# Bald Eagle Restoration on the Northern Channel Islands, California

## May 2003—December 2003

## 2nd Annual Report

MONTROSE SETTLEMENTS RESTORATION PROGRAM

MSRP

Restoring Natural Resources
harmed by DDTs and PCBs

# Bald Eagle Restoration on the Northern Channel Islands, California
# May 2003—December 2003
# 2nd Annual Report

*Prepared by:*

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

*Prepared for:*

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

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# EXECUTIVE SUMMARY

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

In 2002, a study was initiated to determine the feasibility of restoring bald eagles to the Northern Channel Islands. The Institute for Wildlife Studies (IWS) was contracted by the National Park Service to conduct the study. The goal was to release 12 bald eagles per year for five years through a technique called "hacking" and monitor the population to determine how well they adapted to the new environment and whether they accumulated body burdens of organochlorine contaminants that would prohibit successful breeding.

IWS released 11 eagles from hacking towers in 2003. These eagles were acquired from captive-breeding eagles at the San Francisco Zoo, or removed from wild nests in Alaska. Each bird was equipped with a GPS/VHF telemetry package to allow post-release monitoring. One bird was recaptured within a week of release because it appeared to have trouble flying. It is currently being rehabilitated at the Orange County Bird of Prey Center. Only one eagle died this year, ending up in the ocean while attempting to fly to the mainland.

As of the end of December 2003, there are 15 bald eagles on the Northern Channel Islands (seven from 2002, eight from 2003). On the mainland, a 2002 bird has flown as far as western Montana and was in central Utah as of the end of December. In addition, a 2003 bird flew to southern Oregon in late August and remained in the area through December.

Bald eagles on Santa Cruz Island have been observed feeding primarily on feral pig carcasses, although they occasionally have been seen feeding upon marine mammal carcasses in the Chinese Harbor area. Bald eagles from both 2002 and 2003 have also continued to use Santa Rosa Island during the late fall and winter. Many of these eagles have been seen feeding on carcasses and gut piles left from the guided hunts and culling activities.

It is unknown whether bald eagles on the Northern Channel Islands will ingest enough DDT-contaminated food to affect their breeding in the future. In 2003, IWS began collecting tissue samples from potential food items to evaluate DDE concentration. Baseline data were

collected from eagles prior to release and tissue was collected from prey species and from various levels of the food web for contaminant and stable isotope analyses. Eagles will be recaptured in 2004 to collect blood samples to determine how much contamination the birds have accumulated since being released. In addition, feather samples will be collected for stable isotope analyses to help determine where within the food chain the eagles have been feeding. This information will assist modeling efforts to predict future contaminant burdens in the eagles and to predict reproductive success.

The high survival and retention rates of released bald eagles on the Northern Channel Islands is reason for optimism regarding the success of the program. The continued movement of eagles among the islands indicates that the releases on Santa Cruz Island are likely to restore bald eagles to two or more of the 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, 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 Settlement Restoration Program. Phil Schempf and Mike Jacobson with the Fish and Wildlife Service, Juneau, Alaska, and Jim Spickler (Eco-Ascension Research and Consulting, Arcata, California) greatly assisted with locating and removing eaglets from wild nests in Alaska. We thank Dr. Scott Weldy (Orange County Bird of Prey Center) for his work in rehabilitating the eagle that had flight difficulties and Dr. Winston Vickers for treating the sick eagle from Alaska. Geoff Cline provided the cover page photo of four immature bald eagles in a eucalyptus tree at Chinese Harbor.

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# INTRODUCTION

Bald eagles (*Haliaeetus leucocephalus*) once nested on all the California Channel Islands off the coast of southern California (Kiff 1980; Fig. 1). Bald eagles began declining on the Channel Islands in the late 19th Century and disappeared from the islands by the early 1960's. Human persecution contributed to the decline, but the ultimate cause of bald eagle extirpation


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

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).

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) and the California Department of Fish and Game, initiated a program to reintroduce bald eagles to Santa Catalina Island, California (Fig. 1). Unfortunately, when the eagles began laying eggs in 1987, all the eggs broke in the nests. 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). Although DDE still precludes the successful nesting of bald eagles on Santa Catalina Island, manipulation of the nests has allowed the population to grow to at least 15 birds, including five breeding pair.

Funding for continued bald eagle restoration in southern California became available in December 2000, when a decade-long lawsuit against the companies responsible for discharging DDT into the Southern California Bight was settled. The Montrose Settlements Restoration Program was developed to oversee monies for natural resource restoration received from this settlement. The Trustee Council that oversees the program is composed of representatives of federal and state agencies that have interests in the Southern California Bight, including the National Oceanic and Atmospheric Administration, U. S. Fish and Wildlife Service, National Park Service (NPS), California Department of Fish and Game, California State Lands Commission, and the California Department of Parks and Recreation.

In April 2002, the Trustee Council approved funding to study the feasibility of reintroducing bald eagles to the Northern Channel Islands. During the first year of the project IWS released 12 eagles on Santa Cruz Island, of which nine survived and seven remained on the Northern Channel Islands (Sharpe et al. 2003). This report covers the period from May through December 2003 and summarizes the second season of eagle releases on Santa Cruz Island and the subsequent follow-up of eagles released in both 2002 and 2003.

## 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 $km^2$ with 124 km of shoreline and a maximum elevation of 753 meters. Santa Cruz Island is the most rugged and topographically diverse of the Northern Channel Islands and

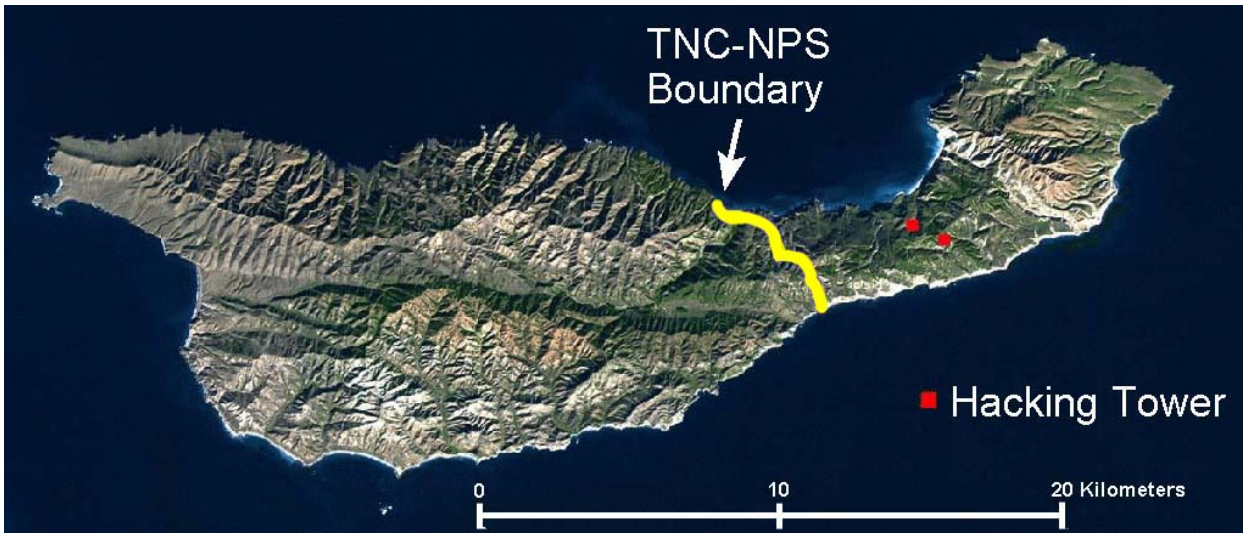


*Figure 2. Map of Santa Cruz Island, California indicating placement of two hacking towers. The boundary between The Nature Conservancy (TNC) and National Park Service (NPS) land is shown in yellow.*

has a Mediterranean climate, with mean monthly temperatures 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.

# METHODS

## Permitting

IWS has the required Federal Fish and Wildlife Permit (Permit TE744878-8) and a signed Memorandum of Understanding with the California Department of Fish and Game 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 us to band and radio-tag the eaglets prior to release and a Letter of Authorization from the National Oceanic and Atmospheric Administration that allows collecting and possessing biological samples from dead marine mammals for contaminant and stable isotope analyses.

In order to remove eaglets from Alaska, IWS also has a Letter of Authorization from the United States Forest Service, the agency managing the area from which eaglets are collected, and a Scientific Permit from the Alaska Department of Fish and Game.

## Bald Eagle Acquisition

Young bald eagles approximately 8 weeks old were acquired from two different sources: the Avian Conservation Center (ACC) at the San Francisco Zoo and from wild nests near Juneau, Alaska. Eagle chicks from the ACC were produced by some of their seven pairs of captive-breeding eagles comprised of birds originating from California genetic stock. To find active wild nests, Phil Schempf and Mike Jacobson (FWS, Juneau) flew a helicopter survey of the collection area. We then traveled by boat to the area, where Jim Spickler (Eco-Ascension Research and Consulting, Arcata, California) climbed the nest trees and removed the eaglets by placing the birds into a padded nylon bag and carrying them to the ground (Fig. 3).

*Figure 3. Young bald eagle after being removed from a wild nest near Juneau, Alaska.*

Each bird was examined to make sure it was healthy and then transported back to the boat, where it was placed into a dog kennel (56 cm x 81 cm x 58 cm; W x D x H). Fresh fish were cut into small pieces (~2 $cm^2$) and placed in each cage 2-3 times per day. The birds were flown from Juneau to Los Angeles, California, transported by van to Ventura, California and then transported to Santa Cruz Island by NPS boat.

## Bald Eagle Hacking

IWS used the two hacking towers constructed in 2002 for releasing bald eagles on Santa Cruz Island (Sharpe et al. 2003; Fig. 4). These are located on the eastern portion of the island owned by the NPS (Fig. 2).

The eagles were placed in the hacking towers upon arrival on Santa Cruz Island. Two or three birds were placed in each cage and fed marine fish and feral pig (*Sus scrofa*) until their release 2-6 weeks later at approximately 12 weeks of age (Fig. 5). Each cage was monitored using a solar-powered video system (Sharpe et al. 2003) to insure that all birds were eating and

remained healthy. IWS 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, each bird was fit with a combination 70 g PTT GPS unit (Microwave Telemetry, Inc., Columbia, MD) and VHF transmitter (Advanced Telemetry Systems, Isanti, MN; Fig. 6), blue patagial wing markers with a unique letter/number combination, and a FWS leg band. The satellite transmitters used in the second season varied from those used in 2002 in two ways: the antenna attachment was reinforced and a smaller VHF transmitter was attached to the side, instead of underneath, the GPS unit (Fig. 6). At the time of banding, personnel also collected ~10 cc of blood from each bird to provide for baseline contaminant and stable isotope analyses.

*Figure 4. South hacking tower located on Santa Cruz Island, California.*

*Figure 5. Two bald eagles in a hacking tower on Santa Cruz Island, California.*

*Figure 6. PTT GPS unit with VHF transmitter (gray) attached to the side. The whole unit weighs approximately 100 g.*

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

## Post-Release Monitoring

Following the release of each eagle, IWS biologists closely monitored each bird to insure that they were finding food and remaining healthy. Biologists also continued monitoring bald eagles that were released in 2002. During observations, any interactions with other bald or golden eagles were noted. Biologists usually were able to locate the birds for visual monitoring using a VHF telemetry receiver (Communications Specialists, Inc., Orange, California). Eagles that could not be located using telemetry could usually be relocated using the GPS data that was retrieved via computer from Argos, Inc. (Largo, MD). Biologists attempted to locate each bird 2-3 times per week throughout the period covered by this report.

## Beach Watch Surveys

In order to gain a better understanding of the potential contamination that bald eagles might acquire by feeding on beached animals, IWS biologists conducted monthly surveys of seven beaches on Santa Cruz Island: Chinese Harbor, Prisoner's Harbor, Laguna Beach, Johnson's Beach, Pozo Beach, Sauces Beach, and Christy Beach (Fig. 7). Beaches were monitored at low tides to maximize likelihood of finding beached organisms. Data were collected by walking the beaches and recording findings onto a standard datasheet (Appendix I). The information recorded for each carcass located included species (if possible), stage of decomposition, age and sex (if possible), evidence of scavenging, evidence for the cause of death, the presence of oil, and whether a photograph was taken. Carcass location was recorded with a hand-held GPS unit and photographs of carcasses were taken using a Canon PowerShot A70 digital camera. Data were entered later into a standard Access (Microsoft Corp.) database created by the NPS. Location data were entered into ArcView GIS (ESRI, Redlands, California) so that IWS could correlate beach use by the eagles with known carcass locations.

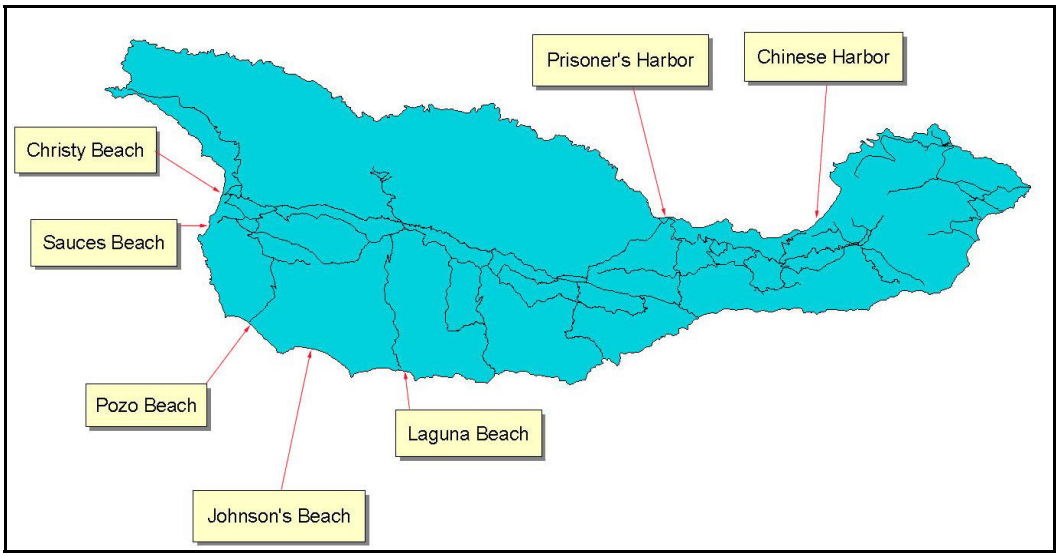


*Figure 7. Locations of beaches on Santa Cruz Island, California where monthly surveys were conducted for beached carcasses from May to December 2003.*

When possible, project personnel placed a video camera near marine mammal carcasses to record foraging occurrences by bald eagles. The system consisted of a tripod-mounted color video camera in a weatherproof housing, a VCR in a modified Pelican case, a 12-volt deep cycle battery, and a flexible solar panel. In order to ensure the safety of the equipment it had to be placed well above high tide near the carcass and the site had to receive direct sunlight for at least several hours per day to recharge the battery.

## Tissue Sampling

In order to determine bald eagle exposure to contaminants through their diet and to create a stable isotope food web model, samples of bald eagle blood and feathers, and other tissue (muscle and adipose) samples of feral pigs, marine mammals, and seabirds were collected for analyses. These sample analyses will be used to predict the likelihood of successful future bald eagle reproduction on the Northern Channel Islands. The protocol for tissue collection was developed by the FWS and IWS (Appendix II) and finalized in September 2003. Samples were stored in chemically clean glass containers and frozen for later shipment to the Battelle Laboratory for DDE/PCB analyses, and the University of New Brunswick's Stable Isotopes in Nature Laboratory (SINLAB) for stable isotope analyses.

# RESULTS

## Bald Eagle Acquisition

On 22 May, three young bald eagles produced at the San Francisco Zoo were shipped to Ventura, California via cargo van. In addition, an eaglet that had been removed from a nest on Santa Catalina Island because of injuries was brought to Ventura after being rehabilitated. These birds were taken by boat to Santa Cruz Island on the morning of 23 May and placed in the North Tower.

In mid-July, three IWS biologists and a biologist with Eco-Ascension Research and Consulting traveled to Juneau, Alaska to collect eight young eaglets from nests. On 14 July, Phil Schempf and Mike Jacobson (FWS, Juneau) flew a helicopter survey of the Couverden area to locate potential donor nests. They found 18 nests between Point Couverden and Lynn Sisters (Fig. 8) and recorded GPS coordinates for each nest to allow project personnel to find the nests from the ground.

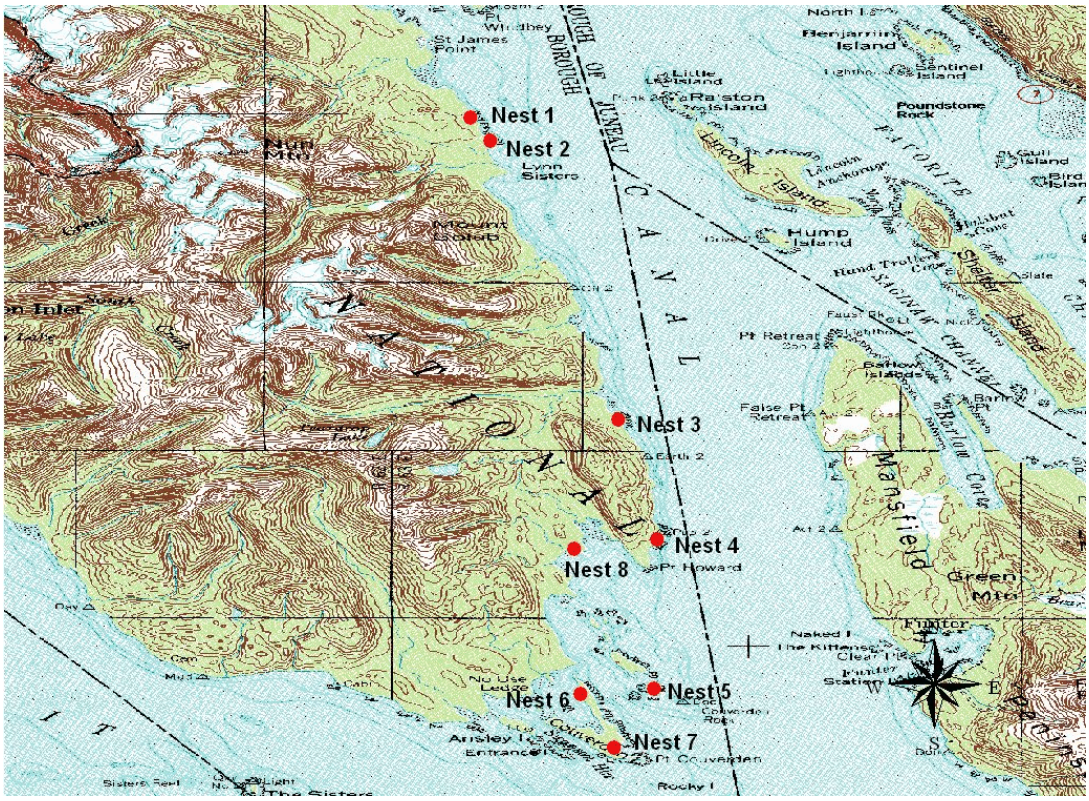


*Figure 8. Location of nests near Juneau, AK from which we removed bald eagles chicks in 2003.*

Biologists traveled to the Couverden area aboard a FWS boat on 15 July to remove the eaglets. They climbed to two nests, each containing two eaglets (Nests 1 and 2; Fig. 8), and removed one bird from each nest (Table 1). These birds were transported back to the boat and placed into airline transport kennels. On 16 July, three more nests were relocated, each with two chicks, and one eaglet was removed from each nest (Nests 3-5; Fig. 8). Project personnel removed two more chicks from two different nests (Nests 6-7; Fig. 8) on 17 July, the second nest (Nest 7) having only one chick in it. The eighth chick was removed from a nest with two eaglets present on 18 July (Nest 8; Fig. 8).

All eight birds were shipped via air cargo to Los Angeles, California on 19 July. These birds, as well as a single bird from the San Francisco Zoo, were picked up on the evening of 19 July and were taken by boat to Santa Cruz Island on the morning of 20 July. One of the birds from Alaska (from Nest 1) had developed a physical problem while in the kennel so that it was unable to stand. IWS veterinarian Winston examined this bird immediately after it arrived in Los Angeles and then took it for further diagnostic examinations. The bird was diagnosed with osteomyelitis (bone infection) in its vertebrate and died on 29 July (Appendix III).

## Bald Eagle Hacking

The eagles from the San Francisco Zoo were the first to be released on the island (Table 1). The second group of eagles comprised of seven Alaskan birds and one from the San Francisco Zoo, varied widely in age. The oldest eagle was from the Zoo and it was placed into the North Tower with another Zoo bird that had not yet been released. These birds were banded on 23 July and released on 25 July (Table 1). Five eaglets were placed in the South Tower, three in one cage and two in the other, and were released on 21 August (Table 1). The remaining two birds from Alaska were placed together in the North Tower, banded on 29 August and released on 31 August (Table 1).

Table 1. Identification, release information, and current status of bald eagles released on Santa Cruz Island, California, 2003.

| FWS Leg Band | Sex[a] | Patagial Marker | Source[b] | Release Point | Release Date | Fledge Date | Status/Latest Location[c] |
|---|---|---|---|---|---|---|---|
| 629-47354 | F | A-12 | Zoo | North Tower, Box 2 | 6/13/03 | 6/13/03 | Alive, s. Oregon |
| 629-47355 | F | A-13 | Zoo | North Tower, Box 2 | 7/01/03 | 7/01/03 | Alive, Santa Rosa Is. |
| 629-47364 | M | NA | Zoo | North Tower, Box 1 | 7/25/03 | 7/25/03 | Alive, Rehabilitation |
| 629-47357 | M | A-15 | Zoo | North Tower, Box 1 | 7/25/03 | 7/25/03 | Dead 9/6/03 |
| 629-47361 | F | A-14 | Nest 5 | South Tower, Box 3 | 8/21/03 | 8/23/03 | Alive, Santa Rosa Is. |
| 629-47359 | F | A-16 | Nest 2 | South Tower, Box 3 | 8/21/03 | 8/22/03 | Alive, Santa Rosa Is. |
| 629-47360 | F | A-17 | Nest 6 | South Tower, Box 3 | 8/21/03 | 8/23/03 | Alive, Santa Rosa Is. |
| 629-47362 | F | A-18 | Nest 3 | South Tower, Box 4 | 8/21/03 | 8/23/03 | Alive, Santa Rosa Is. |
| 629-47363 | F | A-19 | Nest 4 | South Tower, Box 4 | 8/21/03 | 8/21/03 | Alive, Santa Rosa Is. |
| 629-47358 | F | A-20 | Nest 7 | North Tower, Box 2 | 8/31/03 | 9/02/03 | Alive, Santa Cruz Is. |
| 629-47356 | M | A-21 | Nest 8 | North Tower, Box 2 | 8/31/03 | 9/02/03 | Alive, Santa Cruz Is. |

[a] Determined by karyotyping for birds from San Francisco Zoo, and morphometrics for Alaskan birds.
[b] Bald eagles from the San Francisco Zoo, CA (Zoo) or wild nests near Juneau, AK (see Fig. 8).
[c] As of 12/31/03

## Post-Release Monitoring

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

As of 31 December, nine of the 11 eagles released are being tracked and monitored on a regular basis. Bird 629-47364, which had been rehabilitated for a leg injury prior to being brought to Santa Cruz Island, was not seen flying during the first week out of the tower, not even when approached. We recaptured the bird on 1 August and transported it to the Orange County Bird of Prey Center to be examined and rehabilitated. Veterinarian Dr. Scott Weldy reported the bird had a developmental problem in the use of its wings.

The remaining 2003 birds have moved between the four Northern Channel Islands, as well as to the mainland. Below is a brief summary of the movements and status of each eagle released. Each bird is referred to by its patagial tag number (see Table 1).

*A-12*

A-12 spent two months exploring Santa Cruz Island before flying to the mainland on 22 August (Fig. 9). It flew approximately 1000 km to northeastern California in one week. It remained in the Goose Lake area of northern California and southern Oregon through the end of December. There was one reported sighting of the bird at Goose Lake in early December.

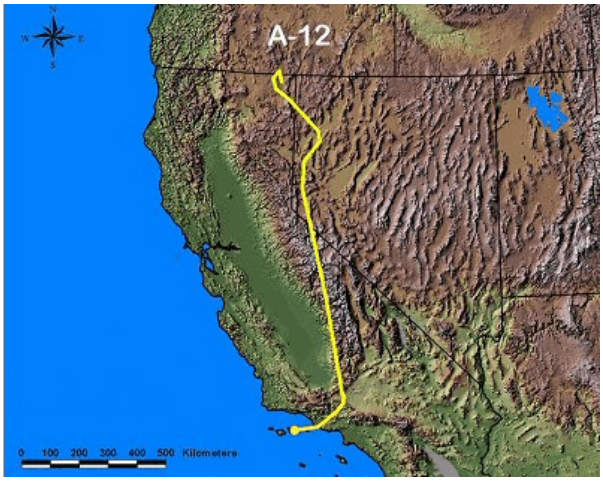


*Figure 9. Locations for bald eagle A-12 through December 2003.*

*A-13*

A-13 spent one month on Santa Cruz Island before flying to Anacapa Island on 6 August (Fig. 10). It spent three weeks on Anacapa before returning to Santa Cruz Island on 30 August. On 16 December, it flew to Santa Rosa Island and remained there through the end of the month.

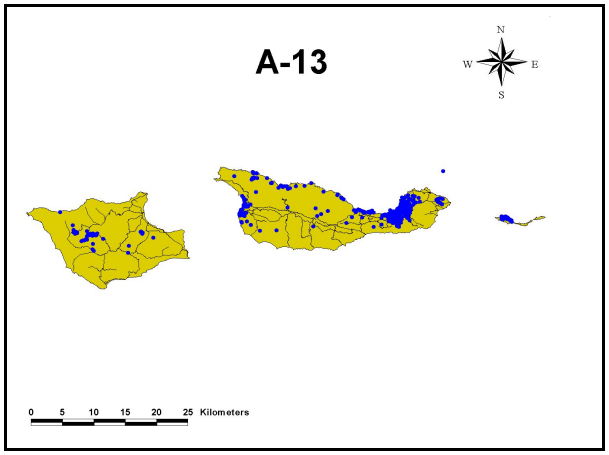


*Figure 10. Locations for bald eagle A-13 on the Northern Channel Islands, California, 2003.*

*A-14*

A-14 has spent most of its time on Santa Cruz Island. On 15 December it flew to Santa Rosa Island, spending one night there before returning to Santa Cruz Island on 16 December (Fig. 11).

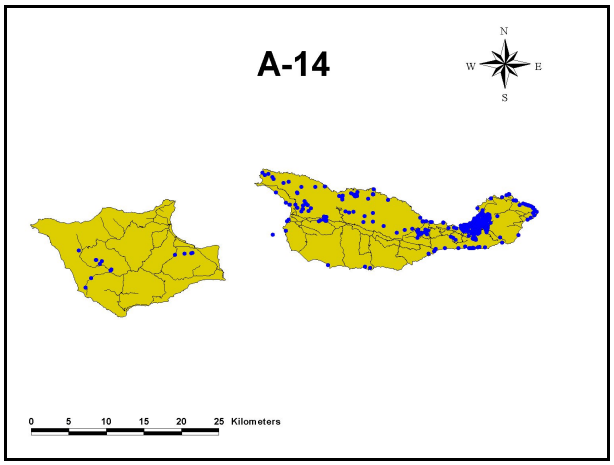


*Figure 11. Locations for bald eagle A-14 on the Northern Channel Islands, California, 2003.*

*A-15*

A-15 spent two weeks on Santa Cruz Island before flying to Anacapa Island on 6 August, the same day A-13 flew to Anacapa (Fig. 12). Most of its time was spent on West Anacapa, but A-15 did make a few short trips to East Anacapa. On 4 September it flew to Santa Cruz Island for a day and then returned to Anacapa Island on 5 September. On 6 September, A-15 flew to Santa Cruz Island and then started flying towards the mainland. The bird ended up in the ocean approximately 3.5 km short of the mainland coast. It drifted in the ocean until it washed up on Hermosa Beach, where the carcass was collected by P. Sharpe on 18 September.

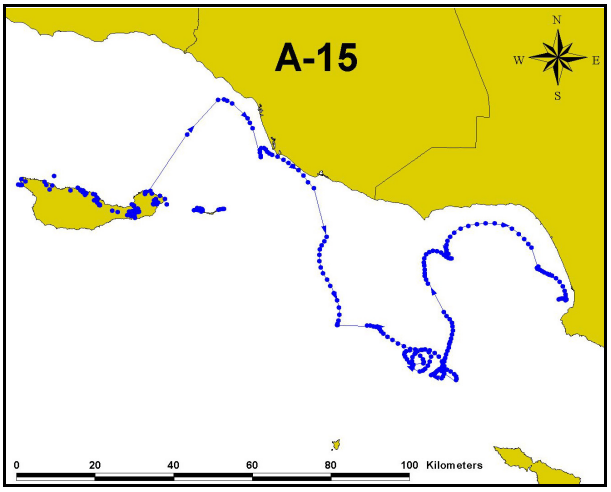


*Figure 12. Locations for bald eagle A-15 before washing ashore on 18 September 2003.*

*A-16*

A-16 spent three months on Santa Cruz Island before flying to Santa Rosa Island on 14 November (Fig. 13). It remained on Santa Rosa Island through December.

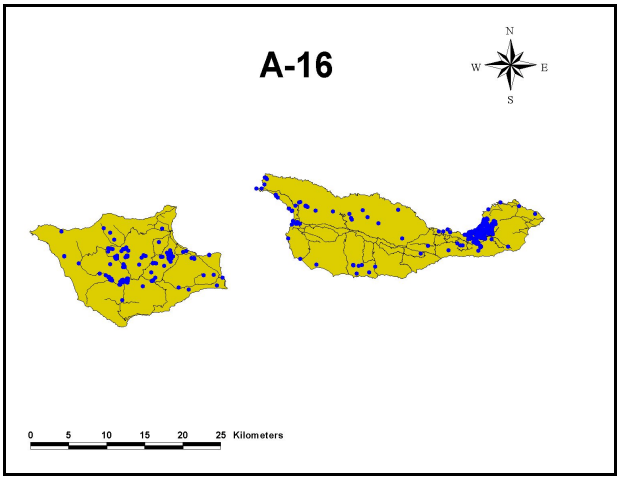


*Figure 13. Locations for bald eagle A-16 on the Northern Channel Islands, California, 2003.*

*A-17*

A-17 spent two months on Santa Cruz Island before flying to Santa Rosa Island with A-18 and A-19 on 12 October. A-17 remained on Santa Rosa Island through December (Fig. 14).

*A-18*

A-18 spent two months on Santa Cruz Island before flying to Santa Rosa Island with A-17 and A-19 on 12 October. A-18 also remained on Santa Rosa Island through December (Fig. 15).

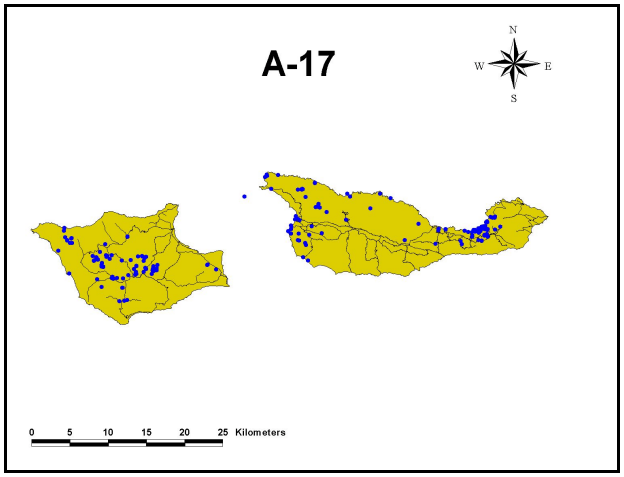


*Figure 14. Locations for bald eagle A-17 on the Northern Channel Islands, California, 2003.*

*A-19*

A-19 spent two months on Santa Cruz Island before flying to Santa Rosa Island with A-17 and A-18 on 12 October. A-19 returned to Santa Cruz Island on 22 October, spending a week there, mostly in the Chinese Harbor area. On 29 October, A-19 returned to Santa Rosa Island. It flew to San Miguel Island on 9 December, spent the night, and returned to Santa Rosa Island on 10 December. The bird remained on Santa Rosa Island through the end of December (Fig. 16).

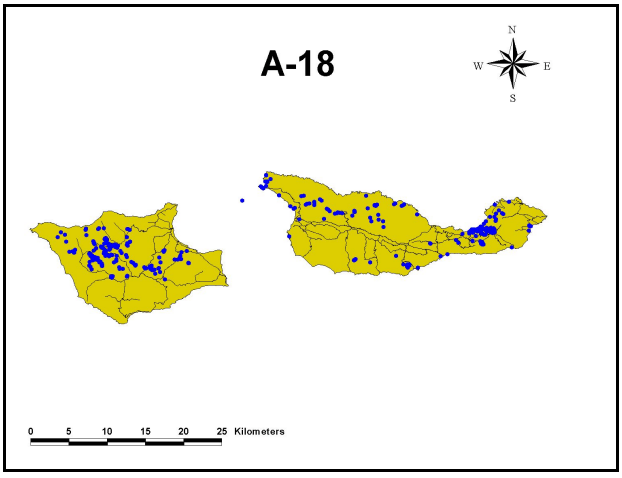


*Figure 15. Locations for bald eagle A-18 on the Northern Channel Islands, California, 2003.*

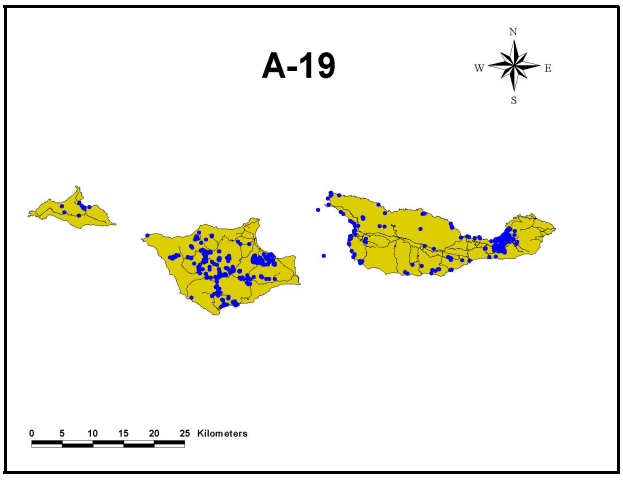


*Figure 16. Locations for bald eagle A-19 on the Northern Channel Islands, California, 2003.*

*A-20*

A-20 spent most of 2003 on Santa Cruz Island, but did fly to Santa Rosa and San Miguel Islands on 1-2 November (Fig. 17).

*A-21*

A-21 remained on Santa Cruz Island through December. It has spent most of its time in the Chinese Harbor area (Fig. 18).

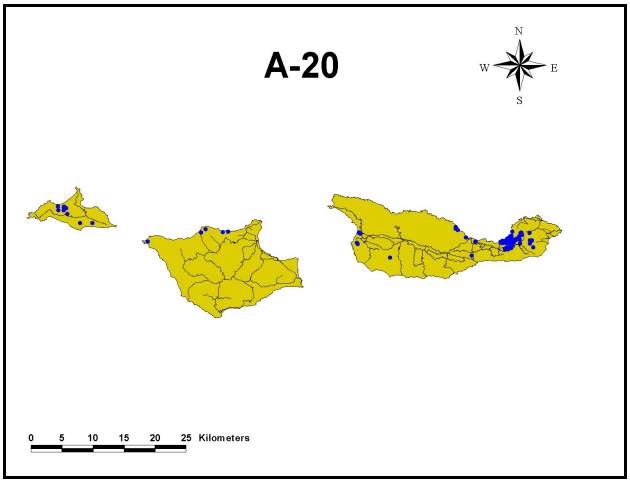


*Figure 17. Locations for bald eagle A-20 on the Northern Channel Islands, California, 2003.*

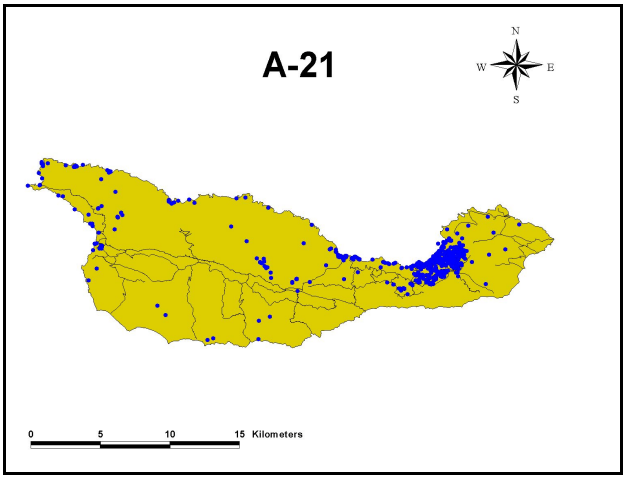


*Figure 18. Locations for bald eagle A-21 on the Northern Channel Islands, California, 2003.*

While monitoring the newly released eagles, IWS continued to monitor the birds released in 2002. Below is a brief summary of the movements and status of the 2002 eagles between May and December 2003. Again, each bird is referred to by its patagial tag number (Table 2).

*A-00*

A-00 has visited all of the Northern Channel Islands and the mainland since its release in 2002. In the beginning of May 2003 it spent a few days on each of Santa Cruz, Santa Rosa, and

West Anacapa Islands (Fig. 19). The bird's GPS transmitter stopped transmitting data from 13 May through the beginning of August, at which time the signal was from the same location on West Anacapa Island as it had been in May. At the time it was unclear whether the transmitter had dropped off the bird or if the bird was dead. VHF telemetry from NPS boats and from East Anacapa Island confirmed the transmitter was on West Anacapa Island. Personnel were unable to travel to West Anacapa Island to look for the transmitter because of the brown pelican closure and, later, because personnel were needed to track birds on Santa Cruz Island. A-00 was observed by biologists attempting to trap golden eagles on Santa Rosa Island in November 2003, confirming the bird had dropped its transmitter.

Table 2. Identification, release information, and status of bald eagles released on Santa Cruz Island, California in 2002.

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

[a] Determined by karyotyping for birds from San Francisco Zoo and morphometrics for Alaskan birds.
[b] Eagles from the Avian Conservation Center, San Francisco Zoo, California (Zoo) and nests near Juneau, Alaska.
[c] As of 12/31/2003

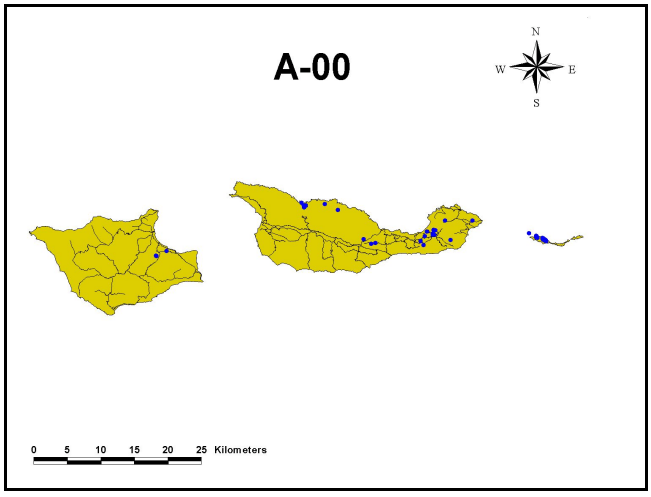


*Figure 19. Locations for bald eagle A-00 on the Northern Channel Islands, California, 2003.*

*A-01*

A-01 has visited all of the Northern Channel Islands since its release in 2002. Between May and August 2003 it was on Santa Cruz Island (Fig. 20). On 3 August the bird's GPS transmitter stopped transmitting data, but the bird was observed still wearing the transmitter and we were receiving VHF telemetry. On 13 September A-01 was observed feeding on a feral pig carcass, at which time it was noted that the antenna for the GPS unit was missing. On 14 September A-01 was still on Santa Cruz Island, but by 4 October its VHF signal appeared to be originating on Santa Rosa Island. Again, biologists working on golden eagle trapping on Santa Rosa Island observed A-01 there in November 2003.

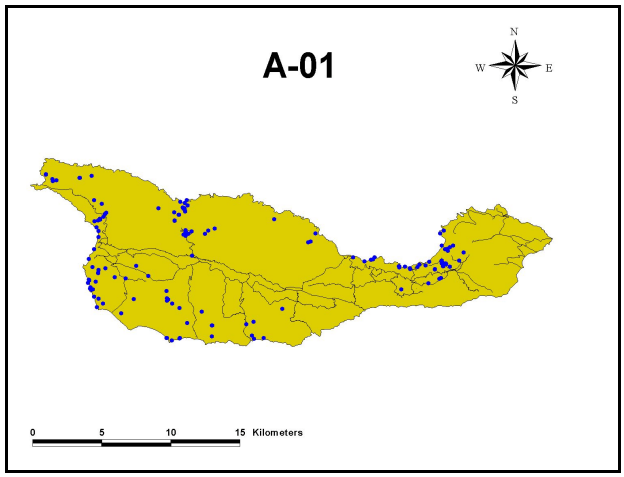

*Figure 20. Locations for bald eagle A-01 on Santa Cruz Island, California, 2003.*

*A-02*

A-02's GPS transmitter stopped functioning in 2002, but we continued to relocate the bird using VHF telemetry until the VHF unit separated from the GPS transmitter and fell off the bird in February 2003. Occasional visual observations were made throughout 2003, mostly in the Chinese Harbor area of Santa Cruz Island.

*A-04*

A-04 has remained on Santa Cruz Island since its release. The bird spent most of the period between May and December 2003 in the Chinese Harbor area (Fig. 21).

*A-07*

A-07 has continued moving among the western states between May and December 2003 (Fig. 22). As of 1 May it was at Lake Crowley, Mono County, California, and then between 9 May and 28 May it flew to Yellowstone National Park, Wyoming. There it spent a month and a half before flying to southwestern Montana. It spent August in Montana, mostly at Delmoe Lake, Jefferson County, before returning to Yellowstone National Park at the beginning of September. In mid-October the bird began heading south. As of the end of December it was in central Utah, following the same southerly path through Utah as it used the previous winter (Fig. 22).

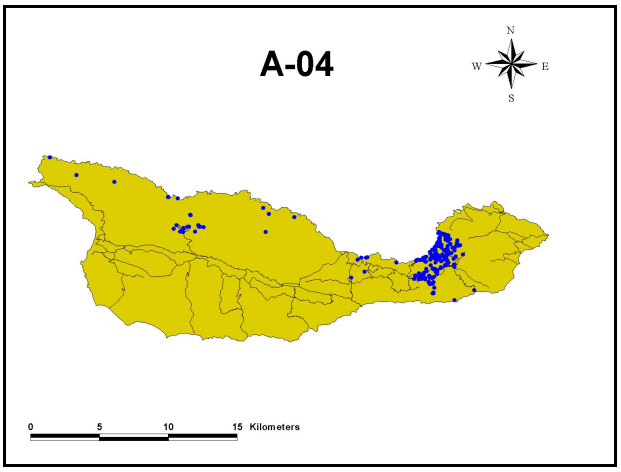


*Figure 21. Locations for bald eagle A-04 on Santa Cruz Island, California, 2003.*

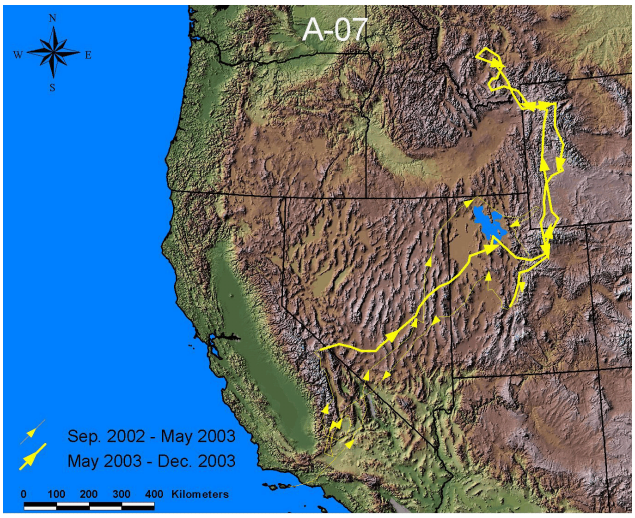


*Figure 22. Locations for bald eagle A-07 during 2002 and 2003.*

A-08

A-08 has spent time on Santa Cruz, Santa Rosa, and San Miguel Islands since its release. It spent all of May and half of June 2003 on Santa Cruz Island and the remainder of June on Santa Rosa Island. It returned to Santa Cruz Island on 2 July (Fig. 23). Its GPS transmitter stopped functioning on 3 July, but we continued to receive the VHF transmitter signal. On 18 July, we recovered the bird's dropped transmitter on a ridge above Chinese Harbor. The bird was not

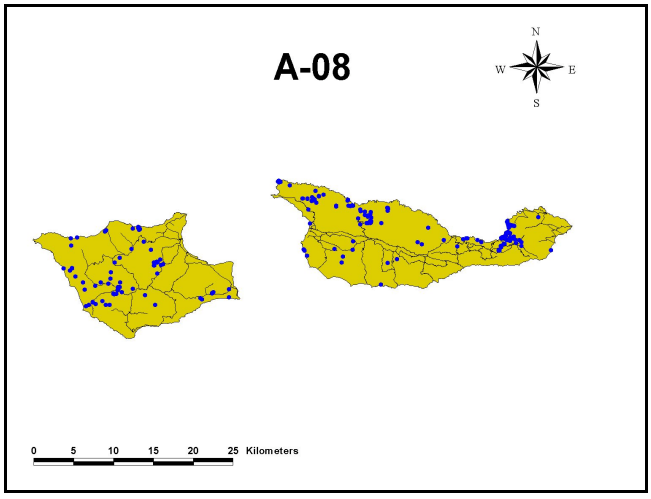


*Figure 23. Locations for bald eagle A-08 on the Northern Channel Islands, California, 2003.*

seen again until a biologist at Hopper Mountain, California reported seeing it at a condor feeding location in October. The condors at the food item harassed the eagle and did not let it feed while the biologist was watching. As of the end of December, the bird's location is unknown.

*A-10*

A-10's GPS unit stopped functioning in 2002. Personnel were able to continue tracking the bird using VHF telemetry. Between May and mid-July 2003, its VHF signal seemed to be originating on Anacapa Island. On 28 July the bird was observed at the North Tower, but it was not carrying a transmitter. On 27 September we recovered the bird's transmitter in the bottom of San Pedro Canyon on the east end of Santa Cruz Island. Between August and December the bird was observed occasionally, mostly in the Chinese Harbor area on Santa Cruz Island.

*A-11*

A-11 remained on Santa Cruz Island between May and December 2003 (Fig. 24). In November the GPS data indicated the transmitter was stationary. We recovered the transmitter on China Pines Ridge on Santa Cruz Island on 28 November. The last time the bird was observed on Santa Cruz Island was on 8 December near Chinese Harbor.

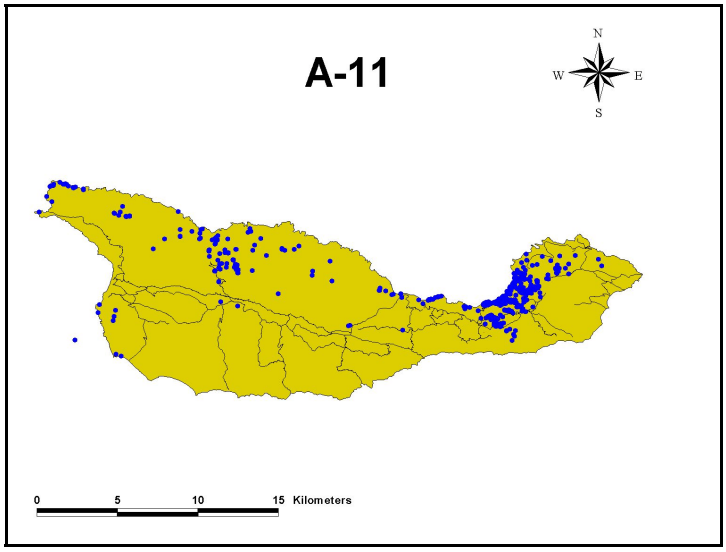


*Figure 24. Locations for bald eagle A-11 on Santa Cruz Island, California, 2003.*

*Bald Eagle Sightings on Other Islands*

Bald eagles that traveled to Santa Rosa Island were occasionally reported by people working/visiting on that island. Brian Latta (Santa Cruz Predatory Bird Research Group) reported seeing a number of different tagged bald eagles on Santa Rosa Island during trips in May, August,

October, and November. These eagles were observed during helicopter surveys and at carcasses placed for golden eagle trapping efforts. On 16 December, Mark Senning (NPS) observed two bald eagles on Santa Rosa Island, one of which was identified as A-18.

*Other Bald Eagle Sightings*

During monitoring of released eagles on Santa Cruz Island, project personnel also recorded an incidence of an eagle originally released on Santa Catalina Island. On 4 August K-10 was observed soaring above the North Tower. On 22 August we observed this bird flying above the South Tower and on 23 August it was feeding on a pig carcass at the South Tower. This bird was captive-bred at the San Francisco Zoo and fostered into a wild nest on Santa Catalina Island in 2001.

*Foraging Activity*

During monitoring of the eagles we recorded many incidences of foraging by the eagles. Most of the foraging observations were of feeding on pig carcasses placed by IWS personnel (Fig. 25). We have 206 visual records of different eagles feeding on or perching close to pig carcasses.

Pig carcasses were provided for eagles on a year-round basis. Most carcasses were placed out in June through September to provide food for the recent fledglings (Table 3). Pig carcasses were placed in front of the hack towers just prior to releasing the birds to attract ravens and allow the eagles to observe foraging activity. For the first two to four weeks post-release, personnel continued placing pig carcasses near the hack towers. Once the birds started exploring the island carcasses were placed in various locations in the vicinity of the towers and in areas visited regularly by the eagles. For the rest of the year, 1-2 pig carcasses were provided each week and all released eagles regularly fed on these food sources. Over 90% of observations of eagles feeding upon or perched near food sources were recorded at pig carcasses.

Bald eagles were observed feeding upon, or perched near, five dead marine mammals, all in the Chinese Harbor area (Table 4).

Table 3. Number of feral pig carcasses delivered to the field per month between May and December 2003.

| Month | # Pig Carcasses |
|---|---|
| May | 3 |
| June | 19 |
| July | 19 |
| August | 16 |
| September | 19 |
| October | 16 |
| November | 14 |
| December | 10 |
| **Total** | 116 |

*Figure 25. Immature bald eagles feeding on a feral pig carcass on Santa Cruz Island, California, 2003.*

Table 4. Observations of bald eagles feeding on or perched near marine mammal carcasses on Santa Cruz Island, California from May 2003 through December 2003.

| Prey Species/Location | Date | Eagles Present |
|---|---|---|
| California Sea Lion (*Zalophus californianus*) | | |
| Chinese Harbor | 06/08/2003 | A-02 A-04 A-11 |
| Chinese Harbor | 06/25/2003 | A-12 |
| Unidentified Marine Mammal | | |
| Chinese Harbor | 06/10/2003 | A-04 A-11 |
| Chinese Harbor | 10/30/2003 | A-04 A-11 A-14 A-16 A-21 |
| Chinese Harbor | 11/10/2003 | A-02 A-10 A-11 A-13 A-14 A-16 A-20 A-21 |

Eagles have fed on several other prey species as well. Although no IWS personnel have seen birds fishing yet, we have one report of a recreational fisherman seeing an eagle catch a fish close to Prisoner's Harbor. The eagles likely feed on dead fish on the beach, however, the only observed incidence of this occurred on 10 November when A-21 was seen feeding on a leopard shark (*Triakis semifasciata*) carcass at Chinese Harbor. The only observation of an eagle taking

live prey was on 2 September, when A-11 killed and ate a common raven (*Corvus corax*) inside the North Tower.

*Intraspecific Interactions*

The released bald eagles often were observed soaring and perching together, especially in the Chinese Harbor area. There have been antagonistic encounters between bald eagles at carcasses, but they are often seen feeding together as well.

Eagle A-11 was present at the North Tower as three of the 2003 eagles fledged. On 1 July the release door was opened for A-13 to fledge. A-11 landed on the roof of the tower, vocalized, and stooped on A-13 as it clung to the front perch. On 31 August the release door was opened for A-20 and A-21 to fledge. A-11 again landed on the roof while A-20 and A-21 were still in the tower. A-11 repeatedly flew off, circled, and returned to the tower roof. When the young birds emerged from the tower, A-11 vocalized and stooped at the young eagles on the front perch of the tower, almost knocking one of the young birds off the perch.

*Bald Eagle/Golden Eagle Interactions*

There were few interactions observed between the bald eagles and golden eagles. There were three recorded occasions on which golden eagles flew over pig carcasses on which bald eagles were feeding (19 June, 6 July, and 31 August). The only time there was any direct interaction observed was on 24 September, when a golden eagle landed on a pig carcass and fed for a few minutes before A-18 landed next to the golden eagle, which then flew away.

## Beach Watch Surveys

We conducted monthly surveys on seven beaches from May to December 2003 and located a variety of potential food sources for bald eagles. The majority of carcasses were found on beaches at Chinese Harbor and Prisoner's Harbor (Table 5).

Table 5. Carcasses found during surveys of seven beaches on Santa Cruz Island, California from May to December 2003. Each beach was surveyed once per month.

| | Beach Surveyed[1] | | | | | | |
|---|---|---|---|---|---|---|---|
| Prey Item | CH | JB | PB | SB | CB | PH | LB |
| BIRD | | | | | | | |
| Northern fulmar (*Fulmarus glacialis*) | 2 | . | 1 | . | . | . | . |
| Brown pelican (*Pelecanus occidentalis*) | 1 | . | . | . | . | . | . |
| Common murre (*Uria aalge*) | 1 | . | . | . | . | . | . |
| Pelagic cormorant (*Phalacrocorax pelagicus*) | 1 | . | . | . | . | . | . |
| Western gull (*Larus occidentalis*) | . | . | . | . | . | 2 | 1 |
| Unidentified gull (*Larus* spp.) | . | . | . | 1 | . | 1 | . |
| Unidentified loon (*Gavia* spp.) | . | . | . | . | . | . | . |
| Unidentified bird | 4 | . | . | . | . | 1 | . |
| FISH | | | | | | | |
| Thornback ray (*Platyrhinoidis triseriata*) | 6 | . | . | . | . | . | . |
| Ocean sunfish (*Mola mola*) | 1 | . | . | . | . | . | . |
| Unidentified fish | . | . | . | . | . | 1 | . |
| MAMMAL | | | | | | | |
| Sea lion (*Zalophus californianus*) | 5 | . | 2 | 2 | . | 2 | . |
| Feral pig (*Sus scrofa*) | 2 | . | . | . | . | . | . |
| Unidentified dolphin | 1 | . | . | . | . | . | . |
| UNIDENTIFIABLE ITEM | . | . | . | . | 1 | . | . |

[1] CH = Chinese Harbor, JB = Johnson's Beach, PB = Pozo Beach, SB = Sauces Beach, CB = Christy Beach, PH = Prisoner's Harbor, LB = Laguna Beach

Because their position in the food chain allows marine mammals to biomagnify environmental contaminants, their carcasses are a potential significant source of DDE to bald eagles residing on the Channel Islands. A total of nineteen marine mammal carcasses were observed on beaches between May and December 2003, either during beach watch surveys (11 carcasses) or during bald eagle observations (8 carcasses; Table 6). Fifteen of the carcasses were California sea lions *(Zalophus californianus)*. Most of the marine mammal carcasses were found

at Chinese Harbor and GPS and VHF telemetry data confirm eagle activity at most of these carcasses.

Table 6. Total marine mammal carcasses recorded on Santa Cruz Island, California from May through December 2003 during beach watches or direct observations at beaches.

| Prey Species/Location | Date | Location Method |
|---|---|---|
| California Sea Lion (*Zalophus californianus*) | | |
| Chinese Harbor (2 carcasses) | 06/07/2003 | Field Observation |
| Prisoner's Harbor | 06/09/2003 | Beach Watch |
| Chinese Harbor | 06/12/2003 | Beach Watch |
| Sauces Beach | 06/24/2003 | Beach Watch |
| Chinese Harbor | 06/25/2003 | Field Observation |
| Pozo Beach | 06/26/2003 | Beach Watch |
| Prisoner's Harbor | 07/07/2003 | Beach Watch |
| Chinese Harbor (2 carcasses) | 07/15/2003 | Beach Watch |
| Sauces Beach | 09/23/2003 | Beach Watch |
| Chinese Harbor (2 carcasses) | 09/26/2003 | Beach Watch |
| Chinese Harbor | 12/07/2003 | Field Observation |
| Pozo Beach | 12/20/2003 | Beach Watch |
| Unidentified Marine Mammal | | |
| Chinese Harbor | 05/19/2003 | Field Observation |
| Chinese Harbor | 06/10/2003 | Field Observation |
| Chinese Harbor | 10/30/2003 | Field Observation |
| Chinese Harbor | 11/10/2003 | Field Observation |

Remote video cameras were deployed on three marine mammal carcasses at Chinese Harbor (May 19-23, June 8-10, June 25-30) to record use by eagles. The camera did capture eagle activity at the carcasses on the first two occasions, but was placed too far from the carcasses to discern the patagial marker numbers. The third time the camera was used it recorded a marine mammal carcass for 5 days. No eagles fed on the carcass the entire time, although there was a lot of raven and gull activity at the carcass.

## Tissue Sampling

During 2003, IWS began collecting tissue samples for contaminants and stable isotope analyses. Samples for bald eagles were collected during banding activities when the eagles were approximately 11.5 weeks old, and included blood and feather samples. Tissue from feral pigs, sea lions, and gulls were also collected (Appendix IV)

# DISCUSSION

After the first two seasons of bald eagle releases there are now 15 immature bald eagles on the Northern Channel Islands (seven from 2002, 8 from 2003). Survival for eagles released in 2003 was 90% (excluding the recaptured bird) and second-year survival for eagles released in 2002 was 100%. The single eagle mortality for 2003 occurred when a recently fledged bird went in the ocean. While we observed fewer mortalities in 2003 from birds dying while attempting to cross the Channel, it appears that crossing large expanses of water is a significant potential source of mortality for young eagles. Several eagles released on Santa Catalina Island have died at sea or been rescued from the water (Sharpe and Garcelon 2000, Garcelon *unpublished data*) and young bald eagles are occasionally found floating in the ocean in southeastern Alaska (P. Schempf, *personal communication*). The presence of the 2002 birds on Santa Cruz Island may have reduced the tendency for the 2003 birds to leave the island, especially at a young age, therefore increasing survival

Bald eagles on Santa Cruz Island were usually in the area of Chinese Harbor, based upon both visual sightings and telemetry data. Most of the pig carcasses placed by IWS personnel were along the ridges surrounding Chinese Harbor, and beach surveys indicated that the area also had the highest availability of naturally occurring carrion. Therefore, eagles likely could find food in the area more reliably than other portions of the island. Because of the higher occurrence of marine mammal carcasses in the Chinese Harbor area, we may try to lure the eagles away from this area by placing pig carcasses at more distant locations in the future.

Pig carcasses appear to be the primary food source for bald eagles on Santa Cruz Island. Carcasses generally are provided fresh and remain available to eagles for 5-10 days. Many of the locations of pig carcasses are known because they are placed in the field by our staff or we are

informed of the date and location of the pig carcasses if they are placed by non-IWS personnel. Bald eagle activity at pig carcasses has been verified by direct observation, recorded on video using remote camera systems, and correlated with the telemetry data from the eagles carrying transmitters. Because bald eagles appear to prefer scavenging over hunting and killing (Stalmaster 1987), the lack of observed fishing by the eagles is likely a result of the availability of pig carcasses. As the eagles on the Northern Channel Islands mature, and pig numbers are reduced, we expect the birds will hunt live prey more often.

Immature bald eagles are generally scavengers (Gerrard and Bortolotti 1988), so providing an ample supply of food may increase the probability that the young eagles remain on the Northern Channel Islands. During the eagle restoration on Santa Catalina Island at least 50% of the released birds generally remained on the island. Throughout the reintroduction, feral pig and goat carcasses were usually available as a result of hunting activities. Feral pig and goat eradication is nearing completion on Santa Catalina Island, so opportunities for eagles to feed on carcasses are now essentially non-existent. In recent years all released bald eagles have been leaving the island within 2-3 months of fledging (Sharpe and Dooley 2001, Sharpe 2002). The lack of scavenging opportunities may force the young eagles to fly to the mainland in search of food.

Although marine mammal carcasses do not appear to compose a large part of the bald eagles' diets on Santa Cruz Island, most of the released eagles have been observed feeding on marine mammals. These carcasses are often ephemeral and in various states of decomposition, often offering little for eagles to feed upon. Of course, marine mammal carcass locations are not always known. Even on the beaches for which IWS personnel conduct regular beach surveys, it is likely that carcasses appear and disappear between the monthly surveys. In addition, because much of Santa Cruz Island's coastline is relatively inaccessible it is likely that unrecorded marine mammal carcasses wash ashore on remote beaches. However, there is little telemetry data placing eagles at remote beach locations, suggesting there are few areas outside of the Chinese Harbor area where marine mammal carcasses frequently wash ashore and attract bald eagles.

Santa Rosa Island continues to attract the immature bald eagles from Santa Cruz Island, primarily in the fall and winter. Five of the ten eagles released this year spent the latter part of the year on Santa Rosa Island. GPS telemetry data indicate that the birds on Santa Rosa Island are generally using the areas along the roads and ridges. Multiple reports have been received of the

birds feeding on mule deer (*Odocoileus hemionus*) and Roosevelt elk (*Cervus canadensis*) carcasses or gut piles left from hunting and culling activities. Therefore, we continue to be concerned about the potential threat of lead poisoning caused by ingestion of lead bullet fragments by the eagles. When the pig eradication program begins on Santa Cruz Island in 2004, the eagles may remain on Santa Cruz Island throughout the year due to the abundance of pig carcasses.

The modified GPS units used in 2003 appeared more reliable than the 2002 versions, providing more locations per unit time. Furthermore, none of the units lost their antennas. One problem did occur with the VHF transmitters. For the transmitters built in 2003 we requested they be programmed with a 14-hour activity cycle to increase battery life. About 50% of the transmitters, which were set to turn on at 0600 hrs, changed their activity period by up to 14 hours. This reduced their operational period during daylight hours and constrained our ability to track the birds during parts of the day. We are dealing with the manufacturer regarding this issue to avoid this problem with birds released in 2004.

One concern raised about restoring bald eagles to the Northern Channel Islands was the potential negative impact upon breeding sea birds, especially on Anacapa Island. This season there was little use of Anacapa Island by any of the bald eagles from the 2002 or 2003 releases. Therefore, it is improbable that bald eagles had a negative impact on breeding sea birds in 2003.

The main question regarding the feasibility of restoring bald eagles to the Northern Channel Islands is whether the bald eagles will be able to reproduce once they mature, or whether DDE accumulation will negatively affect eagle reproduction. To help address this question attempts will be made to capture eagles in 2004 to collect blood and feather samples for contaminants and stable isotope analyses. The results will help model the intake of contamination over the eagles' first 1-2 years in the wild and allow predictions of contaminant loads at maturity.

The high foraging rates by bald eagles on pig carcasses may minimize the DDE contaminant accumulation by the birds. The newly released eagles are likely to continue feeding primarily on pig carcasses in the next few years, as the carcasses will become even more readily available and widely dispersed as a result of the planned feral pig eradication program. When modeling potential future contaminant loads for bald eagles on the Northern Channel Islands, it should be kept in mind that pigs are an abundant, and likely contaminant-free, food source that will not be available for more than the next 2-3 years on Santa Cruz Island. Once the pigs are

eradicated, the eagles residing on the island will be forced to find alternate food sources, which could increase the probability of their feeding on marine mammals and other potentially contaminated food sources.

Given concurrence from the Montrose Trustee Council and the NPS, IWS will release 12 more young eagles in 2004. In addition, IWS personnel will continue to collect tissue samples from organisms in the food web for contaminants and stable isotope analyses, as well as blood and feather samples from the eagles prior to release to get baseline data.

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# APPENDIX I. BEACH WATCH SURVEY FORM

Beach Monitoring Survey Form

BEACH _____ DATE_____
SURVEYORS _____
Time begin _____ time end _____ approx. tide ht. _____ Percent of total _____
Wind _____ general weather_____ beach surveyed_____

Beached Organisms

| Species | Condition | Sex | Age | Previous | Post | Scavenged | Cause of Death | Oiled | Oil Extent | Where Oiled | Photo | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
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Codes for Beached Organisms Categories
**Condition:** 1 (live dying), 2 (fresh dead), 3 (decomposing), 4 (dried, mumified), U (unknown).
**Sex:** F(female), M (male), U (unknown).
**Age:** HY (hatch year), AHY (after hatch year), FY (first year), SY (second year), TY (third year), IM (immature), AD (adult), PC (pup, newly hatched chick/egg, or calf) U (unknown).
**Toe Clipping:** Indicate number of toes clipped when you encountered animal (previous), and number clipped when you left it (post). Leave blank if no toes to clip. Indicate "6" if all toes have been clipped on bird with two feet. Indicate "8" if all toes have been clipped on bird with one foot. Indicate "9" if animal is removed from beach. Use comments if necessary.
**Scavenged:** Y (yes), N (no), U (unknown).
**Probable Causes of Death:** 1 (shot), 2 (tangled in fishing net/line), 3 (tangled in plastic), 4 (unknown), if other write in.
**Oiled:** Y (yes), N (no), U (unknown).
**Oil Extent:** 1 (small globules, <2% of body), 2 (2-33% of body), 3 (34-66% of body), 4 (67-100% of body).
**Where Oiled:** 1 (dorsal only), 2 (ventral only), 3 (entire body), 4 (head only), 5 (feet only), 6 (wings/flippersonly), 7 (other).
**Photo:** Y (yes), N (no).
**Tag:** Y (yes), N (no).
**Comments:** Indicate number, color, and location of any tags present. Disposition and label of removed animal. Length measurements. Photo roll and frame numbers.

Beach Monitoring Survey Form

BEACH _____ DATE _____

Human activity (note dogs on beach also)

| number | Activity Code | Comments |
|---|---|---|
| | | |
| | | |
| | | |

**Human Activity Codes** for Beach Monitoring Survey Form

1-Research, 2-Tidepooling/exploring, 3-Walking, 4-Exercising dog (or other type of pet: note in comments), 5-Sunbathing, 6-Fishing (including clamming or other extractive activity: note specific type in comments), 7-Kayaking, 8-Kite flying, 9-Other

Live Animal Count (shorebirds/marine mammals etc)

| # oiled | Total | Tally(count) | Species | Comments |
|---|---|---|---|---|
| | | | | |
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Band and tag information for live animals. Species, color, location, number, tag type_____

_____

_____

Tar balls/pancakes (number, size/type, fresh/weathered) _____

Main debris types and approx. quantities _____

_____

_____

Notes (presence of *Arundo donax*, disturbance to archeological sites, pig activity, etc.):

_____

_____

_____

_____

_____

# APPENDIX II. 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 Battelle Laboratory 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 University of New Brunswick's Stable Isotopes in Nature Laboratory (SINLAB) 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 phthlates 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 tissue 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.

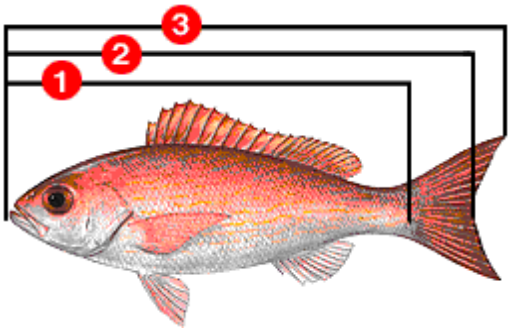


**Exhibit 2. Description of Different Length Measurements**

(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, mackeral), 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), euphasiids (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 EC.

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 (Beckye 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.

# APPENDIX III. HISTORY AND NECROPSY REPORT FOR SICK BALD EAGLE FROM ALASKA

History:

A bald eagle chick captured in Alaska as part of a group being transported to Santa Cruz Island by Dr. Peter Sharpe was examined due to a lack of normal mobility of both legs.

The bird was reported as not appearing to be grossly abnormal on removal from the nest. No known trauma occurred just prior to removal due to fright or during the removal itself. Approximately 2 – 3 hours after removal from the nest it was noted by the biologists that the bird was unable to stand on its own. The bird was examined by me initially at LAX airport on 07/19/03 when the group of birds arrived at that location on their way to Santa Cruz Island. It was evident that the bird had serious problems, so the decision was made to transport the bird to the Catalina Island veterinary clinic operated by the Institute for Wildlife Studies for further examination, diagnostics, and treatment.

Physical findings on initial physical exam:

Bilateral paresis of legs with inability to stand or balance, even with assistance in rising.
Decreased proprioception of rear legs present with slight decrease in cloacal muscle tone.
Bilateral crepitus of both wingtips just proximal to, or possibly involving, carpal joints. Moderate lethargy.
Watery feces and clumping of dried feces on feathers around cloaca. No blood present in feces.
Small pressure sore developing to right of cloaca secondary to abnormal posture (weight being borne on pelvic bones).
Moderately underweight (body weight 3.68 Kg)
Moderate dehydration
Mucous membranes slightly pale.
Lungs and airways mild increased airway sounds but no rales or crackles detected.
A history of occasional regurgitation after feeding was noted.

Diagnostics done:

Blood samples – submitted to Antech Diag. Lab for routine CBC, chem's, Aspergillus antibody and antigen, and chlamydia PCR.

Results are included here and were suggestive of bacterial or fungal infection (WBC ~45,000), with heterophilia, anemia (PCV 28), and hypoalbuminemia (albumin 1.3). Some electrolyte abnormalities were present but may have represented artifacts of blood handling. Aspergillus and chlamydia tests were negative.

Radiographs of the wings and spine revealed an area of increased bone density in the spinal vertebrae at the level of the lumbosacral junction. This density was suggestive of healing injury or possibly osteomyelitis. The films also revealed fractures of the distal radius and ulna on both wings. Displacement of distal fragments from the body of the bone were minimal, and in the case of both ulnas, the fractures involved the epiphyses. The wing fractures were very recent and had apparently resulted from the bird using its wings to compensate for the lack of use of its legs. Bone density in the wings (as judged by radiographic appearance) was slightly less than normal subjectively.

Initial diagnosis:

Serious infection of unknown type, possibly bacterial or fungal osteomyelitis with secondary spinal dysfunction +/- vertebral fracture (probably chronic aggravated by handling).
Wingtip fractures bilaterally.

Initial Treatment:

The bird was started on antibiotic, anti-fungal, and anti-regurgitation therapy. Fluid support was begun, vitamins administered, feeding support initiated (tube and force feeding), and the wings bandaged to prevent further shifting of bone fragments in the wingtips. Over the next few days, the bird improved in attitude and strength in response to the supportive care, but neurological function of the legs changed very little, suggesting an ongoing restriction of spinal / lower motor neuron function.

Additional diagnostics:

The eagle was transported on 07/23/03 to Advanced Veterinary Imaging for CT scanning to determine the exact status of the spinal cord in the vicinity of the apparent bony lesion of the vertebrae seen on regular x-rays. Interpretation of the resulting CT images by multiple radiologists suggested sclerosis and narrowing of the spinal canal secondary to osteomyelitis (bacterial or fungal infection of the bone) of the last lumbar vertebrae, and probable spontaneous fracture of that vertebrae at some point in the past prior to the removal from the nest.

Follow-up blood testing showed that white blood cell counts were declining and red blood cell counts increasing slowly, suggesting some positive response to the antibiotic and / or the anti-fungal therapy was occurring.

Therapy was continued in an attempt to reduce infection in the site and improve spinal function. A consultation with a veterinary surgeon specializing in neurological disease was scheduled to determine if surgical intervention was feasible (as was suggested by the radiologists from the CT scan).

In the 24 hours prior to the scheduled consultation, the bird declined in appetite and activity and appeared decidedly weaker. Regurgitation began to occur again (several episodes) despite medication designed to decrease this tendency. The bird was transported from Catalina Island to Irvine, CA for the neurogical / surgical assessment by Dr. Wayne Berry, then taken from there to the veterinary practice of Dr. Scott Weldy in Lake Forest, CA. The bird appeared very weak at that time and began passing frank blood in its stool, the first time this had occurred since capture. During the afternoon the bird acutely collapsed and died.

A necropsy was performed and tissues submitted for histopathology to Antech Diagnostic Lab. Necropsy and histopathology results suggested a multifactorial disease process that was pre-existing at the time of capture. This disease process had advanced to death despite the therapy that had been instituted.

Notable findings of gross necropsy and histopathological exam:

1) Osteomyelitis of the spinal column was confirmed at the previously identified site.
2) Extensive infection with the protozoal organism Leukocytozoan was noted, which may have contributed to the bird's demise due to large numbers of the organism in the tissues, especially lung.
3) Other bacterial organisms were noted in significant numbers in several other tissues.
4) Intestinal intussusception (infolding of one section of intestine inside another) and severe secondary inflammation of the serosal surface of the intestine was noted. This was likely an acute physical change that was secondary to bacterial intestinal infection that was pre-existing at the time of capture. Development of the intussusception hastened the eagle's decline dramatically because of its effect of causing functional intestinal blockage and serious bleeding.
5) Air sacculitis and aspiration pneumonia were present, and appeared to be acute, probably secondary to accidental aspiration of fluid expelled during the bird's recent regurgitation episodes.
6) Wingtip fractures were as previously noted on radiographs, but there was no evidence of infection at those sites.

Summary:

The bald eagle chick described above had pre-existing disease at the time of its capture that was not easily detectable by the biologists capturing the bird, but that nevertheless was very serious, and would have resulted in the bird's demise in the wild. Capture may have slightly aggravated the reduction in function of the spine that the bird was experiencing, but a spinal fracture was already present secondary to the vertebral infection, and was doubtless limiting the bird's mobility in the nest. Because osteomyelitis usually arises secondary to infection elsewhere in the body, it is likely that the intestinal infection that eventually resulted in intussesception was already very severe at the time of capture. The proximate cause of death of the bird was aspiration pneumonia, but this was secondary to multiple other preexisting factors that proved

insurmountable in this bird's case, despite intensive diagnostics and therapy.

T. Winston Vickers, DVM
Institute for Wildlife Studies

# APPENDIX IV. Tissue samples collected for contaminant and stable isotope analyses, Santa Cruz Island, California, 2003.

| Sample ID[1] | Description | Analysis | Species[2] | Eagle ID | Date |
|---|---|---|---|---|---|
| 03GNTBE13D01 | ~4.5 mL Whole Blood | DDT/PCB | BE | 629-47354 | 06/11/2003 |
| 03GNTBE13D02 | ~0.2 mL Whole Blood | Stable Isotope | BE | 629-47354 | 06/11/2003 |
| 03GNTBE13D03 | ~0.2 mL Plasma | Stable Isotope | BE | 629-47354 | 06/11/2003 |
| 03GNTBE13D04 | ~2 mL Plasma | DDT/PCB | BE | 629-47354 | 06/11/2003 |
| 03GNTBE13F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47354 | 06/11/2003 |
| 03GNTBE14F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47355 | 06/25/2003 |
| 03GNTBE14D01 | ~3 mL Whole Blood | DDT/PCB | BE | 629-47355 | 06/25/2003 |
| 03GNTBE14D02 | ~0.2 mL Whole Blood | Stable Isotope | BE | 629-47355 | 06/25/2003 |
| 03GNTBE14D03 | ~2 mL Plasma | DDT/PCB | BE | 629-47355 | 06/25/2003 |
| 03GNTBE14D04 | ~0.2 mL Plasma | Stable Isotope | BE | 629-47355 | 06/25/2003 |
| 03GNTBE15D01 | ~3 mL Whole Blood | DDT/PCB | BE | 629-47357 | 07/23/2003 |
| 03GNTBE15D02 | ~0.2 mL Whole Blood | Stable Isotope | BE | 629-47357 | 07/23/2003 |
| 03GNTBE15D03 | ~2 mL Plasma | DDT/PCB | BE | 629-47357 | 07/23/2003 |
| 03GNTBE15D04 | ~0.2 mL Plasma | Stable Isotope | BE | 629-47357 | 07/23/2003 |
| 03GNTBE15F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47357 | 07/23/2003 |
| 03GNTBE16F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47364 | 07/23/2003 |
| 03GNTBE16D01 | ~2 mL Whole Blood | DDT/PCB | BE | 629-47364 | 07/23/2003 |
| 03GSTBE17D01 | ~3.5 mL Whole Blood | DDT/PCB | BE | 629-47359 | 08/16/2003 |
| 03GSTBE17D02 | ~0.15 mL Whole Blood | Stable Isotope | BE | 629-47359 | 08/16/2003 |
| 03GSTBE17D03 | ~2 mL Plasma | DDT/PCB | BE | 629-47359 | 08/16/2003 |
| 03GSTBE17D04 | ~0.15 mL Plasma | Stable Isotope | BE | 629-47359 | 08/16/2003 |
| 03GSTBE18D01 | ~2 mL Whole Blood | DDT/PCB | BE | 629-47360 | 08/16/2003 |
| 03GSTBE18D02 | ~2 mL Whole Blood | DDT/PCB | BE | 629-47360 | 08/16/2003 |
| 03GSTBE18D03 | ~0.1 mL Whole Blood | Stable Isotope | BE | 629-47360 | 08/16/2003 |
| 03GSTBE18D04 | ~2 mL Plasma | DDT/PCB | BE | 629-47360 | 08/16/2003 |
| 03GSTBE18D05 | ~0.15 mL Plasma | Stable Isotope | BE | 629-47360 | 08/16/2003 |
| 03GSTBE19D01 | ~3.5 mL Whole Blood | DDT/PCB | BE | 629-47361 | 08/16/2003 |

## Appendix IV. Continued.

| Sample ID[1] | Description | Analysis | Species[2] | Eagle ID | Date |
|---|---|---|---|---|---|
| 03GSTBE19D02 | ~0.25 mL Whole Blood | Stable Isotope | BE | 629-47361 | 08/16/2003 |
| 03GSTBE19D03 | ~2 mL Plasma | DDT/PCB | BE | 629-47361 | 08/16/2003 |
| 03GSTBE19D04 | ~0.25 mL Plasma | Stable Isotope | BE | 629-47361 | 08/16/2003 |
| 03GSTBE17F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47359 | 08/16/2003 |
| 03GSTBE18F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47360 | 08/16/2003 |
| 03GSTBE19F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47361 | 08/16/2003 |
| 03GSTBE20D01 | ~3.5 mL Whole Blood | DDT/PCB | BE | 629-47362 | 08/17/2003 |
| 03GSTBE20D02 | ~0.2 mL Whole Blood | Stable Isotope | BE | 629-47362 | 08/17/2003 |
| 03GSTBE20D03 | ~2 mL Plasma | DDT/PCB | BE | 629-47362 | 08/17/2003 |
| 03GSTBE20D04 | ~0.2 mL Plasma | Stable Isotope | BE | 629-47362 | 08/17/2003 |
| 03GSTBE21D01 | ~2 mL Whole Blood | DDT/PCB | BE | 629-47363 | 08/17/2003 |
| 03GSTBE21D02 | ~0.15 mL Whole Blood | Stable Isotope | BE | 629-47363 | 08/17/2003 |
| 03GSTBE21D03 | ~2 mL Plasma | DDT/PCB | BE | 629-47363 | 08/17/2003 |
| 03GSTBE21D04 | ~0.2 mL Plasma | Stable Isotope | BE | 629-47363 | 08/17/2003 |
| 03GSTBE20F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47362 | 08/17/2003 |
| 03GSTBE21F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47363 | 08/17/2003 |
| 03GNTBE22F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47358 | 08/27/2003 |
| 03GNTBE23F01 | 3 Breast Feathers | Stable Isotope | BE | 629-47356 | 08/27/2003 |
| 03GNTBE22D01 | ~2 mL Whole Blood | DDT/PCB | BE | 629-47358 | 08/27/2003 |
| 03GNTBE22D02 | ~0.1 mL Whole Blood | Stable Isotope | BE | 629-47358 | 08/27/2003 |
| 03GNTBE22D03 | ~1.25 mL Plasma | DDT/PCB | BE | 629-47358 | 08/27/2003 |
| 03GNTBE22D04 | ~0.1 mL Plasma | Stable Isotope | BE | 629-47358 | 08/27/2003 |
| 03GNTBE23D01 | ~2.5 mL Whole Blood | DDT/PCB | BE | 629-47356 | 08/27/2003 |
| 03GNTBE23D02 | ~0.25 mL Whole Blood | Stable Isotope | BE | 629-47356 | 08/27/2003 |
| 03GNTBE23D03 | ~2 mL Plasma | DDT/PCB | BE | 629-47356 | 08/27/2003 |
| 03GNTBE23D04 | ~1.5 mL Plasma | DDT/PCB | BE | 629-47356 | 08/27/2003 |
| 03GNTBE23D05 | ~0.1 mL Plasma | Stable Isotope | BE | 629-47356 | 08/27/2003 |
| 03GXXXX01P01 | 1 Blank Unused Filter | DDT/PCB | XX | . | 11/25/2003 |
| 03GXXXX01W01 | 2 mL Distilled Water | DDT/PCB | XX | . | 11/26/2003 |

## Appendix IV. Continued.

| Sample ID[1] | Description | Analysis | Species[2] | Eagle ID | Date |
|---|---|---|---|---|---|
| 03GNLSS01A01 | ~20 g Adipose | Stable Isotope | SS | . | 11/26/2003 |
| 03GNLSS01M01 | ~2 g Muscle | Stable Isotope | SS | . | 11/26/2003 |
| 03GFPSS02A01 | ~20 g Adipose | Stable Isotope | SS | . | 11/28/2003 |
| 03GFPSS02M01 | ~2 g Muscle | Stable Isotope | SS | . | 11/28/2003 |
| 03GNLSS03A01 | ~20 g Adipose | Stable Isotope | SS | . | 11/29/2003 |
| 03GNLSS03A02 | ~50 g Adipose | DDT/PCB | SS | . | 11/29/2003 |
| 03GNLSS03M01 | ~2 g Muscle | Stable Isotope | SS | . | 11/29/2003 |
| 03GNLSS03M02 | ~50 g Muscle | DDT/PCB | SS | . | 11/29/2003 |
| 03GCHSL01A01 | ~20 g Adipose | Stable Isotope | SL | . | 12/07/2003 |
| 03GCHSL01A02 | ~50 g Adipose | DDT/PCB | SL | . | 12/07/2003 |
| 03GCHSL01M01 | ~5 g Muscle | Stable Isotope | SL | . | 12/07/2003 |
| 03GCHSL01M02 | ~50 g Muscle | DDT/PCB | SL | . | 12/07/2003 |
| 03GNLSS04A01 | ~20 g Adipose | Stable Isotope | SS | . | 12/21/2003 |
| 03GNLSS04M01 | ~2 g Muscle | Stable Isotope | SS | . | 12/21/2003 |
| 03GNLSS04A02 | ~50 g Adipose | DDT/PCB | SS | . | 12/21/2003 |
| 03GNLSS04M02 | ~50 g Muscle | DDT/PCB | SS | . | 12/21/2003 |
| 04GCBCG01M01 | ~2 g Muscle | Stable Isotope | CG | . | 01/07/2004 |
| 04GCBCG01F01 | 3 Breast Feathers | Stable Isotope | CG | . | 01/07/2004 |

[1] See Appendix II for description of Sample ID codes.
[2] BE = Bald eagle, SL = California sea lion, SS = Feral pig, CG = California gull, XX = Field blank.