Bald eagle restoration in the Channel Islands presents a special situation due to the observed ongoing reproductive impairment of Santa Catalina Island bald eagles through exposures to DDTs and PCBs. Thus, selecting restoration options requires consideration of interrelated factors and depends ultimately on the outcome of an ongoing Northern Channel Islands (NCI) Feasibility Study. At present, this Restoration Plan can only select a course of continued interim efforts and establish a set of future options associated with each of the different potential outcomes of the NCI Feasibility Study.

B.1 GOALS AND NEXUS TO INJURY

The bald eagle is a priority resource for restoration that continues to demonstrate injury from the contaminants of the case. The Trustees' overall goal is to restore self-sustaining bald eagles to the Channel Islands. Bald eagles historically nested on the Channel Islands prior to the releases of the contaminants, but by the early 1960s had disappeared from the area (Kiff 1980). In 1980, a multiagency program reintroduced the birds to Santa Catalina Island but their breeding continues today to be impaired by DDTs and PCBs. Due to the continued presence of these contaminants, it is not yet known to what extent the bald eagle restoration goal is attainable in the near term, while DDTs and PCBs persist in the marine environment at levels still capable of causing injuries to these birds.

B.2 BACKGROUND

Bald eagles were a resident breeding species on all of the California Channel Islands from before the turn of the century until at least the 1930s (Willett 1933, Kiff 1980). Ornithologists and egg collectors reported bald eagles to be common on the Northern Channel Islands between the late 1800s through the 1930s. From the 1800s to 1950, bald eagle nesting areas were reported from a minimum of 35 different locations on the islands, making the Channel Islands a stronghold for this species in Southern California (Kiff 2000). However, due to the lack of systematic surveys, this number is likely an underestimate (Kiff 2000). The last confirmed nesting of an eagle on the Channel Islands was in 1949 on Anacapa Island (Kiff 1980).

Little published information is available regarding the status of bald eagles on the Channel Islands after the 1940s, but a few adult birds continued to be observed on some of the islands into the late 1950s and 1960s. Santa Catalina Island residents remember seeing eagles up until the middle to late 1950s (Kiff 1980, Garcelon 1988). By the early 1960s, bald eagles had disappeared from all of the Channel Islands (Kiff 1980). Timing of the decline of bald eagles on the Channel Islands coincided closely with the extirpation of peregrine falcons and bald eagles from other portions of their North American range as a result of eggshell thinning effects of DDE (Kiff 2000, Garcelon 1988). The reduction of bald eagle populations in many areas of the country has been correlated with high levels of organochlorine compounds and specifically with metabolites of DDTs (Stickel et al. 1966, Krantz et al. 1970). Other factors contributing to the decline of bald eagles on the Channel Islands and Southern California included historical persecution by humans (egg collecting and shooting), and limited nesting opportunities on the mainland of Southern California due to development and recreation (Kiff 1980).

Raptor species, such as bald eagles and peregrine falcons, are particularly susceptible to these contaminants because they are high trophic level predators. Because DDTs and PCBs are slow to

break down and are strongly attracted to fats, they bioaccumulate and become more concentrated in animals at higher levels in the food web. When feeding on food contaminated with DDE (a metabolite of DDT) and PCBs, animals at the top of the food web, like bald eagles and peregrine falcons, can accumulate harmful concentrations of these chemicals. DDE has been demonstrated to cause eggshell thinning and subsequent reproductive failure in many species of birds feeding in the marine ecosystem (Hickey and Anderson 1968, Risebrough et al. 1971, Gress et al. 1973). DDE in the diet of bald eagles has negatively affected the ability of the eagles to produce young (Wiemeyer et al. 1993). The continuing influence of this contaminant also accounted for the inability of bald eagles to recolonize the islands after other sources of mortality had ceased (Kiff 2000).

Bald eagles are currently listed as threatened under the Endangered Species Act, but have been proposed for delisting due to substantial recovery of the species on the mainland. The U.S. Fish and Wildlife Service (USFWS), in its Pacific Bald Eagle Recovery Plan, set recovery goals for bald eagles for specific zones in California. The Recovery Plan indicates that the most suitable habitat in Southern California is on the Channel Islands, especially Santa Cruz and Santa Catalina Islands (Jurek 2000, USFWS 1986). As outlined in the Recovery Plan, the recovery population goal is the minimum nucleus of nesting pairs which, if self-sustaining over the long term, will be capable of maintaining the genetic variability in the breeding population (USFWS 1986). This population goal is 6 nesting pairs for the Channel Islands zone and a minimum of 16 territories needed to provide secure habitat for the recovered population. Although Santa Catalina Island currently has 5 breeding pairs, they continue to suffer reproductive problems and are not considered self-sustaining (see Section B.2.3).

B.2.1 Historical Numbers of Bald Eagles on the Northern Channel Islands

Kiff (2000) showed a minimum of 24 different bald eagle nesting territories on the Northern Channel Islands (Anacapa, Santa Cruz, Santa Rosa and San Miguel) with a maximum of 14 nesting pairs reported in the same year on those islands. Santa Cruz Island regularly supported a minimum of at least five pairs of bald eagles, which nested in niches and potholes on the sea cliffs (Kiff 1980). Known nesting areas on Santa Cruz Island included Pelican Bay, San Pedro Point, Blue Banks, Valley Anchorage, Chinese Harbor, Potato Harbor, and Middle Grounds. Anacapa Island had as many as three nesting pairs in some years. However, since collectors or ornithologists did not visit large portions of the Northern Channel Islands very often, if at all, the estimates of nesting pairs are likely an underestimate (Kiff 2000).

B.2.2 Ecological Role of Bald Eagles on the Channel Islands

Bald eagles historically played an important role in the ecology of the Channel Islands by serving as both a top carnivore and a scavenger. Bald eagles prey primarily on fish taken live from the ocean; however, they also feed on seabirds and the carcasses of animals that wash up on shore.

No other species plays the same ecological role as the bald eagle. In the absence of bald eagles on the Northern Channel Islands, golden eagles (not native to the Northern Channel Islands) have become established. Nesting adult bald eagles defend territories and would likely have excluded golden eagles from establishing on the islands (USFWS 2004). The golden eagle, a

terrestrial predator, has had tremendous negative impacts on native island foxes, a species that does not have evolutionary adaptations to avoid predation (Coonan 2001, Roemer 1999).

In addition to their role in the balance of natural systems, bald eagles were revered by Native American cultures historically occupying the Channel Islands and are still admired and valued by people for whom the bald eagle is both a striking bird and our American symbol.

B.2.3 Santa Catalina Island Bald Eagle Program

In 1980, the USFWS and the Institute for Wildlife Studies, with the cooperation of the California Department of Fish and Game and Santa Catalina Island Conservancy, initiated a program to reintroduce bald eagles to Santa Catalina Island. Between 1980 and 1986, 33 eagles from wild nests were raised on three different artificial nest or hacking platforms on Santa Catalina Island (Garcelon 1988). The birds were released once they were able to fly (at around 12 weeks of age). Some of these birds matured and formed breeding pairs on the island. In 1987, the first bald eagle eggs were laid but soon broke. Subsequent contaminant analysis of egg remains revealed DDE levels sufficient to cause complete reproductive failure (Garcelon et al. 1989). During 1991–1993, the Institute for Wildlife Studies studied food habits of the released eagles and documented high levels of DDE in the tissues of certain prey items commonly consumed by these eagles (Garcelon 1997, Garcelon et al. 1997a, 1997b).

Since 1989, the reintroduced population has been maintained through manipulations of eggs and chicks at each nest site and through hacking of additional birds. From 1980 to 2004, a total of 21 birds have been hacked onto Santa Catalina Island (Sharpe 2004). During that same period, 47 chicks and 3 eggs (of which 2 hatched) have been fostered into nests on the island (Sharpe 2004). Adult bald eagles successfully reared 40 of these 49 chicks. Because of the high DDE concentrations in the eggs, this active program of manipulation and augmentation is necessary to maintain the Santa Catalina Island bald eagle population at this time.

In the egg manipulation process, structurally deficient eggs laid by the birds affected by DDE are replaced with artificial eggs. The adult eagles continue to incubate the artificial eggs, while the real eggs are removed 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 or by wild birds, are then fostered back into the nests. From 1980 to 2004, a total of 80 eggs were removed from nests on Santa Catalina Island, 14 of which hatched (Sharpe 2004). In 2005, the eggs will be artificially incubated in a facility on Santa Catalina Island rather than at the ACC.

Bald Eagle Territories on Santa Catalina Island

Nesting bald eagles have established five territories on Santa Catalina Island since 1984 (see Figure 3.4-3 in Section 3). A brief description of each territory is provided below.

- The West End territory was established in 1991 and is located 0.5 kilometers (km) (0.3 miles) from the northwestern end of the island on a rock pinnacle approximately 75 meters (246 feet) above the water. 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 (Sharpe 2004). The nest has been used since 1991.

- The Pinnacle Rock territory is located 4.3 km (2.7 miles) southwest of the city of Avalon. It was initially occupied in 1990 and the original pair, a 5-year old female and a 4-year old male, have continuously nested there since 1990 (Sharpe 2004).
- The Twin Rocks territory is located 5 km (3 miles) northwest of Avalon. The territory was first occupied in 1984 and has contained active nests in 1985, 1987, and 1989. A new 4-year old male joined the female of the original pair in 1995. The first eggs of the new pair were laid in 1997, but were abandoned after the egg switch. In 1998, the original female was replaced by a 12-year old female and this pair has nested in the territory every year to present (Sharpe 2004).
- The Seal Rocks territory is located 4.5 km (2.8 miles) southeast of the city of Avalon. The original pair of this territory first nested in 1988. The female of this pair died on May 5, 1993, from DDE contaminant poisoning (Garcelon and Thomas 1997). In 1995, another adult female laid two infertile eggs. A new female and male began occupying the territory in 1997. In 1999, the pair laid one egg but the nest was destroyed during a storm. The pair did not attempt to nest in 2000, but successfully fledged a fostered chick in 2001 through 2004 (Sharpe 2004).
- The Two Harbors territory is located 2 km (1.2 miles) southwest of the town of Two Harbors. This territory was first active in 2003 by a pair of 5-year old birds. The male of this territory is an ACC-produced eagle that was fostered into the West End territory in 1998. The female of this territory hatched from an egg laid in the West End territory in 1998 and was fostered into the Pinnacle Rock nest (Sharpe 2003).

Summary of Contaminant Data

Organochlorine contaminants, especially DDE, have been related to deleterious effects on bald eagle reproduction (Krantz et. al 1970, Grier 1982, Wiemeyer et al. 1984, 1993). Wiemeyer et al. (1993) reported that less than 3.6 micrograms per gram (µg/g) DDE (wet weight) was found in eagle eggs where normal reproduction was occurring (mean 5-year production $\geq$1.0 fledgling per nest). When DDE levels in bald eagle eggs exceed 3.6 µg/g (wet weight), declines in productivity are expected (productivity was almost halved), with considerable reduction in productivity expected when eggs exceed 6.3 µg/g wet weight (mean 5-year production $\leq$0.27 fledgling per nest) (Wiemeyer et al. 1993).

In addition to DDE, other contaminants have been associated with reduced nest success (Wiemeyer et al. 1993, Nisbet 1989). Of particular concern are PCBs, which co-occur with DDTs in eagle eggs (Wiemeyer et al. 1993) and have adverse effects that translate into reduced number of fledglings produced per nest. Adverse effects associated with PCB exposure include embryo and chick mortality, edema, growth retardation, and deformities (Peakall 1994). Normal reproduction has been associated with eagle eggs containing less than 4.0 µg/g PCBs (Wiemeyer et al. 1984). In the analysis by Wiemeyer et al. (1993) of data on eagle eggs containing both DDTs and PCBs, less than 3.0 µg/g total PCBs (wet weight) was measured in eggs where mean 5-year productivity approached 1.0 fledgling per nest. Productivity was substantially reduced (0.61 fledgling per nest) in nests where eggs had more than 5.6 µg/g total PCBs (wet weight) (Wiemeyer et al. 1993).

Sprunt et al. (1973) reported that a minimum of 0.7 eaglet per active nest is considered necessary to prevent a bald eagle population from declining. Kubiak and Best (1991) reported that 1.0 eaglet per nest is expected from a healthy eagle population. Similarly, the USFWS Pacific Bald Eagle Recovery Plan identifies the goal of 1.0 fledged young per pair with an average success rate per occupied site of not less than 65 percent over a 5-year period (USFWS 1986).

Contaminant Levels in Bald Eagle Eggs

Bald eagle eggs collected from Santa Catalina Island that failed to hatch have been monitored for DDE and PCB levels from 1989–2004 (Figures B-1 and B-2). Eagle eggs collected from the Pinnacle Rock and West End nests continue to show the highest DDE concentrations among the five different territories on the island. Unlike the other territories on the island, these nests have been occupied by the original female of that territory throughout the study period. Because these nests have been occupied by the same female over a period of 13 to14 years, continuous, long-term information on DDE concentrations in the eggs can be used to measure changes in contamination over time.

The concentrations of DDE in eggs from all five territories, and PCBs in eggs from three territories exceed thresholds (<3.6 µg/g and <3 µg/g, respectively) associated with reduced productivity (<1.0 fledgling/nest). In addition, no significant change (e.g., no reduction) in the DDE levels has occurred in these territories over time. For example the DDE concentrations in eggs show no temporal change over the past 4 years (i.e., 2001-2004, regression analysis, $p>0.05$) with most nests showing no trend ($p>0.2$). The concentration of DDE in one nest (Seal Rocks) did show an indication of a trend that could be considered borderline ($p=0.054$). The lack of statistical significance in the short term may reflect the limited number of observations for each nest ($df_{residuals} = 2$). However, regressions on data from two nests monitored since 1989 (Pinnacle Rock and West End) show no significant long-term change in DDE levels as well ($p > 0.4$, $df_{residuals} > 10$).

A change in the female of a territory can affect the contaminant levels in eggs (e.g., the Seal Rocks and Twin Rocks territories, Figures B-1 and B-2). This effect may result from female prey preference, foraging style, and age. Although concentrations in recent eggs from the Seal Rocks territory are significantly lower than in eggs from 1990 and 1992 (when the same nest was occupied by a different pair of eagles), concentrations continue to exceed the adverse effect threshold for DDE (3.6 µg/g). The presence of a new female in the Twin Rocks Territory since 1998 has resulted in egg concentrations that still exceed the effect threshold for DDE. Despite the lower DDE levels in these eggs, the detrimental effects of eggshell thinning continue today as evidenced by a broken egg found in the Twin Rocks nest in 2003.

The Two Harbors territory was established in 2003 by two 5-year-old birds, but concentrations in the single sample from 2003 already exceeded the threshold concentration for DDE and PCBs necessary for healthy eagle reproduction (Figures B-1 and B-2).

Given that DDE and PCB levels in eggs are not declining, and currently exceed thresholds associated with reduced productivity (<1.0 fledgling/nest), it is unlikely that eagles would be able to be self-sustaining on Santa Catalina Island in the foreseeable future.

Limited Hatching Success Despite Artificial Incubation

The first bald eagle nesting attempts failed on Santa Catalina Island due to egg breakage in the nest. To remove the risk of adults crushing the eggs during incubation and to reduce environmental factors such as water loss, bald eagle eggs have been collected since 1989 and placed in an artificial incubation facility. Between 1989 and 2004, 80 eggs have been collected and transported primarily to the San Francisco Zoo. Without such intervention, successful reproduction is highly unlikely as documented by the continued breaking of eggs that are left in the nests. For example, in 2000 an egg broke in each of the three active nests (Pinnacle Rock, West End, and Twin Rocks), and in 2003 an egg broke in the Twin Rocks territory. Despite the efforts to hatch these eggs in a controlled environment, only 14 of the 80 eggs (18 percent) have hatched to date. Low hatching success may be the result of embryo mortality often attributed to PCBs and/or eggshell thinning generally associated with DDT and its breakdown products (DDE and DDD). The low hatching rate confirms the continued effect of DDTs and PCBs despite measures to reduce the effects of eggshell thinning by placing the eggs in an optimal, controlled environment. However, despite the limited hatching success of these eggs even with artificial incubation under optimal conditions, such efforts are necessary to maintain the population on Santa Catalina Island.

Conclusion

The available egg data and limited hatching success even with artificial incubation indicate that overall concentrations of DDE and total PCBs in failed-to-hatch eggs from all territories continue to exceed thresholds for adverse effects (reduced nest success). Based on the current levels of DDE and PCBs in eggs and the lack of any significant trends in reduction of DDE levels in eggs, Santa Catalina Island bald eagles are not likely to reach a state of self-sustainability in the foreseeable future.

Costs of the Santa Catalina Program

From 2002–2005, the average annual cost of supporting the Santa Catalina Island bald eagle program (including monitoring, retrieval of eggs from nests, artificial incubation of eggs, failed-to-hatch egg contaminant analysis, fostering healthy chicks into nests, and agency support) was approximately $270,000. In recent years, the Trustees have assumed full funding of the Santa Catalina Island program to ensure that the option of maintaining a population of bald eagles on Santa Catalina Island could receive consideration within this Restoration Plan.

B.2.4 Northern Channel Islands Bald Eagle Feasibility Study

Since bald eagles have not naturally recolonized other Channel Islands, the Trustees initiated a Feasibility Study in 2002 to determine whether bald eagles reintroduced to the Northern Channel Islands (and thus farther from the main source of contamination) would have sufficiently low exposures that they can successfully breed and produce young.

From 2002 to 2004, 34 bald eagle juveniles were released on Santa Cruz Island (12 birds in 2002, 10 in 2003, and 12 in 2004). These birds were either hatched from eggs from the captive breeding population at the San Francisco Zoo or were juveniles collected from the wild in Alaska. Of these 34 birds, 19 birds are known to have survived to date and have been observed

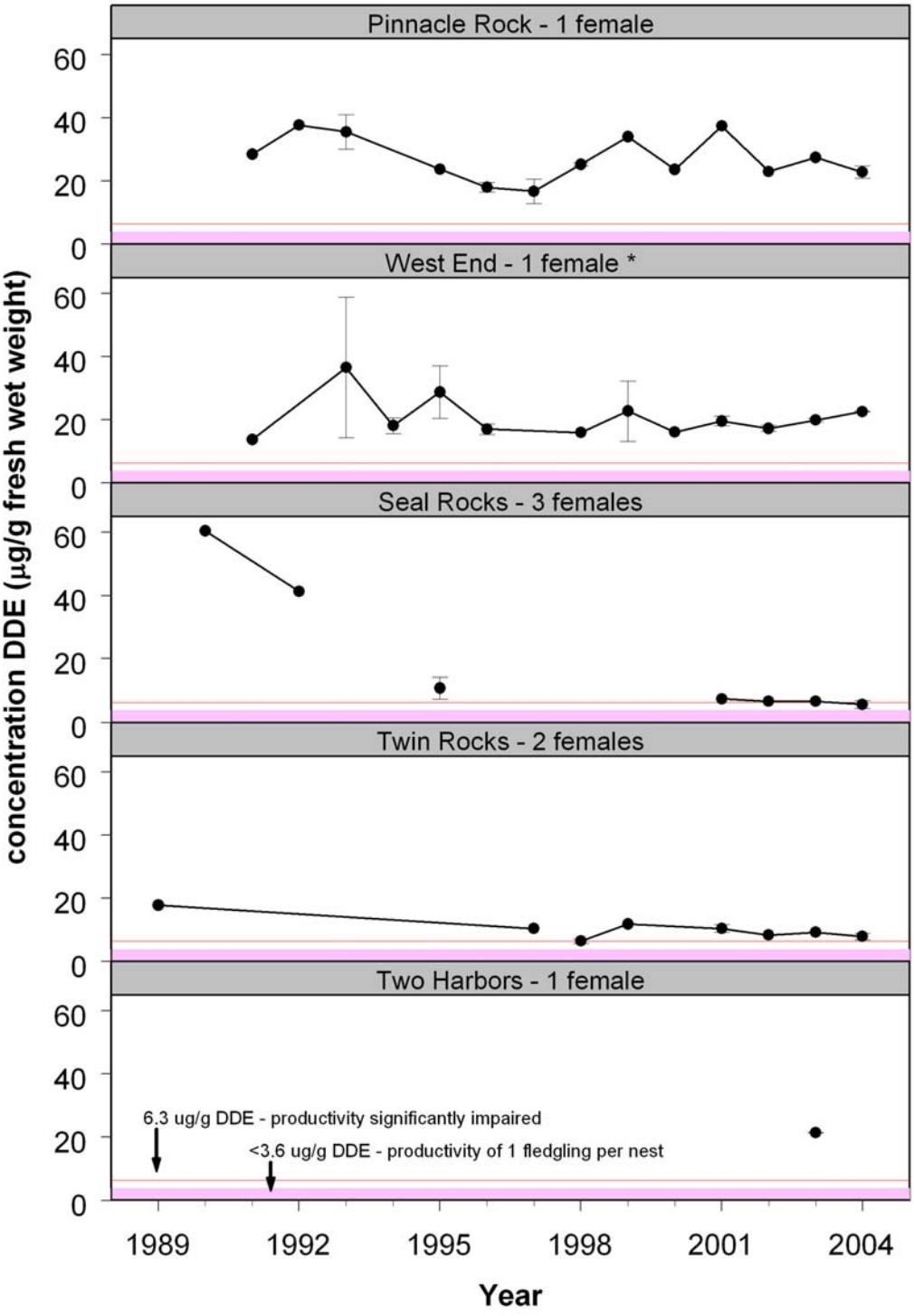

Figure B-1. Levels of DDE in Santa Catalina bald eagle failed-to-hatch eggs from 1989–2004.

Each panel includes data from one of the five bald eagle territories on Santa Catalina Island. Threshold DDE contamination levels are indicated for each panel as labeled in the Two Harbors panel. Line breaks within a panel indicate a change in females within a territory. For the West End Territory(*), a second female joined the original pair in 1992 and has assisted in incubation of eggs, but has not produced any eggs used in this analysis.

Figure B-1 [BACK]

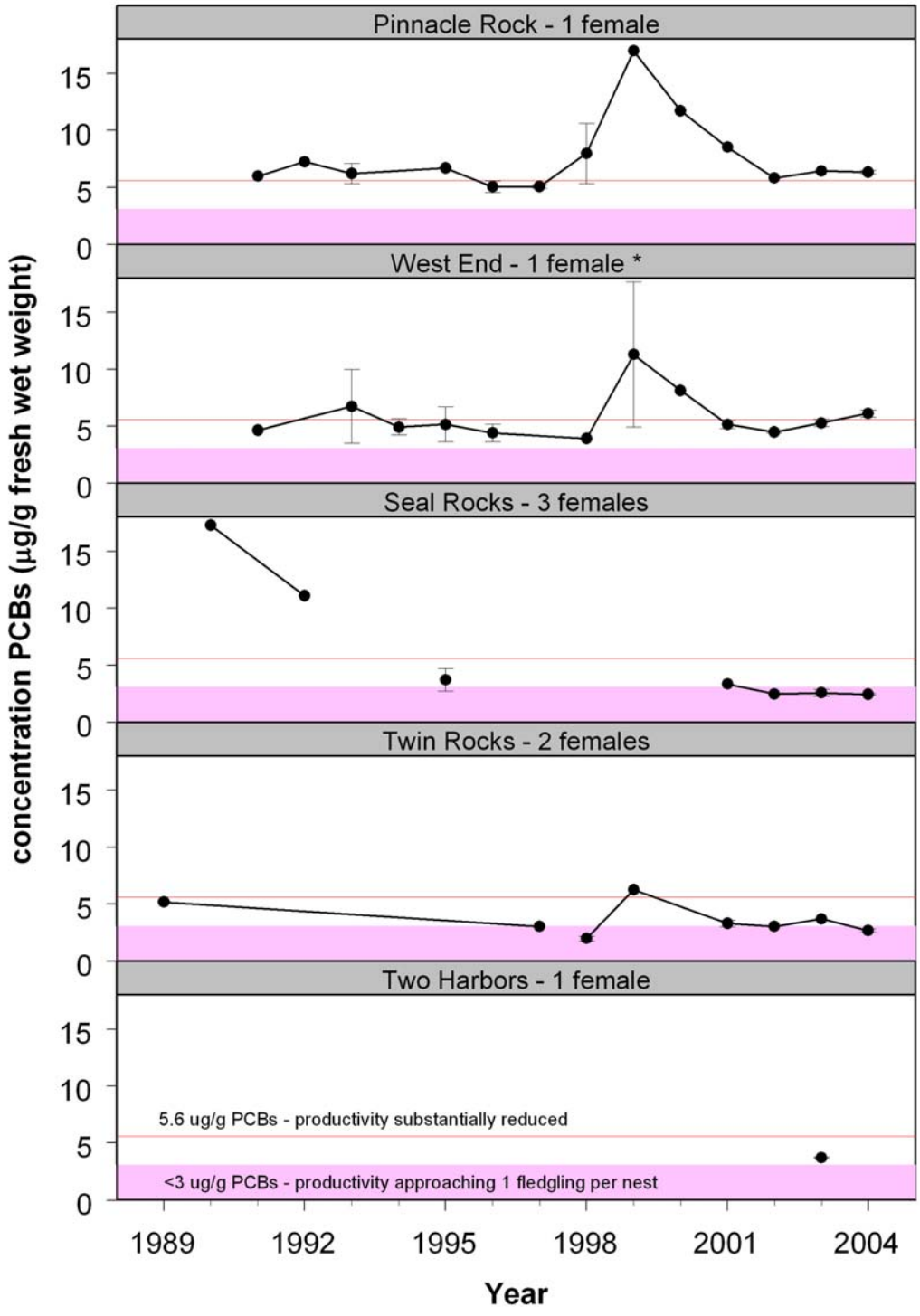

Figure B-2. Levels of PCBs in Santa Catalina bald eagle failed-to-hatch eggs from 1989–2004.

Each panel includes data from one of the five bald eagle territories on Santa Catalina Island. Threshold PCB contamination levels are indicated for each panel as labeled in the Two Harbors panel. Line breaks within a panel indicate a change in females within a territory. For the West End Territory(*), a second female joined the original pair in 1992 and has assisted in incubation of eggs, but has not produced any eggs used in this analysis.

Figure B-2 [BACK]

or recorded recently on the Northern Channel Islands (J. Dooley, pers. comm., 2005). These birds have been documented moving among Santa Cruz, San Miguel, Santa Rosa, and Anacapa Islands. An additional 7 birds may have survived; however, no recent GPS data (due to transmitters falling off or no longer working) or recent sightings confirm this statement (J. Dooley, pers. comm., 2005). Of these 7 birds, 3 were last recorded on the mainland and the other 4 were last reported on Anacapa or Santa Rosa Islands. The remaining 8 of the 34 eagles that were released are known or are suspected to have died as follows: five eagles perished trying to cross the Santa Barbara Channel to the mainland, one was hit by a car in Salt Lake City, Utah, one died after getting stuck in a tree on Santa Rosa Island, and one is assumed dead although the cause of death is unknown (J. Dooley, pers. comm., 2005).

Since the study began, eagles have crossed to the mainland, ranging as far as Yellowstone National Park in Wyoming. Eagles have also been documented from Oregon, Northern California, and Utah. The presence of the bald eagles on the Northern Channel Islands has attracted bald eagles from nearby Santa Catalina Island. A minimum of two eagles from Santa Catalina Island have been documented spending time on Santa Cruz Island (J. Dooley, pers. comm., 2005).

In August 2004, biologists recaptured three eagles released in 2003 to collect blood and feather samples, which will be analyzed to determine current contaminant levels in the birds. When the bald eagles on the Northern Channel Islands begin to reproduce, biologists will monitor their nests to determine if the eagles are capable of hatching eggs in the wild. Since it takes as many as 5 years for bald eagles to reach reproductive age, the Trustees anticipate having initial results of the first breeding attempts around 2007–2008.

Monitoring is an important component of the Feasibility Study. Appendix A of the Feasibility Study outlined the central components of the monitoring program, including obtaining bald eagle blood samples and prey items for DDT and PCB analysis, tracking movement of the birds with satellite telemetry, and performing stable isotope analysis on prey resources (MSRP 2002). Once the birds begin breeding, nest monitoring will be initiated to determine reproductive success. Nest monitoring will likely continue for several years after the first breeding attempts to obtain data from multiple pairs over several years and to account for unsuccessful breeding attempts that are typical of first-time breeders. Specific details of the nest monitoring will be developed as part of the overall ongoing monitoring program. This monitoring program is evaluated on a yearly basis in consultation with experts and is adaptive based on analytical results and monitoring from the field.

For the study period from 2002–2005, a total of approximately $2.3 million was budgeted in support of the Feasibility Study. This cost covers all aspects of the Feasibility Study including obtaining, caring for, and releasing bald eagle juveniles, fieldwork, monitoring, contaminant analysis, and agency support. The Trustees anticipate allocating an additional $1 million over the next several years in support of the Feasibility Study. Costs would likely decrease after 2006 as the released birds mature and emphasis shifts to nest monitoring and contaminant analysis (rather than the release of additional birds). Therefore, the total estimated cost of the NCI Feasibility Study is $3.3 million.

B.2.5 Bald Eagle Decision Tree

It is currently unknown whether self-sustaining bald eagles can inhabit any of the Northern Channel Islands because of persisting effects from the contaminants of the Montrose case. In evaluating and selecting a favored course of action for the restoration of bald eagles, the Trustees have considered ongoing reproductive injuries to bald eagles inhabiting Santa Catalina Island and possible outcomes of the Feasibility Study.

Long-term restoration options may be shown in the form of a decision tree that illustrates the different available courses of action under each outcome scenario of the NCI Feasibility Study. The Trustees used this decision tree to select a favored course of action under the different outcomes. The favored course of action is highlighted in blue on Figure B-3 and evaluated in Section B.3. A second possible course of action is evaluated in Section B.4.

Once the results of the Feasibility Study are known and the Trustees have selected their final course of action for restoring bald eagles on the Channel Islands, a decision document will be made available for public review and comment.

B.3 RESTORE BALD EAGLES TO THE NORTHERN CHANNEL ISLANDS ONLY IF THE NCI FEASIBILITY STUDY DEMONSTRATES THEY CAN SUCCESSFULLY REPRODUCE ON THEIR OWN

B.3.1 Project Description and Methods

This course of action involves the restoration of bald eagles to the Northern Channel Islands pending the successful outcome of the Feasibility Study. If the results of the Feasibility Study show that the birds released on Santa Cruz Island are able to breed in a self-sustained manner and without human intervention, the Trustees would continue releasing and monitoring bald eagles on Santa Cruz Island with the goal of restoring breeding bald eagle pairs to all Northern Channel Islands. The general methods for additional hacking and monitoring would be the same as those outlined in the NCI Feasibility Study and Environmental Assessment (MSRP 2002).

As depicted in the Bald Eagle Decision Tree, this course of action does not include active bald eagle restoration efforts on the Channel Islands if the Feasibility Study demonstrates that bald eagles inhabiting the Northern Channel Islands cannot breed in a self-sustaining manner due to ongoing exposure to contaminants. Under the scenario that reproduction is impaired on the Northern Channel Islands, the Trustees would not release additional birds or actively maintain breeding pairs through egg manipulation as is currently done on Santa Catalina Island. Rather, the Trustees propose to continue periodic monitoring of bald eagle reproduction on the Channel Islands. If bald eagles begin breeding successfully in the future, the Trustees would then reconsider initiating active restoration efforts (e.g., hacking additional birds) to promote the recovery of the bald eagle on the Channel Islands.

Under this course of action, continued financial support of the Santa Catalina Island bald eagle program would cease. This decision reflects the Trustees' desire to use restoration funds for actions that are sustainable in nature. As summarized in Section B.2.3, egg data indicate that Santa Catalina Island bald eagles are not likely to reach a state of self-sustainability in the foreseeable future due to ongoing contamination. The Trustees are concerned that supporting

bald eagles in an environment where they would likely continue to experience contaminant-related reproductive failures is not an ideal means of achieving natural resource restoration for this case. Therefore, this course of action proposes to discontinue funding for the Santa Catalina Island program after 2005.

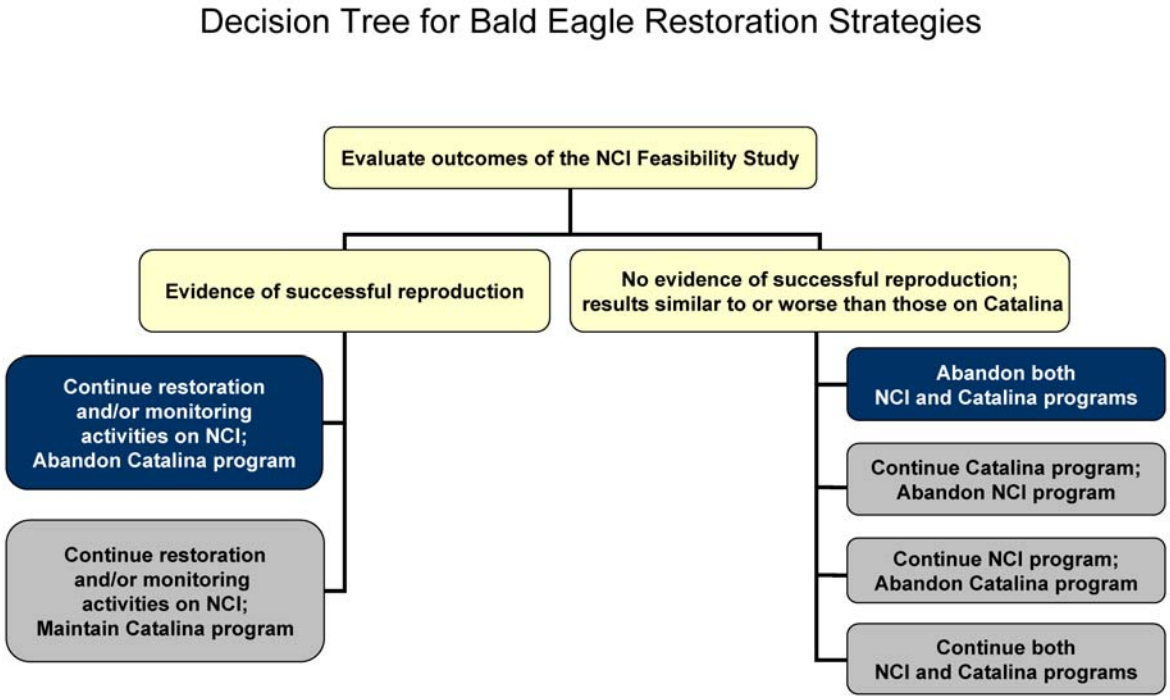

Figure B-3. Potential options and preferred options for restoring bald eagles to the Channel Islands for the different possible outcomes of the ongoing NCI Feasibility Study.

B.3.2 Environmental Benefits and Impacts

Biological

Benefits

Bald eagles historically played an important role in the ecology of the Channel Islands by serving as both a top carnivore and a scavenger. Bald eagles prey primarily on fish taken live from the ocean; however, they also feed on seabirds and the carcasses of animals that wash up on shore. Restoration of bald eagles to the Channel Islands provides benefits to the island ecosystems since no other species fills the same ecological role.

The presence of the bald eagle on the Channel Islands likely provides benefits to the endangered island fox. Predation by golden eagles on island foxes has resulted in precipitous declines in island fox populations on the Northern Channel Islands (Coonan et al. 1998, USFWS 2004). The presence of territorial bald eagles on the Northern Channel Islands would likely benefit the island fox if they deter golden eagles from inhabiting the islands.

Back of Figure B-3

Impacts

Individual bald eagles would be impacted by the restoration efforts. During the first 3 years of the Feasibility Study, 8 of the 34 released birds (approximately 24 percent) are known to have died from various causes (see Section B.2.4). The majority of these deaths (5 of 8, 63 percent) were from recently fledged eagles crossing the Santa Barbara Channel. This source of mortality was also reported by Sharpe and Garcelon (2000) when a bald eagle fledgling died while trying to fly to the mainland from Santa Catalina Island. Overall, the survival rate of eagles released on the Northern Channel Islands appears to be within the normal range of eagle survival in the wild and for a reintroduction program. The loss of several individuals is not considered significant in light of the overall recovery of the bald eagle in the United States and the efforts to restore this species to the Channel Islands.

This course of action proposes to cease funding of the Santa Catalina Island bald eagle program after 2005. Human intervention is currently necessary to enable the eagle pairs on the island to continue to fledge young and maintain pair bonds. One potential outcome of stopping human intervention and allowing the nests to fail is that eagle pair bonds may break down and the birds may abandon the island. If that is the case, additional restoration efforts may be needed to reestablish breeding bald eagles on Santa Catalina Island in the future should contaminant levels decline sufficiently to allow for successful reproduction.

The potential impact by eagles to the avian populations, particularly seabirds, of the Northern Channel Islands was analyzed in depth as part of the Feasibility Study/Environmental Assessment (MSRP 2002). Since bald eagles have had a long historical presence on the Channel Islands prior to their extirpation and presumably coexisted with the seabird populations there, restoration of bald eagles is not expected to have a significant impact on the populations of these birds. Avian species known to be in the diet of eagles on Santa Catalina Island occur in greater numbers on the Northern Channel Islands. However, an increase in the availability of these birds would not necessarily result in a proportional increase in the eagle's diet because it is energetically expensive for eagles to pursue and capture live birds (Sharpe and Garcelon 1999a), and pursuits of birds are usually unsuccessful (Bayer 1987, Ofelt 1975, Parrish 1995). Based on these factors, it is estimated that the overall bird component of the eagle's diet would remain close to the 9 percent observed on Santa Catalina Island but species composition would differ among islands (Sharpe and Garcelon 1999a).

Monitoring results from 2002 and 2003 of the Feasibility Study showed that released bald eagles foraged primarily on pig carcasses placed by field biologists (Sharpe et al. 2004). Eagles were also observed feeding on marine mammal carcasses on Santa Cruz Island and on mule deer and elk carcasses or gut piles on Santa Rosa Island, and a recreational fisherman reported an eagle catching fish off Santa Cruz Island (Sharpe et al. 2004). Telemetry data have recorded little use of Anacapa Island by bald eagles during the seabird breeding season; therefore, it is unlikely that released eagles have had a measurable impact on seabird populations on that island (Sharpe et al. 2004).

Physical

Benefits

There are no known benefits to the physical environment.

Impacts

There are no known impacts to the physical environment.

Human Use

Benefits

The bald eagle's presence on Santa Catalina Island provides benefits to humans on many levels. The presence of bald eagles provides both aesthetic and recreational benefits to visitors of the Northern Channel Islands.

The bald eagle also plays an important role in the cultural history of the Channel Islands. The presence of bald eagles on the island fills an important cultural, as well as ecological, niche on the islands.

Impacts

There are no known impacts to cultural resources, recreation, aesthetics, or transportation.

B.3.3 Likelihood of Success/Feasibility

Under the best case scenario, bald eagles would be able to successfully breed on the Northern Channel Islands. Should that be the case, additional eagles would be hacked onto the islands using methods proven successful during the Feasibility Study. Ultimate success of the project would be achieved when bald eagles are self-sustaining on the Northern Channel Islands.

B.3.4 Performance Criteria and Monitoring

Monitoring for this project would include concepts outlined in the monitoring plan developed for the Feasibility Study and would be adapted accordingly. Specific performance criteria for successful reproduction (e.g., productivity) of the Northern Channel Islands birds would be defined by the Trustees, in consultation with experts, prior to 2007.

B.3.5 Evaluation

The Trustees have evaluated this project against all screening and evaluation criteria developed to select restoration projects and concluded that this project is consistent with these selection factors. The implementation of this course of action is dependent on the outcome of the Feasibility Study. The initial results of the Feasibility Study will not begin to be known until the birds reach maturity and begin breeding, likely in 2007–2008. If the Feasibility Study shows evidence of successful reproduction in Northern Channel Islands bald eagles, the Trustees would

proceed with hacking additional eagles onto the islands. The Trustees have determined that this type and scale of restoration project would provide long-term benefits to injured bald eagles and facilitate the recovery of this species on the Channel Islands. For these reasons, the Trustees have chosen this course of action as the favored strategy for bald eagle restoration on the Channel Islands.

B.3.6 Budget

To fund this course of action, the Trustees propose allocating a total of $6.2 million for bald eagle restoration on the Northern Channel Islands. This allocation would cover the costs of the Santa Catalina Island bald eagle program through 2005 (approximately $1.2 million spent since 2001), the ongoing NCI Feasibility Study (approximately $3.3 million), and additional costs of continued hacking and monitoring of bald eagles on the Northern Channel Islands in the future should the results of the NCI Feasibility Study indicate successful reproduction. In the event that the NCI Feasibility Study demonstrates that bald eagles inhabiting the Northern Channel Islands sustain reproductive injuries similar to those experienced by Santa Catalina Island bald eagles, approximately $1–2 million of the $6.2 million would remain. Under this scenario, the Trustees would use a portion of these remaining funds for continued monitoring of bald eagles in the Channel Islands and the remainder would either be set aside for future bald eagle restoration efforts on the Channel Islands (should eagles begin to successfully breed in the future) or re-allocated to seabird restoration efforts.

B.4 ENSURE A CONTINUED BALD EAGLE PRESENCE ON THE CHANNEL ISLANDS EVEN IF THE NCI FEASIBILITY STUDY DEMONSTRATES THEY CANNOT SUCCESSFULLY REPRODUCE ON THEIR OWN

B.4.1 Project Description and Methods

This course of action would provide funding for bald eagle restoration on the Channel Islands even if the NCI Feasibility Study demonstrates that bald eagles cannot breed in a self-sustained manner because of ongoing contamination. Under this course of action, efforts to restore bald eagles to the Channel Islands would focus on the maintenance of the Santa Catalina Island bald eagle program for the long term, with the hope that eventually the Santa Catalina Island birds' exposures would decline to a level allowing them to reproduce on their own. Maintenance of the bald eagles on Santa Catalina Island would be favored over the Northern Channel Islands due to the existing infrastructure and ongoing program on Santa Catalina Island. Under this course of action, financial support of the Santa Catalina Island program would continue after 2005.

Summary of Program Activities on Santa Catalina Island

Currently, the reintroduced population on Santa Catalina Island is maintained through manipulations of eggs and chicks at each nest site. Observation of adult eagles begins in January every year to determine the location of breeding pairs and their respective nest sites. Nest sites are located by observing area of increased use by adults and searching previously used nesting areas. When nest sites are confirmed, observation blinds are set up to observe nests. From the blinds, data are collected on the chronology of nesting, behavior during incubation, nestling and

adult behavior during brood rearing, taxon of prey delivered to the nest, and rates of prey delivery. At the West End and Seal Rocks nests, video cameras are set up prior to the breeding season to allow close observations of nesting activities.

Structurally deficient eggs laid by nesting pairs are replaced with artificial eggs within 1 to 4 days of the date that eagles are confirmed incubating. The adult eagles continue to incubate the artificial eggs, while the real eggs are removed and artificially incubated. In the past, eggs have been transferred to the San Francisco Zoo. In 2005, artificial incubation will take place in a facility on Santa Catalina Island. Chicks that hatch from these removed eggs, or those produced by captive adults at the ACC or by wild birds, are then fostered back into the nests after the adults have incubated the eggs for approximately 30 days. Failed-to-hatch eggs are saved for contaminant analysis. Project staff return to the nests when the chicks are 8 weeks of age to equip them with USFWS and colored leg bands, wing markers, and a back-pack style radio transmitter. At this time, a blood sample is also collected for contaminant analyses and morphological measurements are made to determine sex. Radiotelemetry is used to locate and visually observe behavior of fledged eagles. Each fledged bird is located every 1 to 3 days during their first month of flight. Observers record their location, behavior, and interaction with other eagles.

In addition to egg manipulation, this course of action would examine other potential management options to reduce contaminant exposure to bald eagles on Santa Catalina Island. These options may include experimenting with supplemental feeding of contaminant-free prey, treating the eggs in the nest to potentially allow the birds to hatch the chicks on their own, and reducing the number of nests actively manipulated to focus on those nests with less contaminated eggs.

B.4.2 Environmental Benefits and Impacts

Biological

Benefits

Bald eagles historically played an important role in the ecology of the Channel Islands by serving as both a top carnivore and a scavenger. Bald eagles prey primarily on fish taken live from the ocean; however, they also feed on seabirds and the carcasses of animals that wash up on shore. The bald eagle fills a distinct niche in the Channel Islands. The presence of the bald eagle provides benefits to the Channel Island ecosystem since no other species fills the same ecological role. The presence of the bald eagles on Santa Catalina Island may benefit the island fox if they deter golden eagles from inhabiting the island.

Impacts

Bald eagles will prey on avian species, particularly medium to large-sized seabirds such as gulls (*Larus* sp.) and loons. Data collected on eagle food habits on Santa Catalina Island show that they may occasionally take smaller bird species, either alive or as carrion (Garcelon 1997). Bald eagles prey primarily on fish and carrion and are, therefore, unlikely to have any major impact on other wildlife living on or around the Channel Islands. Birds have been reported to make up only 9 percent of the eagles diet on Santa Catalina Island (Garcelon et al. 1997b). Based on this

information, the Trustees do not expect a significant impact to seabirds from eagles. Seabird populations on Santa Catalina Island have not shown, to our knowledge, any measurable impact from the eagles already breeding on the island.

Physical

Benefits

There are no known benefits to the physical environment.

Impacts

There are no known impacts to the physical environment.

Human Use

Benefits

The bald eagle's presence on Santa Catalina Island provides benefits to humans on many levels. Santa Catalina Island is a popular tourist destination, and the presence of bald eagles provides both aesthetic and recreational benefits to visitors on the island.

The bald eagle also plays an important role in the cultural history of the Channel Islands. The presence of bald eagles on the island fills an important cultural, as well as ecological, niche on the islands.

Impacts

There are no known impacts to cultural resources, recreation, aesthetics, or transportation.

B.4.3 Likelihood of Success/Feasibility

The growing number of bald eagle territories on Santa Catalina Island demonstrates that it is possible to actively maintain breeding bald eagles that successfully fledge young fostered into their nests despite ongoing exposure to contamination. However, the ultimate success of this course of action would be attained when eagles are able to breed on Santa Catalina Island without human intervention or assistance. The goal of the continued manipulation efforts outlined in this action would be to enable the eagle pairs on the island to continue to fledge young and maintain pair bonds so that eagles would be present on the island when contamination levels are low enough to allow for successful reproduction without human intervention.

The likelihood of success for this project is low in the foreseeable future. Based on the current levels of DDE and PCBs in their eggs and the lack of any significant trends in DDE levels in eggs (see Section B.2.3), Santa Catalina Island bald eagles are not likely to reach a state of self-sustainability in the foreseeable future. As outlined in Section 4, the Trustees, for the purpose of developing this restoration plan, have made several assumptions regarding future DDT and PCB distribution and exposure. These assumptions include the prediction that substantial reduction of DDT and PCB contamination in the food web would take more than a decade after any sediment

remediation. However, the feasibility and extent of such remediation remain unknown; therefore, the amount of time contamination will remain in the food web could be much longer. In addition, the Trustees assume that elevated concentration of DDTs and PCBs in some marine mammals, bald eagles, peregrine falcons, and seabirds will persist longer than a decade due to the longer life span of these animals and their foraging preferences, and that impacts from these contaminants would continue into the foreseeable future even if the U.S. Environmental Protection Agency undertakes a sediment source control effort.

B.4.4 Performance Criteria and Monitoring

As described in Section B.4.1, bald eagle adults and chicks are closely monitored throughout the breeding season. Monitoring of the birds would continue using current protocols and any failed-to-hatch eggs would be analyzed for contaminant levels. If funding of this program continues for the long term, the Trustees would evaluate the different components of the monitoring program and look for ways to maximize cost-effectiveness. For example, analysis of failed-to-hatch eggs may not need to be analyzed every year but rather at a set interval.

B.4.5 Evaluation

The Trustees have evaluated this course of action against all screening and evaluation criteria developed to select restoration projects and concluded that this project is consistent with these selection factors. Although this type and scale of project could eventually provide long-term benefits to injured bald eagle populations on the Channel Islands, the Trustees have determined that the benefits are outweighed by the size of the investment required to obtain the benefits, which would foreclose pursuit of other potential sustainable restoration actions. The Trustees assume that elevated concentration of DDTs and PCBs are expected to persist in the environment and that these impacts will continue to impair successful reproduction into the foreseeable future even if the U.S. Environmental Protection Agency undertakes a sediment source control effort. For these reasons, the Trustees have not chosen this course of action (i.e., maintaining bald eagles on Santa Catalina Island for the long term) as a favored restoration strategy.

B.4.6 Budget

Under this course of action, the Trustees propose to allocate a total of $10 million for bald eagle restoration on the Channel Islands. Approximately $4 million would be utilized through the end of the NCI Feasibility Study (supporting both the Northern Channel Islands and Santa Catalina Island programs), leaving approximately $6 million to place into a long-term endowment or other financial mechanism to support the continuation of the Santa Catalina Island bald eagle program for as long as possible or until such time that the birds are able to successfully reproduce on their own. A total of $6 million would fund approximately 22 years of restoration efforts on Santa Catalina Island if the average annual cost remains at approximately $270,000. This amount does not include any interest that may be generated.

Appendix C

Tier 2 Evaluation of Peregrine Falcon Restoration Actions

Appendix C1 Restore Peregrine Falcons to the Channel Islands

Appendix C2 Monitor Natural Recovery of Peregrine Falcons on the Channel Islands

Appendix C3 Restore Peregrine Falcons to the Baja California Pacific Islands