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RESTORING A BALD EAGLE BREEDING POPULATION IN CENTRAL CALIFORNIA AND MONITORING 25 YEARS OF REGIONAL POPULATION GROWTH

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Abstract.—We conducted a hacking project in 1986–1994 to restore a population of breeding Bald Eagles (*Haliaeetus leucocephalus*) in central California, where the species had not nested in more than a half-century. We first documented breeding among release cohorts in 1993, and the population increased to 26 known occupied breeding territories by 2012, exceeding the recovery plan goal for central California. Not all Bald Eagle nesting in the region can be attributed to the hacking project, but because the first seven nesting pairs each included at least one released eagle, we believe that the project expedited the recovery of a Bald Eagle breeding population in central California. The proportion of Bald Eagles returning to breed increased for the final three cohorts in 1991–1994, when we released eaglets younger than the standard fledging age. Eaglets released at or beyond the standard fledging age dispersed relatively quickly, whereas eaglets released at a younger age established more regular feeding patterns at the hack tower, and were more often seen in future seasons. Reintroduction in central California was supported by previous protective measures for the recovery of the global population, particularly the ban on DDT.

Key Words: *Bald Eagle*; Haliaeetus leucocephalus; *California*; *hacking*; *recovery*; *reintroduction*.

RESTAURACIÓN DE UNA POBLACIÓN REPRODUCTORA DE *HALIAEETUS LEUCOCEPHALUS* EN EL CENTRO DE CALIFORNIA Y 25 AÑOS DE SEGUIMIENTO DEL CRECIMIENTO POBLACIONAL A NIVEL REGIONAL

Resumen.—Realizamos un proyecto de cría asistida o *hacking* de 1986 a 1994 para restaurar una población reproductora de *Haliaeetus leucocephalus* en el centro de California, donde la especie no había nidificado durante más de medio siglo. Documentamos la reproducción en individuos de cohortes liberadas en 1993, y la población creció hasta 26 territorios conocidos de cría en el año 2012, número que excedió la meta del plan para el centro de California. No todos los individuos de *H. leucocephalus* que nidifican en la región pueden ser atribuidos al proyecto de cría asistida, aunque considerando que cada una de las primeras siete parejas reproductoras incluyó al menos un águila liberada, creemos que el proyecto aceleró la recuperación de una población reproductora de *H. leucocephalus* en el centro de California. La proporción de individuos que regresaron para reproducirse aumentó para las tres cohortes finales en 1991–1994, cuando liberamos aguiluchos de menor edad que la edad estándar de abandono del nido. Los aguiluchos liberados a la edad estándar de abandono del nido o a mayor edad se dispersaron relativamente rápido, mientras que los aguiluchos liberados a una edad menor establecieron patrones de alimentación más regulares en la torre de *hacking* y fueron vistos más a menudo en temporadas posteriores. La reintroducción en el centro de California fue apoyada por medidas protectoras previas para la recuperación de la población global, particularmente mediante la prohibición del DDT.

[Traducción del equipo editorial]

The Bald Eagle (*Haliaeetus leucocephalus*) experienced severe population declines in the mid-20th century, primarily due to persecution by humans and the effects of organochlorine contaminants from pesticides widely used after World War II (Buehler 2000). Two of these contaminants, DDT and its metabolite DDE, were associated with decreased eggshell thickness and impaired productivity of eagles (Grier 1982, Nisbet 1989, Wiemeyer et al. 1993). Declines were particularly severe in the

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lower 48 United States, where the breeding population decreased to only an estimated 417 pairs by 1963 (Buehler 2000).

In California, Bald Eagle population declines resulted in local extirpations. Although Bald Eagles historically nested statewide (Lehman 1983), most nesting had ceased in the southern Sierra Nevada range and the central California coast by the 1930s (Detrich 1985, Jurek 1990). Bolander (1933) described the last known Bald Eagle nest along the central coast, occupied until 1933. The last known Bald Eagle nest on the southern California mainland was occupied in Santa Barbara County until the early 1950s (Kiff 1980). Thereafter, breeding Bald Eagles in California were almost entirely limited to the northern quarter of the state, although lakes and reservoirs elsewhere continued to host eagles during the winter (Detrich 1985).

Bald Eagle populations have rebounded greatly in recent decades since the banning of DDT in 1972 and enhanced legal protection afforded under the Endangered Species Preservation Act and the Endangered Species Act in 1966 and 1973, respectively. Population size in the lower 48 states increased to nearly 10,000 estimated breeding pairs by 2007 (U.S. Fish and Wildlife Service 2007), with accelerated growth since 1980. This recovery prompted the removal of the Bald Eagle from the endangered species list (U.S. Fish and Wildlife Service 2007), although populations remained small in some regions.

In central and southern California, Bald Eagle breeding populations continued to be absent in the decade following the DDT ban. In 1986, the U.S. Fish and Wildlife Service (U.S.F.W.S.) issued the Pacific Bald Eagle Recovery Plan (U.S.F.W.S. 1986) outlining recovery goals for 47 management zones in seven western states. The recovery plan recommended translocation of eaglets using hacking techniques, when feasible, to establish new breeding populations in suitable habitat. Hacking is a process in which young raptors are transitioned to the wild from a nest or a captive-rearing facility and provided with food and shelter at a release site, where they are free to come and go (Sherrod et al. 1982). Hacking contributed to widespread recovery of Peregrine Falcons (*Falco peregrinus,* Enderson et al. 1998), and has been used in some states to recover Bald Eagle populations (e.g., Hatcher 1990, Nye 2008). In 1980–1986, Sharpe and Garcelon (2005) released Bald Eagles from hack towers on Santa Catalina Island to restore a breeding population in southern California. In central California, the recovery plan prescribed a goal of four breeding pairs for a management zone stretching from the San Francisco Bay Area south to Santa Barbara County, so we conducted a hacking project from 1986–1994 to restore a Bald Eagle breeding population in central California. We here document the recovery of this breeding population after more than a half-century absence, and regional population growth based on 25 yr of monitoring.

STUDY AREA

We conducted the project in a coastal canyon in the Santa Lucia Range near Big Sur, Monterey County, CA (Fig. 1). The release site (elevation 700 masl) was located on a private 97-ha property 3 km from the coast and approximately 8 km from the last known Bald Eagle nesting site in the region. The property was surrounded by the 97,125-ha Ventana Wilderness, the Los Padres National Forest, and state park land. The site contained steep grasslands and outcrops with patches of chaparral and mixed woodlands. Although tall conifers suitable for nesting (e.g., California redwood [*Sequoia sempervirens*]) were near the site, we considered the best potential Bald Eagle nesting habitat to be approximately 75 km to the southeast at San Antonio and Nacimiento reservoirs. These reservoirs were formed when dams were built on the San Antonio and Nacimiento rivers in 1957 and 1965, respectively. Each has a maximum surface area of at least 2200 ha, providing important Bald Eagle habitat that was not available for the historical breeding population. This reservoir complex is an important wintering site, hosting 25–75 Bald Eagles annually (Detrich 1985).

METHODS

Releases. Using hacking techniques, we released 66 Bald Eagles (36 males and 30 females) in central California from 1986–1994 (Table 1). We released only one eaglet in the first year, an individual that was captive-raised in California. For all subsequent releases, we collaborated with the British Columbia Ministry of Environment, Alaska Department of Fish and Game, and California Department of Fish and Wildlife and collected nestlings from wild nests in British Columbia (1987–1990), Alaska (1991–1993), and California (1994). We collected nestlings at about 6 wk of age or later and banded them with an aluminum U.S. Geological Survey leg band and a second leg band with a unique alphanumeric code identifiable in the field. We then transported them to a holding facility in central California. We estimated the age of the eaglets within a 2-wk range based on physical characteristics described by Bortolotti (1984a). During the final two years, we estimated age more precisely based on field measurements of the eighth primary feather (Bortolotti 1984b). We determined the sex of eaglets by measurements of the bill and feet (Bortolotti 1984b). We collected and released eaglets in cohorts of 4–12 birds per breeding season from 1987–1994, with the exception of 1992 in which no eaglets were released (Table 1).

Once we moved a cohort to the hack site, we held the eaglets for acclimations in one or two closed hack boxes on a 9-m tall tower platform. Initially, the hack box measured 2.5 × 2.5 × 1.5 m, large enough to allow eaglets to exercise and fully stretch wings. There was ≥1 m of space on the platform surrounding the box to allow eagles to perch after fledging. In 1988, we expanded the platform to accommodate two larger boxes measuring 3.7 × 3.7 × 1.5 m, while maintaining ≥1 m of open deck space surrounding the box. These boxes were made of wood and supported by vertical metal conduit pipes (see Sharpe and Garcelon 2005). Attendants could

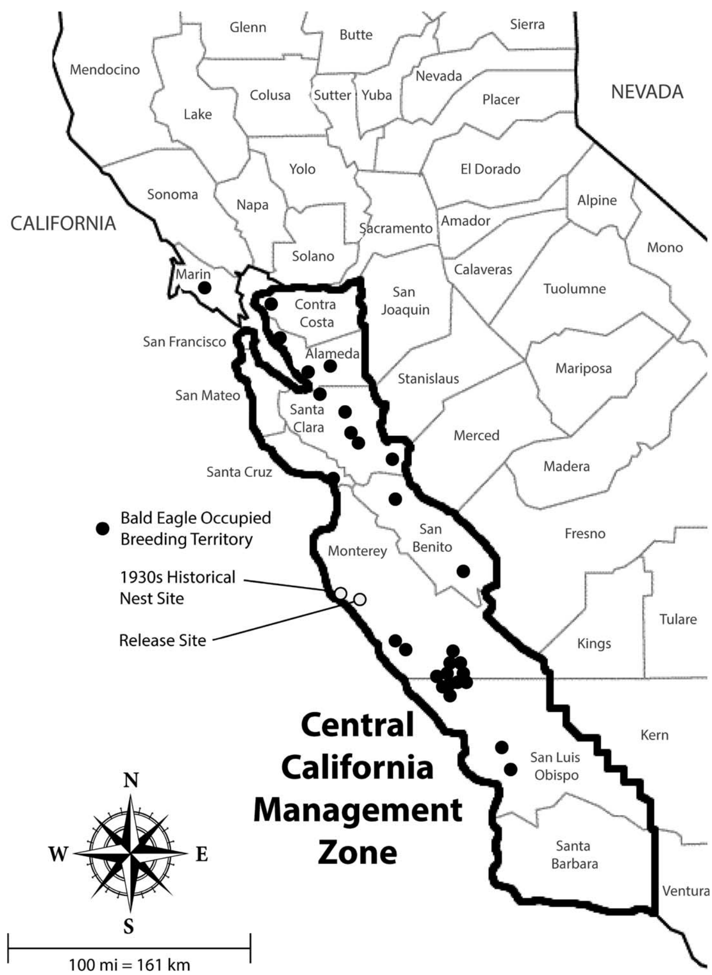

Figure 1. Locations of the Bald Eagle release site and occupied breeding territories in central California from 1993–2012.

monitor the hack boxes from an adjacent blind without being detected, and a sliding door provided access for food provisioning. At dawn and dusk, attendants fed the eaglets a diet composed primarily of fish, with occasional birds or small mammals. The hack box contained a water source and misters, and was partially covered to allow eaglets access to sunlight or shade. During the acclimation period, we attached a backpack harness radio transmitter to each eaglet (Biotrack TW-3, Wareham, U.K.); these transmitters weighed 68 g and had an estimated battery life of $\leq$3 yr.

To discourage premature fledging and early dispersal from the area, we changed our release methods over the course of the project. We defined fledging as an eaglet's first departure from the hack tower and dispersal as an eagle's final departure from the canyon surrounding the hack tower in its first season. Because Bald Eagles are migratory, we expected dispersal, but thought that early dispersal might decrease the chances of eagles returning. On the release day, we dismantled and removed the hack box in predawn darkness. However, we found that this procedure increased the risk of eaglets fledging early, possibly by frightening the birds off of the tower or by allowing exposed eaglets to be more easily pushed off of the tower by returning eagles. Starting in 1990, we conducted releases by opening a door of the hack box without removing it from the tower. We also released birds at different ages. Initially, we released cohorts at 10–12 wk old. In 1989–1990, we held eaglets slightly longer in acclimation, releasing them at 11–13 wk, similar to the timing employed by Sharpe and Garcelon (2005) at Santa Catalina Island. This timing approximates the standard fledging age for wild eaglets, 12 wk (Hunt et al. 1992), with males typically fledging sooner than females (Bortolotti 1986). For the final three cohorts in 1991–1994, we released eaglets at a younger age of 8–11.5 wk. We considered that eaglets released at a younger, more dependent, age might establish a more prolonged feeding pattern at the hack tower and avoid early dispersal.

Monitoring. We monitored post-fledged young birds using radiotelemetry and observations of alphanumeric codes on leg bands. We recorded when each bird fed at the hack tower and determined dispersal dates. Because transmitters could be detected over a range of several km, we expected to receive a signal while near the hack tower for any hacked young remaining in the canyon surrounding the site. If we did not detect a signal while tracking from the hack tower, we considered that the radio-tagged bird was not in the canyon. When an eagle left the canyon, we immediately attempted to track the bird by vehicle, driving to a series of mountain peaks from the Santa Lucia Range north to the San Francisco Bay Area to gain a stronger vantage for receiving radio signals. In some years, we used aircraft (7–23 flights/yr) to track eagle dispersal. We tracked eagles until we could no longer receive a signal or if movement patterns indicated that the bird traveled beyond the central California management zone (Fig. 1). Because we did not track eagles beyond this zone, we could not document the fate of all eagles.

We continued annual monitoring through 2012 to identify eagles from prior releases and document breeding. For each released eagle, we recorded if it was observed alive $\geq$1 yr after release and if seen

TABLE 1. Bald Eagle releases at a hack tower in central California, 1986–1994.

YR	EAGLES RELEASED	MALE	FEMALE	AGE AT RELEASE (WK)	AVG. RELEASE–FLEDGE (d)	AVG. FLEDGE–DISPERSAL (d)	NO. FOUND ALIVE $\geq$1 YR	NO. FOUND BREEDING
1986	1	0	1	11.5	9	4	0	0
1987	4	1	3	10–12	5	67	2	0
1988	12	5	7	10–12	2	44	6	2
1989	10	8	2	11–13	<1	6	2	0
1990	10	5	5	11–13	1	6	2	1
1991	12	7	5	8.5–11.5	7	68[a]	6	2
1992	0	0	0	-	-	-	-	-
1993	12	7	5	8.5–11.5	5	67	10	4
1994	5	3	2	8–10	9	37	1	1
Total	66	36	30	-	-	-	29	10

[a] Two eaglets from 1991 cohort died before dispersing and are not included in average.

attempting to breed in the wild. Because radiotelemetry allowed us to efficiently monitor much of the central California coast, we could easily determine which eagles were present in the region 1 yr after release. However, identifying individuals became more challenging after the 3-yr battery life of transmitters expired. When we located an eagle pair, we confirmed leg band status of each bird when possible, searched for a nest, and monitored the nest from a distance with a 12.7-cm Celestron telescope. We monitored nests every few days during the early nesting period to determine hatch dates, then every few weeks until fledging to determine the number of young. In 2000, we increased our monitoring capability by engaging a network of volunteer birders, landowners, and biologists in central California to help locate and monitor nests.

Data Analysis. We documented the establishment and growth of a breeding population by determining the annual number of known occupied breeding territories in 1986–2012. We considered an occupied breeding territory to be any location where we observed a Bald Eagle associated with an occupied nest. We considered an occupied nest to be a nest where we observed young, eggs, an adult in incubation posture, or two nearby eagles (Postupalsky 1974). We determined the total number of nesting attempts (defined as nests where eggs were laid) among years at occupied nests. We used linear regression to determine a trend in the number of occupied breeding territories, starting from the year we first observed nesting. We also calculated the percent annual change in number of occupied breeding territories in central California, from the San Francisco Bay Area south to Santa Barbara County.

We examined factors associated with dispersal time and how dispersal might be associated with the likelihood that an eagle was present in the region $\geq$1 yr after release. We defined dispersal time as the number of days between fledging and dispersal. We compared mean dispersal times for males and females using a Mann-Whitney *U*-test. We also compared mean dispersal times for 1989–1990 releases and eaglets released in other years. Although we considered the age at release to be an important factor in 1989–1990, we could not test for an association between age and dispersal, because we did not have precise age estimations for most birds. We predicted that eagles dispersing relatively soon after fledging would be less likely to be found in the region the following year, and less likely to eventually breed in the region. We used a Mann-Whitney *U*-test to determine if eagles present $\geq$1 yr following release had a greater dispersal time than eagles apparently not present $\geq$1 yr following release. We did not test for an association between dispersal time and breeding, because we could not always confirm the identity of nesting eagles.

RESULTS

The Bald Eagle breeding population in central California increased from zero known occupied breeding territories in 1986 to 26 in 2012 (Fig. 1). The first documented breeding by a released bird occurred in 1993, when two released birds paired and produced two eaglets in a nest near Nacimiento Reservoir, in San Luis Obispo County. In the next 5 yr, we documented seven occupied breeding territories, with 10 of the 14 breeding eagles identified as birds we had released. All seven territories during these 5 yr were occupied by at least one released bird. From 1993–2012, the annual number of known occupied breeding territories in central California increased consistently ($y = 1.12x - 2229$, $r^2 = 0.86$), with an annual growth of 18% per yr during that time (Fig. 2). We documented 192 nesting attempts and observed a minimum of 275 eaglets at 156 (81%) of the nesting attempts. Nests were located in foothill pine (*Pinus sabiniana*), California sycamore (*Platanus racemosa*), coast live oak (*Quercus agrifolia*) or eucalyptus, often near prominent lakes or rivers.

We found that the time between fledging and dispersal varied greatly among eagles. Mean dispersal time after fledging was 33 d for males and 50 d for

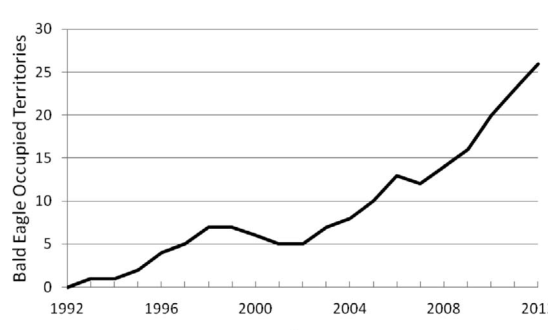

Figure 2. Minimum annual number of Bald Eagle occupied breeding territories in central California in 1993–2012.

females ($U = 645$, $P = 0.07$). The 20 birds released in 1989 and 1990, when we held birds relatively longer prerelease (11–13 wk), had a mean dispersal time of 6 d after fledging, compared to a mean dispersal time of 56 d for eaglets released in other years ($U = 62$, $P < 0.001$). Nearly all eagles dispersed in a northerly direction, as Hunt et al. (1992) reported for wild-fledged eagles in northern California. We observed 29 of the 66 (44%) eagles $\geq$1 yr following release. Eagles taking >3 wk to disperse were more likely to be observed $\geq$1 yr following release. Of the eagles dispersing in >3 wk, 66% (23 of 35) were found $\geq$1 yr after release, and eight were later found breeding. Of the eagles dispersing in $\leq$3 wk, 21% (6 of 29) were found $\geq$1 yr following release, and only one was later found breeding. Eagles found $\geq$1 yr following release had a greater mean dispersal time (mean 61 d) than eagles not found $\geq$1 yr following release (mean 24 d, $U = 215$, $P < 0.001$).

We documented 17 fatalities among the 66 releases and two eagles incurring permanent injuries. For most fatalities, we could not determine cause of death, but at least five eagles died after colliding with power lines. All power-line collisions were $\leq$5 km from the hack tower, and these lines were buried in 2011 to reduce the future collision threat for eagles and California Condors (*Gymnogyps californianus*). We did not estimate survival because many eagles promptly dispersed beyond our monitoring range and did not return; these birds might have died or might have established residency in other regions.

DISCUSSION

The number of occupied breeding territories following the hacking project quickly exceeded the recovery plan goal for the central California management zone (U.S.F.W.S. 1986). The increase in the number of occupied breeding territories in the 18 yr after we discontinued releases and provisioning in 1994 is an indication that the population was sustainable without continued management efforts. We believe the highest annual total we documented (26 occupied breeding territories) likely underestimates the actual number in central California, because the large size of the region and limited access to private land prevented a thorough search. Not all nesting in the region can be attributed to the hacking project. For example, Jurek (1990) documented a Bald Eagle pair producing young 230 km southeast of the release site in Santa Barbara County in 1989–1990, before any of the released birds reached breeding age. However, because the first seven nesting pairs that we documented from 1993–1998 were composed mostly of eagles that we released, we believe that the project expedited the recovery of a Bald Eagle breeding population in central California.

Such rapid recovery in central California would have been unlikely without previous protective measures supporting the recovery of the global population. DDT was banned 21 yr before we observed the first Bald Eagle nesting attempt in central California, and the ban probably mitigated DDT exposure for eagles foraging on inland lakes. We did not test for contaminants in eagles following release, or in eagle eggs or nestlings. However, we observed at least one eaglet in the majority (81%) of nesting attempts, indicating that Bald Eagles in the recovered population did not experience chronic hatching failures. At Santa Catalina Island, 425 km southeast of our site, Bald Eagles continued to experience hatching failure more than 30 yr after the ban, due to the close proximity of massive historical offshore dump sites in the Southern California Bight in the mid-1900s (Sharpe and Garcelon 2005). Hatching failure associated with DDE necessitated manipulation of nests and continued hacking to maintain the island eagle population (Sharpe and Garcelon 2005). Only in 2007 did Bald Eagles resume successful hatching and fledging of young on Santa Catalina Island. Successful hatching occurred more than a decade earlier on the mainland, likely because the mainland population was more distant from the offshore dump sites. The creation of two reservoirs near our release site provided mainland foraging habitat near nesting habitat, further supporting the recovery of the central California population.

At least 15 states implemented hacking projects to accelerate recovery of Bald Eagle breeding populations (Nye 2008). Bald Eagle hacking began in New York, where 198 Bald Eagles were released from 1976–1988 (Nye 2008). In Tennessee, 146 Bald Eagles were released from 1980–1990 (Hatcher 1990). These projects released more eagles than we did in central California, but they documented nesting within a few years after the first releases, indicating that each resulted in rapid establishment of breeding. The known mortality of hacked eagles at our site (17 of 66, 26%) exceeded the rate reported by Nye (2008) in New York (32 of 198, 16%), despite the ultimate success of the project supporting the recovery of a breeding population in central California.

The proportion of Bald Eagles returning to breed in central California increased with the final three cohorts released in 1991–1994. The increase coincided with an increase in mean dispersal times. In the first few years, removing the hack box on the release day increased the risk of premature fledging. Discontinuing this procedure in 1990 helped limit early fledging in later years, and perhaps also early dispersal. However, the greatest improvement in increasing dispersal times started in 1991, when we began releasing eaglets at a younger age (i.e., 8–11.5 wk old). Eagles released at or beyond the standard fledging age dispersed relatively quickly. This effect might also have been influenced by the greater number of males released in those years (Table 1), because males tend to fledge sooner than females (Bortolotti 1986). Few early-dispersing birds were ever found breeding in central California, and three died within a few weeks of release. Eagles released at a younger age were less capable of immediate dispersal, and these birds established a regular feeding pattern at the hack tower. The benefits of greater attachment and familiarity with the site before dispersal perhaps increased their likelihood of establishing a breeding territory in the region in subsequent years. Sharpe and Garcelon (2005) released eaglets close to the standard fledging age at Santa Catalina Island, but the ocean served as a barrier limiting the extent of eagle dispersal, relative to our mainland site. Mainland reintroduction projects with terrain favoring rapid dispersal might benefit from releasing birds younger than the standard fledging age to improve the likelihood of birds remaining at the site, and if they disperse or migrate, returning to the site to breed.

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LITERATURE CITED

BOLANDER, L.P., JR. 1933. Bald Eagle nesting on Monterey coast. *Condor* 35:238.

BORTOLOTTI, G.R. 1984a. Physical development of nestling Bald Eagles with emphasis on the timing of growth events. *Wilson Bulletin* 96:524–542.

———. 1984b. Criteria for determining age and sex of nestling Bald Eagles. *Journal of Field Ornithology* 55:467–481.

———. 1986. Influence of sibling competition on nestling sex ratios of sexually dimorphic birds. *American Naturalist* 127:495–507.

BUEHLER, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* P.G. Rodewald [ED.], The birds of North America. Cornell Lab of Ornithology, Ithaca, NY U.S.A. https://birdsna.org/Species-Account/bna/species/baleag (last accessed 30 December 2016).

DETRICH, P.J. 1985. The status and distribution of Bald Eagle in California. M.S. thesis, California State University, Chico, CA U.S.A.

ENDERSON, J.H., C.M. WHITE, AND U. BANASCH. 1998. Captive breeding and releases of peregrines *Falco peregrinus* in North America. Pages 437–444 *in* R.D. Chancellor, B.-U. Meyburg, and J.J. Ferrero [EDS.], Holarctic birds of prey. World Working Group on Birds of Prey and Owls, Berlin, Germany.

GRIER, J.W. 1982. Ban of DDT and subsequent recovery of reproduction in Bald Eagles. *Science* 218:1232–1235.

HATCHER, R.M. 1990. Nesting Bald Eagles in Tennessee: 1965–1990. *Migrant* 61:89–91.

HUNT, W.G., R.E. JACKMAN, J.M. JENKINS, C.G. THELANDER, AND R.N. LEHMAN. 1992. Northward post-fledging migration of California Bald Eagles. *Journal of Raptor Research* 26:19–23.

JUREK, R.M. 1990. California Bald Eagle breeding population survey and trend, 1970–1990. Nongame bird and mammal section report. California Department of Fish and Game, Sacramento, CA U.S.A.

KIFF, L.F. 1980. Historical changes in resident populations of California island raptors. Pages 651–673 *in* D.M. Power [ED.], The California islands: proceedings of a multidisciplinary symposium. Santa Barbara Museum of Natural History, Santa Barbara, CA U.S.A.

LEHMAN, R.N. 1983. Breeding status and management of Bald Eagles in California – 1981. California Department of Fish and Game Wildlife Management Branch, Administrative Report 83–1. California Department of Fish and Game, Sacramento, CA U.S.A.

NISBET, I.C.T. 1989. Organochlorides, reproductive impairment and declines in Bald Eagle *Haliaeetus leucocephalus* populations: mechanisms and dose-response relationships. Pages 483–489 *in* B.-U. Meyburg, and R.D. Chancellor [EDS.], Raptors in the modern world. World Working Group on Birds of Prey and Owls, Berlin, Germany.

NYE, P. 2008. A review of the natural history of a reestablished population of breeding Bald Eagles in New York. Pages 297–305 *in* B.A. Wright and P. Schempf [EDS.], Bald Eagles in Alaska. Bald Eagle Research Institute, Juneau, AK U.S.A.

POSTUPALSKY, S. 1974. Raptor reproductive success: some problems with methods, criteria, and terminology. Pages 21–31 *in* F.N. Hamerstrom, Jr., B.E. Harrell, and R.R. Olendorff [EDS.], Raptor Research Report No. 2. Management of Raptors. Raptor Research Foundation, Inc., Vermillion, SD U.S.A.

SHARPE, P.B. AND D.K. GARCELON. 2005. Restoring and monitoring Bald Eagles in southern California: the legacy of DDT. Pages 323–330 *in* D.K. Garcelon and C.A. Schwemm [EDS.], Proceedings of the Sixth California Islands Symposium. National Park Service Tech. Pub. CHIS-05-01, Institute for Wildlife Studies, Arcata, CA U.S.A.

SHERROD, S.K, W.R. HEINRICH, W.A. BURNHAM, J.H. BARCLAY, AND T.J. CADE. 1982. Hacking: a method for releasing Peregrine Falcons and other birds of prey. The Peregrine Fund, Boise, ID U.S.A.

U.S. FISH AND WILDLIFE SERVICE. 1986. Pacific Bald Eagle Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR U.S.A.

————. 2007. Endangered and threatened wildlife and plants; removing the Bald Eagle in the lower 48 states from the list of endangered and threatened wildlife. *Federal Register* 72:37,346–37,372.

WIEMEYER, S.N., C.M. BUNCK, AND C.J. STAFFORD. 1993. Environmental contaminants in Bald Eagle eggs – 1980–1984 – and further interpretations of relationships to productivity and shell thickness. *Archives of Environmental Contamination and Toxicology* 24:213–227.

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