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January 16, 2007

U.S. Fish and Wildlife Service
Attn: Recovery Permit Coordinator
Carlsbad Fish and Wildlife Service Office
6010 Hidden Valley Road
Carlsbad, CA 92009

Dear Recovery Permit Coordinator,

Enclosed is the annual report for the Bald Eagle Restoration Program on Santa Catalina Island, California as covered by Federal Fish and Wildlife Permit TE744878-9 issued to the Institute for Wildlife Studies. Please feel free to contact me if you have any questions or require additional information.

Sincerely,

Peter B. Sharpe

Peter B. Sharpe, Ph.D.

Restoration and Management of Bald Eagles on Santa Catalina Island, California, 2006

A Report Prepared for:

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January 2007

INTRODUCTION

Bald eagles (*Haliaeetus leucocephalus*) were extirpated from the Channel Islands by the early 1960s as a result of human persecution and the introduction of the organochlorine pesticide DDT into the Southern California Bight (Fig. 1). 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).

The Institute for Wildlife Studies (IWS), in cooperation with the United States Fish and Wildlife Service (FWS) and California Department of Fish and Game (CDF&G), initiated a program to reintroduce bald eagles to Santa Catalina Island, California (Fig. 1) in 1980. Between 1980 and 1986, 33 eagles were released on the island from 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.

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

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 thinning of the shell (L. Kiff, Expert Report) and 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. 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. Chicks that hatch from these removed eggs, or those produced by captive adults at the Avian Conservation Center (ACC) at the San Francisco Zoo, are then fostered into the nests. From 1989 through 2006, adult bald eagles successfully reared 48 of 59 chicks that were either fostered into nests (57 chicks) or hatched from two of three healthy eggs that were placed into nests. Four of these 59 birds were removed from the nest prior to fledging because of injuries and seven died due to accidents, predation, or unknown causes. An additional 21 eagles have been released through continued hacking activities since 1991 (20 chicks and a 1-year-old bird).

The purpose of this project is to maintain the breeding bald eagles on Catalina Island until they are able to successfully breed on their own without human manipulation. This report summarizes the results of the egg and chick manipulations and subsequent monitoring for the nesting season of 2006.

Table 1. Summary of Bald Eagle egg and chick manipulations on Santa Catalina Island, 1989-2006.

	Year																	
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
# of Active Nests	1	2	2	3	3	2	3	3	2	3	4	3	4	4	5	5	5	5
# of Eggs Laid	2	2-3	3	5	5-6	3	5	5-6	6	7	8	7	8	8	9	11	11	10
# of Eggs Collected	1	1	3	5	4	3	5	4	5	6	6	4	7	7	8	11	11	10
# of Catalina Island Eggs Hatched[a]	0	0	1	2	0	0	0	0	1	1	1	2	0	2	1	3	3	5
# of Eggs Fostered Into Nests on Catalina Island	0	0	2	0	0	0	1	0	0	0	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	5	5	5
# of Chicks Fledged From Nests on Catalina Island	1	0	2	3	1	1	1	2	1	3	2	4	5	6	3	5	5	3
# of Eagles Hacked Onto Catalina Island	0	0	2	0	2	0	2	5	0	4	2	0	4	0	0	0	0	0
# of Island-Produced Eagles Breeding on Island	0	0	0	0	0	0	0	0	1	1	2	1	2	2	3	3	3	3
# of Second Generation Eagles Fledged	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	2

STUDY AREA

Santa 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^2 (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).

Nesting Territories

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

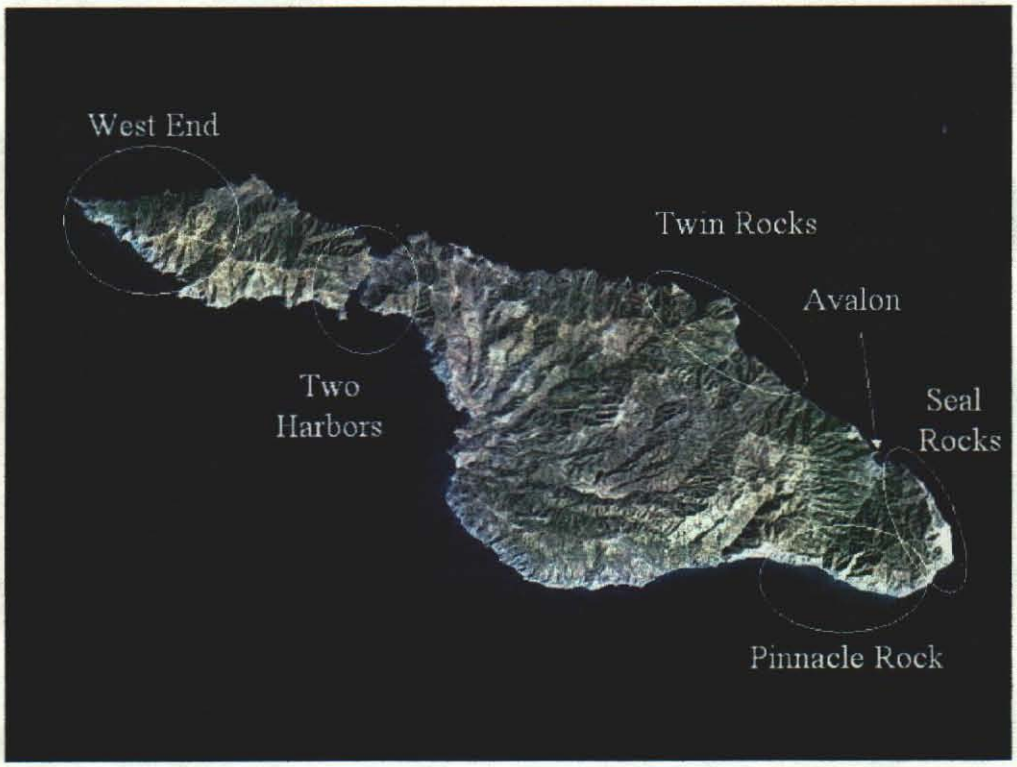

Figure 2. Active bald eagle territories and points of reference on Santa Catalina Island, California.

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. The original male disappeared between the 2005 and 2006 breeding seasons. In 2006, male K-01, fostered into the Pinnacle Rock nest in 2000, was observed in the vicinity of the nest and was apparently

accepted by the two females. 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. In the fall of 2005 the female was found dead in a canyon on the southern edge of their territory. The female was replaced by a 7-year-old female in 2006. There have been six different nest sites in this territory from 1990-2006.

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 has nested every year through 2006.

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 (the current Twin Rocks 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. 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. The pair did not attempt to nest in 2000, but successfully fledged a fostered chick in each year from 2001 through 2006.

The Two Harbors territory is located 2 km SW of the town of Two Harbors (Fig. 2) and was first occupied by a pair of 5-year-old birds in 2003. The nest was constructed on a rock outcrop on a narrow ridge about 50 m above the ocean. This pair fledged a single fostered chick each year from 2003 through 2006.

METHODS

Nest Manipulations

Observations of adult eagles began in January this year at each of last year's nest sites. Once we confirmed that the eagles were going to use the same nests as last year, we set up observation blinds from which to observe the nests. From the blinds we monitored the chronology of nesting through incubation and chick-rearing. We did not quantify behavior or prey delivery data as in previous seasons because a cut in funding at the end of 2005 did not allow for enough personnel for this labor-intensive effort. At the West End, Seal Rocks, and Two Harbors nests we had established video cameras prior to the breeding season that allowed close observations of nesting activity. Through a collaborative effort with the University of Southern California's Wrigley Institute for Environmental Studies we were able to get the live video from the West End and Two Harbors nests on the internet (http://www.iws.org). This allowed us to monitor these nests via the internet to save the 1-2 hour drive time to the nests, or when roads were impassable due to rainfall.

We replaced eggs laid by nesting pairs with artificial eggs within 2-7 days of the date that eagles were confirmed incubating. We replaced the artificial eggs with healthy chicks after the adults had incubated approximately 35 days and returned to the nests when chicks were 8 weeks old to equip them with federal 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).

Monitoring

We monitored each nest from incubation through fledging of chicks. We used radio-telemetry to locate and observe fledged eagles every 1-3 days during their first month of flight and then at least once per week through October, or until they left the island. During observations we recorded each bird's location, behavior, and interaction with other eagles.

Artificial Incubation

In winter 2004/2005 we established an incubation facility at our office in Avalon, California. The facility has two incubators, candler, hatcher, brooder, and all the other equipment necessary to hatch the eggs (Fig. 3). We acquired a Grumbach incubator from the San Francisco Zoo and purchased a Brinsea Contaq X8 incubator. Unlike the Grumbach, which surrounds the

eggs with warm, moist air, the X8 uses an air bladder inflated with warm air that rests on top of the eggs. This more closely mimics the conditions in a nest. Eggs were weighed and measured upon arrival in the facility so that we could estimate weight loss trends. Eggs should typically lose about 15% of their weight during the 35-day incubation period. If weight loss was above the predicted weight loss of a healthy bald eagle egg, then we covered portions of the egg below the aircell with Tegaderm. This reduced water loss through the shell, but allowed gas exchange. The Grumbach incubator, which can be set at higher humidity levels than the Brinsea, was used for eggs for which Tegaderm alone could not control water loss. The remaining eggs were placed in the Brinsea.

Figure 3. Incubation facility with Brinsea incubator (left), Brinsea hatcher (center), and Grumbach incubator (right).

RESULTS

Manipulations and Monitoring

Nests were located in February 2006 in all five previously occupied territories: Twin Rocks, Pinnacle Rock, Seal Rocks, West End, and Two Harbors (Fig. 2).

Twin Rocks

The territory was used by the same pair that used it from 1998-2005. 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. On 1 February, the pair was seen copulating and then they flew to the same nest that was used in 2005. The female was observed in incubation posture on 19 February, at which time one egg was observed. On 23 February we hiked to the nest and replaced two eggs with two artificial eggs. Both eggs were fertile and both hatched (see below).

On 2 April, we fostered one of the chicks that hatched from the Twin Rocks eggs back into the nest. We returned to the nest on 21 May and equipped the eaglet with leg bands, transmitter, and wingmarkers and obtained a blood sample (Table 1). When we went to observe the nest on 26 May the chick was no longer in the nest. Its telemetry signal was coming from the vicinity of the nest, but we were unable to see it. Searches over the next few days failed to turn up the eagle, which appeared to be down in a deep gorge below the nest. The signal continued to come from the gorge, which we were unable to safely access, for the next few months and it is believed that the bird fell out of the nest and into the gorge during a period of strong winds.

Table 1. Biographical data for bald eagle chicks fostered into nests on Santa Catalina Island, California during 2006.

Federal Band	Sex	Wing Marker	Date Fledged	Foster Nest	Status[a]	Comments
629-52401	Male	K-61	6/13/06	Seal Rocks	Unknown	Left island in early August
629-52402	Female	K-62	N/A	Twin Rocks	Dead	Disappeared from nest
629-52423	Female	A-61	.	West End	Dead	Injured. Released on Santa Cruz Is. after recovery
629-52403	Female	K-63	6/17/06	Two Harbors	Alive	On Catalina Island
629-52408	Male	K-64	7/11/06	Pinnacle Rock	Alive	On Catalina Island

[a] As of 12/31/06

West End Territory

The West End trio of birds used the same nest that has been used since 1991. However, the original male, believed to have been released in 1981, disappeared from the territory after the breeding season. A new male, K-01 joined the territory early in the breeding season. This bird was produced by captive birds at the ACC and fostered into the Pinnacle Rock nest in 2000. The original female (Female 1) was not marked with patagial tags, but is believed to be a 20-year-old bird released at the Sweetwater hacktower in 1986. The second female (Female 2), which joined the original pair in 1992, is a 20-year-old bird (K-69) that also was released at the Sweetwater hacktower in 1986. This nest was monitored primarily via our live web cam and birds were regularly seen at the nest throughout February. On 26 February we detected the first egg in the nest. We entered the nest on 2 March and removed two eggs, both of which were infertile, replacing them with artificial eggs.

On 3 April we fostered the second chick that hatched from the Twin Rocks eggs into the nest. We returned to the nest on 23 May to band the bird, but found that it had a fractured right leg. The eaglet was removed and transported to the Orange County Birds of Prey Center for veterinary care. The leg was repaired and the eaglet was eventually transported to Santa Cruz Island to be released from a hacking tower as part of our Northern Channel Islands bald eagle restoration program.

Pinnacle Rock

The Pinnacle Rock pair used the same nest as in 2005. The original female was found dead at the end of 2005, but was replaced with a female that was released from the Bulrush hacking tower in 1999. This female, K-92, had been part of the Rattlesnake territory for the past several years, but we never found any signs of nesting. The 20-year-old male (K-65) was hacked at the Bulrush tower in 1986. The female was seen in the Rattlesnake territory as late as 11 March, copulating with the territorial male. On 16 March, an egg was seen in the Pinnacle Rock nest and K-92 was confirmed to be the breeding female. A second egg was laid on 18 March and we removed both eggs from the nest via helicopter on 20 March. Both eggs showed signs of development and one of the eggs hatched on 23 April, the first egg to ever hatch from this territory.

On 3 May, we fostered the Pinnacle Rock chick back into the nest. We returned to the nest on 16 June to install leg bands, transmitters, and wingmarkers on the eaglet and to obtain a blood sample (Table 1). The eaglet was observed out of the nest for the first time on 11 July. We followed the bird via telemetry and it remained on the island through the end of the year.

Seal Rocks Territory

The Seal Rocks pair used the same nest as in 2005. The 13-year-old female (K-34) is from the captive ACC eagles and was hacked at the Bulrush tower in 1993. The 14-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 birds were seen at the nest throughout February and the first sign of incubation behavior was on 21 February. We entered the nest on 26 February and removed two eggs, replacing them with two artificial eggs. Both eggs were fertile and one hatched on 25 March.

On 1 April we fostered the chick that hatched from the Seal Rocks egg back into the nest. We returned to the nest on 19 May 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 or around 13 June (Table 1). We relocated the bird via telemetry several times per week until it apparently left the island in mid-August.

Two Harbors Territory

The Two Harbors pair used the same nest as last season. The 8-year-old male (K-81) is an ACC-produced eagle that was fostered into the West End nest in 1998. The 8-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 nest was monitored primarily via our live web cam. Activity was noted at the nest starting on 2 February and the birds were first observed incubating on 21 February. On 25 February we entered the nest and removed two eggs, replacing them with two artificial eggs. The eggs were both fertile and one hatched on 29 March.

On 3 April the Two Harbors chick was fostered into the nest. We returned to the nest on 22 May to install leg bands, a transmitter, and wingmarkers on the chick, and to obtain a blood sample. On or around 17 June, the bird was seen outside the nest for the first time (Table 1). Tracked this bird once it left the nest and it remained on the island through the end of the year.

Reports on Previously Released Eagles

Eagle K-02, fostered into the West End nest in 2000, was reported to be breeding at Lake Hemet, California. We confirmed her identity on 17 May, at which time she had a 4-5 week-old chick. The chick successfully fledged around late June.

Eagle K-10, a bird fostered into the Twin Rocks nest in 2001, was found breeding with another Catalina eagle, K-26, on Santa Cruz Island. The pair laid two eggs and successfully hatched and fledged one chick.

Eagle K-11, a bird fostered into the West End nest in 2001, was found breeding with a Santa Cruz female on Santa Cruz Island in early April. The pair successfully hatched and fledged a single chick from a ground nest in the middle of a field on the southwestern portion of the island.

Eagle K-13, a bird fostered into the Pinnacle Rock nest in 2001, was found dead in a canyon at the west end of Catalina Island on 17 February. This bird had spent the past couple of years on the mainland of southern California and we had received many sighting reports of this bird. The bird was too decomposed to determine the cause of death.

Eagle K-23, fostered into the Pinnacle Rock nest in 2002, was seen and photographed with another adult bald eagle near Genoa, Nevada on 17 May.

Eagle K-35, fostered into the West End nest in 2003, was seen at Sweetwater Reservoir near San Diego, California on 21 March.

Eagle K-37, fostered into the Seal Rocks nest in 2003, was seen and photographed at Stanfield Marsh Wildlife Preserve on Big Bear Lake, California on 9 February.

Eagle K-42, fostered into the Twin Rocks nest in 2004, which had previously been on Catalina, moved to San Clemente Island in late 2005. We regularly picked up its signal from San Clemente Island until 16 October. and it was seen several times by IWS employees working on that island. The transmitters are only expected to function for about 2 years, so it is likely the transmitter either stopped functioning or detached from the bird.

Eagle K-43, fostered into the Pinnacle Rock nest in 2004, was reported at Shasta Lake, California on 13 January.

Eagle K-47, fostered into the Seal Rocks nest in 2004, was seen many times along the eastern coastline of Catalina this year. The bird still has a functioning transmitter.

Eagle K-51, fostered into the Pinnacle Rock nest in 2005, remained on Catalina at least through 22 June.

Eagle K-54, fostered into the West End nest in 2005, remained on Catalina through 2006.

Eagle K-55, fostered into the Two Harbors nest in 2005, was found dead underneath power lines near San Antonio Reservoir in Alameda County, California around 25 July.

Eagle K-56, fostered into the Seal Rocks nest in 2005, remained on Catalina through 2006.

Artificial Incubation

In 2006, we collected 8 fertile eggs (10 total eggs) from the five active nests on the island. Of these eggs, we successfully hatched 5 eggs (62.5%), the highest success rate since the artificial incubation aspect of the program began in 1989 (Table 2)

Table 2. Summary of artificial incubation of eggs removed from bald eagle nests on Santa Catalina Island, California in 2006.

Territory/ Egg #	Estimated Lay Date	Estimated Initial Wt.	Days Incubated	End Wt.	Comments
Twin Rocks					
06-01	2/18/06	131.92 g	37	.	Hatched and fostered
06-02	2/21/06	123.79 g	36	.	Hatched and fostered
Two Harbors					
06-03	2/21/06	143.87 g	34	119.71	Died in shell
06-04	2/23/06	142.64 g	34		Hatched and fostered
Seal Rocks					
06-05	2/21/06	140.64 g	33	120.22 g	Died in shell
06-06	2/19/06	138.95 g	34	.	Hatched and fostered
West End					
06-07	3/1/06	136.83 g	4	134.68 g	Infertile
06-08	2/26/06	136.07 g	5	132.91 g	Infertile
Pinnacle Rock					
06-09	3/16/06	95.92 g	36	78.9	Died in shell
06-10	3/18/06	108.95 g	36	.	Hatched and fostered

DISCUSSION

In 2006, we successfully incubated and hatched five bald eagle eggs, the highest success rate since the inception of the nest manipulation portion of the project in 1989. This was the first year since we began manipulating the Catalina eagle nests that we did not need to rely on an outside source of eaglets. Three of the eaglets fledged on Catalina (a fourth later fledged from a tower on Santa Cruz Island) and two of the three eagles remained on the island through the end of the year.

We anticipated the addition of a new breeding pair on Catalina Island in 2006, the Rattlesnake pair. Although we observed copulations between these birds, the female moved to the Pinnacle Rock territory and laid two eggs. Although we have searched for evidence of nesting by the Rattlesnake birds for the past two years, we had never found any evidence of nesting. However, this spring we located a small stand of trees about 500 m up a canyon from the ocean with a nest about 1-1.5 m in diameter. There was no activity at the nest, but it is possible it is a bald eagle's nest. If so, the Rattlesnake pair may have laid eggs that failed to hatch in the past, which could account for the female's move to another territory. Another adult bald eagle with blue wingmarkers (from our Santa Cruz reintroduction) regularly has been seen in the Rattlesnake territory this year. We will closely monitor this potential nest site in 2007 to see if it is being used.

Recalibration of our incubators and greater incubation experience may have helped us increase our hatching success this season. Some eggs, especially from the Seal Rocks nest, have needed little addition of Tegaderm to control their water loss, so we are considering letting the Seal Rocks pair keep their eggs in 2007 to see if they can successfully hatch. The success or failure of this experiment will help direct our future efforts at maintaining a population of bald eagles on Catalina Island.

ACKNOWLEDGMENTS

We thank Ryan Dibala and Jeanne Parker for their hard work on all aspects of this study during 2006. We also thank veterinarian Winston Vickers for his assistance in insuring that the hatchlings were healthy and thriving. The Santa Catalina Island Conservancy provided access to their land and the University of Southern California's Wrigley Institute for Environmental Studies allowed us to use their facilities at Two Harbors to get live video feeds from two of our nests on the Web, greatly decreasing the time needed to travel to nests to check on their status.

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