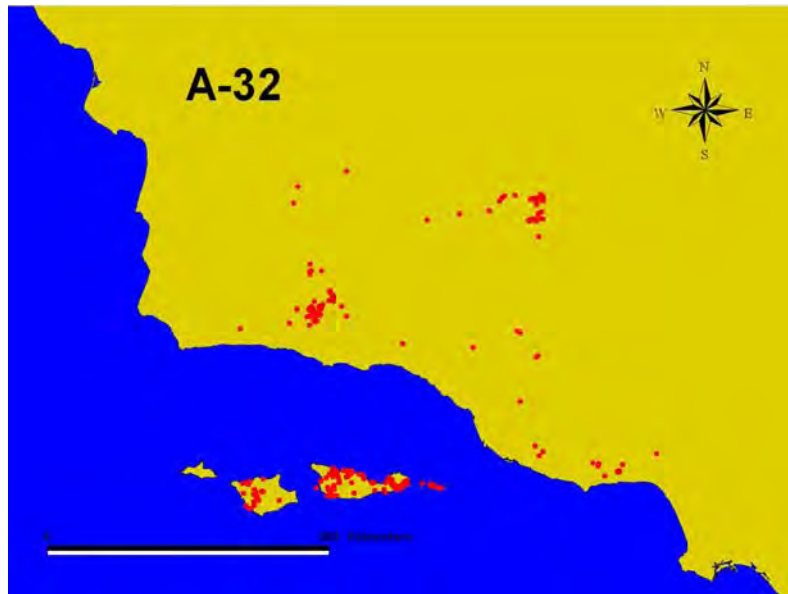


Figure 30. Movements of Bald Eagle A-32 on the California Channel Islands in 2006.

31). On 7 February it flew to San Miguel Island for a few days, returned to Santa Rosa on 11 February, and flew to Santa Cruz on 14 February. It spent a week on Santa Cruz and then returned to Santa Rosa on 21 February. On 7 March, the bird returned to Santa Cruz Island and then moved on to Anacapa Island on 18 March. It flew between Anacapa and Santa Cruz Islands nine times during April. It flew to Santa

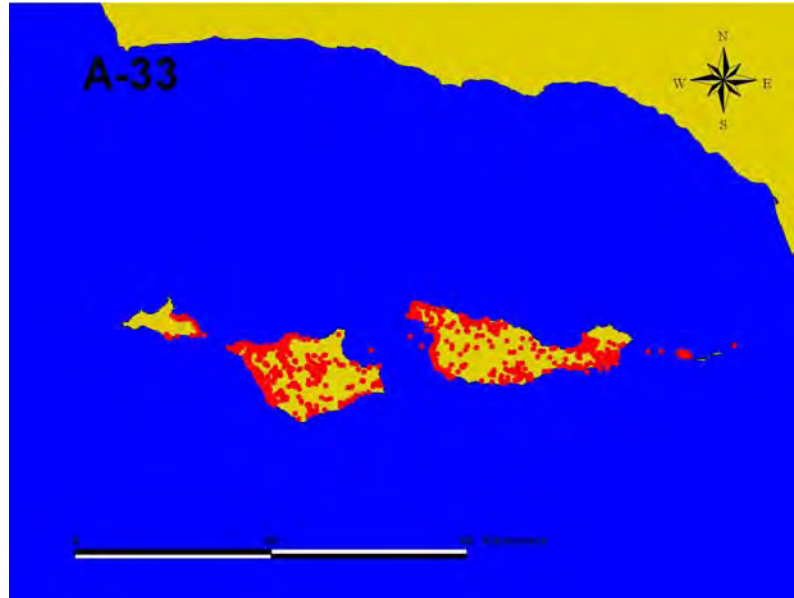


Figure 31. Movements of Bald Eagle A-33 on the California Channel Islands in 2006.

Rosa Island on 22 May before returning to Santa Cruz for the period of 11 June to 2 October. It made a final trip to Anacapa on 2 October, returned to Santa Cruz the next day and then moved to Santa Rosa on 5 October, where it stayed until 10 December. On 10 December it flew to Santa Cruz, but returned to Santa Rosa Island on 16 December and remained there through the end of the year.

A-34 Movements

Eagle A-34 began the year on Santa Rosa Island, where it remained through 10 March (Fig. 32). It flew to Santa Cruz on 11 March and then to Anacapa Island on 13 March, where it remained through 6 August. On 7 August, it flew to Santa Cruz Island, stayed for about a month, and then flew to Santa Rosa Island on 9 September, where it remained through the end of the year.

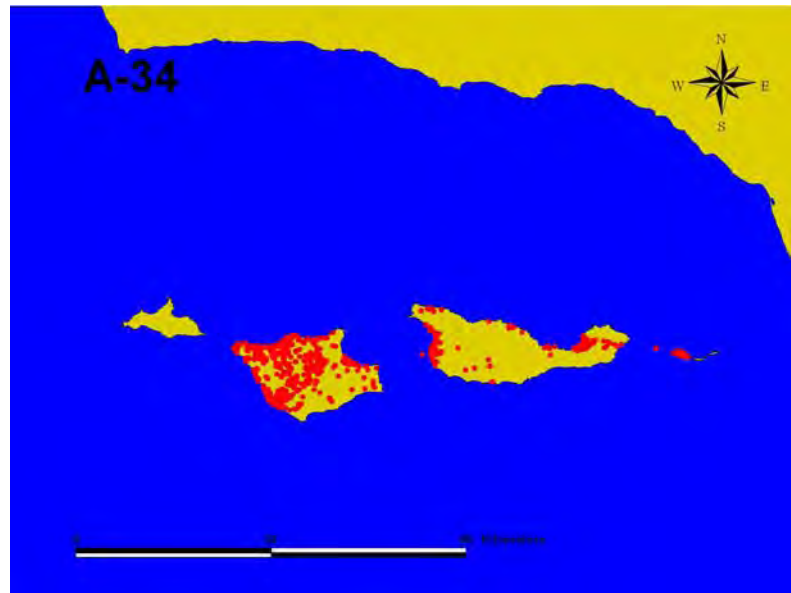


Figure 32. Movements of Bald Eagle A-34 on the California Channel Islands in 2006.

A-35 Movements

Eagle A-35 was removed from Santa Rosa Island last year after it was found with a broken wing and lead poisoning. It was rehabilitated on the mainland and brought back to Santa Cruz Island in April. After it was re-released, it spent April and most of May on Santa Cruz Island (Fig. 33). On 25 May, it flew to Anacapa Island and remained there until 9 September. On 9 September it returned to Santa Cruz Island, remained there until 22 September, and then flew to Santa Rosa Island, where it remained through the end of the year.

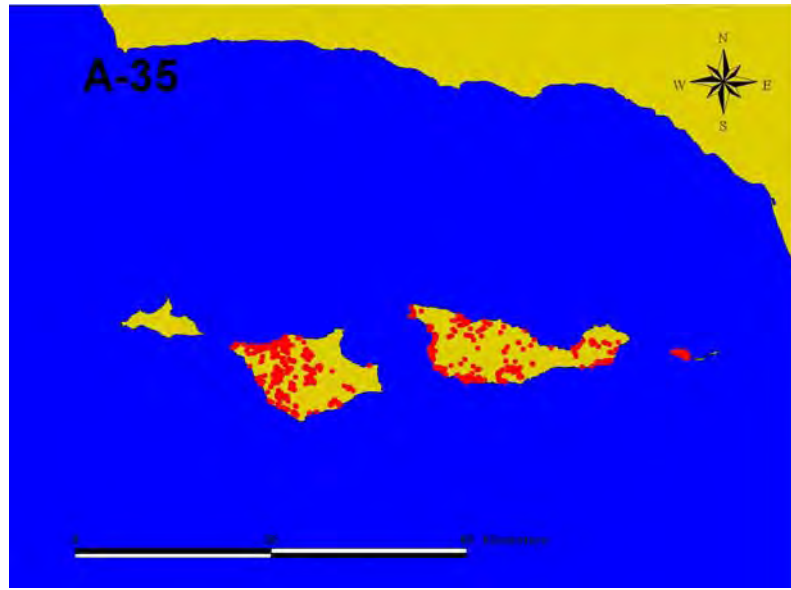


Figure 33. Movements of Bald Eagle A-35 on the California Channel Islands in 2006.

A-36 Movements

Eagle A-36 stayed on Santa Cruz until 8 February, at which time it flew to Santa Rosa Island (Fig. 34). It returned to Santa Cruz Island on 17 February and then flew to Anacapa Island on 19 February, where it stayed until 4 August. It spent 4 August through 10 September on Santa Cruz, and the rest of the year on Santa Rosa Island.

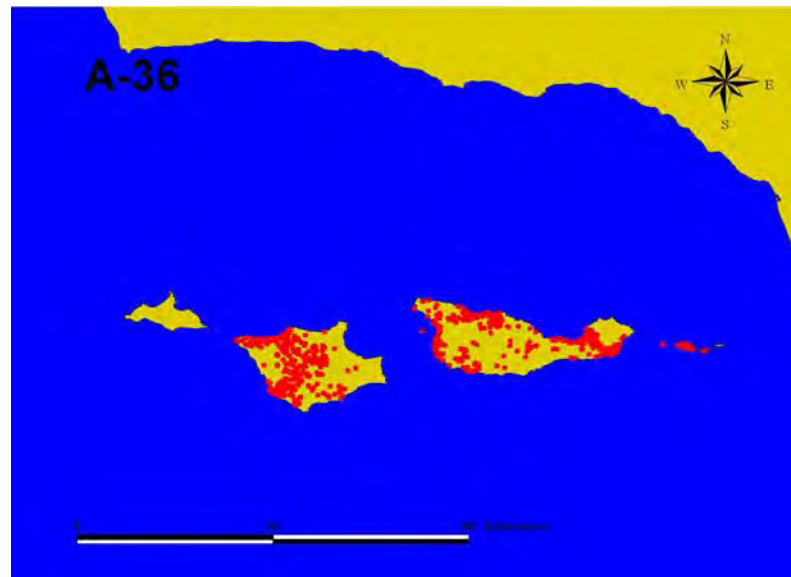


Figure 34. Movements of Bald Eagle A-36 on the California Channel Islands in 2006.

A-37 Movements

Eagle A-37 spent 1-22 January on Santa Cruz Island, 22-27 January on Santa Rosa Island and 27 January through 15 February on Santa Cruz Island (Fig. 35). On 15 February it flew to Anacapa Island and stayed there until 6 August, except for a one-day trip to Santa Cruz Island on 28 February. It then returned to and stayed on Santa Cruz Island until 22 September, before flying to Santa Rosa Island, where it remained through the rest of the year, except for a trip to Santa Cruz Island from 16-22 November.

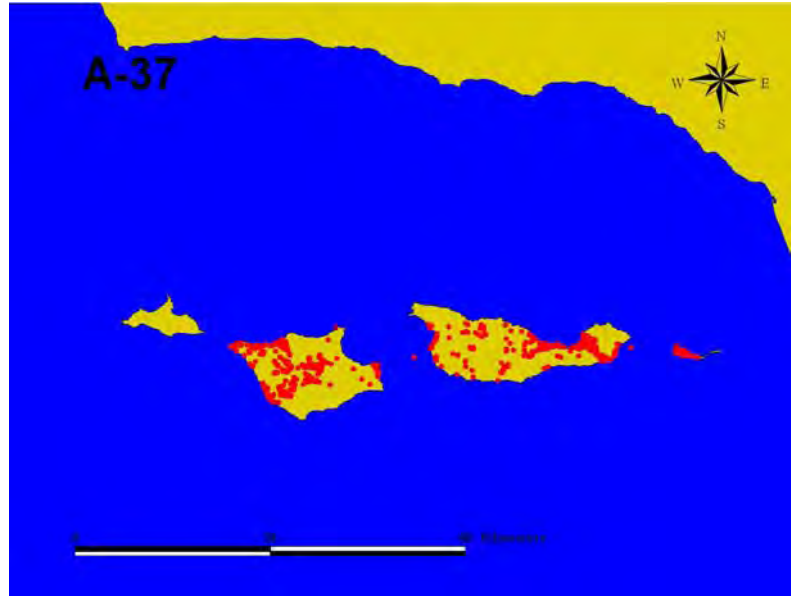


Figure 35. Movements of Bald Eagle A-37 on the California Channel Islands in 2006.

A-39 Movements

We did not receive data from Eagle A-39 until 6 February this year, at which time it was in western Washington (Fig. 36). It remained in the same general area until mid-April and then began moving south. It crossed into Oregon on 19 April and California on 27 April. This bird remained in northeastern California until 28 May before continuing further south. It arrived in the Santa Barbara area

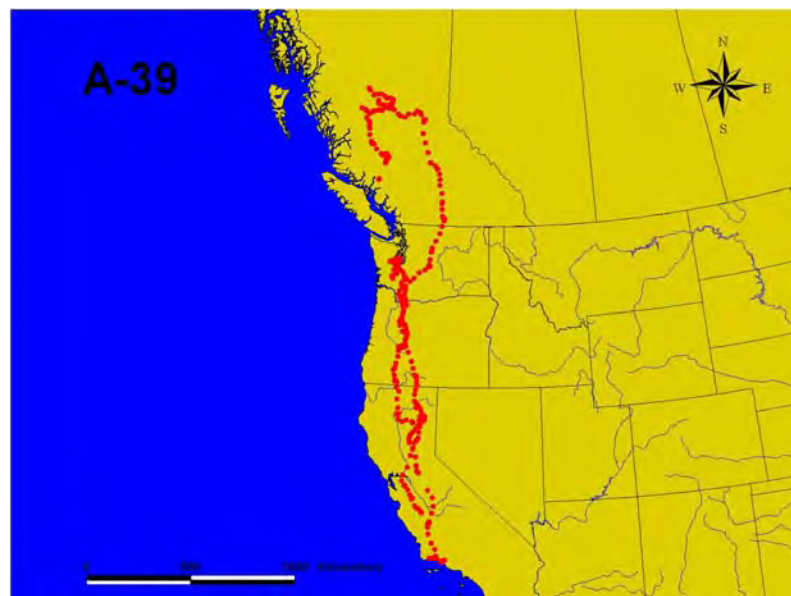


Figure 36. Movements of Bald Eagle A-39 across the western United States and Canada during 2006.

near the coast directly across the channel from the northern Channel Islands on 3 June, but did not return to the islands. It remained in the area until 8 June and then began moving north again. It moved into southern Oregon on 16 June, southern Washington on 26 June, and southern British Columbia on 1 July. By 5 July it had moved up to central British Columbia. It moved further south in early September and then the GPS unit stopped transmitting data on 1 November. This occurred last season and is believed to be related to the shorter day length not allowing the solar panel on the GPS transmitter to recharge the battery sufficiently.

A-40 Movements

Eagle A-40 began the year on Santa Cruz Island and remained there until February (Fig. 37). On 8 February it flew to Santa Rosa Island, returned to Santa Cruz Island on 10 February, and then flew to Anacapa Island on 15 February. It remained on Anacapa through 23 April, except for a few one-day trips to Santa Cruz Island. It flew to Santa Cruz Island on 23 April, returned to Anacapa on 28 April, and then flew back to Santa Cruz Island on 5 May. Once again, it returned to Anacapa on 22 May and stayed until 2 August. It spent 2 August – 9 September on Santa Cruz Island and then flew to Santa Rosa Island. It spent 5 – 8 October on Santa Cruz Island (except for two hours spent on Anacapa Island on 6 October), then returned to Santa Rosa on the morning of 8 October. It returned to Santa Cruz on 29 October and flew to Anacapa on 30 October. On 31 October it left Anacapa around 1000 hours, spent a few hours on Santa Cruz Island, and arrived on Santa Rosa Island around 2100 hours. It flew to Santa Cruz Island on 19 November, to Santa Rosa on the 23rd, back to Santa Cruz on the 27th, to Santa Rosa on the 30th, and back to Santa Cruz on 10 December, where it remained through the end of the year.

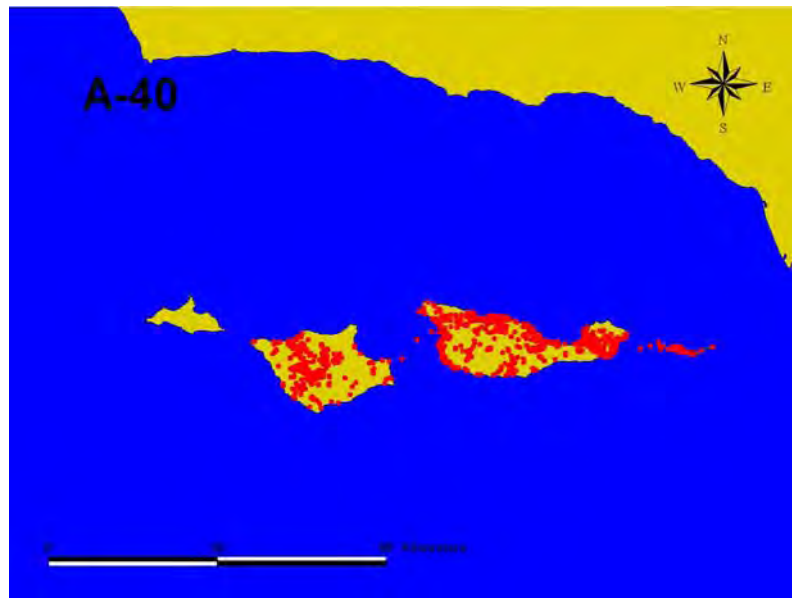


Figure 37. Movements of Bald Eagle A-40 on the California Channel Islands in 2006.

A-42 Movements

Eagle A-42 began the year on Santa Rosa Island, but moved to Santa Cruz Island on 3 January (Fig. 38). On 27 January it flew to Anacapa Island, but returned to Santa Cruz Island on 7 February. On 12 February it returned to Santa Rosa Island, but flew back to Santa Cruz Island on 17 February. On 18 February it apparently tried to fly to the mainland due north from the western end of the island. It went into the water and floated until it was recovered in Chinese Harbor on 22 February.

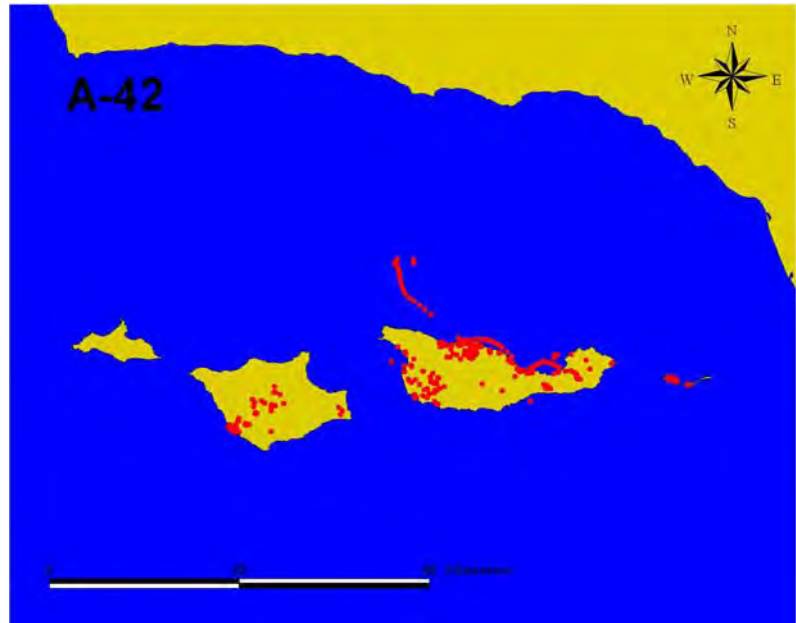


Figure 38. Movements of Bald Eagle A-42 on the California Channel Islands in 2006.

A-43 Movements

Eagle A-43 spent January on Santa Rosa Island, except for a two-day visit to Santa Cruz Island on 3-5 January (Fig. 39). It moved to Santa Cruz Island on 4 February and then on to Anacapa Island on 19 February, where it remained until the end of May. It flew to Santa Cruz on 26 May, back to Anacapa on 3 June, and then flew to Santa Cruz and Santa Rosa on 12 June. The bird flew to Anacapa via Santa Cruz on 14 June and spent most of the

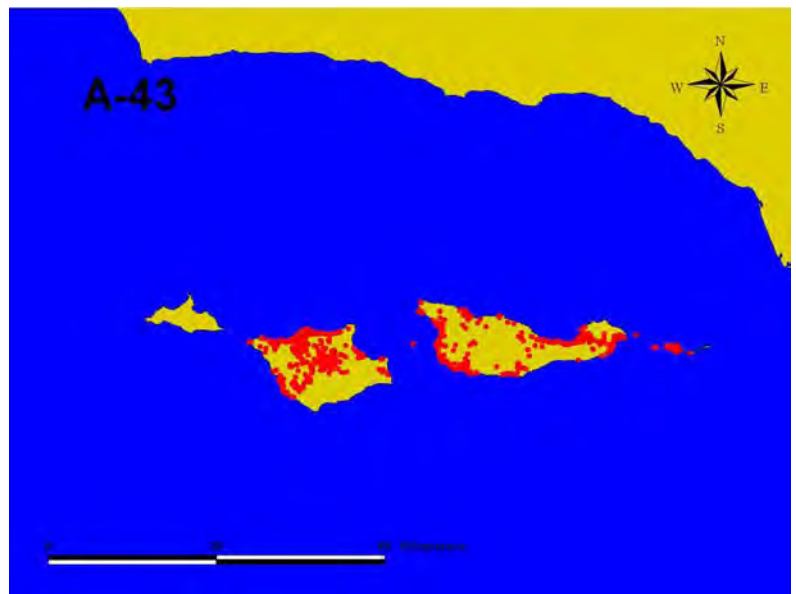


Figure 39. Movements of Bald Eagle A-43 on the California Channel Islands in 2006.

summer there, with several short (3-9 day) visits to Santa Cruz through August. On 2 September, it returned to Santa Cruz Island and then flew to Santa Rosa Island on 14 September, where it remained through the end of the year.

A-44 Movements

Eagle A-44 started the first month and a half of the year on Santa Rosa Island, except for a two-day visit to San Miguel Island on 24-26 January (Fig. 40). It flew to Santa Cruz Island on 16 February and then to Anacapa Island on 19 February. Except for several 1-5 day visits to Santa Cruz and Santa Rosa Islands, it remained on Anacapa until it dropped its transmitter around 8 June. We did get a photo of the bird on one of our remote cameras on Santa Cruz Island on 15 August.

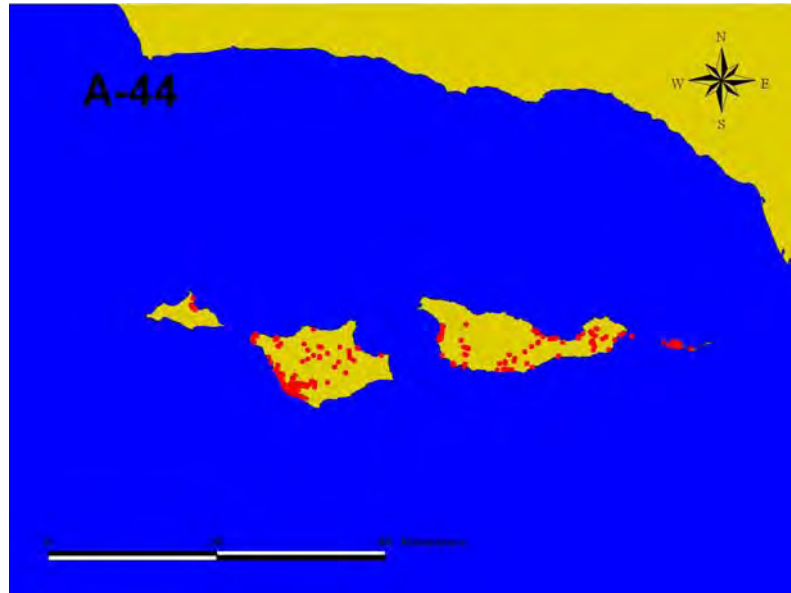


Figure 40. Movements of Bald Eagle A-44 on the California Channel Islands in 2006.

A-45 Movements

Eagle A-45 spent most of January on Santa Rosa Island, except for three days during which it was located on Santa Cruz Island (Fig. 41). On 7 February it flew out to San Miguel Island, spent three days on the eastern half of the island, and then returned to Santa Rosa

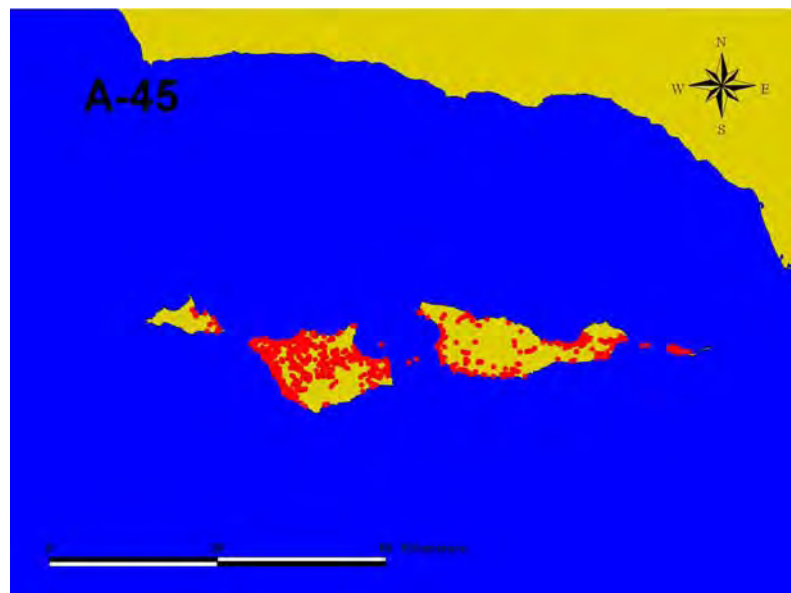


Figure 41. Movements of Bald Eagle A-45 on the California Channel Islands in 2006.

Island. It moved to Santa Cruz Island on 17 February and then on to Anacapa Island on 19 February. It spent most of February through July on Anacapa, with the exception of four 1-7 day visits to Santa Cruz and Santa Rosa Islands. On 7 August it flew to Santa Cruz Island and then moved to Santa Rosa Island on 14 August, where it remained through the rest of the year, except for two visits to Santa Cruz Island that lasted from three to six days.

Overall Island Use

Because the birds move freely among the islands and to the mainland, the GPS units are the most effective way to monitor the released birds. During 2006, we received 26,770 GPS locations from the 15 eagles we released in 2006 and the two wild-hatched chicks, and an additional 50,676 locations from 21 eagles released in previous years that are still carrying functioning transmitters.

The time eagles spent on each of the northern Channel Islands was correlated with the time of the year. They spent more time on Santa Cruz Island during January and February, and more time on Anacapa Island from March through May. From June through September eagles spent most of their time on Santa Cruz Island and from October through December on Santa Rosa Island (Fig. 42). Data for January through May are from eagles released in 2002 – 2005. We began tracking eagles released in 2006 during June, which accounted for the increased number of birds for which we collected data and the increased number of birds using Santa Cruz Island during the summer (Fig. 42).

Trapping

During January 2006, we searched for and attempted to trap eagles on Santa Rosa Island. We used a bownet trap set at several areas on the island, but primarily in the China Camp area, where we observed the most birds. The trap was set on 5, 6, 12, 13, 15, 16, 21, and 22 January, but we had no eagles approach the traps. No eagles were trapped in 2006.

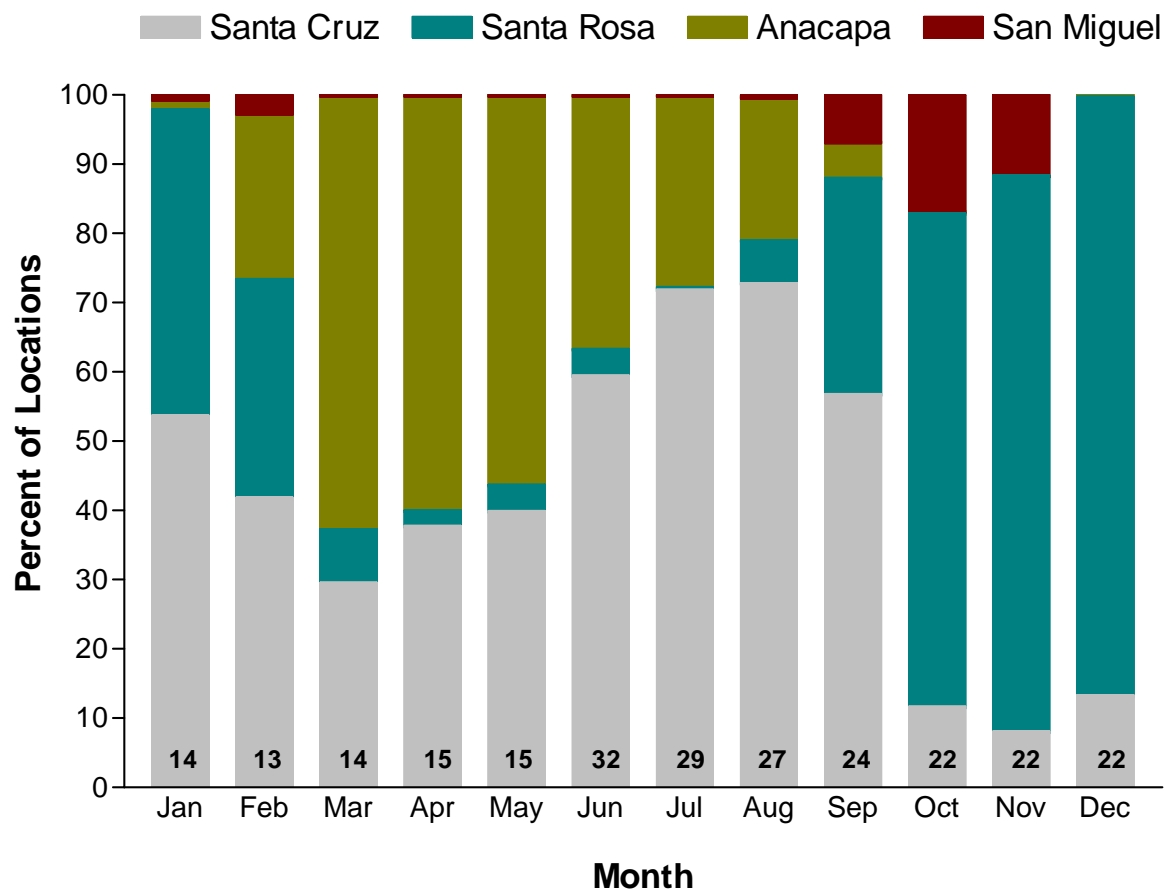


Figure 42. Use of the northern Channel Islands, California by bald eagles during 2006. The bars represent the mean percent of time spent on each island as determined by GPS data. The number on each bar is the number of birds for which we received GPS data during the month.

Tissue Sampling

We collected blood and feather samples from bald eagles during banding activities when the eagles were approximately 8 -11.5 weeks old (Appendix II) or prior to release, in the case of rehabilitated birds. We also collected the remaining samples of yellow croaker to be used for DDT/PCB and stable isotope analyses (Appendix II). All samples were collected using the established collection protocol (Appendix III).

DISCUSSION

This season we completed the release phase of the Montrose Settlements Restoration Program's Bald Eagle Feasibility Study, which is investigating the likelihood of successful bald eagle reintroduction on the northern Channel Islands. The two successful nests this year on Santa Cruz Island, the first in nearly 50 years on the California Channel Islands, were great milestones for our bald eagle restoration projects and are a good indication that bald eagles may now be able to successfully reproduce on the northern Channel Islands. To date we have succeeded in releasing 61 eagles on Santa Cruz Island (24 from Alaska, 34 from the Zoo, 3 from rehabilitation), of which approximately 35 are known or believed to still be on the islands and four are on the mainland.

The survival rate was slightly lower this year versus previous years for the 17 birds released or hatched on Santa Cruz Island. Assuming that birds of unknown status are dead, first year survival in 2006 was 58.8%, compared to 67%, 90%, 67%, and 83% in 2002-2005, respectively. This lower survival rate could be related to the lack of pig carcasses on Santa Cruz Island, which had been an important source of food for scavenging eagles in previous years. Second-year survival has averaged about 89% for eagles released during 2002 (100%), 2003 (89%), 2004 (78%), 2005 (90%), which is slightly higher than the second-year survival reported for eagles in Florida (86%, Millsap et al. 2004) and the Yellowstone region (85%, Harmata et al. 1999). Third year survival has averaged 85% for eagles released in 2002 (88%) and 2003 (67%), and 2004 (100%), similar to that reported by Millsap et al. (2004). Fourth year survival has been 100% for birds released in 2002 and 2003. Fifth year survival for the 2002 cohort was 71.4%, which assumes that two birds that were known to be alive at the end of 2005 (A-06 and A-10), but were not seen after January 2006, did not survive the year.

Drowning/hypothermia continue to be the major source of known mortality for the released eagles. This year, four of six known mortalities occurred in the ocean. Eagles A-47 and A-56 went into the ocean at nearly the same location off the eastern tip of Santa Cruz Island, which suggests that there may be external factors causing the birds to go into the water, at least in cases where the birds are near the islands. It is possible that marine birds or peregrine falcons force the young eagles into the water and they are then unable to take off again or swim to shore. Transmitted birds that spend a large proportion of their time on Anacapa Island during the

spring/summer tend to move only short distances and we believe they likely are mobbed by breeding sea birds when they fly. In previous years we have had three other birds die in the water within 4 km of Anacapa Island, which could also have resulted from mobbing by sea birds. Unfortunately, access to Anacapa Island is extremely limited during the sea bird breeding season, so we are unable to observe the sea bird/eagle interactions.

There was an interesting pattern of island use during 2006. Many young, non-territorial eagles moved to Anacapa Island during the spring and are believed to have been feeding on the many sea birds that breed on West Anacapa Island. During visits to West Anacapa after the sea bird breeding season we found many carcasses of pelicans and gulls and the eagles were likely able to forage largely on dead and dying birds. As the breeding season drew to a close in late summer, the eagles once again moved to Santa Rosa Island at a time that corresponded with the start of fall hunting on that island, where we believe mule deer (*Odocoileus hemionus*) and Roosevelt elk (*Cervus canadensis*) carcasses and/or gut piles become readily available.

Starting in 2007, we will primarily be searching for and monitoring nesting bald eagles on all four of the northern Channel Islands to determine whether nesting attempts are successful. We know of six males (including the two males from Catalina) and six females (one from Catalina) that will be at least four years old in 2007, so there is the potential for up to six breeding pair next season. Currently, annual monitoring is scheduled to continue through 2010. By that time, we should be able to determine whether any human assistance will be needed to maintain the population in the future.

RECOMMENDATIONS

We expect additional pairs of eagles to form and begin reproducing in 2007 and suggest that additional efforts be made to search for nesting eagles on the four northern Channel Islands. Personnel should spend February through April surveying Santa Rosa Island, in addition to Santa Cruz Island. A boat or helicopter should be used to survey all four islands in mid-March to search for nests that may not be visible from shore.

Because there will be no hacking efforts in 2007, we recommend increased trapping efforts on Santa Cruz and Santa Rosa Islands to recapture eagles for contaminant and isotope

analyses. These efforts can begin by June, as nest monitoring should be ending by that time.

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APPENDIX I. Summary of a Boat Survey of the Northern Channel Islands, California, 2006.

Christopher Little, David Rempel, Jessica Dooley
Institute for Wildlife Studies
Bald Eagle Project
Santa Cruz Island

Northern Channel Islands Boat Survey Report

Anacapa, Santa Cruz, Santa Rosa

2/20/2006- 2/21/2006

To conduct a bald eagle survey of the Northern Channel Islands, a small sea-urchin boat was rented for two days, scheduled to leave early Saturday and to returning late Sunday, from February 18-19, 2006. After two days of bad weather and cancellations, the skies cleared and the sea-urchin boat left Channel Islands Harbor at 06:45 on Monday, February 20, 2006, heading southwest. The crew included the captain, Terrell, and bald eagle project employees Christopher Little, David Rempel, and Jessica Dooley.

The boat went first to Anacapa Island, rounding the east point and traveling west to view the Island's south slope. We then circled around the west point and traveled east about one mile to view the Island's north slope.

Observation and Telemetry Results from Anacapa

08:15- Visual on a near-adult bald eagle with blue tags soaring above ridged.

- Signals received- (A-44)

09:00- Visual on 4 young bald eagles flying around, undisturbed by brown pelicans.

- Signals received- (A-45,44,43,40,37,36)

Following Anacapa, the boat traveled west to Smugglers Harbor, Santa Cruz Island. From there we toured west, along the south side of Santa Cruz Island, until we reached Frasier Point on the west end.

Observation and Telemetry Results from South Santa Cruz

11:45- Visual on near-adult bald eagle on high ridge behind Laguna. Possibly either (A-04) or (K-??).

- Signals received- (A-04)

12:20- Visual on two bald eagles (a near-adult and a 2-3 year old) soaring high over Sierra Blanca Ridge.

- Signals received- (A-04)

13:15- Visual on near-adult blue-tagged bald eagle perched on rocky bluff about .5 miles south of Sauces (south of Kinton Point).

- Signals received- none

From the west end of Santa Cruz Island, we traveled west to the east end of Santa Rosa Island. We toured the south side of Santa Rosa and stopped for the evening in Johnson's Lee Harbor, about midway across the Island. The following morning the weather worsened and the wind became too strong to make effective observations. The boat traveled around the west end of Santa Rosa and then to the east to view the north side. The wind picked up and the waves made observations impossible.

Observations and Telemetry Results from Santa Rosa Island

- No bald eagles we observed nor signals received while on Santa Rosa Island.

With the winds not cooperating, we decided to head to the West End of Santa Cruz Island. We toured the entire north side of Santa Cruz Island and docked briefly at Prisoner's Harbor. From Prisoner's Harbor we headed east along the coast toward Chinese Harbor. At this point the weather worsened, so we made the decision to make the channel crossing to Channel Islands Harbor. We arrived back at Channel Islands Harbor at 16:45.

Observations and Telemetry Results from north Santa Cruz Island

12:10- Signals received- from north slope of Mt. Diablo- (A-02) or (A-42) as signals overlap some.

13:00- Visual on two Catalina bald eagles (K-26, K-10) perched on a tall pine tree about .5 miles up the canyon from Pelican Bay. One eagle appears to be amongst a pile of sticks (a nest!?) while the other is perched on an adjacent branch.

APPENDIX II. Tissue samples collected for contaminant and stable isotope analyses, Santa Cruz Island, California, 2006.

Sample ID ¹	Description	Quantity	Analysis	BAEA ID	Date
06GNTBE37D05	Whole Blood	2 mL	DDT/PCB	629-47386	4/8/2006
06GNTBE37D06	Whole Blood	1 mL	Stable Isotope	629-47386	4/8/2006
06GNTBE37D07	Plasma	2 mL	DDT/PCB	629-47386	4/8/2006
06GNTBE37D08	Plasma	0.1 mL	Stable Isotope	629-47386	4/8/2006
06GNTBE48D01	Whole Blood	2 mL	DDT/PCB	629-52404	6/3/2006
06GNTBE48D02	Whole Blood	0.2 mL	Stable Isotope	629-52404	6/3/2006
06GNTBE48D03	Plasma	1.5 mL	DDT/PCB	629-52404	6/3/2006
06GNTBE48D04	Plasma	0.1 mL	Stable Isotope	629-52404	6/3/2006
06GNTBE49D01	Whole Blood	2 mL	DDT/PCB	629-52405	6/3/2006
06GNTBE49D02	Whole Blood	0.1 mL	Stable Isotope	629-52405	6/3/2006
06GNTBE49D03	Plasma	3.5 mL	DDT/PCB	629-52405	6/3/2006
06GNTBE49D04	Plasma	0.5 mL	Stable Isotope	629-52405	6/3/2006
06GNTBE50D01	Whole Blood	2 mL	DDT/PCB	629-52406	6/3/2006
06GNTBE50D02	Whole Blood	0.5 mL	Stable Isotope	629-52406	6/3/2006
06GNTBE50D03	Plasma	3 mL	DDT/PCB	629-52406	6/3/2006
06GNTBE50D04	Plasma	0.5 mL	Stable Isotope	629-52406	6/3/2006
06GNTBE48F01	Breast Feathers	3 feathers	Stable Isotope	629-52404	6/3/2006
06GNTBE49F01	Breast Feathers	3 feathers	Stable Isotope	629-52405	6/3/2006
06GNTBE50F01	Breast Feathers	3 feathers	Stable Isotope	629-52406	6/3/2006
06GNTBE51D01	Whole Blood	2 mL	DDT/PCB	629-52407	6/7/2006
06GNTBE51D02	Whole Blood	0.1 mL	Stable Isotope	629-52407	6/7/2006
06GNTBE51D03	Plasma	4 mL	DDT/PCB	629-52407	6/7/2006
06GNTBE51D04	Plasma	0.5 mL	Stable Isotope	629-52407	6/7/2006
06GNTBE51F01	Breast Feathers	3 feathers	Stable Isotope	629-52407	6/7/2006
06GSTBE52D01	Whole Blood	2 mL	DDT/PCB	629-52409	6/17/2006
06GSTBE52D02	Whole Blood	0.5 mL	Stable Isotope	629-52409	6/17/2006
06GSTBE52D03	Plasma	3 mL	DDT/PCB	629-52409	6/17/2006
06GSTBE52D04	Plasma	1 mL	Stable Isotope	629-52409	6/17/2006
06GSTBE53D01	Whole Blood	2 mL	DDT/PCB	629-52410	6/17/2006
06GSTBE53D02	Whole Blood	0.5 mL	Stable Isotope	629-52410	6/17/2006
06GSTBE53D03	Plasma	3 mL	DDT/PCB	629-52410	6/17/2006
06GSTBE53D04	Plasma	1 mL	Stable Isotope	629-52410	6/17/2006
06GSTBE54D01	Whole Blood	2 mL	DDT/PCB	629-52411	6/17/2006
06GSTBE54D02	Whole Blood	0.5 mL	Stable Isotope	629-52411	6/17/2006
06GSTBE54D03	Plasma	2 mL	DDT/PCB	629-52411	6/17/2006
06GSTBE54D04	Plasma	0.1 mL	Stable Isotope	629-52411	6/17/2006
06GSTBE52F01	Breast Feathers	3 feathers	Stable Isotope	629-52409	6/17/2006
06GSTBE53F01	Breast Feathers	3 feathers	Stable Isotope	629-52410	6/17/2006
06GSTBE54F01	Breast Feathers	3 feathers	Stable Isotope	629-52411	6/17/2006
06GSTBE55F01	Breast Feathers	3 feathers	Stable Isotope	629-52415	6/23/2006
06GSTBE56F01	Breast Feathers	3 feathers	Stable Isotope	629-52416	6/23/2006

Appendix II. Continued

Sample ID ¹	Description	Quantity	Analysis	BAEA ID	Date
06GSTBE57F01	Breast Feathers	3 feathers	Stable Isotope	629-52417	6/23/2006
06GSTBE55D01	Whole Blood	2 mL	DDT/PCB	629-52415	6/23/2006
06GSTBE55D02	Whole Blood	0.1 mL	Stable Isotope	629-52415	6/23/2006
06GSTBE55D03	Plasma	3 mL	DDT/PCB	629-52415	6/23/2006
06GSTBE55D04	Plasma	0.1 mL	Stable Isotope	629-52415	6/23/2006
06GSTBE56D01	Whole Blood	2 mL	DDT/PCB	629-52416	6/23/2006
06GSTBE56D02	Whole Blood	0.1 mL	Stable Isotope	629-52416	6/23/2006
06GSTBE56D03	Plasma	3 mL	DDT/PCB	629-52416	6/23/2006
06GSTBE56D04	Plasma	0.1 mL	Stable Isotope	629-52416	6/23/2006
06GSTBE57D01	Whole Blood	2 mL	DDT/PCB	629-52417	6/23/2006
06GSTBE57D02	Whole Blood	0.1 mL	Stable Isotope	629-52417	6/23/2006
06GSTBE57D03	Plasma	3 mL	DDT/PCB	629-52417	6/23/2006
06GSTBE57D04	Plasma	0.1 mL	Stable Isotope	629-52417	6/23/2006
06GNTBE58F01	Breast Feathers	3 feathers	Stable Isotope	629-52418	6/25/2006
06GNTBE59F01	Breast Feathers	3 feathers	Stable Isotope	629-52419	6/25/2006
06GNTBE60F01	Breast Feathers	3 feathers	Stable Isotope	629-52420	6/25/2006
06GNTBE61F01	Breast Feathers	3 feathers	Stable Isotope	629-52421	6/25/2006
06GNTBE58D01	Whole Blood	2 mL	DDT/PCB	629-52418	6/25/2006
06GNTBE58D02	Whole Blood	0.1 mL	Stable Isotope	629-52418	6/25/2006
06GNTBE58D03	Plasma	3 mL	DDT/PCB	629-52418	6/25/2006
06GNTBE58D04	Plasma	0.1 mL	Stable Isotope	629-52418	6/25/2006
06GNTBE59D01	Whole Blood	2 mL	DDT/PCB	629-52419	6/25/2006
06GNTBE59D02	Whole Blood	0.1 mL	Stable Isotope	629-52419	6/25/2006
06GNTBE59D03	Plasma	3 mL	DDT/PCB	629-52419	6/25/2006
06GNTBE59D04	Plasma	0.1 mL	Stable Isotope	629-52419	6/25/2006
06GNTBE60D01	Whole Blood	2 mL	DDT/PCB	629-52420	6/25/2006
06GNTBE60D02	Whole Blood	0.1 mL	Stable Isotope	629-52420	6/25/2006
06GNTBE60D03	Plasma	3 mL	DDT/PCB	629-52420	6/25/2006
06GNTBE60D04	Plasma	0.1 mL	Stable Isotope	629-52420	6/25/2006
06GNTBE61D01	Whole Blood	2 mL	DDT/PCB	629-52421	6/25/2006
06GNTBE61D02	Whole Blood	0.1 mL	Stable Isotope	629-52421	6/25/2006
06GNTBE61D03	Plasma	3 mL	DDT/PCB	629-52421	6/25/2006
06GNTBE61D04	Plasma	0.1 mL	Stable Isotope	629-52421	6/25/2006
06GMRBE62D01	Whole Blood	2 mL	DDT/PCB	629-52422	6/26/2006
06GMRBE62D02	Whole Blood	0.1 mL	Stable Isotope	629-52422	6/26/2006
06GMRBE62D03	Plasma	3 mL	DDT/PCB	629-52422	6/26/2006
06GMRBE62D04	Plasma	0.1 mL	Stable Isotope	629-52422	6/26/2006
06GMRBE62F01	Breast Feathers	3 feathers	Stable Isotope	629-52422	6/26/2006
06GNTBE63D01	Whole Blood	3 mL	DDT/PCB	629-52423	7/11/2006
06GNTBE63D02	Whole Blood	0.2 mL	Stable Isotope	629-52423	7/11/2006
06GNTBE63D03	Plasma	2.5 mL	DDT/PCB	629-52423	7/11/2006
06GNTBE63D04	Plasma	0.2 mL	Stable Isotope	629-52423	7/11/2006
06GNTBE63F01	Breast Feathers	3 feathers	Stable Isotope	629-52423	7/11/2006
06GNTBE64F01	Breast Feathers	3 feathers	Stable Isotope	629-52424	8/5/2006

Appendix II. Continued

Sample ID ¹	Description	Quantity	Analysis	BAEA ID	Date
06GNTBE64D01	Whole Blood	2 mL	DDT/PCB	629-52424	8/5/2006
06GNTBE64D02	Whole Blood	0.5 mL	Stable Isotope	629-52424	8/5/2006
06GNTBE64D03	Plasma	3 mL	DDT/PCB	629-52424	8/5/2006
06GNTBE64D04	Plasma	0.5 mL	Stable Isotope	629-52424	8/5/2006
06GNSYC03B01	Whole Guttred Fish	1	DDT/PCB/SI		9/12/2006
06GNSYC04B01	Whole Guttred Fish	1	DDT/PCB/SI		9/12/2006

¹ See Appendix III for description of Sample ID codes.

APPENDIX III. SANTA CRUZ ISLAND SAMPLING PROTOCOL

INTRODUCTION

The Montrose Settlements Restoration Program (MSRP) is completing a Bald Eagle Feasibility Study to investigate the likelihood of successful bald eagle reintroduction on the northern Channel Islands. Bald eagle chicks are being released by the Institute for Wildlife Studies (IWS) on Santa Cruz Island and information is being gathered to help determine what degree of human manipulation, if any, will be required for the bald eagles to successfully breed there. Monitoring, sample collection, and analysis of samples for both contaminants (total DDTs and PCBs) and for stable isotopes (carbon, nitrogen, and sulfur isotopes) are being used to aid in this determination.

The results of the DDT and PCB analyses of bald eagle blood, and tissues (primarily muscle and adipose except for fish) of marine fish, marine mammals, and feral pigs will be used to determine the bald eagle exposure through their diet and predict the likelihood of successful reproduction. The Woods Hole Group will complete the sample preparation and DDT/PCB analyses under an agreement with the National Oceanic and Atmospheric Administration.

Stable isotope analysis is a well-established technique that can provide dietary information for different time scales based on a single collection event, with less expense and time than techniques such as monitoring prey delivery to the nest. Samples of bald eagle blood and feathers, prey species, and other species needed to characterize the food web will be collected and analyzed. The isotope laboratory at Northern Arizona University will complete the sample processing and the stable isotope analysis under an agreement with the Fish and Wildlife Service. Currently, carbon and nitrogen analyses will be done for blood samples, and carbon, nitrogen, and sulfur analysis for tissue, feather, and egg samples. The stable isotope results for bald eagle blood and feather samples will be related to trophic level and marine versus terrestrial diet, and the inferences regarding diet will be verified based on telemetry and feeding data collected.

SAMPLE IDENTIFICATION SYSTEM

Samples will be identified with a 12 letter/number code. Two numbers for the year (02 for 2002) followed by the first letter that represents the Principal Investigator (G, for Garcelon in this case), followed by a two letter site designation, a two letter species designation, two numbers for the individual, a one letter identification of the tissue type, and a two number sample ID (see below for codes). So for instance, the sample 02GNTBE03D01 would be collected in 2002 (02) by/for Garcelon (G) at the North hacktower (NT) and would be bald eagle (BE) number 3 (03) blood (D) sample number 1 (01).

Codes

Year:

2002 (02)

2003 (03)

Principal Investigator:

Garcelon (G)

Locations:

Christy's Beach (CB)

Chinese Harbor (CH)

Fox Pen Area (FP)

Johnston's Beach (JB)

Laguna Beach (LB)

No Man's Land (NL)

North Hacktower (NT)

Prisoner's Beach (PB)

Pozo Beach (PZ)

Sauces Beach (SB)

South Hacktower (ST)

Field Blank (XX)

Other codes can be added as needed if samples are collected from other areas and the code system should be revised to include them, but the following Catalina codes of WE, TR, PR, SR or TH should not be used.

Species:

Bald Eagle (BE)

California Gull (CG)

Harbor Seal (SE)

Sea Lion (SL)

Feral Pig (SS)

Add species names as needed for other fish, seabird, and marine mammal species and revise the code system to include them.

Individual:

Sequentially number individuals within a species with a unique number, rather than starting over each year.

Tissue:

Muscle (M)

Adipose (A)

Whole Body or Whole Gutted Body (B)

Blood (D)

Feather (F)

Field Blank (N)

Sample Number:

Number sequentially for each species/tissue type (eg. 02GNTBE01D01, 03GSTBE04D02, 02GCHSL02M01, 03GPZSL05A01).

FIELD COLLECTION RECORDS

The following information should be recorded in a field notebook: date, time, location and GPS coordinates, individuals involved in sampling, species, tissue collected and location of the body from which it was removed, amount collected, and sample container used. Photographs should be taken of the individual sampled and the location on the body from which tissue samples are removed, and the photographs taken noted in the field log. Record for each sample collected whether it was collected for DDT/PCB analysis, stable isotope analysis, or both.

FIELD TECHNIQUES FOR COLLECTING SAMPLES

When collecting samples that require removing tissues in the field, please use the following guidelines to avoid contamination/cross-contamination of the samples.

Use certified chemically clean glass containers (e.g. I-Chem). Containers should be kept capped prior to sample collection. Handling of containers should be kept to a minimum and the inside of the container should not be touched by anything other than the sample.

Clean non-powdered nitrile gloves (vinyl gloves contain phthalates that may interfere with contaminant analysis) should be worn by all sampling personnel. Sampling gloves should be changed in between external examination and cutting (i.e., a new pair of gloves should be worn after opening the body cavity and before sampling internal tissues).

Clean gloves and sampling equipment should not come in contact with any surface (e.g., the ground, necropsy kit, etc.). New scalpel blades should be used for the collection of each sample.

Cross-contamination between tissues should be avoided. This is particularly important after blubber tissue has been handled for chlorinated hydrocarbon sampling. The scalpel and forceps should be cleaned after taking each sample. All tissue surfaces that come into contact with implements that were not cleaned (e.g., blubber when the body was opened) should be cut away with clean implements. The sample should not come into contact with the outside of the sampling container or the ground.

For marine mammals, remove blubber sample from the sternum region with a knife or with a scalpel and forceps. The sample should not come into contact with the outside of the sampling container or the ground.

Label the sampling container, place the sample in a cooler on ice, note sampling location and time, animal ID number, species, tissue (duplicate samples should be numbered sequentially),

date collected, collection site. Labels should be written with waterproof ink and securely attached to the outside of each sample container.

CLEANING SAMPLING EQUIPMENT

In the field, clean equipment between each sample with soapy (Alconox) tap water, rinse with tap water, rinse with distilled water, rinse with pesticide grade isopropanol, air dry, and store equipment wrapped in aluminum foil. At the end of the sampling for that day, chemically clean filter paper (Whatman 934-AH, approximate diameter of 6 cm) should be used to wipe the cleaned equipment and then placed in a vial of the same type and batch used for samples, labeled as a field blank, and stored and transported similarly to the tissue samples. A "blank unused filter" should be saved from each box, the box labeled with date opened, and the filter saved in a jar with the date of the box opened.

After returning from the field, sampling equipment should be washed with hot, soapy (Alconox) water, rinsed with hot tap water, rinsed with 10-15% nitric acid (use protective clothing, gloves, and goggles), rinsed with distilled water, rinsed with pesticide grade isopropanol, air dried, and wrapped in aluminum foil.

ITEMS TO BE SAMPLED

General Information on Field Duplicates and Field Blanks

For stable isotope analysis, no field blanks are necessary because interference and cross-contamination are not a problem. In addition, no field duplicates are required, but sufficient tissue (2 g) will be collected for each sample so the original and a lab duplicate can be run from the field sample. For isotope analysis, field variability is considered by sampling separate individuals of the same species. This intra-specific variability will provide a sense of how isotope signatures vary from one individual to another.

For DDT/PCB analysis, both field duplicates and field blanks will be collected. One field duplicate per 15 samples or per sampling season will be collected unless otherwise noted for a particular sample type. If equipment is not used for more than one sample, one field blank of each sample type per 15 samples or per sampling season will be collected. If equipment is re-used, then a field blank will be collected (after equipment cleaning) at the end of each sampling day to assess potential cross-contamination between samples. Clean filter paper, wetted with isopropanol, will be used to wipe the cleaned equipment. The filter paper will be placed in a pre-cleaned sample jar or aluminum foil and plastic bag of the same type and batch used for samples, labeled with the date, time, and sample collector. One sample of unused filter paper per batch will also be saved. The field blanks will be stored and transported along with the samples collected for DDT/PCB analysis.

Bald Eagle

Blood (DDT/PCB and stable isotope):

Collect whole blood and plasma samples for stable isotope and DDT/PCB analyses from all bald eagles when banded prior to release (12 birds per year) and from any birds re-captured. Label all containers (pre-cleaned glass vials) prior to blood collection using the labeling protocol above. Collect 10 cc of blood during banding or re-capture. Put 2 cc whole blood in a 20 ml vial for DDT/PCB analysis (unless making a duplicate, see below) and approximately 0.1 cc whole blood in another glass vial for stable isotope analyses. Store the samples on ice immediately after collection. Heparin coated vacutainers will be used since it does not cause interference in stable isotope analysis, whereas EDTA may interfere and should not be used as an anti-coagulant.

As soon as possible following collection, spin the remaining blood to get the plasma. Transfer at least 2 cc of plasma into a 20 mL glass vial for DDT/PCB analyses and at least 0.1 cc of plasma into another glass vial for stable isotope analysis. Label the test tube containing the red blood cells (leftover from spinning off the plasma) with the bird=s ID and date collected. The blood cells will be kept in the freezer for possible future use. Freeze all the other blood samples as soon as possible.

One field duplicate (2 cc) per 15 samples or per sampling season, whichever is more frequent, should be collected for both whole blood and plasma. Therefore, collect one duplicate each for whole blood and plasma during the blood collection from chicks during banding. For re-captured birds, collect one duplicate each whole blood and plasma per season or per 15 samples will be taken during blood collection from re-captured birds. Whole blood and plasma duplicates can be from different birds. Select one bird=s sample that has appropriate amounts of plasma to make vials containing 2 cc of plasma (for DDT/PCB analysis). Give the duplicate samples sequential sample numbers.

Quality control for blood collection for the DDT/PCB analysis should address potential interference and cross-contamination. Since no needles or containers are re-used, cross-contamination due to re-use of equipment should not be an issue. However, plastic syringes may leach interfering substances that should be accounted for. Therefore, one field blank per batch of syringes or per sampling season, whichever is sooner, should be included. For the field blank, distilled water should be drawn up into the syringe, transferred to the container as with blood samples, and stored and transported with the blood sample containers.

Feathers (stable isotope only):

For stable isotope analysis, collect three breast feathers from each bird and store in an envelope (one envelope per bird). Collect feathers from the same area on the breast for all birds, and note the location as closely as possible by diagram and photograph (if available). Collect feathers of

same coloration and those that appear of same relative age since the yearly molt is incomplete and some feathers may be retained for 2 to 3 years (McCollough, 1989).

Feral Pig

Muscle and Adipose Tissues (DDT/PCB and stable isotopes):

Tissues will be collected for both stable isotopes (muscle and adipose tissue from five pigs) and DDT/PCB (muscle and adipose tissues from three of the five pigs sampled). Collect muscle and adipose tissues from the leg of five pigs of varying sizes, and record and photograph the location from which the tissue was removed (e.g. upper thigh muscle on front right leg). Remove any associated non-target tissue. Estimate sample mass by placing the vial in a bag and weighing it with the Pesola scale. Collect samples (2 g muscle tissue in a 20 mL glass vial and 20 g adipose tissue in a 60 mL glass vial) for stable isotopes only from two pigs. For three of the five pigs, split the muscle tissue sample into two jars, a 20 mL glass vial with approximately 2 g for stable isotope analysis and a 60 mL glass vial with approximately 50 g for DDT/PCB analyses. For adipose tissue from three of five pigs, place approximately 20 g into one 60 mL glass vial for stable isotopes and 50 g into another 60 mL glass vial for DDT/PCB analyses. In addition,

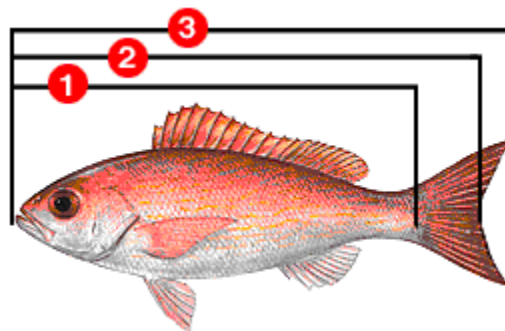
For DDT/PCB analysis, collect one duplicate of both muscle (50 g) and adipose tissue (50 g) and one field blank per sample day (filter paper swipes of re-used equipment in 20 mL or 60 mL glass container).

Marine Fish

Record standard (whole body excluding the tail) and total length, weight, and species for each fish collected. Total length is defined as the length from the most anterior part of the fish to the tip of the longest caudal fin ray. (Exhibit 2 demonstrates the different fish measurements.) Standard length is defined as the length of a fish from the front of the upper lip to the posterior end of the vertebral column.

Exhibit 2. Description of Different Length Measurements

- (1) Standard Length
- (2) Fork Length
- (3) Total Length



Whole Gutted Fish (DDT/PCB and stable isotopes):

Whole fish will be collected and then gutted before freezing to reduce variability due to incomplete assimilation of gut contents.

For DDT/PCB analysis, collect whole fish of 5 different species (5 individuals each) representative of those the eagles are eating or are caught to feed eagles in the hack towers (25

total samples). The entire fish should be gutted, wrapped in aluminum foil, placed in a plastic bag, and frozen. Collect one field duplicate (50 g) per every 15 samples or per sampling season, whichever is sooner for DDT/PCB analyses and make one field blank per sampling day (filter paper swipe of cleaned equipment).

If possible, the fish collected for DDT/PCB analysis will be subsequently analyzed for stable isotopes as well; however, additional fish samples for stable isotopes are necessary to characterize the food web structure.

For stable isotopes, collect five samples per species with at least one species from each functional feeding group: pelagic/epipelagic (e.g. anchovy, topsmelt, barracuda, mackerel), mid-water (e.g. kelp bass, surfperch), benthic (e.g. gobies, sculpin), and demersal (e.g. rockfish). The entire fish should be gutted, wrapped in aluminum foil, placed in a plastic bag, and frozen.

Marine Mammals

Collect muscle and adipose tissues from the same body part as consistently as possible and note the location from which the tissue was removed, with a photograph if possible. Remove any associated tissue and obtain a sample with only the tissue type desired. Separate tissue collected from same organism into samples for stable isotope and DDT/PCB as possible to allow for direct comparison of tissue concentrations and stable isotope profiles.

Muscle and Adipose Tissue (DDT/PCB and stable isotopes):

For stable isotope analyses, collect five samples of muscle tissue (2 g) and five samples of adipose tissue (20 g) from the same organisms sampled for DDT/PCB analysis. Place in the smallest vials in which they will fit. Freeze samples.

For DDT/PCB analyses, collect 15 samples of muscle (50 g) and 15 samples of adipose tissue (50 g). Again, place in smallest vial in which they will fit. Collect one duplicate sample each of muscle (50 g) and adipose tissue (50 g) per 15 samples or per sampling season, whichever is more frequent. Collect one field blank per sampling day by using filter paper to wipe cleaned equipment at the end of each sampling day. Freeze all samples as soon as possible.

Macro-invertebrates (stable isotopes only)

For stable isotope analysis, collect five composite samples each for squid (5 individuals), euphysiids (fill 20 mL vial using plankton net), snails (15 individuals with shells removed), mussels (5 individuals, soft body only), and shrimp (10 individuals) (25 composite samples total). Place samples in pre-cleaned glass vials, store samples on ice until frozen, and freeze samples as soon as possible.

Sea Birds

Breast Muscle (stable isotopes only):

For stable isotope analyses, collect 15 samples of breast muscle (2 g) from relatively fresh sea bird carcasses remove any associated non-muscle tissue, and place in 20 mL vials. Note and photograph the quadrant of the breast muscle area (e.g. upper right) from which the tissue was removed. Keep samples on ice and freeze them as soon as possible.

Feathers (stable isotopes only):

Collect three closely located breast feathers from each bird, note the location on the breast from which they were removed, and place in one envelope per bird.

SAMPLE STORAGE

Manually check the freezer temperature before storing samples and 5 days a week or check weekly with a freezer temperature recorder to ensure the samples are maintained at -20 °C.

SAMPLE SHIPPING

Samples should be shipped in batches to the appropriate analytical laboratory or the Fish and Wildlife Service Office based on information provided by the Fish and Wildlife Service contact (Becky Stanton and/or Annie Little). Samples should be placed in a cooler with foam packing material and a chain of custody form. Samples should be transported frozen with ice packs on the ferry and then with additional ice packs if hand delivered or with sufficient dry ice if shipped.

LITERATURE CITED

McCollough, M. A. (1989) Molting sequence and aging of bald eagles. *The Wilson Bulletin* **101**, 1-10.