

# Restoration and Management of Bald Eagles on Santa Catalina Island, California, 2003



*A Report Prepared for:*

Montrose Settlements Restoration Program

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## INTRODUCTION

Bald eagles (*Haliaeetus leucocephalus*) were once common residents on the California Channel Islands off the coast of Southern California (Fig. 1). Bald eagle numbers began declining on the Channel Islands in the late 19<sup>th</sup> Century and disappeared from the Channel Islands by the early 1960s. Human persecution contributed to the decline, but the ultimate cause of bald eagle extirpation from the Channel Islands was likely the introduction of the organochlorine pesticide DDT into the Southern California Bight. DDE (a metabolite of DDT) levels have been found to be inversely correlated with eggshell thickness and productivity in bald eagles (Hickey and Anderson 1968, Wiemeyer et al. 1984). The decline in bald eagle populations in southern California was concurrent with declines in seabird breeding success in the Southern California Bight and with continent-wide declines in bald eagle populations, much of which was also attributed to the impacts of DDT (Risebrough et al. 1971, Anderson et al. 1975, Grier 1982, Wiemeyer et al. 1984).



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

Efforts to restore bald eagles on the California Channel Islands began in 1980 when the Institute for Wildlife Studies (IWS), in cooperation with the United States Fish and Wildlife Service (FWS), initiated a program to reintroduce bald eagles to Santa Catalina Island, California (Fig. 1). Between 1980 and 1986, 33 eagles were released on the island from three

different artificial nest or “hacking” platforms (Garcelon 1988). Many of these birds matured and formed breeding pairs on the island, but all the eggs produced broke in the nest.

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

Since 1989, the reintroduced population has been maintained through manipulations of eggs and chicks at each nest site and through additional hacking of birds (Table 1). Because of the high DDE concentrations in the eggs, this active program of manipulation and augmentation is the only way to maintain the Catalina Island bald eagle population at this time. In the egg manipulation process, artificial eggs are substituted for the structurally deficient eggs laid by the birds affected by DDE. The adult eagles continue to incubate the artificial eggs while the removed eggs are relocated and artificially incubated at the Avian Conservation Center (ACC) at the San Francisco Zoo. Chicks that hatch from these removed eggs, or those produced by captive adults at the ACC, are then fostered into the nests. Between 1989 and 2003, adult eagles on Catalina Island successfully reared 35 of 44 chicks that were either fostered into nests (42 chicks) or hatched from two of three healthy eggs that were placed into nests (Table 1). Three of these 44 birds were removed from the nest prior to fledging because of injuries and six died due to accidents or predation (Table 1). Continued hacking activities have also resulted in the release of an additional 21 eagles since 1991 (20 chicks and a 1-year-old bird; Table 1).

The purpose of this project is to maintain the breeding bald eagles on Catalina Island in the interim between completion of the injury assessment studies and the full-scale environmental restoration program now being planned. Our restoration and management objectives were to (1) document the chronology of nesting for all breeding pairs on the island, (2) collect eggs from wild nests on Catalina Island for artificial incubation, (3) foster healthy chicks into active nests, (4) collect tissues (blood, prey items, non-hatching eggs and embryos) for analyses of contaminants, (5) quantify incubation behavior, (6) quantify the behavior of adults and chicks between the time of hatching and fledging, (7) identify food items and quantify the rate at which prey deliveries were made to the nest, and (8) monitor movement and behavior of all chicks fledged on the island. This report summarizes the results of the egg and chick manipulations and subsequent monitoring for the nesting season of 2003.

Table 1. Summary of Bald Eagle egg and chick manipulations on Santa Catalina Island, 1989-2003.

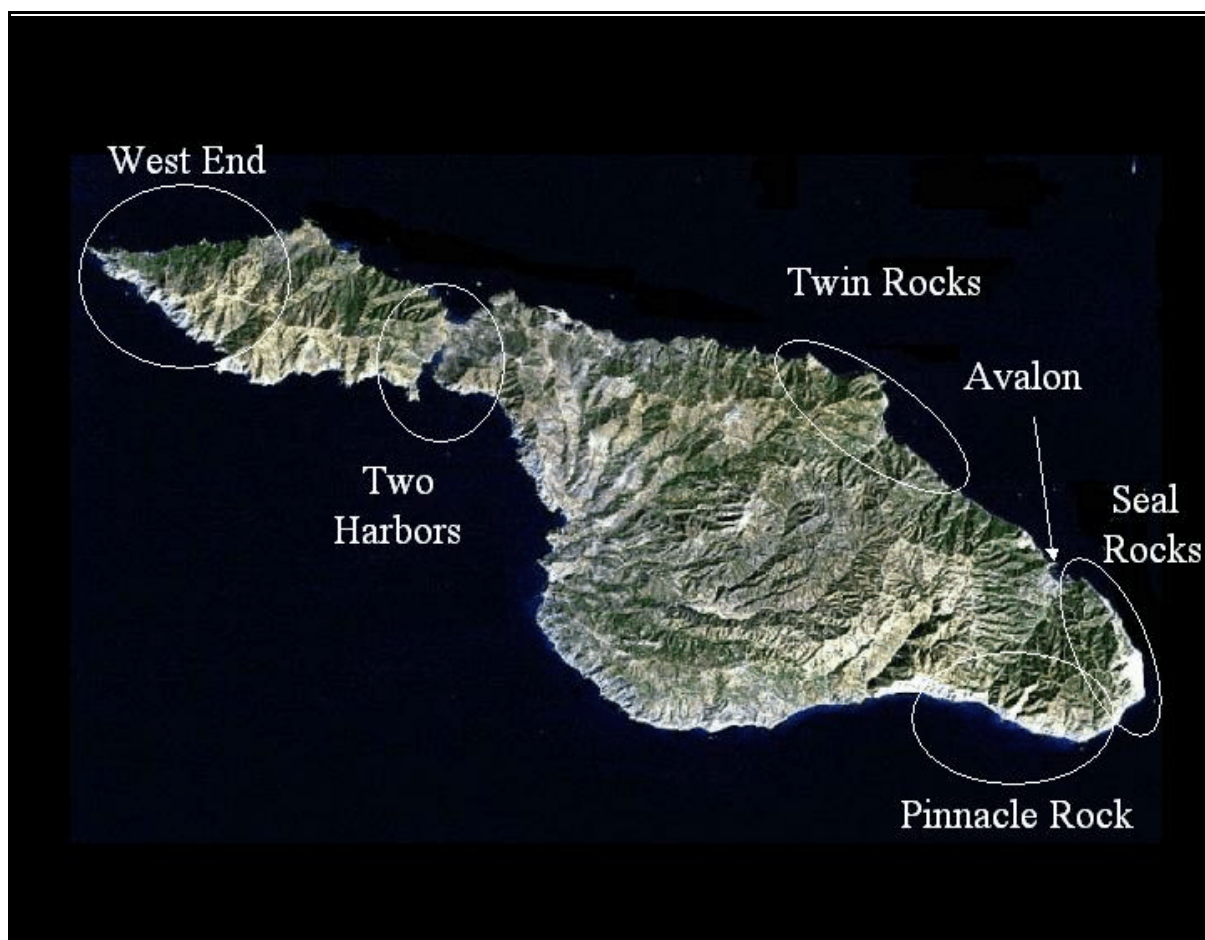
	Year														
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
# of Active Nests	1	2	2	3	3	2	3	3	2	3	4	3	4	4	5
# of Eggs Laid	2	2-3	3	5	5-6	3	5	5-6	6	7	8	7	8	8	9
# of Eggs Collected	1	1	3	5	4	3	5	4	5	6	6	4	7	7	8
# of Catalina Island Eggs Hatched <sup>a</sup>	0	0	1	2	0	0	0	0	1	1	1	2	0	2	1
# of Eggs Fostered Into Nests on Catalina Island	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0
# of Chicks Fostered Into Nests on Catalina Island	1	0	0	3	2	2	1	5	1	4	3	4	5	7	4
# of Chicks Fledged From Nests on Catalina Island	1	0	2	3	1	1	1	2	1	3	2	4	5	6	3
# of Eagles Hacked Onto Catalina Island	0	0	2	0	2	0	2	5	0	4	2	0	4	0	0
# of Island-Produced Eagles Breeding on Island	0	0	0	0	0	0	0	0	1	1	2	1	2	2	3
# of Second Generation Eagles Fledged	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

<sup>a</sup> Hatched by the Santa Cruz Predatory Research Group (1991) or San Francisco Zoo (1992-Present)

## STUDY AREA

Catalina Island is located 34 km south of Long Beach, California. The island is 34 km long, 0.8 to 13.0 km wide, and covers 194 km<sup>2</sup> (Fig. 2). Elevations range from sea level to 648 m. Mean annual temperatures range from 12 to 20° C near the coast, and yearly precipitation averages 31 cm (NOAA 1985).

Vegetation on Catalina Island has been described by Thorne (1967). Predominant habitat types include: oak woodland, dominated by scrub oak (*Quercus dumosa*) and Catalina cherry (*Prunus lyonii*); grassland, dominated by oats (*Avena* spp.); and coastal sage, dominated by sage (*Salvia apiana* and *S. mellifera*), low shrubs (*Rhus integrifolia* and *R. ovata*) and prickly-pear cactus (*Opuntia* spp.).



**Figure 2. Active bald eagle territories and points of reference on Santa Catalina Island, CA.**

## Nesting Territories

Five territories of nesting bald eagles have occurred on the island since 1984. A brief description of each territory is provided below.

The West End territory is located 0.5 km from the northwest end of the island (Fig. 2), and was established in 1991. The territory was initially occupied by a 10-year-old male and a 5-year-old female, but a second female has assisted in breeding activities since 1992 (Garcelon et al. 1995, Sharpe and Dooley 2001). The nest is located on a rock pinnacle approximately 75 m above the water, and has been used since 1991.

The Pinnacle Rock territory is located 4.3 km southwest of the city of Avalon, extending from Silver Canyon to approximately 1 km east of the East End Light (Fig. 2). It was initially occupied in 1990 by a 5-year-old female and a 4-year-old male, and this territory has contained active nests each year since 1990. The pair has remained intact and has used six different nest sites from 1990-2002 (Phillips and Garcelon 1996, Sharpe and Garcelon 1999, 2000a,b).

The Twin Rocks territory is located 5 km northwest of Avalon, extending from Torqua Springs to Little Gibraltar (Fig. 2). This territory was first occupied in 1984 and contained active nests in 1985, 1987 and 1989. The female remained in the territory until January 1995 when she was joined by a 4-year-old male. The pair exhibited incubation behavior in 1996, but no eggs were found in the nest (Phillips and Garcelon 1996). The first eggs were laid by the new pair in 1997, but the birds did not return to the nest after the egg switch. In 1998, the female was replaced by a 12-year-old female and the pair have nested every year through 2003.

The Seal Rocks territory is located 4.5 km SE of the city of Avalon (Fig. 2). The pair first nested in 1988, using several different nests through 1993. The female from this territory died on 5 May 1993 from DDE contaminant poisoning (Garcelon and Thomas 1997). In 1995, another adult female laid two infertile eggs. Because no male was observed in the territory, the eggs were removed to prevent excessive stress associated with incubation by only one adult. The female abandoned the nest and the territory remained unoccupied until a new pair moved into the Seal Rocks territory in 1997 (Sharpe and Garcelon 1998). There was no evidence of nesting in 1998. Prior to the 1999 breeding season the female was replaced by a 6-year-old bird. In 1999 the pair built a nest and laid one egg, but the nest blew out of the tree the following evening and there was no further nesting activity (Sharpe and Garcelon 2000a). The pair did not attempt to nest in 2000, but successfully fledged a fostered chick in 2001 and 2002.

The Two Harbors territory is located 2 km SW of the town of Two Harbors (Fig. 2) and was first active in 2003. The territory is occupied by a pair of 5-year-old birds. The nest was constructed on a rock outcrop on a narrow ridge about 50 m above the ocean.

# METHODS

## Nest Manipulations

Observations of adult eagles began in January this year to determine the location of breeding pairs and their respective nest sites. We located nest sites by observing areas of increased use by adult eagles and searching previously used nesting areas. When nest site locations were confirmed, we set up observation blinds from which to observe nests. From the blinds we monitored and quantified chronology of nesting, behavior during incubation, nestling and adult behavior during brood rearing, taxon of prey delivered to the nest, and rates of prey deliveries. At the West End and Seal Rocks nests we had video cameras present (set up prior to breeding season) that allowed close observations of nesting activity.

We replaced eggs laid by nesting pairs with artificial eggs within 1-4 days of the date that eagles were confirmed incubating. We replaced the artificial eggs with healthy chicks after the adults had incubated approximately 30 days and returned to the nests when chicks were 8 weeks of age to equip them with federal and colored leg bands, wingmarkers, and a backpack-style radio-transmitter. At this time we also collected a blood sample (~10 cc) for contaminant analyses and made morphological measurements to determine sex (Bortolotti 1984, Garcelon et al. 1985).

## Incubation Behavior

We sampled incubation behavior at all nests by monitoring them for approximately 6 hours/day for 1-3 days/week. The sex of adult birds was determined by the presence of patagial wingmarkers, leg bands, and size of adults. We recorded the exact times that adults laid on and stood from the eggs, probed the nest, or rolled the eggs. Additionally, descriptive notes were recorded to summarize general behavior and interaction of adults during the incubation period.

We used the Mann-Whitney U-test to evaluate sex-specific differences in duration of complete incubation bouts. We defined complete incubation bouts as those in which we observed the incubating bird both start and end its attendance at the nest (i.e. switch with its mate).

## Chick-Rearing and Nestling Behavior

We monitored behavior of chicks and adults at all nests using interval sampling (Tacha et al. 1985) following the fostering of chicks. Postures and behaviors (See Appendix I) of chicks and any adults on the nest were recorded at 1-minute intervals, and sampling generally was

conducted 2-3 days/week, up to 8 hours/day. Fog occasionally prevented or delayed sampling of behavior. We distinguished the roles of adult male and female eagles during the chick rearing period by comparing the proportion of time that each sex spent on the nest. We calculated the proportion of time that chicks spent in postures and behaviors for each day that birds were monitored. We evaluated the relationship of the age of the chicks to the proportion of time spent in each posture and behavior to document the onset of particular behaviors as chick development progressed. Changes in the frequency of occurrence of key postures and behaviors were plotted over time to demonstrate trends in behavior during the nestling period.

## **Prey Deliveries**

Concurrent with interval sampling of behavior, we recorded date, time, and taxonomic information for all prey items delivered to the nests. We calculated mean rates of prey delivery for each nest as the number of items delivered divided by the amount of time the nests were observed.

## **Post-Fledging Behavior**

We used radio-telemetry to locate and visually observe behavior of fledged eagles. We located and observed the fledged birds every 1-3 days during their first month of flight and recorded location, behavior, and interaction with other eagles.

## **Collection of Tissue Samples**

We collected 9-10 cc of blood for contaminant and DNA analyses during banding activities of juvenile bald eagles on Catalina Island. The ACC also collected samples of egg shells and embryos from the Catalina Island eggs transported to San Francisco for incubation. Egg contents were placed in chemically clean jars and frozen.

# **RESULTS**

## **Manipulations and Monitoring**

Nests were located from February-March 2003 in four previously occupied territories (Twin Rocks, Pinnacle Rock, Seal Rocks, and West End) and in a newly formed territory (Two Harbors) (Fig. 2).



### ***Twin Rocks***

The territory was used by the same pair that used it from 1998-2002. The male (K-33) was a bird that hatched from a Catalina egg in 1992 and the female (K-17) was a bird released at the Bulrush hacktower in 1984. In late January, the pair was seen working on the same nest that they used in 2002. The pair worked on the nest until 20 February, when they were observed exhibiting incubation behavior and one egg was confirmed to be in the nest. We entered the nest via helicopter on 22 February and removed one egg. The egg was fertile and was artificially incubated at the ACC, but did not hatch. A second egg was seen in the nest on 23 February, but we did not remove it. This egg was not present in the nest as of 5 March.

In mid-March the birds began spending less time incubating the artificial eggs and eventually abandoned the nest by the end of March. No chick was fostered into the nest in 2003.

### ***West End Territory***

The West End trio of birds used the same nest that has been used since 1991. The male has lost his wingmarkers, but is believed to be K-77, a 22-year-old bird released from a hacktower in 1981. The original female was not marked with patagial tags, but is believed to be a 17-year-old bird released at the Sweetwater hacktower in 1986. The second female, which joined the original pair in 1992, is a 17-year-old bird (K-69) that was also released at the Sweetwater hacktower in 1986. Nest construction was first observed on 30 January and continued until an egg was observed on 16 February. We entered the nest on 18 February and removed two fertile eggs. Neither egg hatched after incubation at the Zoo.

One ACC-produced chick was fostered into the West End nest on 8 April. On 31 May, we returned to the nest to install leg bands, transmitters, and wingmarkers on the chick and to obtain a blood sample (Table 2). We continued monitoring the nest until the chick fledged on 20 June. We located the bird several times per week until it left the island around 22 August. It was reported near Yachats, OR on 10 September.

### ***Pinnacle Rock***

The Pinnacle Rock pair used the same nest as in 2002. The 17-year-old male (K-65) was hatched at the Bulrush tower in 1986. The female, who has lost her wingmarkers, is believed to be a 18-year-old bird hatched at the Bulrush tower in 1985. The birds were first seen at the nest on 6 February. On 19 February a single egg was seen in the nest and we removed the egg via helicopter on 22 February. The removed egg showed signs of development but it did not hatch.

On 28 March, we introduced one ACC-produced chick into the nest, again using a helicopter. On 11 April we were unable to see the chick in the nest, so we hiked to the nest to search for the bird. Upon entering the nest we found the chick, alive, but entangled in fishing line that was attached to a fish brought to the nest. The line had cut the tendon on the bird's right tarsometatarsus, so the chick was removed for veterinary care. Dr. Winston Vickers, DVM repaired the injuries and the bird was rehabilitated by IWS personnel. On 23 May, the bird was transported to Santa Cruz Island, California to be released as part of the bald eagle restoration feasibility study being conducted on the Northern Channel Islands (Sharpe et al. 2003).

Table 2. Biographical data for bald eagle chicks successfully fledged from nests on Santa Catalina Island, California during 2003.

Federal Band	Color Band	Wing Marker	Date Fledged	Foster Nest	Status <sup>a</sup>	Comments
629-47351	5/C	K-35	6/20/03	West End	Alive	From captive pair at ACC. Left the island around 22 August.
629-47352	6/Z	K-36	6/21/03	Two Harbors	Unknown	From captive pair at ACC. Left island around 21 August.
629-47353	7/C	K-37	6/22/03	Seal Rocks	Unknown	From captive pair at ACC. Left island around 8 September.

<sup>a</sup> As of 12/15/03

### ***Seal Rocks Territory***

The Seal Rocks pair used the same nest as in 2002. The 10-year-old female (K-34) is from the captive ACC eagles and was hacked at the Bulrush tower in 1993. The 11-year-old male (K-25) hatched from an egg from the West End territory and was fostered into the Pinnacle Rock nest in 1992. The first activity at the nest was on 15 February and the first sign of incubation behavior was on 26 February. We entered the nest on 2 March and removed two eggs, replacing them with two artificial eggs. Both eggs were fertile and one hatched on 5 April, but died within a week of complications from a yolk-sac infection.

A single ACC-produced chick was fostered into the nest on 15 April. We returned to the nest on 2 June to install leg bands, a transmitter, and wingmarkers on the chick, and to obtain a blood sample. We continued to monitor the nest until the bird fledged on 22 June (Table 2). We located the bird several times per week until it left the island around 8 September. We have had no reports of this bird on the mainland.

## ***Two Harbors Territory***

The Two Harbors pair nested for the first time this season. The 5-year-old male (K-81) is an ACC-produced eagle that was fostered into the West End nest in 1998. The 5-year-old female (K-82) hatched from an egg laid in the West End territory in 1998 and was fostered into the Pinnacle Rock nest. The birds were first observed incubating on 3 March. On 6 March we entered the nest and removed two eggs, replacing them with artificial eggs. Both eggs were fertile, but neither hatched.

A single ACC-produced chick was fostered into the nest on 8 April. We returned to the nest on 1 June to install leg bands, a transmitter, and wingmarkers on the chick, and to obtain a blood sample (Fig. 3). We continued to monitor the nest until the bird fledged on 21 June (Table 2). We located the bird several times per week until it left the island around 21 August. There have been no additional sightings of this bird on the mainland.



**Figure 3. Banding a bald eagle chick at the Two Harbors nest. Note backpack transmitter and patagial wingmarkers.**

## **Incubation Behavior**

We monitored the incubation behavior at the Twin Rocks nest for 9 days between 22 February and 22 March, at the West End nest for 14 days between 18 February and 3 April, at the Pinnacle Rock nest for 10 days between 20 February and 25 March, at the Seal Rocks nest for 15 days between 26 February and 10 April, and at the Two Harbors nest for 9 days between 4 March and 4 April.

All adults took part in incubation duties. The mean bout length did not differ significantly between adults within a territory ( $P > 0.07$ ; Table 3), except for the Seal Rocks birds, where the male spent less time incubating per bout than the female ( $P = 0.03$ ). No complete bouts were recorded for the male at Twin Rocks, so no comparison could be made. The trio of adults in the West End territory had shorter mean incubation bouts when compared to adults in other territories.

Table 3. Number (n), mean, and standard deviation (SD) of length of complete incubation bouts (hrs:minutes) for adult eagles observed during incubation at the Pinnacle Rock, Seal Rocks, Twin Rocks, Two Harbors, and West End nests on Santa Catalina Island, 2003.

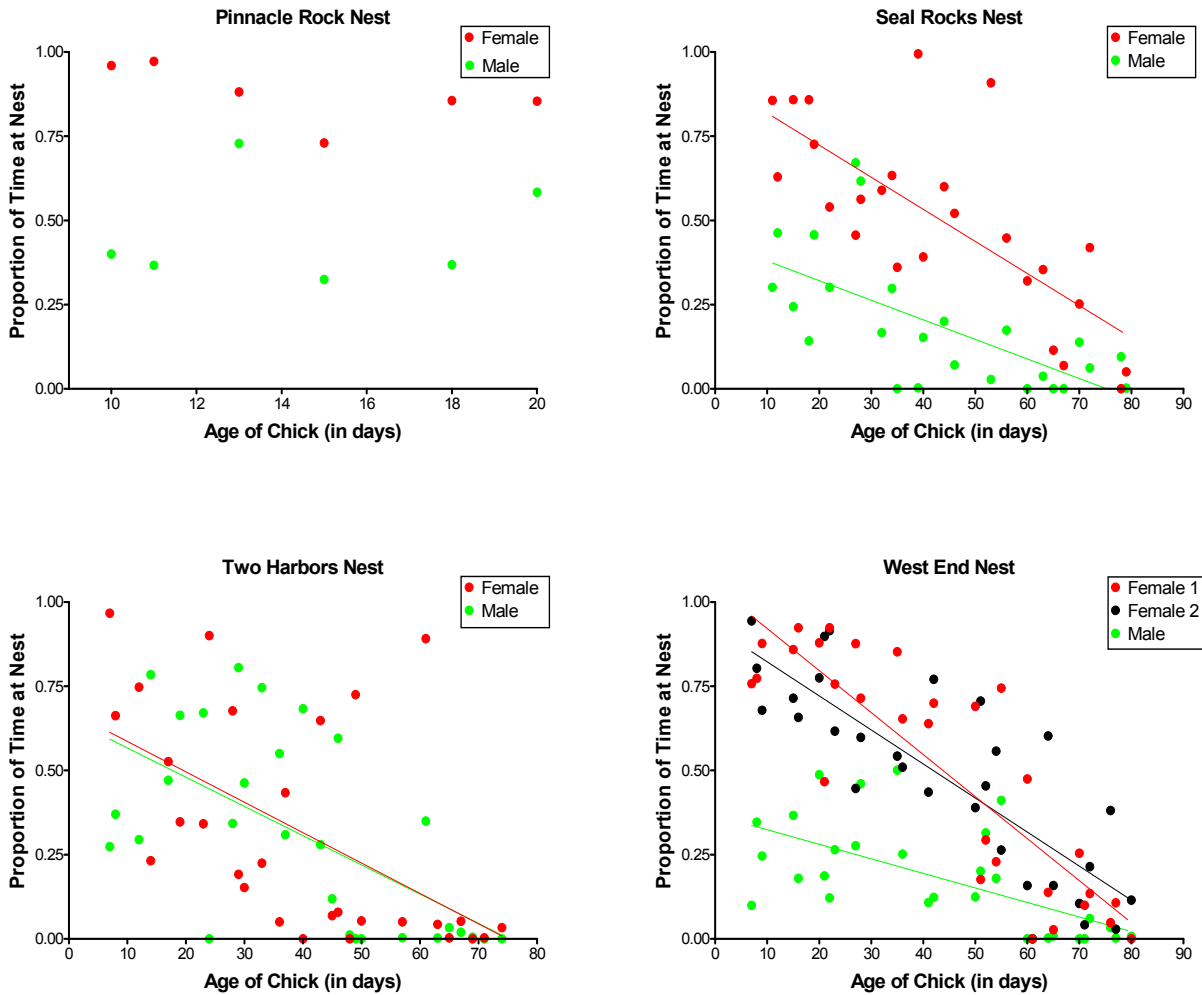
Territory	Male			Female 1			Female 2 <sup>a</sup>		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Pinnacle Rock	11	2:04	1:01	8	2:21	1:00	.	.	.
Seal Rocks	14	1:32	1:12	12	2:25	1:12	.	.	.
Twin Rocks	.	.	.	2	2:58	1:15	.	.	.
Two Harbors	7	2:56	0:26	5	2:14	0:40	.	.	.
West End	30	1:13	1:15	37	1:04	0:44	22	0:44	0:37

<sup>a</sup> Second female that was released from the same hacktower with Female 1 in 1986 and is believed to be the non-breeding female of the West End trio.

## Chick-Rearing and Fledgling Behavior

We made behavioral observations for 6 days at the Pinnacle Rock nest (28 March-5 April) before the chick was removed, 21 days at the West End nest (8 April-20 June), 25 days at the Seal Rocks nest (15 April-22 June), and 29 days at the Two Harbors nest (8 April-14 June). Three of four chicks fostered into nests this year successfully fledged. Adult females spent a significantly greater portion of their time at nests than males at the Pinnacle Rock (88% vs. 46%,  $P = 0.0002$ ) and Seal Rocks nests (50% vs. 18%;  $P = 0.0001$ ). At the West End nest there was no significant difference in the amount of time Female 1 and Female 2 spent at the nest (50% and 48%, respectively), but the male spent significantly less time at the nest (18%) than either female ( $P \leq 0.0001$ ). The Two Harbors birds both spent 31% of their time at the nest. There was also a significant negative relationship between time spent at the nest and the age of the chick for all adults at the West End, Seal Rocks, and Two Harbors nests ( $P \leq 0.0016$ ; Fig. 4). There was no significant relationship for the Pinnacle Rock birds ( $P \geq 0.2371$ ), but the chick was removed from the nest when it was approximately 20 days old (Fig. 4).

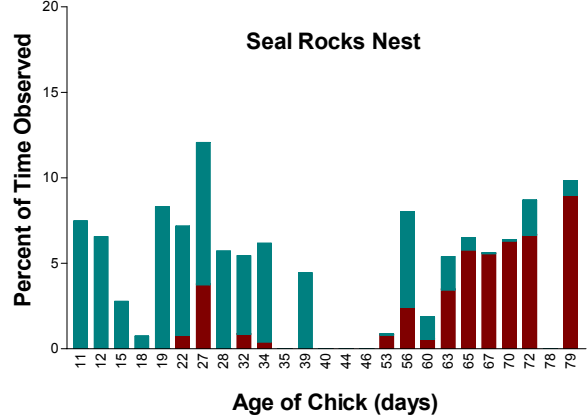
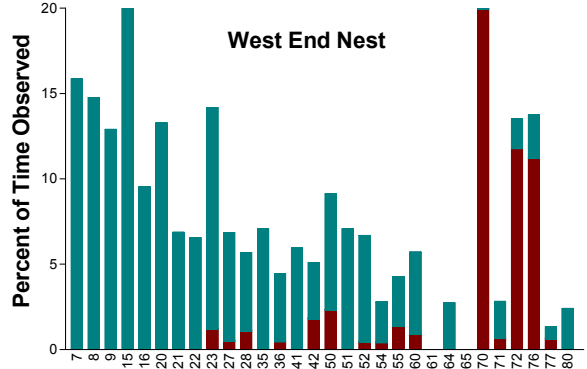
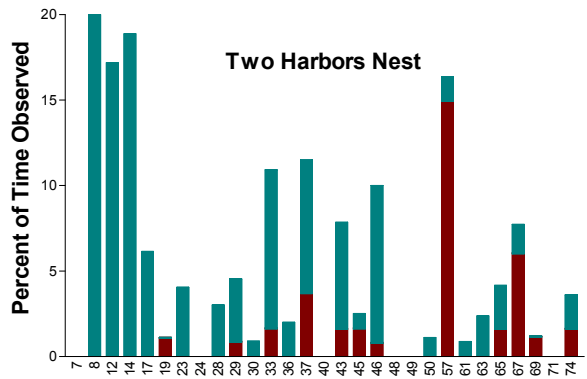
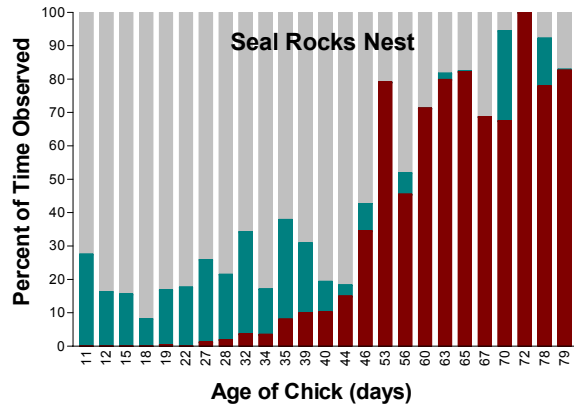
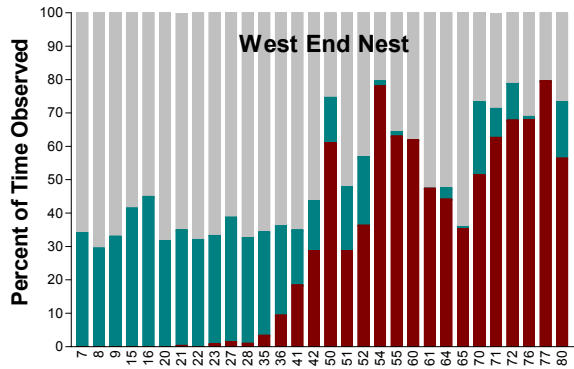
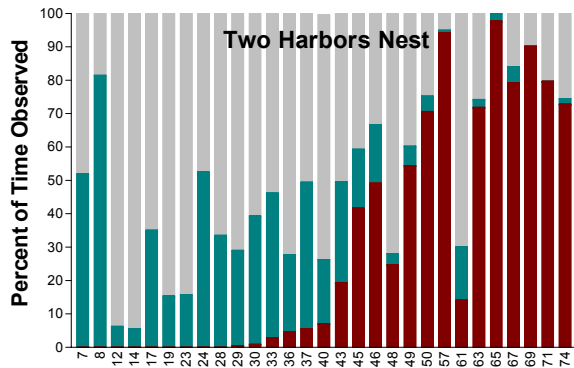
The proportion of time the chicks spent standing increased rapidly at an age of about 40 days at all three nests (Fig. 5). The chicks fed on their own as early as 19 days of age, but self-feeding did not increase substantially until they were at least 40 days of age (Fig. 6).



**Figure 4. Proportion of time spent by adult bald eagles at the Pinnacle Rock, Seal Rocks, Two Harbors, and West End nests during chick rearing on Santa Catalina Island, California. The lines in the graphs are the best fit for the female (---), male (---), and Female 2 at the West End (----).**

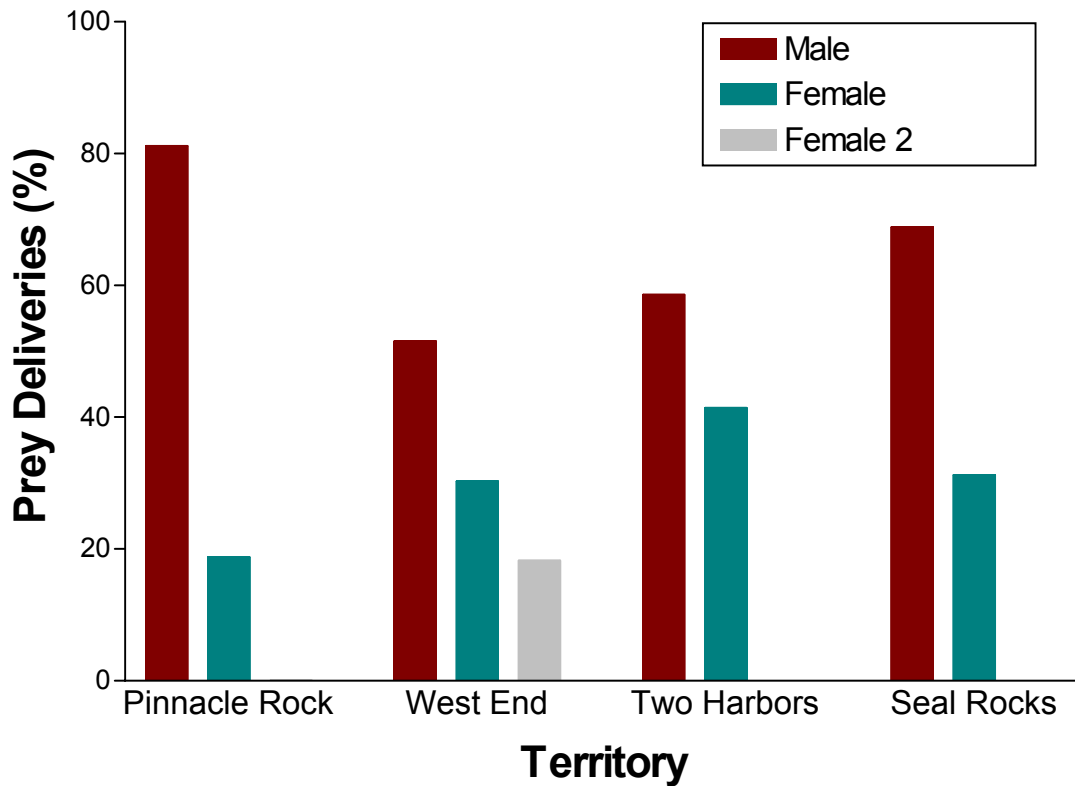
## Prey Deliveries

We observed 16 prey deliveries at the Pinnacle Rock nest during 39.7 hours of observations (0.40 items/hr), 33 prey deliveries during 214.5 hours of observations at the West End nest (0.15 items/hr), 16 prey deliveries during 161.2 hours of observations at the Seal Rocks nest (0.10 items/hr), and 29 prey deliveries during 153 hours of observations at the Two Harbors nest (0.19 items/hr). At all nests, the males made more prey deliveries than the females (Fig. 7).



**Figure 5.** Percent of time that chicks spent in 3 different postures at the Two Harbors, West End, and Seal Rocks nests, Santa Catalina Island, California, 2003.

**Figure 6.** Percent of time that chicks were observed being fed by adults or self-feeding at the Two Harbors, West End, and Seal Rocks nests, Santa Catalina Island, California, 2003.



**Figure 7. Percent of prey deliveries made by adults to nests in 4 different territories in 2003. Female 2 is a second female helper at the West End nest.**

Fish made up the largest portion of prey items delivered to nests in all territories (87.5 - 93.8%) and only three birds were seen brought to nests (Table 4). The Two Harbors birds have their nest above an out grow pen for white seabass maintained by Hubbs-Sea World. Dead fish from this pen are regularly thrown out for the eagles to feed upon.

### **Additional Eagle Sightings**

There were reports of 10 different Catalina-released eagles from people on the mainland or other Channel Islands during 2003.

K-01, (FWS Band # 629-29498), fostered into the Pinnacle Rock nest in 2000, was reported on San Clemente Island, California on 24 April. The next day, this bird was seen soaring above Silver Peak on Catalina Island.

K-02 (FWS Band # 629-29499), fostered into the West End nest in 2000, was seen by IWS personnel on Santa Cruz Island, California on 4 March.

Table 4. Food items delivered to the Pinnacle Rock, Seal Rocks, Two Harbors, and West End nests during monitoring on Santa Catalina Island, California, 2003.

Food Item	Prey deliveries							
	Pinnacle Rock		Seal Rocks		Two Harbors		West End	
	n	% of Total	n	% of Total	n	% of Total	n	% of Total
<u>FISH</u>								
Unknown fish	9	56.3	13	81.3	12	41.4	20	60.6
Pacific sardine ( <i>Sardinops sagax</i> )	3	18.8	1	6.3	1	3.4	0	0.0
White seabass ( <i>Atractoscion nobilis</i> )	2	7.4	0	0.0	0	0.0	0	0.0
California Sheephead ( <i>Semicossyphus pulcher</i> )	1	6.3	0	0.0	0	0.0	2	6.1
Kelp bass ( <i>Paralabrax clathratus</i> )	0	0.0	0	0.0	1	3.4	0	0
Catalina conger ( <i>Gnathophis catalinensis</i> )	0	0.0	0	0.0	0	0.0	1	3.0
White seabass ( <i>Atractoscion nobilis</i> )	0	0.0	0	0.0	13	44.8	1	3.0
Opaleye ( <i>Girella nigricans</i> )	0	0.0	0	0.0	0	0.0	2	6.1
Calico surfperch ( <i>Amphistichus koelzi</i> )	0	0.0	0	0.0	0	0.0	2	6.1
Kelp bass ( <i>Paralabrax clathratus</i> )	0	0.0	0	0.0	0	0.0	1	3.0
Giant kelpfish ( <i>Heterostichus rostratus</i> )	0	0.0	0	0.0	0	0.0	1	3.0
Blacksmith ( <i>Chromis punctipinnis</i> )	0	0.0	0	0.0	0	0.0	1	3.0
Fish Subtotal	15	93.8	14	87.5	27	93.1	31	93.9
<u>BIRDS</u>								
Unknown gull ( <i>Larus</i> sp.)	0	0.0	0	0.0	1	3.4	0	0.0
Heermann's gull ( <i>Larus heermanni</i> )	1	6.3	0	0.0	0	0.0	1	3.0
Birds Subtotal	1	6.3	0	0.0	1	3.4	1	3.4
<u>MAMMALS</u>								
Unknown mammal	0	0.0	0	0.0	0	0.0	1	3.0
Mammal Subtotal	0	0.0	0	0.0	0	0.0	1	3.0
<u>OTHER</u>								
Unknown	2	12.5	2	12.5	1	3.4	0	0.0
Other Subtotal	2	12.5	2	12.5	1	3.4	0	0.0
<b>TOTAL FOOD ITEMS</b>	<b>16</b>		<b>16</b>		<b>29</b>		<b>33</b>	



K-11 (FWS Band # 629-02780), fostered into the West End nest in 2001, was first reported near Klamath Falls, Oregon on 10 January. By 21 March the eagle had returned to southern California and was spotted at Lake Cachuma, Santa Barbara County, California. On 4 August, this eagle was seen by IWS personnel near an eagle hacking tower on Santa Cruz Island.

K-13 (FWS Band # 629-02783), fostered into the Pinnacle Rock nest in 2001, was reported at Sweetwater Reservoir near San Diego, California during January, and then again in November of this year.

K-16 (FWS Band # 629-02784), fostered into the Seal Rocks nest in 2001, was reported near Sheridan, Placer County, California on 10 January.

K-20 (FWS Band # 629-02789), hacked from the Bulrush tower in 2001, was seen at Lake Cachuma on 23 February.

K-23 (FWS Band # 629-02790), fostered into the Pinnacle Rock nest in 2002, was reported at the Lewiston Fish Hatchery, Trinity County, California on 15 January. This eagle had been seen in the area for about one month prior to the report.

K-22 (FWS Band # 629-02791), fostered into the Pinnacle Rock nest in 2002, seen alive on 8 February near Cape Meares, Oregon. Unfortunately, it was reported dead near Brandon, Oregon on 28 April. The bird had been seen feeding on stillborn sheep a few days earlier.

K-28 (FWS Band # 629-02799), fostered into the Seal Rocks nest in 2002, was seen at Lake Cachuma on 20 December. This was the third Catalina bird seen at the lake in 2003.

## **Collection of Tissue Samples**

We collected blood samples for chemical analyses from three juvenile bald eagles on Catalina Island this season. In addition, the ACC collected the egg contents and embryos from eggs that were collected on Catalina Island and failed to hatch (Appendix II).

## **DISCUSSION**

The egg and chick manipulations during 2003 were successful. We were able to foster four eagles into a total of four nests on the island, although one had to be removed because of injuries. Removal of eggs from bald eagle nests may cause abandonment of nests in some cases (Anthony et al. 1994), but because of our ability to access nests quickly, bald eagles on Catalina Island rarely abandon nests following our manipulations.

Our results from this season indicate that the reproduction of bald eagles on Catalina Island continues to suffer from greatly reduced hatchability of eggs. We collected eight eggs this year, all

of which were fertile, but of which only one egg hatched (12.5% hatching rate). Unfortunately, the eaglet died at the Zoo from an infection before it could be fostered into a nest. Since the egg removal phase of this project began in 1989, only 11 of 59 fertile eggs have hatched (18.6% hatching rate). The eggs collected from Catalina nests have the potential for excessive water loss associated with abnormal eggshell structure (Risebrough 1993), but the ACC is able to control water loss using a variety of techniques following the transport of the eggs to the Zoo. Most of the eggs collected now develop to within a week of the predicted hatch date before dying in the shell from unknown causes. The low hatching success, and the fact that an additional egg broke in the Twin Rocks nest following egg removal, further emphasize the need for active management of the population and clean-up of the contaminated environment.

It is unclear why the Twin Rocks birds abandoned their nest this season. The artificial eggs were still present and the nest was abandoned before the 35-day incubation period was complete. We will monitor the nest closely next season to make sure the adults are behaving normally before fostering a chick into the nest.

The Two Harbors pair had a lower overall nest attendance rate when compared to breeding birds in other territories. The lower rate is primarily a result of a drastic drop in nest attendance at approximately Day 50 of chick rearing (see Fig. 4). Before Day 50 the birds had attendance rates similar to that in other territories. The drop in attendance could be a result of inexperience, as this was their first breeding attempt. There are also cliffs near the nest upon which the adults are often seen perched, so it is possible that the birds were monitoring the nest from nearby perches. The adults apparently were not neglecting the eaglet because prey delivery rates were similar to that in other territories and the eagle successfully fledged.

We anticipate productivity at the Catalina Island eagle nests in 2004 to be similar to this year, with the possible addition of one breeding territory near Avalon. We will begin searching for breeding activity in mid-January next year to avoid missing active nests and locate pairs that may have formed or moved since the previous breeding season.

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# Appendix I

## ADULT BEHAVIORS TO BE RECORDED DURING SCAN SAMPLING

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### POSTURES

Standing (ST)	Bird is upright on one or both of its feet on any substrate
Sitting (SI)	Bird is resting its weight on its tarsometatarsus (not its feet) and does not have its sternum touching the nest substrate
Lying (L)	Bird is prone on the nest with its sternum touching the nest substrate
Flying (F)	Feet of bird are not touching any substrate (flapping or hovering)

### BEHAVIORS

Brooding (BR)	Bird is sheltering chick under body or wing, and may be pulling nest material around its body
Resting (R)	Bird is lying in nest with its head resting on the substrate
Eating (EA)	The act of pulling at or swallowing food
Feeding (FE)	The act of preparing or giving food to a chick
Preening (PR)	Bird has its beak buried in its feathers or is running its beak along the shaft of a feather
Nest Maintenance (NM)	Bird bringing nest material, or arranging nest material in the nest
Walking (WA)	Moving around the nest either in the standing or sitting postures
Vocalizing (V)	Head back, and appearing to vocalize
Out of view (O)	Bird is either facing away from camera and behavior is unknown, or bird is blocked from view by the nest or another bird
Alert (A)	Bird is attentively looking around or in a particular direction
Non-Descript (N):	Behavior belongs to no definite class (e.g., non-alert scanning, watching chick)

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## Appendix I (continued)

### CHICK BEHAVIORS TO BE RECORDED DURING SCAN SAMPLING

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#### POSTURES

Standing (ST)	Bird is upright on one or both of its feet on any substrate
Sitting (SI)	Bird is resting its weight on its tarsometatarsus (not its feet) and does not have its sternum touching the nest substrate
Lying (L)	Bird is prone on the nest with its sternum touching the nest substrate
Flying (F)	Feet of bird are not touching any substrate (flapping or hovering)

#### BEHAVIORS

Resting (R):	Bird is lying in nest with its head resting on the substrate.
Eating (EA)	The act of pulling at or swallowing food without help from an adult
Feeding (FE)	Act of taking food from the adult or swallowing food offered by the adult.
Preening (PR)	Bird has its beak buried in its feathers or is running its beak along the shaft of a feather
Playing (PL):	Toying with nest material, feathers, or food
Wing Exercising (WE):	Flapping both wings while the feet are in contact with the nest substrate
Walking (WA)	Moving around the nest either in the standing or sitting postures
Wing-flap/Jump (J):	Flapping wings and jumping from one part of the nest to another.
Wing Stretch (WS):	Extending one wing or a wing and a leg.
Wings Out (WO):	Extending both wings out, usually precedes a wing-flap/jump or flying.
Out of view (O)	Bird is either facing away from camera and behavior is unknown, or bird is blocked from view by the nest or another bird
Non-Descript (N):	Behavior belongs to no definite class (e.g., non-alert scanning, watching chick)

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## Appendix II

Specimens collected from bald eagles on Catalina Island, CA for analyses in 2003.

Tissue Type	Collection Location	Description
Whole Blood	West End Nest	10.0 cc from 8-week old eaglet (K-35)
Whole Blood	Two Harbors Nest	9.5 cc from 8-week old eaglet (K-36)
Whole Blood	Seal Rocks Nest	10.0 cc from 11-week old eaglet (K-37)
Egg Contents and Shell <sup>a</sup>	West End Nest	Zoo ID # 03-0021
Egg Contents and Shell <sup>a</sup>	West End Nest	Zoo ID # 03-0022
Egg Contents and Shell <sup>a</sup>	Pinnacle Rock Nest	Zoo ID # 03-0023
Egg Contents and Shell <sup>a</sup>	Twin Rocks Nest	Zoo ID # 03-0024
Egg Contents and Shell <sup>a</sup>	Seal Rocks Nest	Zoo ID # 03-0036
Hatched Chick, Shell, Yolk Sac <sup>a</sup>	Seal Rocks Nest	Zoo ID # 03-0037
Egg Contents and Shell <sup>a</sup>	Two Harbors Nest	Zoo ID # 03-0041
Egg Contents and Shell <sup>a</sup>	Two Harbors Nest	Zoo ID # 03-0042

<sup>a</sup> Collected by staff at San Francisco Zoo. Egg shells were rinsed in water, air dried, and stored in aluminum foil. Shell contents were placed directly into a chemically clean jar, sealed with an evidence label, and frozen.