Bald Eagle Restoration on the Northern Channel Islands, California

January — December 2004

3rd Annual Report

MONTROSE SETTLEMENTS RESTORATION PROGRAM

MSRP

Restoring Natural Resources
harmed by DDTs and PCBs

Bald Eagle Restoration on the Northern Channel Islands, California
January — December 2004
3rd Annual Report

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EXECUTIVE SUMMARY

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

In 2002, the Institute for Wildlife Studies (IWS) initiated a 5-year bald eagle restoration feasibility study on Santa Cruz Island, under a contract with the National Park Service. Since that time, 34 eagles have been released on the island. The birds have been released using a technique called "hacking" and the population has been intensively monitored to determine how well they have adapted to the new environment and whether they are accumulating body burdens of organochlorine contaminants that could prohibit successful breeding.

IWS released 12 eagles from hacking towers in 2004. These eagles were acquired from captive-breeding eagles at the San Francisco Zoo (2 birds), removed from wild nests in Alaska (9 birds), or acquired from the Shasta Wildlife Rescue and Rehabilitation Center in Redding, California (1 bird). Each bird was equipped with a GPS/VHF telemetry package to allow post-release monitoring. Only one of this year's released eagles died this year, ending up in the ocean while attempting to fly to the mainland. In addition, a bird released in 2002 was killed by a car in Utah.

As of the end of December 2004, 24 of the 34 bald eagles released are still on the northern Channel Islands (seven from 2002, six from 2003, 11 from 2004). Two other birds released on Santa Cruz, one from 2002 and one from 2003, were reported in Oregon during 2004. In addition to the birds released on Santa Cruz, two eagles previously released on Santa Catalina Island, and several unmarked bald eagles have been sighted on the northern Channel Islands.

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, and there have been several instances of unsuccessful fishing attempts by a Catalina bird and a 2002 Santa Cruz bird. Bald eagles have continued to use Santa Rosa Island, especially during the fall through spring, where they have been seen feeding on carcasses

and gut piles of mule deer (*Odocoileus hemionus*) and Roosevelt elk (*Cervus canadensis*) left from the guided hunts and culling activities, and on marine mammal carcasses on the beaches.

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 2004, IWS began trapping eagles released in previous years to collect blood for contaminants analyses. As of December 31 we have captured three eagles released in 2003. We also have continued collection of potential food items to evaluate DDE contamination.

The high survival and retention rates of released bald eagles on the northern Channel Islands are 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. Additionally, the sightings of unmarked bald eagles and eagles from Catalina indicate that other eagles are being attracted to the islands, further increasing the population of bald eagles on 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, U.S. Navy, Alaska Department of Fish and Game, U.S. Forest Service, and the Avian Conservation Center (ACC) at the San Francisco Zoo. Funding for the project was made available by the Montrose 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) assisted with locating and removing eaglets from wild nests in Alaska. We also thank Dr. Winston Vickers for treating the sick and injured eagles from Alaska, and Suanne Prigmore for flying the eagle from the Shasta Wildlife Rescue and Rehabilitation Center in Redding, California to Camarillo, California in her private plane.

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INTRODUCTION

Bald eagles (*Haliaeetus leucocephalus*) once nested on all the California Channel Islands off the coast of southern California (Fig. 1). Kiff (1980) estimated that in the early 1900's there were a minimum of 24 pairs nesting on the Channel Islands, including five pairs on Santa Cruz Island, three pairs on Santa Rosa Island, three pairs on San Miguel Island, and three pairs on Anacapa Island. Interviews with long-time island residents suggest there may have been as many as nine eagle pairs nesting on Santa Rosa Island (personal communication, DKG). Grinnell and Miller (1944) referred to the Channel Islands as one of two bald eagle "breeding metropolises" in California, the other being the northeastern section of the state.

Bald eagle numbers began declining on the Channel Islands in the late 1800's due to human persecution, including shooting, poisoning and egg-collecting (Kiff 1980). The ultimate cause of bald eagle extirpation from the Channel Islands was likely the introduction of the organochlorine pesticide DDT into the Southern California Bight (Fig. 1). By the early 1960s bald eagles had been extirpated from the California Channel Islands.

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), California Department of Fish and Game (CDF&G), and the Santa Catalina Island Conservancy, initiated a program to reintroduce bald eagles to Santa Catalina Island, California (hereafter Catalina) (Garcelon 1988; Fig. 1). Many of these birds matured and formed breeding pairs on the island, but all the eggs produced broke in the nest. Concentrations of DDE in the remains of eggs removed from failed nests implicated this contaminant as the causal agent of the lack of productivity (Garcelon et al. 1989). Eggs removed from nests on Catalina exhibited thinning of the shell (Garcelon 1997) and areas of gross structural abnormalities of the eggshell that resulted in rapid water loss and a weakening of the eggshell (Risebrough 1993). Mean levels of DDE in egg remains removed from nests in 1987 and 1988 were twice as high as that which has been shown to cause complete reproductive failure (Wiemeyer et al. 1984), indicating that there was still a large amount of DDE in the food chain.

The apparent source of the pollution was eventually traced to the Montrose Chemical Corporation's manufacturing plant in Torrance, California. Between 1947 and 1961 an estimated 37 to 53 million liters of DDT-contaminated acid sludge, containing 348-696 metric tons of

DDT, was disposed at an ocean dump site 16 km northwest of Catalina Island (Chartrand et al. 1985). In addition, an estimated 1800 metric tons of DDT was discharged from the Joint Water Pollution Control Plant outfall, 3.3 km offshore of Palos Verdes Peninsula (Chartrand et al. 1985)

Figure 1. California Channel Islands located off the coast of Southern California, USA.

After a successful lawsuit against the polluters, the Montrose Settlements Restoration Program (MSRP) was developed to oversee the settlement monies set aside for natural resource restoration. The Trustee Council that oversees the program is composed of representatives of Federal and State agencies that have interests in the Southern California Bight, including the National Oceanic and Atmospheric Administration (NOAA), FWS, National Park Service (NPS), CDF&G, California State Lands Commission, and the California Department of Parks and Recreation.

In 2002, funding provided by the MSRP allowed IWS to begin a five-year feasibility study to determine if bald eagles could be successfully restored on the northern Channel Islands. The project objectives are to release 12 bald eagles per year on Santa Cruz Island (hereafter

Santa Cruz) by hacking (Garcelon and Roemer 1990) and then carefully monitor the eagles' movements, forage use, and survival. Forage use and analyses of prey samples are to be used to evaluate the potential source of organochlorine contaminants that could affect the establishment of a self-sustaining bald eagle population. This report summarizes the third year of the feasibility study that occurred from January through December 2004.

STUDY AREA

Santa Cruz is located approximately 20 miles off the coast of Ventura and Santa Barbara counties. Santa Cruz 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 m. Santa Cruz is the most rugged and topographically diverse of the northern Channel Islands and has a Mediterranean climate, with mean monthly temperatures ranging from 11.7 - 20.9° C and a mean annual rainfall of 50 cm (Junak et al. 1995). The NPS owns and manages the eastern 24% of the island and The Nature Conservancy (TNC) owns and manages the western 76% of the island.

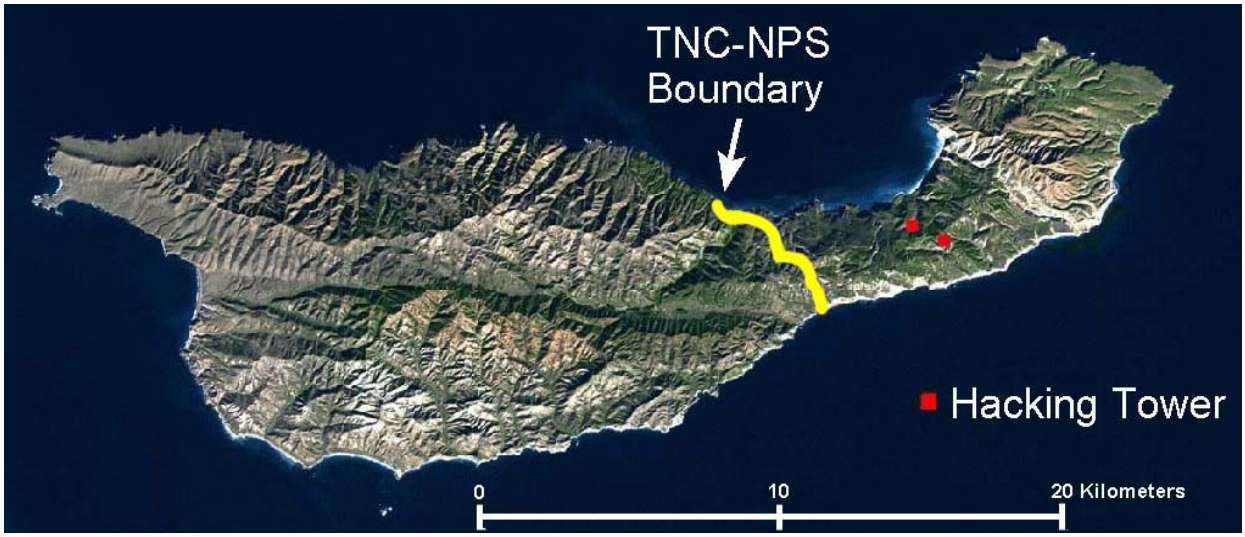

Figure 2. Map of Santa Cruz Island, California indicating placement of two hacking towers. The boundary between The Nature Conservancy (TNC) and National Park Service (NPS) land is shown in yellow.

METHODS

Permitting

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

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 were acquired from three different sources in 2004: the Avian Conservation Center (ACC) at the San Francisco Zoo, California, the Shasta Wildlife Rescue and Rehabilitation Center in Redding, California, and from wild nests near Juneau, Alaska. Eagle chicks from the ACC were produced by some of their five 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) conducted a helicopter survey of the collection area. After the nests were located we traveled by boat to the area, where Jim Spickler (Eco-Ascension Research and Consulting (EARC), Arcata, California) climbed the nest trees and removed the eaglets by placing the birds into a padded nylon bag and lowering them to the ground.

Each bird was examined to make sure it was healthy, transported back to the boat, and 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 by NPS boat to Santa Cruz.

Bald Eagle Hacking

The eagles were placed in one of two hacking towers (North or South Tower) upon arrival on Santa Cruz (Fig. 3). The towers each had two separate cages and two to four birds were placed in each cage. The eaglets were fed a variety of marine fish and feral pig (*Sus scrofa*) until their release. Each cage was monitored remotely using a wireless video system to insure that all birds were eating and healthy. We also kept daily records of how much food was placed in and removed from each cage, as well as of the general behavior and appearance of each bird.

Figure 3. Hacking tower on Santa Cruz Island, California for releasing bald eagles.

When they were approximately 11 weeks old, we fit each bird with a combination satellite/VHF transmitter (Fig. 4), patagial wing markers, and federal leg band. The satellite transmitters record hourly GPS locations of the bird and then upload them to a satellite approximately every three days. This allowed us to relocate birds that we were unable to find using traditional VHF telemetry. We also collected ~10 cc of blood from each bird for baseline contaminant analyses and vaccinated them against West Nile Virus.

Figure 4. A 70 g GPS unit with a side-mounted VHF transmitter (gray) used to track bald eagles.

When the birds were approximately 12 weeks old, we opened the release doors on each cage. It took up to two weeks for the birds to fledge from the towers. We continued to place food items in and around the towers to provide a known food source for the birds while they developed their flight/scavenging skills.

Post-Release Monitoring

Following the release of the eagles, we closely monitored each bird to insure that they were finding food and healthy. We usually were able to locate the birds for visual monitoring using a VHF telemetry receiver (Model R1000, Communications Specialists, Inc., Orange, California). Eagles that we were unable to locate using telemetry could usually be relocated using the GPS data that we retrieved via computer from Argos, Inc. (Largo, Maryland). We attempted to locate each bird at least 2-3 times per week.

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: Chinese Harbor, Prisoner's Harbor, Laguna Beach, Johnson's Beach, Pozo Beach, Sauces Beach, and Christy Beach (Fig. 5). Beaches were monitored at low tide 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., Redmond, Washington) database created by the NPS. Location data were entered into ArcView GIS (ESRI, Redlands, California) so that we could correlate beach use by the eagles with known carcass locations.

When possible, we 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.

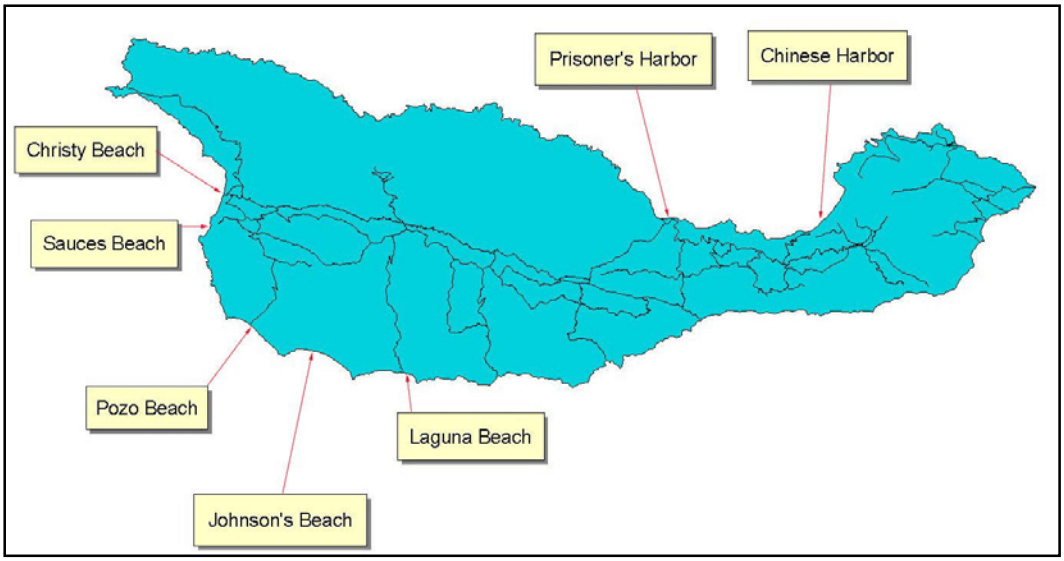

Figure 5. Locations of beaches on Santa Cruz Island, California where monthly surveys were conducted for beached carcasses from January to December 2004.

Trapping

In July 2004, we began trapping older bald eagles to collect follow-up blood and feather samples for contaminants and stable isotope analyses. Trap sites were selected in areas where bald eagles were seen frequently. Prior to trapping efforts we placed pig carcasses at the trap site to attract eagles to the area. A bownet was placed in the ground, covered with dirt and grass, and baited with a pig hindquarters. Traps were set before daylight and observed from a blind. If a target bald eagle entered the trap we tripped the trigger with a remote control. We collected approximately 10 cc of blood and several breast feathers from each trapped bird. Trapped eagles were also given a West Nile vaccine and their transmitter was replaced with a refurbished transmitter, if needed.

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 Woods Hole Group for DDE/PCB analyses, and Northern Arizona University for stable isotope analyses.

RESULTS

Bald Eagle Acquisition

On 10 June, two young bald eagles produced at the ACC were shipped to Los Angeles, California. These birds were taken by boat to Santa Cruz on the morning of 11 June and placed in the North Tower.

On 16 July, four IWS biologists and a biologist with EARC traveled to Juneau, Alaska to collect young eaglets from nests. On 17 July, Phil Schempf and Mike Jacobson (FWS, Juneau) flew a helicopter survey of the Couverden area to locate potential donor nests. They found and recorded the GPS locations of 18 nests between Point Couverden and Lynn Sisters (Fig. 6).

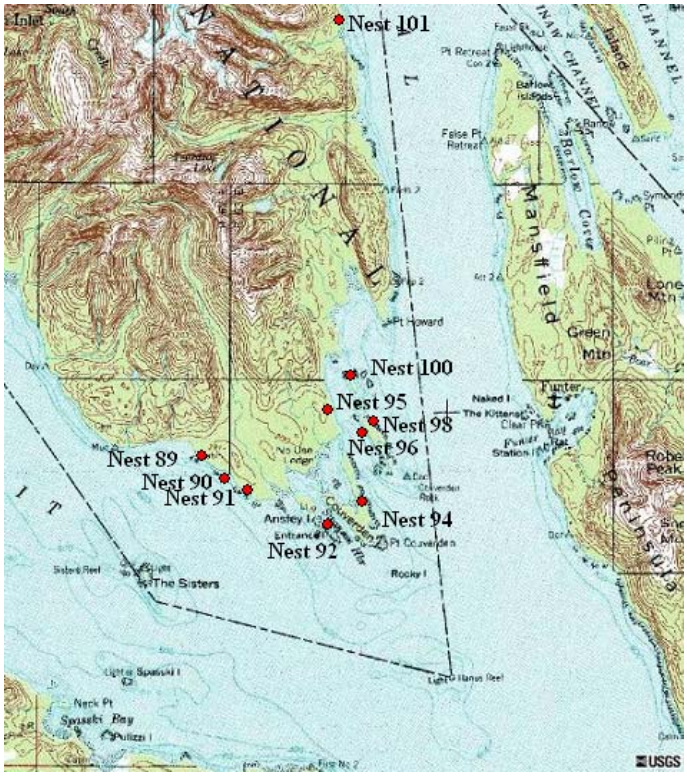

Figure 6. Location of nests in the Couverden area of southeastern Alaska from which bald eagle chicks were removed in July 2004.

We traveled to the Couverden area by boat on 18 July to relocate the nests and remove eaglets. Ten nests were entered between 18 and 20 July and 11 eaglets were collected (Table 1). At Nest 89 (Table 1, Fig. 6), one of the two eaglets jumped or fell out of the nest while our climber was resting about 3 m below the nest. This bird fractured its

radius and ulna and was brought to California for medical treatment. We removed the second eaglet for release on Santa Cruz. We did not remove or touch the birds in Nest 94 (Table 1, Fig. 6) so as not to spread avian pox to birds we had already collected. All birds were transported back to the FWS boat and placed into kennels.

Table 1. Information on eaglets removed from nests near Juneau, Alaska during July 2004.

Date	Nest[1]	No. Eaglets Present	No. Eaglets Removed	Notes
7/18/04	101	2	1	One chick banded and left in nest.
7/18/04	100	2	1	One chick banded and left in nest.
7/19/04	89	2	2	One chick jumped/fell and fractured wing.
7/19/04	90	1	1	
7/19/04	91	2	2	
7/19/04	92	2	1	One chick banded and left in nest
7/20/04	94	2	0	One chick dead from avian pox and second chick infected.
7/20/04	96	1	1	
7/20/04	98	1	1	
7/20/04	95	1	1	

[1] See Figure 6 for nest locations

The eleven birds were shipped via Alaska Air Cargo to Los Angeles, California on 22 July. The eagle with the fractured wing was transported to the IWS clinic on Catalina where veterinarian Dr. Winston Vickers set the wing. As of 31 December, the bones have healed but the bird droops its injured right wing. It is being held on Catalina while we determine whether it is releasable. The remaining birds were taken by boat to Santa Cruz on the morning of 23 July and placed into one of four release cages (Table 2). Six of the Alaska birds were placed in the South Tower (3 per cage). The smallest four birds were put in one cage in the North Tower because the other cage was still occupied by one of the ACC birds.

On 2 August we were notified of a rescued bald eaglet at the Shasta Wildlife Rescue and Rehabilitation Center, Redding, California. After being granted permission to translocate the eaglet by the California Department of Fish and Game and the U.S. Fish and Wildlife Service, it was flown to the Camarillo Airport on 15 August and brought to the island on 16 August. It was placed in a vacant chain-link pen for three days until it was moved to the South Tower for release.

Table 2. Identification, release information, and current status of bald eagles released on Santa Cruz Island, California 2004.

FWS Leg Band	Sex[1]	Patagial Marker	Source[2]	Release Point	Release Date	Status/Latest Location[3]
629-47365	F	A-22	Zoo	North Tower, Cage 1	7/09/04	Alive, Santa Rosa Is.
629-47366	F	A-23	Zoo	North Tower, Cage 2	7/26/04	Unk, Santa Rosa Is. 9/4/04
629-47372	F	A-24	Nest 90	South Tower, Cage 4	8/18/04	Alive, Santa Rosa Is.
629-47373	M	A-25	Nest 92	South Tower, Cage 4	8/18/04	Unk., San Miguel Is. 10/14/04
629-47374	M	A-26	Nest 100	South Tower, Cage 4	8/18/04	Dead, 10/6/04
629-47375	F	A-27	Nest 96	South Tower, Cage 3	8/19/04	Alive, Santa Rosa Is.
629-47376	M	A-28	Nest 101	South Tower, Cage 3	8/19/04	Alive, Santa Rosa Is
629-47377	M	A-29	Nest 89	South Tower, Cage 3	8/19/04	Alive, Santa Cruz Is.
629-47378	F	A-30	Rehab	South Tower, Cage 4	8/19/04	Alive, Santa Rosa Is.
629-47379	F	A-31	Nest 91	North Tower, Cage 1	9/12/04	Unk., Anacapa Is. 9/20/04
629-47380	F	A-32	Nest 98	North Tower, Cage 1	9/12/04	Alive, San Miguel Is.
629-47381	M	A-33	Nest 95	South Tower, Cage 4	10/9/04	Alive, Santa Cruz Is.

[1] Determined by karyotyping for birds from San Francisco Zoo, and morphometrics for Alaskan birds.
[2] Bald eagles from the San Francisco Zoo, California (Zoo), wild nests near Juneau, Alaska (see Fig. 5), or Shasta Wildlife Rescue and Rehabilitation Center, Redding, California (rehab).
[3] Status as of 31 December 2004.

Bald Eagle Hacking

Upon acquiring the eaglets from the ACC, we noted that one bird (A-22) was missing its hallux talon. It was monitored daily and there was no evidence that the chick was experiencing problems with locomotion, feeding or perching. In late June we observed that the other ACC chick (A-23) was losing tail feathers. We collected five feathers which had been "pinched off" over the next week. The two birds from the ACC were banded on 6 July (Table 2), at which time we noted A-22 was growing a new talon and A-23 was regrowing its tail feathers. We released A-22 on 9 July and it fledged the same day. We kept A-23 in the tower longer to give it time to regrow its tail feathers. A-23 was released on 26 July and fledged the same day.

After A-23 fledged, two of the four Alaska chicks in the North Tower were moved to the now vacant cage on 28 July. At this time we noticed that the smallest chick had a small growth above its right eye. Avian pox was suspected and later determined to be the cause of the growth. We moved the other apparently healthy bird out of the cage to isolate the sick bird. We constructed a quarantine pen of chain-link fence panels, wood boards, shade cloth and

camouflage netting at the Navy Site and moved the sick bird to the pen on 29 July to further isolate the pox-infected eaglet and to allow for easier observation and treatment. The chick was fed and monitored daily and handled on a regular basis to clean and treat its lesions. Antibiotics also were placed in its food to reduce the chances of secondary infections. On 3 October, IWS veterinarian Winston Vickers performed surgery on the bird to remove the large lesions around the bird's right eye and on its head. After the surgery the pox lesions grew again and on 4 November the bird was transported to Catalina to be under the close care of Dr. Vickers. As of 31 December, the bird still had large pox lesions covering its right eye. It will be released on Santa Cruz once it recovers.

On 6 August we noticed a small growth above the right eye of A-33 (Table 2). This bird had been shipped in the same crate from Alaska with the first bird to develop avian pox. It was moved back into the hack box with the other infected eaglet on 28 July, and then isolated on its own after the other bird was moved to the Navy Site. After a few weeks A-33's lesions grew larger, so we moved it to the Navy Site on 26 August and placed it in a quarantine pen. A-33's pox lesions healed in approximately one month. It was banded on 7 October (Table 2) and moved to the South Tower. It was released on 9 October and fledged the same day.

The other two Alaska chicks in the North Tower were kept inside the tower for an extra few weeks to insure that they did not develop avian pox. When no lesions developed, the birds were released on 12 September (Table 2).

The six Alaska birds in the South Tower were banded on 16 August. The three birds in Cage 4 were released on 18 August and fledged the same day (Table 2). The cage door was closed again and the bird from the Shasta Wildlife Rescue and Rehabilitation Center was banded and placed in the empty cage the evening of 18 August. The other three Alaska birds and the Shasta bird were released on 19 August. Two of the Alaska birds fledged on the same day they were released, but it took the other five birds up to two weeks to fledge (Table 2).

Post-Release Monitoring

We began daily post-fledging tracking and monitoring of the eagles as soon as the cage 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, 8 of the 12 eagles released in 2004 are being tracked and monitored on a regular basis, but only two of these birds are known to be on Santa Cruz. Most of the birds are currently on Santa Rosa Island, with at least one on San Miguel Island (Table 2).

A-22 Movements

A-22 spent two weeks exploring the north shore of Santa Cruz before flying to Anacapa Island (hereafter Anacapa) on 25 August (Fig. 7). It spent one month on Anacapa before returning to Santa Cruz for one day. It flew to Santa Rosa Island (hereafter Santa Rosa) on 22 August and remained there through the end of the year, except for one data point on 29 November that placed it on San Miguel Island (hereafter San Miguel).

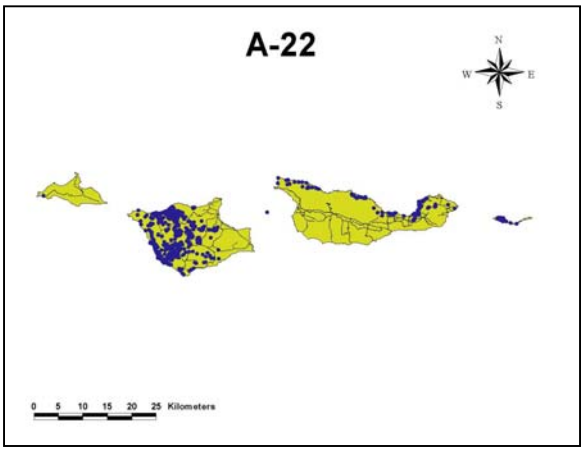

Figure 7. Locations for Bald Eagle A-22 on the northern Channel Islands, California during 2004.

A-23 Movements

A-23 spent one month on Santa Cruz before flying to Santa Rosa on 21 August (Fig. 8). It spent ten days on Santa Rosa before its GPS data indicated its transmitter was not moving. The transmitter information was forwarded to a NPS fox technician working on Santa Rosa and the transmitter was recovered on 10 September. The status of this bird is unknown.

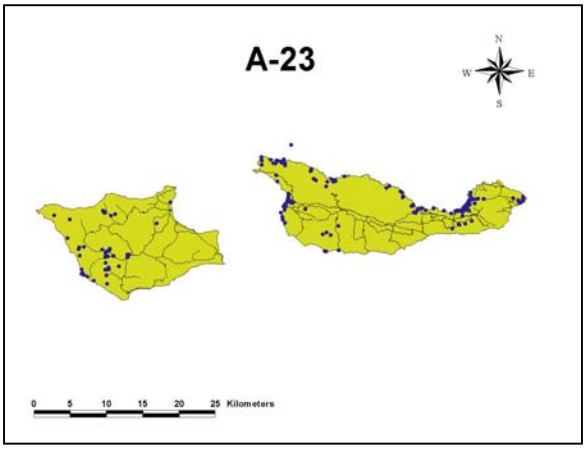

Figure 8. Locations for Bald Eagle A-23 on the northern Channel Islands, California during 2004.

A-24 Movements

A-24 spent three weeks on Santa Cruz, spent 22-23 September on Anacapa, then returned to Santa Cruz (Fig. 9). On 11 October it flew to Santa Rosa and remained there through the end of the year.

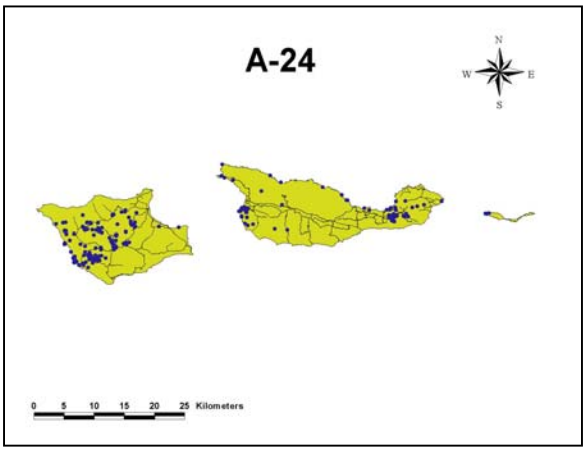

Figure 9. Locations for Bald Eagle A-24 on the northern Channel Islands, California during 2004.

A-25 Movements

A-25 spent almost one month on Santa Cruz before flying to Anacapa on 12 September (Fig. 10). It spent one week on Anacapa before returning to Santa Cruz for one day. On 21 September it flew to Santa Rosa, spent one day there, and then flew to San Miguel. It spent ten days on San Miguel, returned to Santa Rosa for two days, and then spent two days on Santa Cruz. It returned to San Miguel on 6 October. We stopped receiving GPS data on 14 October, at which time it was still on San Miguel. The current status of this bird is unknown.

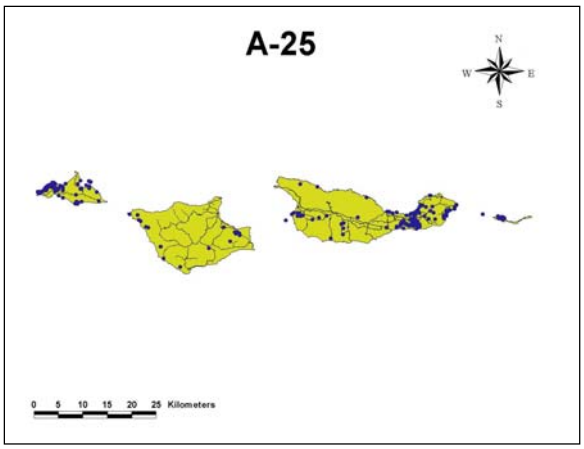

Figure 10. Locations for Bald Eagle A-25 on the northern Channel Islands, California during 2004.

A-26 Movements

A-26 spent five weeks on Santa Cruz before attempting to fly to the mainland on 22 September (Fig. 11). It ended up in the ocean about 5 km off the coast of Santa Barbara, but was picked up by a passing fisherman and taken to The Cat and Bird Clinic in Santa Barbara. We arranged for the bird to be picked up and transported back to Santa Cruz on 23 September. It was placed in the South Tower for observation, fed and monitored daily.

On 27 September we re-released A-26. Over the following ten days it spent time on San Miguel, Santa Rosa, Santa Cruz, and Anacapa. On 3 October it flew to Anacapa, along with A-27 and A-28. It apparently tried to fly to the mainland again on 6 October, but ended up in the ocean. It floated southeast of Anacapa for two weeks before we stopped receiving GPS data (Fig. 11). The bird was never recovered.

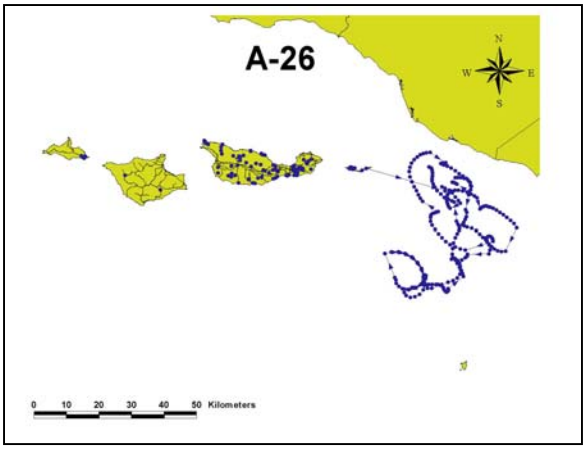

Figure 11. Locations for Bald Eagle A-26 on and around the northern Channel Islands, California during 2004.

A-27 Movements

A-27 spent five weeks on Santa Cruz before flying to Anacapa with A-26 and A-28 on 3 October. It returned to Santa Cruz two days later (Fig. 12). It flew to San Miguel on 23 October and Santa Rosa on 24 October. It remained on Santa Rosa until 3 December, at which time it flew to San Miguel again. It returned to Santa Rosa on 8 December and remained there through the end of the year.

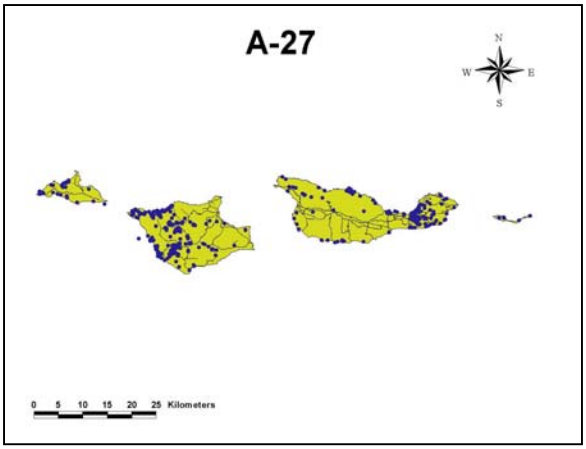

Figure 12. Locations for Bald Eagle A-27 on the northern Channel Islands, California during 2004.

A-28 Movements

A-28 spent six weeks on Santa Cruz before flying to Anacapa with A-26 and A-27 on 3 October (Fig. 13). It returned to Santa Cruz on 5 October and spent seven more weeks there before flying to Santa Rosa on 21 November. It remained on Santa Rosa through the end of the year.

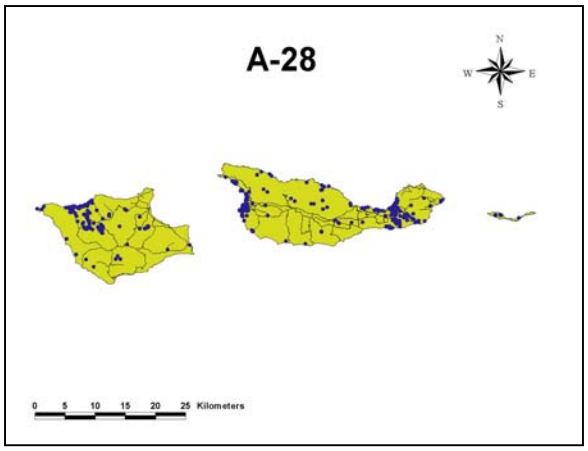

Figure 13. Locations for Bald Eagle A-28 on the northern Channel Islands, California during 2004.

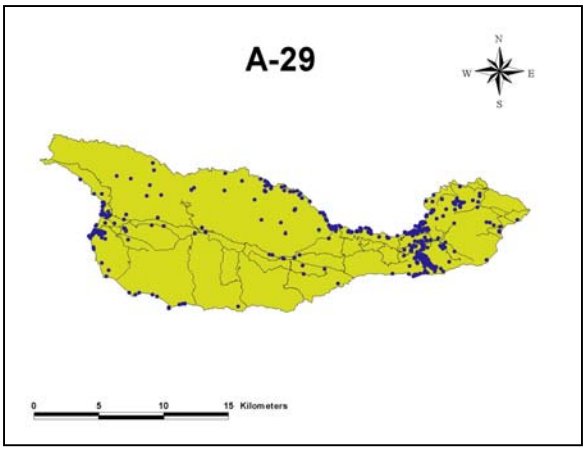

Figure 14. Locations for Bald Eagle A-29 on Santa Cruz Island, California during 2004.

A-29 Movements

A-29 has remained on Santa Cruz since being released (Fig. 14). It has spent most of its time in the area of the hack towers, Chinese Harbor and the north shore, although it has flown to the west end and other areas of the island.

A-30 Movements

A-30 spent two months on Santa Cruz before flying to Santa Rosa on 1 November (Fig. 15). It remained on Santa Rosa through the end of the year.

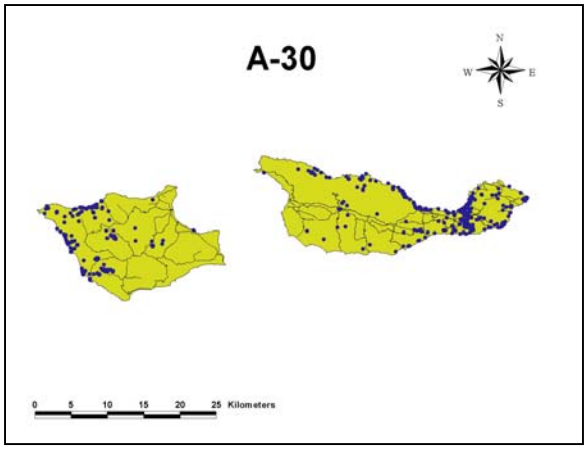

Figure 15. Locations for Bald Eagle A-30 on the northern Channel Islands, California during 2004.

A-31 Movements

A-31 spent one week on Santa Cruz before flying to Anacapa on 19 September (Fig. 16). Its transmitter stopped transmitting data on 20 September. The status of this bird is unknown.

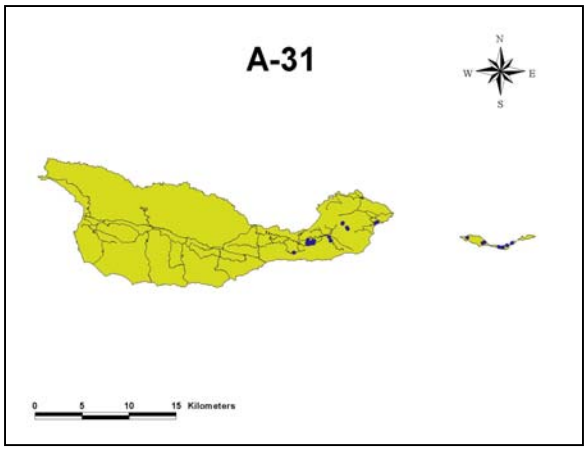

Figure 16. Locations for Bald Eagle A-31 on the northern Channel Islands, California during 2004.

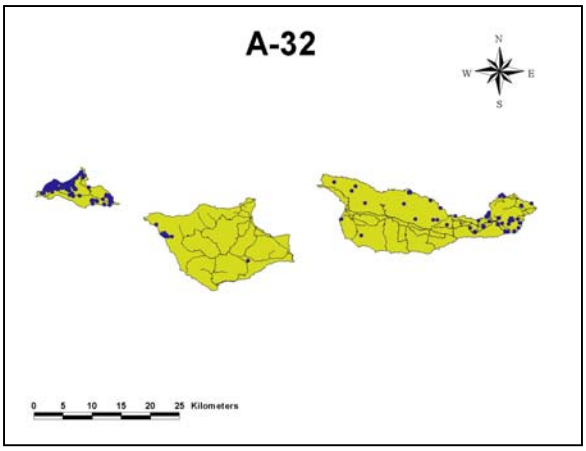

Figure 17. Locations for Bald Eagle A-32 on the northern Channel Islands, California during 2004

A-32 Movements

A-32 spent 10 days on Santa Cruz before flying to Santa Rosa on 21 September. It only spent two days on Santa Rosa before flying to San Miguel, where it remained through the end of the year (Fig. 17).

A-33 Movements

A-33 spent two weeks on Santa Cruz before flying to Anacapa on 24 October (Fig. 18). It spent nine days on Anacapa, returned to Santa Cruz on 1 November, returned to Anacapa on 2 November, and then returned to Santa Cruz Island on 5 November, where it remained for the rest of the year.

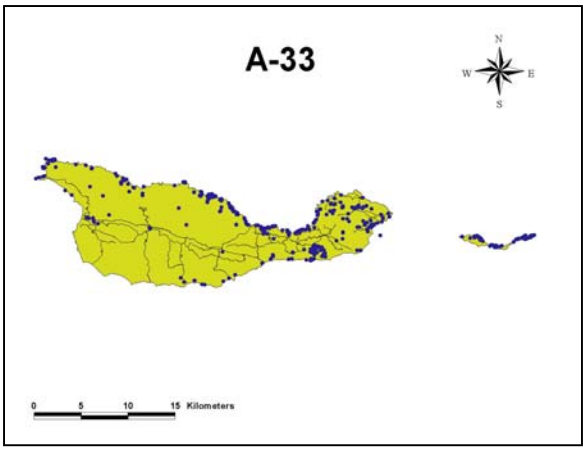

Figure 18. Locations for Bald Eagle A-33 on the northern Channel Islands, California during 2004.

While monitoring the newly released eagles, IWS continued to monitor the birds released in 2002 and 2003. Below is a brief summary of the movements and status of the 2002 and 2003 eagles during 2004. Each bird is referred to by its patagial tag number (Table 3).

A-00 Movements

A-00 has visited all of the northern Channel Islands and the mainland since its release in 2002. The bird's GPS transmitter fell off on Anacapa in May 2003. In 2004, A-00 was seen on Santa Cruz on 24-25 January and 21 September. It was photographed on Santa Rosa on 22 November (Fig. 19).

Figure 19. Bald Eagle A-00, at age 2.5 years, flying on Santa Rosa Island, California in November 2004.

A-01 Movements

A-01 has visited all of the northern Channel Islands since its release in 2002. On 3 August 2003 the bird's GPS transmitter stopped transmitting data due to a missing antenna, but the VHF transmitter continued functioning. In 2004 it was seen on Santa Rosa on 16 January and 6 March. It was seen on Santa Cruz on 4 separate occasions in April. Its transmitter fell off at the end of April and was recovered on 28 April. A-01 was photographed on Santa Rosa on 21 September (Fig. 20).

Table 3. Identification, release information, and current status of bald eagles released on Santa Cruz Island, California during 2002 and 2003.

FWS Leg Band	Sex[1]	Patagial Marker	Source[2]	Release Point	Release Date	Fledge Date	Status, Latest Location[3]
629-02795	M	A-00	Zoo	North Tower, Cage 1	6/25/02	6/26/02	Alive, Santa Rosa Is.
629-02796	F	A-01	Zoo	North Tower, Cage 1	6/25/02	6/28/02	Alive, Santa Rosa Is.
629-02798	F	A-02	Zoo	North Tower, Cage 2	6/25/02	6/30/02	Alive, Santa Rosa Is.
629-02797	F	A-03	Zoo	North Tower, Cage 2	6/25/02	6/30/02	Dead
629-14042	F	A-04	Alaska	North Tower, Cage 2	8/15/02	8/15/02	Alive, Santa Cruz Is.
629-14041	F	A-05	Alaska	North Tower, Cage 2	8/15/02	8/15/02	Dead
629-14043	M	A-06	Zoo	North Tower, Cage 1	8/19/02	8/20/02	Dead
629-14044	M	A-07	Alaska	North Tower, Cage 1	8/17/02	8/20/02	Dead
629-14045	M	A-08	Alaska	South Tower, Cage 3	8/26/02	8/27/02	Alive, Santa Rosa Is.
629-14046	F	A-09	Alaska	South Tower, Cage 3	8/26/02	8/27/02	Dead
629-14047	F	A-10	Alaska	South Tower, Cage 4	9/7/02	9/9/02	Alive, Santa Cruz Is.
629-14048	F	A-11	Alaska	South Tower, Cage 4	9/7/02	9/9/02	Alive, Santa Cruz Is.
629-47354	F	A-12	Zoo	North Tower, Cage 2	6/13/03	6/13/03	Alive, c. Oregon
629-47355	F	A-13	Zoo	North Tower, Cage 2	7/01/03	7/01/03	Unknown, Montana
629-47364	M	NA	Zoo	North Tower, Cage 1	7/25/03	7/25/03	Alive, Rehab.
629-47361	F	A-14	Alaska	South Tower, Cage 3	8/21/03	8/23/03	Alive, Santa Rosa Is.
629-47357	M	A-15	Zoo	North Tower, Cage 1	7/25/03	7/25/03	Dead
629-47359	F	A-16	Alaska	South Tower, Cage 3	8/21/03	8/22/03	Alive, Santa Rosa Is.
629-47360	F	A-17	Alaska	South Tower, Cage 3	8/21/03	8/23/03	Alive, ne. Oregon
629-47362	F	A-18	Alaska	South Tower, Cage 4	8/21/03	8/23/03	Alive, Santa Rosa Is.
629-47363	F	A-19	Alaska	South Tower, Cage 4	8/21/03	8/21/03	Alive, Santa Rosa Is.
629-47358	F	A-20	Alaska	North Tower, Cage 2	8/31/03	9/02/03	Alive, Santa Rosa Is.
629-47356	M	A-21	Alaska	North Tower, Cage 2	8/31/03	9/02/03	Alive, Santa Cruz Is.

[1] Determined by karyotyping for birds from San Francisco Zoo, and morphometrics for Alaskan birds.
[2] Bald eagles from the Avian Conservation Center, San Francisco Zoo, California (Zoo) or wild nests near Juneau, Alaska (Alaska).
[3] As of 12/31/04.

A-02 Movements

A-02's GPS transmitter stopped functioning in 2002, but we continued to relocate the bird using VHF tracking until the VHF unit fell off the bird in February 2003. In 2004, A-02 was seen on Santa Rosa on 16 January, 10 February, and 4 December. It was seen on Santa Cruz on 28 April, 5 separate times in August, and on 17 September.

Figure 20. Bald Eagle A-01, at age 2+ years, flying on Santa Rosa Island, California in September 2004.

A-04 Movements

A-04 has spent most of its time on Santa Cruz Island since being released. It dropped its transmitter on 20 September 2004. It spent most of 2004 in the Chinese Harbor area (Fig. 21) and has been seen on numerous occasions.

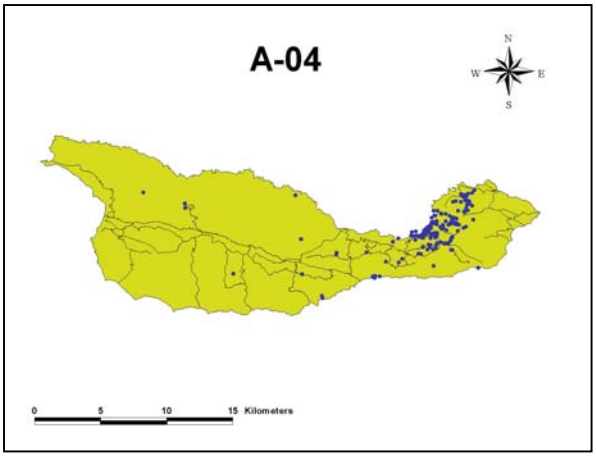

Figure 21. Locations of Bald Eagle A-04 on Santa Cruz Island, California during 2004.

A-07 Movements

A-07 flew to the mainland one month after being released in 2002. It spent time in California, Nevada, Utah, Idaho, Wyoming and Montana. It spent January through 10 June 2004 in central Utah (Fig. 22), an area that is a popular overwintering area for bald eagles in Utah, according to biologists with the Utah Division of Wildlife Resources. On 10 June A-07 was struck and killed by a car near Manti, Utah. The bird's transmitter was returned to IWS and the carcass was sent to the National Eagle Repository in Colorado.

A-08 Movements

A-08 has spent time on Santa Cruz, Santa Rosa and San Miguel and the mainland since its release. Its GPS unit fell off in 2003. In 2004 it was seen on Santa Rosa on 13 and 16 January and photographed there on 22 November (Fig. 23).

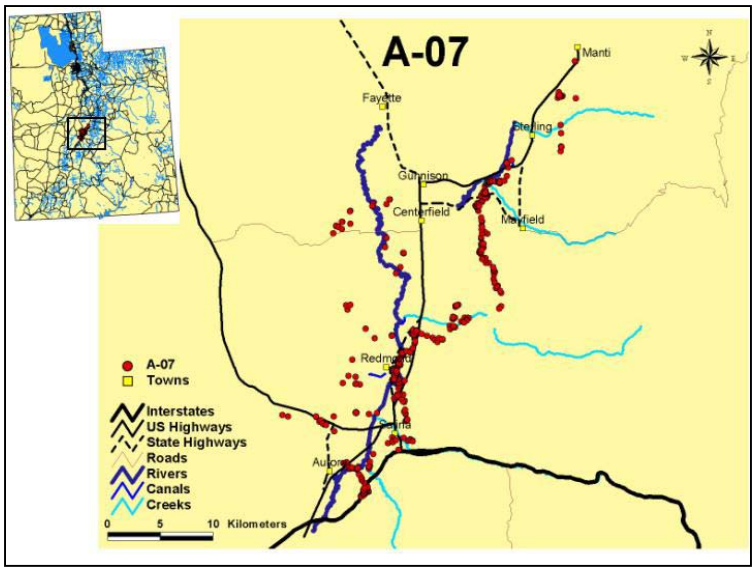

Figure 22. Locations of Bald Eagle A-07 in Utah during 2004.

A-10 Movements

A-10's GPS unit stopped functioning in 2002 and fell off in 2003. In 2004 it was seen once at Chinese Harbor on Santa Cruz on 1 August.

A-11 Movements

A-11 has spent time on Santa Cruz and Santa Rosa. Its transmitter fell off in November 2003. In 2004, it was seen on Santa Rosa on 13 and 14 January. It was seen on Santa Cruz on six separate occasions between June and August in the Chinese Harbor area.

Figure 23. Bald Eagle A-08, at age 2.5 years, flying on Santa Rosa Island, California in November 2004.

A-12 Movements

A-12 flew to the mainland on 22 August 2003. It flew to Goose Lake in northern California and remained there through the end of the year, at which time it stopped transmitting

GPS data. The status of this bird was unknown until it was sighted in Crook County, Oregon on 3 September 2004.

A-13 Movements

A-13 spent time on Santa Rosa, Santa Cruz and Anacapa before flying to the mainland on 20 April 2004 (Fig. 24). In May it spent two weeks at Point Mugu Naval Air Base where it was seen almost daily perched on an osprey platform and scavenging on birds in the lagoon on the base. It spent one month in the Los Angeles/Ventura/Santa Barbara County area before heading north. Over the next month it made its way north along the eastern edge of the coast range of California. Between mid-June and the end of July it worked its way through parts of Oregon, Nevada, Utah, Idaho and Montana (Fig. 25). Its GPS transmitter stopped transmitting data on 30 July. The status of this bird is unknown.

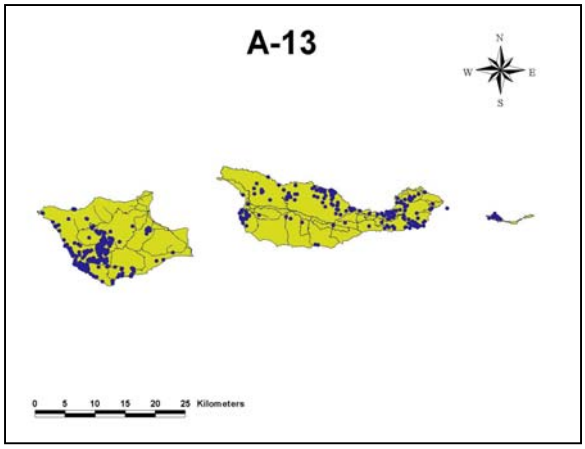

Figure 24. Locations for Bald Eagle A-13 on Santa Cruz Island, California during 2004.

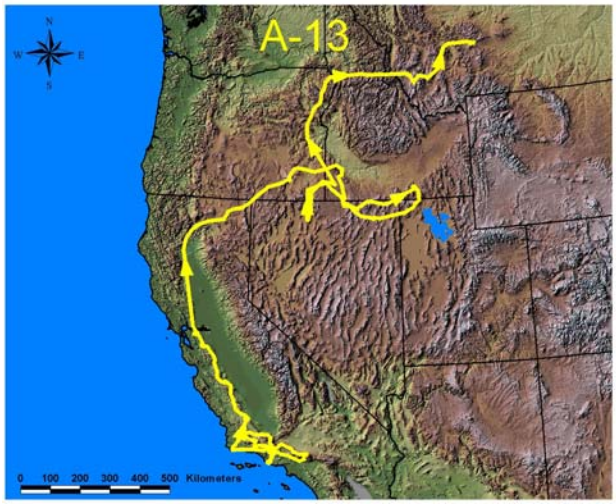

Figure 25. Locations of Bald Eagle A-13 after leaving the California Channel Islands.

A-14 Movements

A-14 has spent time on Santa Cruz and Santa Rosa (Fig. 26). In 2004 it spent January through April and July through mid-August on Santa Cruz. It spent May through June and mid-August through September on Santa Rosa. On 14 August, it was trapped on Santa Cruz, at which time we drew blood and collected feathers for contaminants and stable isotope analyses. At the beginning of October its GPS data indicated its transmitter had dropped on Santa Rosa and the transmitter was not recovered in 2004.

A-16 Movements

A-16 has also spent time on Santa Cruz and Santa Rosa (Fig. 27). In 2004, it spent January through mid-July on Santa Rosa, mid-July through mid-August on Santa Cruz, and mid-August through December on Santa Rosa. It was photographed on Santa Rosa in November. At the beginning of December its GPS data indicated its transmitter had dropped or malfunctioned. The transmitter was not recovered in 2004.

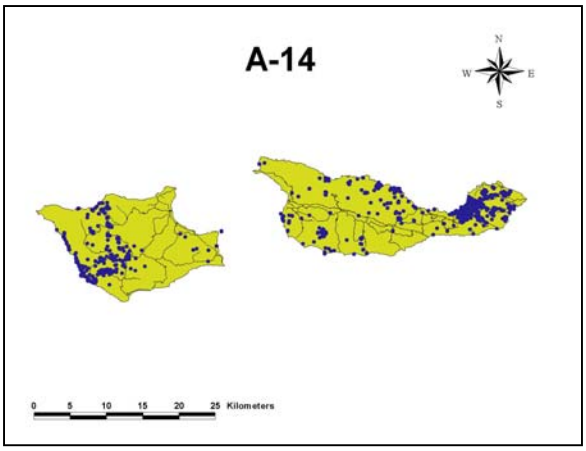

Figure 26. Locations for Bald Eagle A-14 on the northern Channel Islands, California during 2004.

A-17 Movements

A-17 has also spent time on Santa Cruz and Santa Rosa. In 2004 it spent January and February on Santa Rosa before dropping its transmitter, which was recovered in mid-March (Fig. 28). The bird was seen two times in March on Santa Rosa and once in April on Santa Cruz. A sighting of the bird was reported to IWS on 24 September in northeastern Oregon.

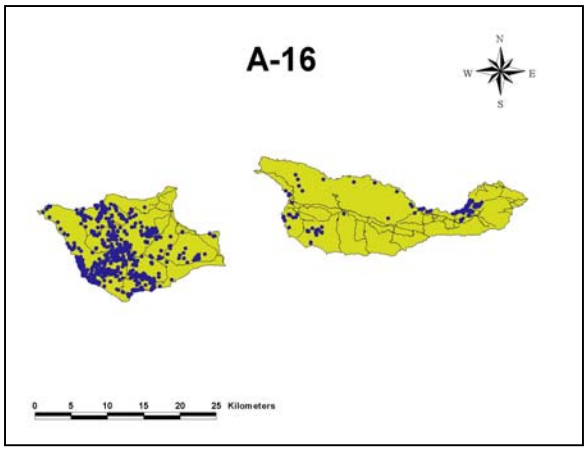

Figure 27. Locations for Bald Eagle A-16 on the northern Channel Islands, California during 2004.

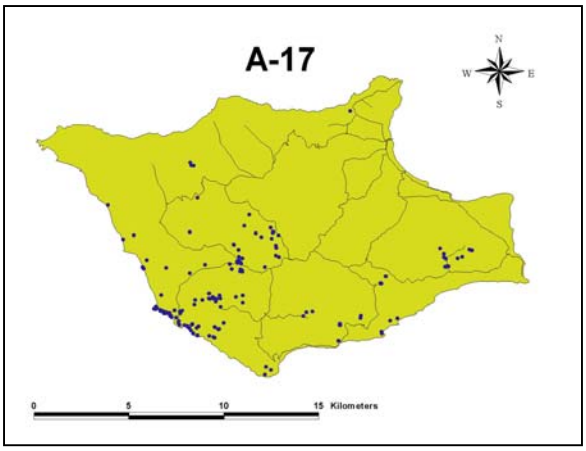

Figure 28. Locations for Bald Eagle A-17 on Santa Rosa Island, California during 2004.

A-18 Movements

A-18 has also spent time on Santa Cruz and Santa Rosa (Fig. 29). It spent 2004 flying back and forth between the two islands. It spent most of its time on Santa Rosa but flew to Santa Cruz about once per month for about one week per visit for the months of February through May and spent one month on Santa Cruz from mid-July to mid-August. It returned to Santa Rosa in mid-August and remained there through the end of the year.

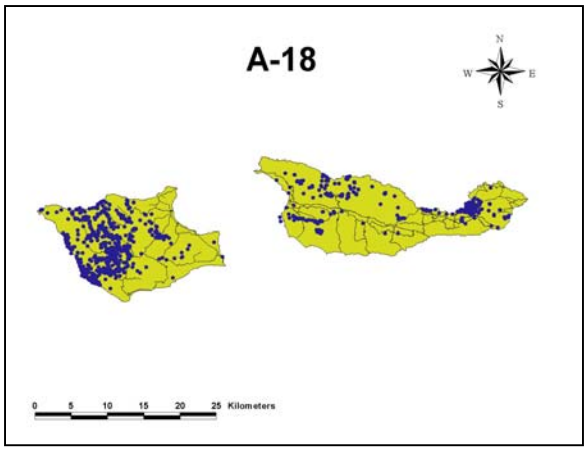

Figure 29. Locations for Bald Eagle A-18 on the northern Channel Islands, California during 2004.

A-19 Movements

A-19 has spent time on Santa Cruz, Santa Rosa, San Miguel and Anacapa. It spent most of 2004 flying back and forth between Santa Cruz and Santa Rosa (Fig. 30). It spent one week on Anacapa during late February and early March. It spent most of March on Santa Cruz and flew back and forth between Santa Cruz, Santa Rosa, and Anacapa between 22 March and 25 July. During that time there were eight separate trips to Anacapa, each lasting 2-22 days, and five trips to Santa Rosa lasting 4-10 days.. It spent about one month on Santa Cruz from the end of July to mid-August and then returned to Santa Rosa, where it remained at least until it dropped its transmitter at the beginning of October. The transmitter was recovered in late October.

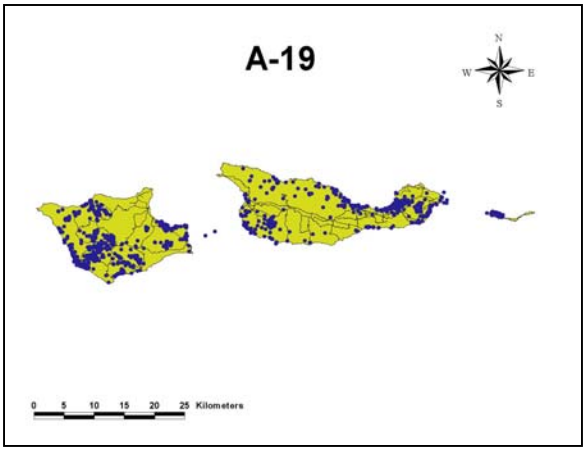

Figure 30. Locations for Bald Eagle A-19 on the northern Channel Islands, California during 2004.

A-20 Movements

A-20 has spent time on Santa Cruz, Santa Rosa and San Miguel. It spent January through March and mid-June through mid-August on Santa Cruz and April through mid-June and mid- August through the end of the year on Santa Rosa (Fig. 31). She dropped her transmitter in June, which was found in the Chinese Harbor area on 29 July. Fortunately, A-20 was trapped on 13 August on Santa Cruz and we were able to replace her transmitter, draw blood, and collect feather samples.

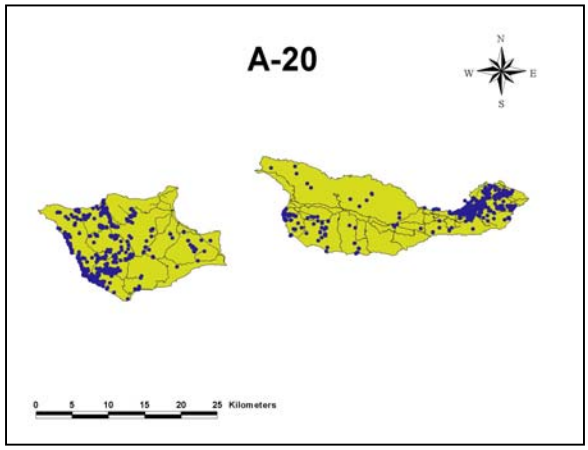

Figure 31. Locations for Bald Eagle A-20 on the northern Channel Islands, California during 2004.

A-21

A-21 has spent time on Santa Cruz and Santa Rosa (Fig. 32). It spent January through February and mid-July through mid-August on Santa Cruz Island. A-21 was trapped on Santa Cruz Island on 25 July and we collected blood and feather samples. It spent most of August through December on Santa Rosa Island with brief visits to Santa Cruz Island. It returned to Santa Cruz Island on 31 December.

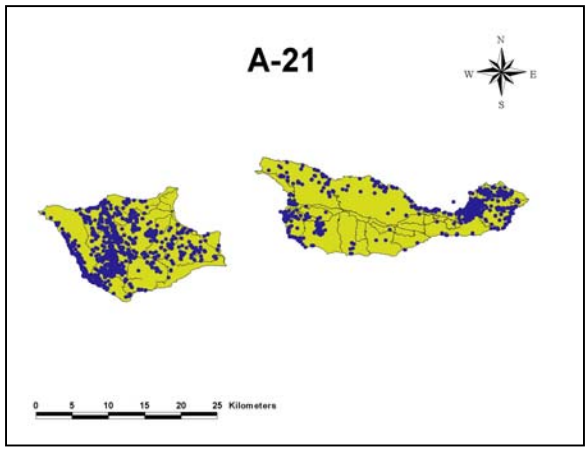

Figure 32. Locations for Bald Eagle A-21 on the northern Channel Islands, California during 2004.

Overall Island Use

The GPS transmitters are the most effective way to monitor the released birds. During 2004, we received 11,278 GPS locations from the 12 eagles we released in 2004, as well as

20,148 locations from eight eagles released in 2003, and 1,776 locations from two birds released in 2002 that are still carrying functioning transmitters.

All four of the northern Channel Islands were used by released bald eagles in 2004. The eagles spent more time on Santa Rosa than any other island (Fig. 33). Data for January through June are from eagles released in 2002 and 2003. We began releasing young eagles in July, which accounted for the increased usage of Santa Cruz from July through September (Fig. 33). However, the 2004 releases also moved their center of activity to Santa Rosa Island in October through December.

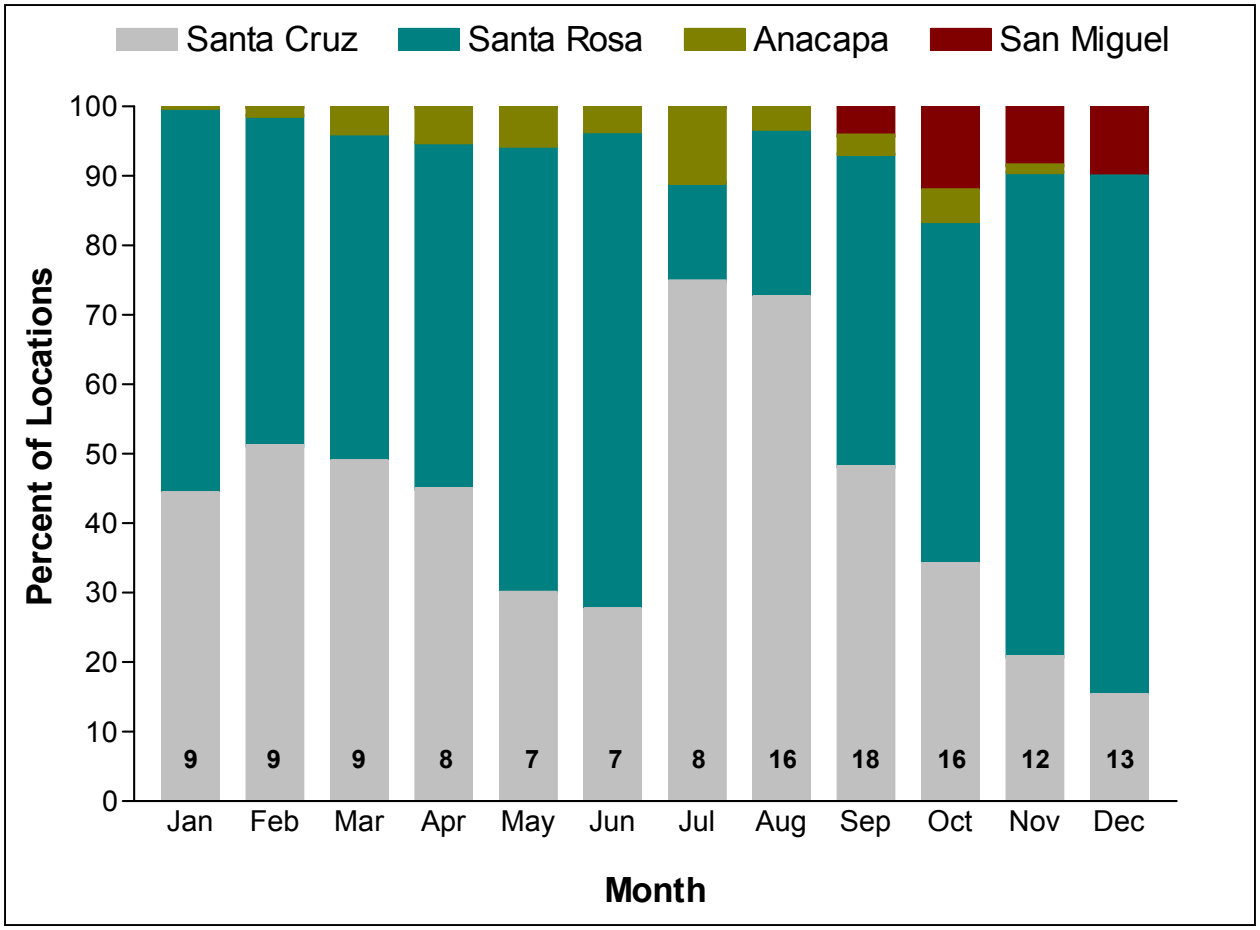

Figure 33. Use of the northern Channel Islands, California by bald eagles in 2004. The bars represent the mean percent of time spent on each island as determined by GPS data. The number on each bar is the number of birds for which we received GPS data during each month.

Foraging Activity

During monitoring activities we recorded many incidences of foraging by the eagles. We have 224 records of eagles feeding on or perching close to pig carcasses, which represents 87% of our observations of eagles feeding upon or perched near food sources on Santa Cruz (Fig. 34). GPS, VHF and video data confirm eagle activity at most of the pig carcass locations.

Pig carcasses were provided for eagles year-round, although most were provided from June through September as food for the recent fledglings (Table 4). Pig carcasses were placed in front of the hack towers a day or two 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, we continued placing pig carcasses near the hack towers. Once the birds started moving around 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.

Table 4. Number of feral pig carcasses delivered to the field per month in 2004.

Month	# of Pig Carcasses
January	7
February	7
March	4
April	7
May	1
June	7
July	8
August	13
September	18
October	4
November	6
December	5
Total	87

At least 15 bald eagles were observed feeding upon or perched near 10 marine mammal carcasses, all but one in the Chinese Harbor area (Table 5).

During approximately 36 hours of direct observations of bald eagles in the Chinese Harbor area we observed 5.5 hours of eagles feeding on marine mammal carcasses.

Eagles have fed on a variety of other prey species as well. Catalina eagle K-10 was seen fishing on 18 March, 26 April and 27 May, and A-04 was seen fishing on 27 November. The only successful fishing attempt was on 18 March. Bald eagles on Santa Rosa were seen feeding on a variety of carcasses in 2004. During January 2004, eagles A-08, A-11, and A-16 were seen feeding on elephant seal (*Mirounga angustirostris*) afterbirth, and eagles A-16, A-17, and A-18 fed on a mule deer carcass (*Odocoileus hemionus*) in a bownet trap set during golden eagle trapping. Eagle A-01 was reported next to a dead elephant seal pup in March 2004, four tagged but unidentified eagles were perched near deer remains during a helicopter deer census in October, and A-24 was seen feeding on a marine mammal carcass in December 2004.

Table 5. Observations of bald eagles feeding on or perched near marine mammal carcasses on Santa Cruz Island, California in 2004.

Prey Species/Location	Date	Eagles Present
California Sea Lion (*Zalophus californianus*)		
Chinese Harbor	03/30/2004	A-14
Chinese Harbor	05/12/2004	A-04
Chinese Harbor	09/22/2004	A-30
Prisoners Harbor	12/04/2004	A-33, A-0?
Prisoners Harbor	12/07/2004	A-33
Prisoners Harbor	12/08/2004	A-33
Common Dolphin (*Delphinus delphis*)		
Chinese Harbor	08/01/2004	A-02, A-10, A-11, A-14, A-18, A-20, A-23
Chinese Harbor	08/03/2004	A-02, A-20, A-21
Chinese Harbor	08/05/2004	A-18, A-23
Unidentified Marine Mammal		
Chinese Harbor	03/18/2004	A-14, A-20
Chinese Harbor	04/02/2004	A-01
Chinese Harbor	05/25/2004	A-0?

Chinese Harbor	07/31/2004	A-04, A-??, A-11, A-16, A-18, A-21, K-10
Chinese Harbor	08/05/2004	A-02, A-16, A-19

Bald Eagle/Bald Eagle Interactions

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

Catalina eagle K-10 and Santa Cruz eagle A-04 were often seen together in 2004, usually in the Chinese Harbor area. K-10 was seen defending a pig carcass for A-04 on 14 February. On 20 February, the two birds were seen interacting in flight and K-10 was grabbing sticks and grass. On 18 March, K-10 caught a fish and A-04 chased after him and vocalized. The last time the two were seen together on Santa Cruz was 31 July. K-10 left the island later in the year and was reported in Wasco County, Oregon on 12 October.

Bald Eagle/Golden Eagle Interactions

There were few observed interactions between bald eagles and golden eagles on the islands. On 16 January, A-02 vocalized at a juvenile golden eagle from a perch on Santa Rosa as it flew past. On 22 April, golden eagle trappers witnessed A-01, a female, attack a male golden eagle lure bird during golden eagle trapping on Santa Cruz. The golden eagle trappers left their blind and A-01 flew away. The lure bird was not injured but was not used for trapping again.

Beach Watch Surveys

We conducted monthly surveys on seven beaches in 2004 and located a variety of potential food sources for bald eagles. The majority of carcasses were found on beaches at Chinese Harbor (Table 6).

Marine mammals are a potential source of large amounts of DDE contamination in the Southern California Bight. A total of 31 marine mammal carcasses were observed on beaches in 2004 (Table 7), either during beach watch surveys (22 carcasses, Tables 6 and 7) or during field

observations (9 carcasses; Tables 5 and 7). Most of the carcasses (25) were California sea lions (*Zalophus californianus*). GPS and VHF data confirm eagle activity at most of these carcasses.

Table 6. Carcasses found during surveys of seven beaches on Santa Cruz Island, California in 2004. Each beach was surveyed once per month.

	Beach Surveyed[1]						
Prey Item	CH	JB	PB	SB	CB	PH	LB
BIRD							
Black-footed Albatross (*Phoebastria nigripes*)	.	.	.	.	.	.	1
Northern fulmar (*Fulmarus glacialis*)	.	.	.	1	1	.	.
Brown pelican (*Pelecanus occidentalis*)	1	.	.	.	.	.	.
Brandt's cormorant (*Phalacrocorax penicillatus*)	3	.	.	.	.	.	.
California gull (*Larus californicus*)	.	.	.	.	1	.	.
Western gull (*Larus occidentalis*)	.	.	.	.	1	1	3
Unidentified cormorant (*Phalacrocorax spp.*)	3	.	.	.	.	2	.
Unidentified gull (*Larus spp.*)	2	.	.	.	.	.	.
Unidentified bird	2	.	.	.	.	.	.
FISH							
Unidentified fish	.	.	1	.	1		.
INVERTEBRATES							
Rock crab (*Cancer aniennarius*)	.	.	1	.	.	.	.
Sheep crab (*Loxorhynchus grandis*)	.	.	.	.	.	1	.
Starfish (*Pisaster spp.*)	.	.	.	.	.	.	1
MAMMAL							
California sea lion (*Zalophus californianus*)	12	3	2	2	.	3	.
Harbor seal (*Phoca vitulina)*	1	.	.	1	.	.	.
Feral pig (*Sus scrofa*)	.	.	.	.	.	1	.
Unidentified mammal	.	.	.	.	.	.	.
UNIDENTIFIABLE ITEM	1	.	.		.	.	.
TOTAL ITEMS	**25**	**3**	**4**	**4**	**4**	**9**	**5**

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

Table 7. Marine mammal carcasses recorded on Santa Cruz Island, California in 2004 during either Beach Watch Surveys or other field activities.

Prey Species/Location	Date	Location Method
California Sea Lion (*Zalophus californianus*)		
Chinese Harbor	03/17/2004	Beach Watch
Pozo Beach	03/19/2004	Beach Watch
Johnson's Beach	03/19/2004	Beach Watch
Chinese Harbor	03/30/2004	Beach Watch
Sauces Beach (2 carcasses)	04/02/2004	Field Observation
Prisoners Harbor	05/11/2004	Beach Watch
Chinese Harbor (2 carcasses)	05/12/2004	Beach Watch
Prisoners Harbor	06/01/2004	Field Observation
Chinese Harbor	06/13/2004	Field Observation
Pozo Beach	06/30/2004	Beach Watch
Johnson's Beach	08/30/2004	Beach Watch
Chinese Harbor	09/22/2004	Field Observation
Chinese Harbor	09/24/2004	Field Observation
Chinese Harbor (3 carcasses)	11/26/2004	Beach Watch
Prisoners Harbor	12/04/2004	Beach Watch
Chinese Harbor (5 carcasses)	12/09/2004	Beach Watch
Johnson's Beach	12/14/2004	Beach Watch
Harbor Seal (*Phoca vitulina*)		
Chinese Harbor	03/17/2004	Beach Watch
Sauces Beach	04/02/2004	Beach Watch
Common Dolphin (*Delphinus delphis*)		
Chinese Harbor	07/31/2004	Field Observation
Unidentified Marine Mammal		
Chinese Harbor	04/02/2004	Field Observation
Chinese Harbor	05/25/2004	Field Observation

Remote video cameras were deployed on four California sea lion carcasses at Chinese Harbor (March 17-19, March 30-April 02, May 12-15, September 22-23) and two California sea lion carcasses at Prisoner's Harbor (May 11, December 4-9) to record use by eagles. The only carcass that had eagle activity recorded was at Prisoner's Harbor in December. A-33 was recorded feeding on this carcass on 7 December for approximately 35 minutes and on 8 December for approximately 15 minutes.

Trapping

Three eagles released in 2003 (A-14, A-20, A-21) were trapped in July and August. A-04, released in 2002, was almost trapped on 19 August but the netting got caught on the trigger mechanism so that the net did not fully deploy. A-04 was seen at other trapping locations through December but did not go into the trap while the bownet was set. IWS personnel spent 112 hours trapping during 13 days from July through December.

Tissue Sampling

We collected blood and feather samples from bald eagles during banding activities when the eagles were approximately 11.5 weeks old (12 eagles) and during trapping activities when the eagles were >1 year old (3 eagles, Appendix III). Seventy nine tissue samples from feral pigs, sea lions, seabirds, fish and snails were also collected (Appendix III). Samples were shipped to the Woods Hole Group and to Northern Arizona University for analyses.

DISCUSSION

The bald eagle restoration project on the northern Channel Islands has been successful at establishing bald eagles on the islands during the first three seasons of the five year project. To date we have released 34 eagles on the island (23 from Alaska, 10 from the Zoo, 1 from

California), of which at least 21 are still on the islands and two are in Oregon. There are seven birds known or assumed to be dead: three from the Zoo and four from Alaska.

One of the eagles released in 2004 died in the ocean this year while apparently trying to fly to the mainland. This continues to be our highest source of mortality, but is not unique to the bald eagles released on Santa Cruz Island. Millsap et al. (2004) fitted 59 bald eagle fledglings with PTT transmitters in Florida and at least one of those birds apparently died in the ocean. Young eagles released on Santa Catalina Island have also been found dead at sea or washed up on beaches, indicating that long distance flights across open water may be a significant source of mortality for young bald eagles.

Since the inception of this bald eagle restoration study, minimum first-year survival has averaged 75% (67%, 90%, and 67% in 2002-2004, respectively). This survival rate, which assumes birds of unknown status are dead, is similar to first-year survival reported for bald eagles in Florida (63%, Wood 1992; 77%, Millsap et al. 2004), Alaska (71%, Bowman et al. 1995), northern California (77%, Jenkins et al. 1999), and Santa Catalina Island (70-75%, unpublished data), but slightly lower than that found in the Greater Yellowstone Ecosystem (86.7%, Harmata et al. 1999). Second-year survival has averaged 95% for eagles released on Santa Cruz in 2002 (100%) and 2003 (89%), which is slightly higher than the second-year survival reported for eagles in Florida (86%, Millsap et al. 2004) and the Yellowstone region (85%, Harmata et al. 1999). Only one of the 2002 eagles died in 2004 (hit by a car in Utah), bringing third year survival to 88%, the same as reported by Millsap et al. (2004).

As in past years, bald eagles on Santa Cruz were usually in the area of Chinese Harbor, based upon both sightings and telemetry data. Most of the pig carcasses placed by IWS personnel were along the ridges surrounding Chinese Harbor, and during our Beach Watch surveys, 63% of potential prey items located were in Chinese Harbor (46%) and Prisoner's Harbor (17%), including 68% of the marine mammal carcasses found. Chinese and Prisoner's Harbors face north and northwest, the direction of the prevailing winds and currents, which may explain why more carcasses wash up on these beaches as opposed to beaches that face south and west. Therefore, eagles likely could find food in this area more reliably than other portions of the island. With the initiation of the feral pig eradication project on Santa Cruz in 2005, we expect the eagles to spend more time away from Chinese Harbor because of the increased availability of carcasses across the island.

We have observed few fishing attempts by the eagles. Bald eagles have been observed successfully capturing fish as young as 15 weeks of age (Altman 1983), but this behavior is usually not observed consistently on Catalina until the birds are at least a year old. Stalmaster (1987) suggested that bald eagles' order of preference for acquiring food is likely (1) stealing prey from others, (2) scavenging on carrion, and (3) hunting and killing. Because of the large number of marine and terrestrial mammal carcasses available to bald eagles on Santa Cruz, Santa Rosa, and San Miguel, the bald eagles may not switch to fishing until they begin to establish and defend territories, which would reduce their ability to forage widely for carrion as they are able to do now. Once the pigs on Santa Cruz are eradicated, the eagles residing there will be forced to find alternate food sources, which will likely cause them to switch to more fish and birds.

The use of marine mammal carcasses by eagles, as was observed on Santa Cruz and Santa Rosa, could pose a substantial threat to the eagles' ability to reproduce successfully. On Catalina, marine mammal carcasses are believed to be one of the major sources of DDE contamination for bald eagles (Garcelon 1997), where biannual pinniped surveys during 2000-2004 recorded an average of 255 (range 182-565) individual sea lions and harbor seals (*Phoca vitulina*; F. Starkey, personal communication). The northern Channel Islands, especially San Miguel and Santa Rosa, support much larger populations of pinnipeds (Point Bennett on San Miguel Island alone can have 40,000 northern elephant seals present (http://www.nps.gov/chis/sightings.htm)), and therefore may have a high availability of DDE-contaminated carcasses. Contaminants analyses of sea lion samples we have collected to date are not yet complete, but will help determine the contaminant load that bald eagles could be acquiring by feeding on marine mammal carcasses. If the pinnipeds on the northern Channel Islands do carry large contaminant loads, as those on Catalina were shown to have in the early 1990s, the islands of concern would be primarily San Miguel and Santa Rosa because of the large breeding populations of pinnipeds found there. Santa Cruz does not appear to have a high density of marine mammals. Although we found 31 marine mammal carcasses on Santa Cruz beaches in 2004, 20 of these were on Chinese Harbor beach. Once the bald eagles establish territories, this beach would likely be within one or two territories and other eagles would probably be excluded from the area so that only a few adult eagles would have access to the majority of carcasses available.

Because of the large proportion of time that the bald eagles spend on Santa Rosa, we are still concerned about the use of lead in hunting activities. In the Greater Yellowstone area, lead-induced mortalities of bald eagles were the second leading cause of death and resulted from ingesting large caliber bullet fragments, presumably while feeding on ungulates (Harmata et al. 1999). Because bald eagles are known to feed on deer and elk carcasses on Santa Rosa Island there is an opportunity for them to ingest lead. Fortunately, we have not yet had a known death from lead poisoning amongst our released eagles.

One concern that was raised about restoring bald eagles to the northern Channel Islands was the potential negative impact upon breeding sea birds, especially on Anacapa. Because it is difficult to get any direct observations of the eagles on Anacapa because of restricted access throughout most of the year, we have had to rely solely on the GPS data to determine any possible impact on breeding sea birds. The use of Anacapa by released bald eagles has been minimal since the project began (Sharpe et al. 2003, 2004). During 2004, 10 bald eagles were known to have visited Anacapa. Eight of these eagles were birds released in 2004 that each made single visits to Anacapa between 25 July and 1 November. The longest visit was by A-22, which stayed on Anacapa from 25 July through 21 August. All other trips to Anacapa by eagles released in 2004 lasted for 2-8 days. Most of these trips occurred within a couple months of fledging, when the sea bird breeding season was drawing to a close and before we would expect the eagles to begin taking live prey. There were two known visits to Anacapa by older eagles (2003 releases). A-13 made a single trip to Anacapa between 24 and 30 March. A-19 made eight separate trips to Anacapa between 26 February and 25 July, each lasting 2-22 days. These visits fell within the sea bird breeding season and we would predict that the older eagles would be more likely to prey on sea birds. However, the generally short duration of the stays on Anacapa and the frequent trips to Santa Cruz and Santa Rosa by A-19 suggest that the eagle may not have been finding much food on Anacapa. As in past seasons, we do not believe that bald eagles had a measurable impact on the breeding sea birds on Anacapa during 2004 because of the infrequent use of that island by bald eagles, especially during the sea bird breeding season.

The success of this restoration project ultimately will be determined by the ability of the eagles to breed and form a self-sustaining population. Bald eagles generally breed at about 4-6 years of age, but may breed as young as 3-4 years of age (Mulhern et al. 1994). The oldest birds from our Santa Cruz releases will be 3 years old in spring 2005 and K-10 from Catalina will be 4

years old. During 2004, we had no evidence that the eagles had begun to form territories, based upon our GPS and VHF telemetry data. Pair formation could begin in 2005 among the older birds and we expect the first breeding activity to occur in 2006 or 2007. We will monitor the eagles on the islands intensively over the next two years in order to find any breeding activity and monitor any nests to determine their fate.

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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

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

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 Woods Hole Group will complete the sample preparation and DDT/PCB analyses under an agreement with the National Oceanic and Atmospheric Administration.

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

SAMPLE IDENTIFICATION SYSTEM

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

Codes

Year:

2002 (02)
2003 (03)

Principal Investigator:

Garcelon (G)

Locations:

Christy's Beach (CB)
Chinese Harbor (CH)
Fox Pen Area (FP)
Johnston's Beach (JB)
Laguna Beach (LB)
No Man's Land (NL)
North Hacktower (NT)
Prisoner's Beach (PB)
Pozo Beach (PZ)
Sauces Beach (SB)
South Hacktower (ST)
Field Blank (XX)
Other codes can be added as needed if samples are collected from other areas and the code system should be revised to include them, but the following Catalina codes of WE, TR, PR, SR or TH should not be used.

Species:

Bald Eagle (BE)
California Gull (CG)
Harbor Seal (SE)
Sea Lion (SL)
Feral Pig (SS)
Add species names as needed for other fish, seabird, and marine mammal species and revise the code system to include them.

Individual:

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

Tissue:

Muscle (M)
Adipose (A)
Whole Body or Whole Gutted Body (B)
Blood (D)
Feather (F)
Field Blank (N)

Sample Number:

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

FIELD COLLECTION RECORDS

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

FIELD TECHNIQUES FOR COLLECTING SAMPLES

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

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

Clean non-powdered nitrile gloves (vinyl gloves contain 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,

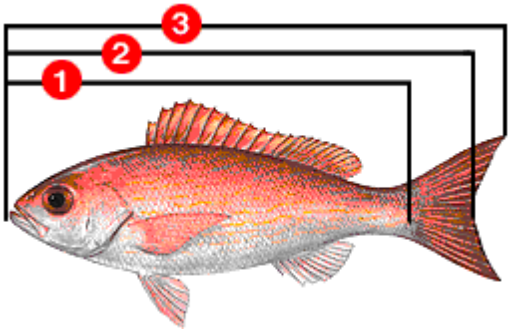
For DDT/PCB analysis, collect one duplicate of both muscle (50 g) and adipose tissue (50 g) and one field blank per sample day (filter paper swipes of re-used equipment in 20 mL or 60 mL glass container).

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. Tissue samples collected for contaminant and stable isotope analyses, Santa Cruz Island, California, 2004.

Sample ID[1]	Description	Analysis	Species	BAEA ID	Date
04GCBCG01M01	2 g Muscle	Stable Isotope	California Gull	.	01/07/04
04GCBCG01F01	3 Breast Feathers	Stable Isotope	California Gull	.	01/07/04
04GNSKR01B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Rockfish	.	03/16/04
04GNSKB01B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/16/04
04GCHSL02A01	35 g Adipose	DDT/PCB	California Sea Lion	.	03/17/04
04GCHSL02A02	15 g Adipose	Stable Isotope	California Sea Lion	.	03/17/04
04GCHSL02M01	75 g Muscle	DDT/PCB	California Sea Lion	.	03/17/04
04GCHSL02M02	10 g Muscle	Stable Isotope	California Sea Lion	.	03/17/04
04GNSJS01B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/18/04
04GNSJS02B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/18/04
04GNSJS03B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/18/04
04GNSJS04B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/18/04
04GNSJS05B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/18/04
04GNSJS06B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/18/04
04GNSKB02B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/18/04
04GNSKB03B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/18/04
04GNSKB04B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/18/04
04GNSKB05B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/18/04
04GNSKB06B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/18/04
04GPZSL03A01	50 g Adipose	DDT/PCB	California Sea Lion	.	03/19/04
04GPZSL03A02	25 g Adipose	Stable Isotope	California Sea Lion	.	03/19/04
04GPZSL03M01	75 g Muscle	DDT/PCB	California Sea Lion	.	03/19/04
04GPZSL03M02	10 g Muscle	Stable Isotope	California Sea Lion	.	03/19/04
04GSBSL04A01	50 g Adipose	DDT/PCB	California Sea Lion	.	03/21/04
04GSBSL04M01	50 g Muscle	DDT/PCB	California Sea Lion	.	03/21/04
04GNSJS07B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/31/04
04GNSJS08B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	03/31/04
04GNSKB07B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/31/04
04GNSKB08B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	03/31/04
04GCHBC01M01	10 g Muscle	Stable Isotope	Brandt's Cormorant	.	04/09/04
04GCHBC01F01	3 Breast Feathers	Stable Isotope	Brandt's Cormorant	.	04/09/04
04GCHBC02M01	10 g Muscle	Stable Isotope	Brandt's Cormorant	.	04/09/04
04GCHBC02F01	3 Breast Feathers	Stable Isotope	Brandt's Cormorant	.	04/09/04
04GNSKB09B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	04/10/04
04GNSKB10B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Bass	.	04/10/04
04GNSKR02B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Rockfish	.	05/13/04
04GNSJS09B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	05/20/04
04GPBSL05M01	5 g Muscle	Stable Isotope	California Sea Lion	.	06/01/04

Appendix III. Continued

Sample ID	Description	Analysis	Species	BAEA ID	Date
04GPBSL05A01	20 g Adipose	Stable Isotope	California Sea Lion	.	06/01/04
04GPBSL05M02	50 g Muscle	DDT/PCB	California Sea Lion	.	06/01/04
04GPBSL05A02	50 g Adipose	DDT/PCB	California Sea Lion	.	06/01/04
04GCHSL06A01	50 g Adipose	DDT/PCB	California Sea Lion	.	06/13/04
04GCHSL06A02	20 g Adipose	Stable Isotope	California Sea Lion	.	06/13/04
04GCHSL06M01	50 g Muscle	DDT/PCB	California Sea Lion	.	06/13/04
04GCHSL06M02	5 g Muscle	Stable Isotope	California Sea Lion	.	06/13/04
04GNSYC01B01	Whole Gutted Fish	DDT/PCB/SI	Yellowfin Croaker	.	06/20/04
04GNSYC02B01	Whole Gutted Fish	DDT/PCB/SI	Yellowfin Croaker	.	06/29/04
04GNSJS10B01	Whole Gutted Fish	DDT/PCB/SI	Jacksmelt	.	06/29/04
04GNTBE24D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47365	07/06/04
04GNTBE24D02	0.1 mL Whole Blood	Stable Isotope	Bald Eagle	629-47365	07/06/04
04GNTBE24D03	2 mL Plasma	DDT/PCB	Bald Eagle	629-47365	07/06/04
04GNTBE24D04	0.1 mL Plasma	Stable Isotope	Bald Eagle	629-47365	07/06/04
04GNTBE25D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47366	07/06/04
04GNTBE25D02	0.1 mL Whole Blood	Stable Isotope	Bald Eagle	629-47366	07/06/04
04GNTBE25D03	2 mL Plasma	DDT/PCB	Bald Eagle	629-47366	07/06/04
04GNTBE25D04	0.1 mL Plasma	Stable Isotope	Bald Eagle	629-47366	07/06/04
04GNTBE24F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47365	07/06/04
04GNTBE25F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47366	07/06/04
04GLBBA01M01	2 grams Muscle	Stable Isotope	Black-footed Albatross	.	07/13/04
04GLBBA01F01	3 Breast Feathers	Stable Isotope	Black-footed Albatross	.	07/13/04
04GCPBE23F02	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47356	07/25/04
04GCPBE23D06	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47356	07/25/04
04GCPBE23D07	0.2 mL Whole Blood	Stable Isotope	Bald Eagle	629-47356	07/25/04
04GCPBE23D08	2.5 mL Plasma	DDT/PCB	Bald Eagle	629-47356	07/25/04
04GCPBE23D09	0.3 mL Plasma	Stable Isotope	Bald Eagle	629-47356	07/25/04
04GCPBE22F02	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47358	08/13/04
04GCPBE22D05	2.5 mL Whole Blood	DDT/PCB	Bald Eagle	629-47358	08/13/04
04GCPBE22D06	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47358	08/13/04
04GCPBE22D07	3.0 mL Plasma	DDT/PCB	Bald Eagle	629-47358	08/13/04
04GCPBE22D08	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47358	08/13/04
04GCPBE17F02	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47361	08/14/04
04GCPBE17D05	3 mL Whole Blood	DDT/PCB	Bald Eagle	629-47361	08/14/04
04GCPBE17D06	1 mL Whole Blood	Stable Isotope	Bald Eagle	629-47361	08/14/04
04GCPBE17D07	2 mL Plasma	DDT/PCB	Bald Eagle	629-47361	08/14/04
04GCPBE17D08	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47361	08/14/04
04GPBWG01F01	3 Breast Feathers	Stable Isotope	Western Gull	.	08/06/04
04GPBWG01M01	2 g Muscle	Stable Isotope	Western Gull	.	08/06/04

Appendix III. Continued

Sample ID	Description	Analysis	Species	BAEA ID	Date
04GSTBE26D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47372	08/16/04
04GSTBE26D02	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47372	08/16/04
04GSTBE26D03	3 mL Plasma	DDT/PCB	Bald Eagle	629-47372	08/16/04
04GSTBE26D04	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47372	08/16/04
04GSTBE27D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47373	08/16/04
04GSTBE27D02	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47373	08/16/04
04GSTBE27D03	2 mL Plasma	DDT/PCB	Bald Eagle	629-47373	08/16/04
04GSTBE27D04	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47373	08/16/04
04GSTBE28D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47374	08/16/04
04GSTBE28D02	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47374	08/16/04
04GSTBE28D03	3 mL Plasma	DDT/PCB	Bald Eagle	629-47374	08/16/04
04GSTBE28D04	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47374	08/16/04
04GSTBE29D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47375	08/16/04
04GSTBE29D02	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47375	08/16/04
04GSTBE29D03	3 mL Plasma	DDT/PCB	Bald Eagle	629-47375	08/16/04
04GSTBE29D04	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47375	08/16/04
04GSTBE30D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47376	08/16/04
04GSTBE30D02	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47376	08/16/04
04GSTBE30D03	3 mL Plasma	DDT/PCB	Bald Eagle	629-47376	08/16/04
04GSTBE30D04	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47376	08/16/04
04GSTBE31D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47377	08/16/04
04GSTBE31D02	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47377	08/16/04
04GSTBE31D03	3 mL Plasma	DDT/PCB	Bald Eagle	629-47377	08/16/04
04GSTBE31D04	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47377	08/16/04
04GSTBE26F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47372	08/16/04
04GSTBE27F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47373	08/16/04
04GSTBE28F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47374	08/16/04
04GSTBE29F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47375	08/16/04
04GSTBE30F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47376	08/16/04
04GSTBE31F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47377	08/16/04
04GNSWG02F01	3 Breast Feathers	Stable Isotope	Western Gull	.	08/17/04
04GNSWG02M01	2 g Muscle	Stable Isotope	Western Gull	.	08/17/04
04GSTBE32D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47378	08/18/04
04GSTBE32D02	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47378	08/18/04
04GSTBE32D03	2 mL Plasma	DDT/PCB	Bald Eagle	629-47378	08/18/04
04GSTBE32D04	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47378	08/18/04
04GSTBE32F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47378	08/18/04
04GPBSS05A01	50 g Adipose	DDT/PCB	Feral Pig	.	08/27/04
04GPBSS05A02	50 g Adipose	DDT/PCB	Feral Pig	.	08/27/04

Appendix III. Continued

Sample ID	Description	Analysis	Species	BAEA ID	Date
04GPBSS05A03	20 g Adipose	Stable Isotope	Feral Pig	.	08/27/04
04GPBSS05M01	50 g Muscle	DDT/PCB	Feral Pig	.	08/27/04
04GPBSS05M02	50 g Muscle	DDT/PCB	Feral Pig	.	08/27/04
04GPBSS05M03	2 g Muscle	Stable Isotope	Feral Pig	.	08/27/04
04GNTBE33D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47379	09/10/04
04GNTBE33D02	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47379	09/10/04
04GNTBE33D03	0.5 mL Whole Blood	Stable Isotope	Bald Eagle	629-47379	09/10/04
04GNTBE33D04	2.5 mL Plasma	DDT/PCB	Bald Eagle	629-47379	09/10/04
04GNTBE33D05	0.5 mL Plasma	Stable Isotope	Bald Eagle	629-47379	09/10/04
04GNTBE34D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47380	09/10/04
04GNTBE34D02	0.2 mL Whole Blood	Stable Isotope	Bald Eagle	629-47380	09/10/04
04GNTBE34D03	2 mL Plasma	DDT/PCB	Bald Eagle	629-47380	09/10/04
04GNTBE34D04	0.1 mL Plasma	Stable Isotope	Bald Eagle	629-47380	09/10/04
04GNTBE33F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47379	09/10/04
04GNTBE34F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47380	09/10/04
04GNSKR03B01	Whole Gutted Fish	DDT/PCB/SI	Kelp Rockfish	.	09/30/04
04GSTBE35F01	3 Breast Feathers	Stable Isotope	Bald Eagle	629-47381	10/07/04
04GSTBE35D01	2 mL Whole Blood	DDT/PCB	Bald Eagle	629-47381	10/07/04
04GSTBE35D02	0.2 mL Whole Blood	Stable Isotope	Bald Eagle	629-47381	10/07/04
04GSTBE35D03	2 mL Plasma	DDT/PCB	Bald Eagle	629-47381	10/07/04
04GSTBE35D04	2 mL Plasma	DDT/PCB	Bald Eagle	629-47381	10/07/04
04GSTBE35D05	0.1 mL Plasma	Stable Isotope	Bald Eagle	629-47381	10/07/04
04GPBBT01B01	3 snails, shells removed	Stable Isotope	Black Turban Snail	.	11/07/04
04GPBBT02B01	3 snails, shells removed	Stable Isotope	Black Turban Snail	.	11/07/04
04GPBBT03B01	3 snails, shells removed	Stable Isotope	Black Turban Snail	.	11/07/04
04GPBBT04B01	3 snails, shells removed	Stable Isotope	Black Turban Snail	.	11/07/04
04GPBBT05B01	3 snails, shells removed	Stable Isotope	Black Turban Snail	.	11/07/04
04GNSPM01B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/16/04
04GNSPM02B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/16/04
04GNSPM03B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/16/04
04GNSPM04B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/16/04
04GNSPM05B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/16/04
04GNSPM06B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/16/04
04GNSPM07B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/17/04
04GNSPM08B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/17/04
04GNSPM09B01	Whole Gutted Fish	DDT/PCB/SI	Pacific Mackerel	.	11/18/04
04GCHSL07A01	50 g Adipose	DDT/PCB	California Sea Lion	.	11/26/04
04GCHSL07M01	50 g Muscle	DDT/PCB	California Sea Lion	.	11/26/04
04GPBSL08A01	50 g Adipose	DDT/PCB	California Sea Lion	.	12/04/04
04GPBSL08M01	50 g Muscle	DDT/PCB	California Sea Lion	.	12/04/04

[1] See Appendix II for description of Sample ID codes.