

BREEDING BALD EAGLES IN CAPTIVITY

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Large scale declines in some populations of Bald Eagles (*Haliaeetus leucocephalus*) in the contiguous United States have been documented by Broley (1958), Abbott (1967), and Sprunt et al. (1973). The percentage of pairs producing young and the average number of young produced annually per successful pair have been reduced in declining populations (Sprunt et al. 1973). Environmental pollutants have been implicated in the deaths of Bald Eagles (Reichel et al. 1969, Mulhern et al. 1970, Belisle et al. 1972) and in the reduced reproductive success of some populations (Wiemeyer et al. 1972).

To produce Bald Eagles for controlled studies dealing with non-reproductive effects of environmental pollutants, and to determine the requirements for breeding this species in captivity, a captive breeding project was initiated in the Section of Environmental Studies at the Patuxent Wildlife Research Center, Laurel, Maryland. Problems associated with captive propagation of raptors have been overcome for some species, but published accounts of Bald Eagles successfully breeding in captivity are rare. Hulce (1886, 1887, Bebe 1886) bred a pair of Bald Eagles in an enclosed porch beside his house in Ohio. His birds began producing fertile eggs in their sixth year and successfully raised three young over a two year period. A 14-year-old female Bald Eagle produced two young on her fourth attempt after being paired with three different males at the Buffalo Zoological Gardens (Anon. 1909, Herrick 1932b). A pair of Bald Eagles collected in Alaska during 1932-33 produced young on two occasions at the San Diego Zoo. Two young were raised in 1938 when the 6-year-old female and 5-year-old male bred in a large flight pen containing 30 additional species of raptorial birds (Hancock 1973). In 1953 the birds produced one young that lived for six days before being thrown from the nest (Anon. 1969). Barger (1963) reported that a pair of Bald Eagles at the Wisconsin Conservation Department's game farm at Poynette hatched two young in 1958; both died before 17 days of age.

Repeated breeding by a pair of White-tailed Sea Eagles (*Haliaeetus albicilla*) at the Vienna Zoo has been documented by Fiedler (1970). His birds produced at least one young per year from 1961 through 1969. The birds originally bred in a large flight pen containing various species of raptors but were moved to separate quarters after they killed two Bearded Vultures (*Gypaetus barbatus*) during their first breeding season.

TABLE 1
MEASUREMENTS (MM) OF ADULT FEMALE NORTHERN AND SOUTHERN BALD EAGLES¹
COMPARED TO A CAPTIVE FEMALE

	Wing	Tail	Tarsus	Middle Toe
Southern Bald Eagle ³	584–588 ² (576.5)	247–286 (271.2)	101–107 (103)	66–77 (71.8)
Northern Bald Eagle ⁴	605–685 (640.2)	300–365 (339.4)	83–110 (101.9)	70–82 (74.5)
Captive Female	568	271	99	70

¹ After Friedmann (1950).

² Extremes; means in parentheses.

³ Eleven specimens from Georgia, Florida, Louisiana, and Baja California.

⁴ Forty-two specimens from Bering Island, Alaska, Northwest Territories, New Brunswick, Maine, Massachusetts, New York, Pennsylvania, Virginia, Idaho, North Carolina (only wing length based on 42 specimens, other measurements based on 16 specimens).

We will here report on the successful breeding of a pair of captive Bald Eagles and present data on our husbandry methods.

METHODS AND MATERIALS

Source of Birds.—In January 1965, a female Bald Eagle (approximately 3 years old) was shipped to this center from Madison Co., Alabama where it was found with an injured wing beneath a high voltage line. After the wing healed, she was paired with a male taken from a nest near Juneau, Alaska in 1965 (at age 40 days) and exhibited at the National Zoological Park in Washington, D. C. until its transfer to Patuxent in 1968.

The size of the Bald Eagle gradually decreases from Alaska to Florida (Bent 1937) and is the basis for separating the birds into northern (*H. l. alascanus*) and southern (*H. l. leucocephalus*) subspecies (Friedmann 1950). Body measurements of our captive female indicate that she probably belongs to the southern race (Table 1). Bent (1937) states that the two Bald Eagle races intergrade extensively where their ranges overlap. Past records indicate that captive Bald Eagle breeding experiments were successful when birds with similar origins were paired together (Hancock 1973). The pronounced latitudinal difference in origin in our breeding eagles (58°N. Lat. versus 25–40°N. Lat.) indicates that formation of a pair bond may be as important to successful breeding as the pairs' origin.

The sex of our eagles was determined by cloacal examination and later confirmed by plasma steroid hormones (Dieter 1973).

Facilities.—The eagles were housed in the end cage of a row of eight flight pens located in a 3.2 ha fenced field surrounded by mixed stands of deciduous and pine (*Pinus virginiana*) trees. The flight pen floors and adjacent field were planted in *Lespedeza* sp. and left uncut during each breeding season. A row of smaller flight pens containing a colony of American Kestrels (*Falco sparverius*) faced the eagle pens. A one-story building near the flight pens originally contained offices, but was converted to a receiving warehouse for the Center in 1970. Because the end pen containing the

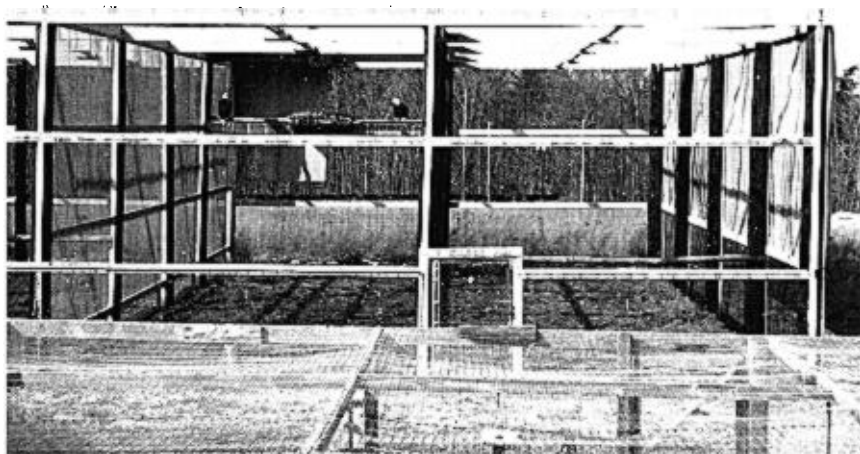


FIG. 1. Raptor flight pen containing a pair of breeding Bald Eagles. Pens in foreground house breeding American Kestrels.

breeding eagles faced the loading platform, canvas was placed on the end of the pen to minimize disturbance caused by the passage and unloading of trucks.

The pen of our breeding pair measured $22 \times 11 \times 5.5$ m high and had its long side in common with the adjacent pen (Fig. 1). Utility poles placed 1.5 m in the ground at 5.5 m intervals were used for the upright supports. Large beams supported the wire on the roof of the pens. The exterior sides and top of the pens were covered with 2.5×5 cm mesh weld wire. A double layer of poultry netting was used as a partition between adjacent pens. Hardware cloth, 91 cm wide, and buried 61 cm in the ground, surrounded the pens to prevent mammalian predators from burrowing into them. The hardware cloth overlapped the weld wire at ground level and was securely attached to it. Plywood sheets were nailed opposite the perch on the back and side wall for protection from the prevailing wind.

The pen contained a heated $61 \times 61 \times 10$ cm stainless steel water pan, a feeding stump for each bird, perches, and a nest platform. The nest platform was placed 3.7 m above the ground and was made of 1.2×1.2 m plywood supported by two beams attached to adjacent poles. A man-made nest, lined with pine bark mulch, was wired to the platform and was repaired before each nesting season. Sticks were placed on the ground to provide supplemental nest materials for the eagles.

To give the nest area some protection from the weather, three sheets of 1.2×2.4 m translucent fiberglass were attached to the roof over the nest platform. Hancock (1973) found that Bald Eagles nesting below the tree crown in British Columbia experienced a higher fledging rate than those nesting without an overhead cover. A plexiglass mirror, placed above the nest in December 1971, allowed the nest contents to be seen from outside the pen (Fig. 2). Following the 1972 breeding season, we modified the

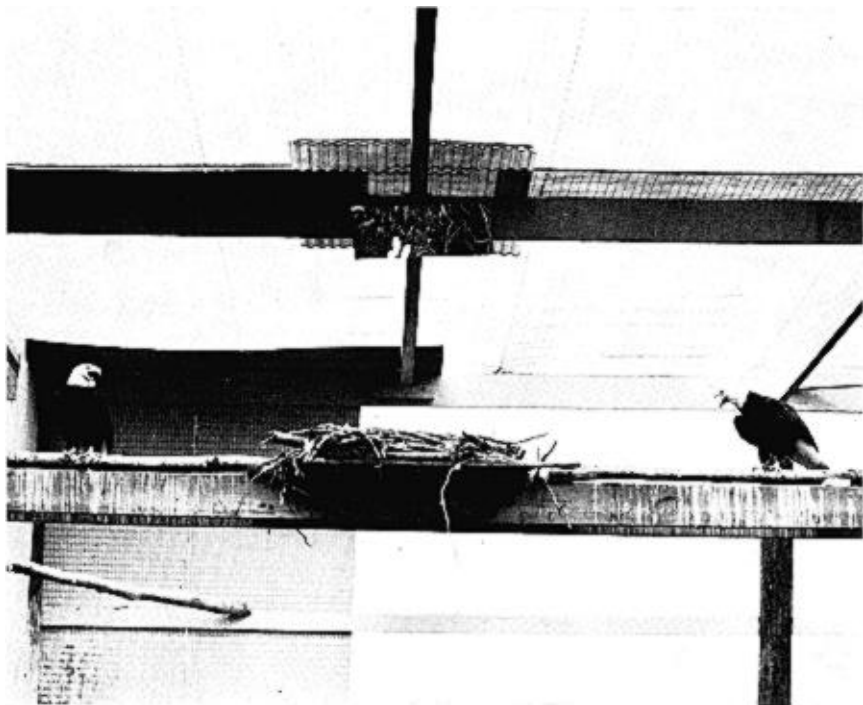


FIG. 2. Elevated nesting platform with three Bald Eagle eggs (visible in mirror above the nest).

eagle breeding pen by adding two additional sheets of fiberglass above the nest and fiberglass insulation beneath it.

Food.—During the breeding season the eagles were fed thawed whole animals once each morning; feeding was increased to twice a day after the eggs hatched and until the young fledged. Typical food included: laboratory rats, hamsters, guinea pigs, young chickens, and whole fish (both brackish and salt water species). During the non-breeding season the birds were fed once each morning 6-days a week. At that time, the diet consisted of whole animals or fish twice a week and one of two commercial foods (Zu-preem and Nebraska Brand Birds of Prey Diet) on the remaining days.

RESULTS AND DISCUSSION

In December 1969 three pairs of Bald Eagles were simultaneously placed in three of the completed pens; five pairs of Peregrine Falcons (*Falco peregrinus*) were placed in the remaining five pens. Following their placement in the flight pens, the eagles were usually examined once a year. Prior commitments during the 1970–72 breeding seasons precluded detailed obser-

vations. Extended observations were made with a 30× spotting scope during the 1973 season from an elevated blind about 120 m from the pens.

Behavior.—The breeding pair never was imprinted to humans even though the male was hand-raised as a nestling. During the non-breeding season, the eagles retreated at the approach of a person or vehicle. Following egg-laying and until the eggs or young were removed each year, the male attempted to attack anyone who approached the pen; the female often screamed from the nest perch.

Bald Eagles breeding in Florida tolerated crows (*Corvus* sp.) and vultures (Cathartidae) near the nest site (Howell 1937); Bald Eagles nesting in British Columbia ignored crows and Ospreys (*Pandion haliaetus*) unless they tried to perch in the nest tree (Retfalvi 1965). Herrick (1932a) reported that a female Bald Eagle brooding young rose quickly to her feet and raised her wings when a crow flew directly over the nest. On another occasion the male drove off a flock of crows early in the reproductive season when the first egg may have already been in the nest. In our study, crows, vultures, and an Osprey flying over the pen area during the breeding season elicited a series of high-pitched screams and rapid wing movements from the perched eagles.

Few instances of intraspecific conflict between eagles in adjacent pens were noted. On three occasions, a non-breeding eagle in an adjacent pen was frightened and flew along or into the partitioning wire where it was immediately attacked by one of the members of the breeding pair. These conflicts may have been kept at a minimum by having the perches and nest platform in the same position in each pen. No occurrences of strife were observed between members of our breeding pair.

The eagles added to their man-made nest by occasionally bringing a stick or more often, a tuft of dried grass to it prior to and following egg-laying.

Reproduction.—The breeding eagles may have had insufficient time to form a pair bond in the flight pen before the 1970 breeding season; also, this 5-year-old male may not have been sexually mature, which may explain why no reproductive activities were observed during that year.

In 1971, the pair was first seen incubating on 3 March. Following 56 days of incubation, we removed one whole egg and fragments of at least one other egg. No embryos were visible. In a review of captive Bald Eagle breeding projects, Hancock (1973) found that three of four pairs of mature birds that eventually hatched eggs produced infertile clutches during their first nesting attempt. The cause of infertile first clutches in captive eagles is unknown; field studies of known-age eagles are needed to determine if this commonly occurs among wild birds. Removal of the first clutch from captive eagles laying for the first time might stimulate reneesting, although only a few

instances of wild eagles renesting following removal of their eggs have been recorded (Hoxie 1910, Herrick 1924, Bent 1937).

In 1972, the female began laying on 29 February and had deposited three eggs by 6 March. Incubation appeared to begin with the laying of the first egg. One egg hatched on 5 April and a second young appeared to be present on 8 April. An unseasonal ice storm on the night of 7 April left portions of the nest covered with ice. Both eaglets were dead by 10 April. On 19 April, we removed the remaining egg which contained an embryo that had died a few days before hatching. The embryo plus the unabsorbed yolk weighed 64 g, less than that of an eaglet from Canada weighing 85 g at hatching (Herrick 1932b). Remains of the dead eaglets were not found. The adult eagles had brought food to the nest, but we are uncertain whether the young were fed. No further breeding attempts were observed that year. The female was found to be blind in the right eye prior to the 1973 breeding season.

On 16 January 1973, we observed the eagles bringing dried grass to the nest. The first egg was laid on 26 February. The pair copulated on a perch adjacent to the nest 2 days later. The female laid a second egg on 1 March; the third egg was first seen 4 days later.

Incubation on a regular basis did not begin until the second egg was laid. Both birds participated in incubation, as found by Herrick (1932a), with the female spending approximately twice as much time on the eggs as the male (N. Gerrard, pers. comm.). On three occasions just before dark the birds were observed sitting side by side on the nest in an incubating position for periods ranging up to 20 min (N. Gerrard, pers. comm.). Nicholson (1952) reported flushing both birds from two Florida nests after dark, but in his personal communication to Bent (1937) he stated that in both instances one bird was incubating or brooding while the other was perched near the nest.

A slight change in the normal incubation posture (back horizontal) was first noted on 2 April when the incubating eagle assumed a brooding posture in which its back sloped slightly toward its tail. Observations with the aid of the mirror on that date, during periods when the incubating adult was off the nest, indicated that pipping had not begun. The brooding posture became more pronounced on later days.

One egg was well pipped on 3 April; this egg probably hatched on 4 April. A second egg was pipped on 5 April and two young were present the next day. The third young hatched on 8 April after an incubation period of at least 34 days. Incubation periods reported for other studies include 34 to 35 days for wild Bald Eagles in Ohio (Herrick 1932a), 35 to 36 days for eagles in Florida (Nicholson 1952), and 35 to 37 days for a captive pair in Ohio (Hulce 1886, 1887).

Antagonism between the nestlings was apparent soon after hatching. Fighting was first observed the day after the second eaglet hatched and occurred when both adults were away from the nest. Two days later the young were again pecking at each other's head and, at one point, were grasping each other's beak. At that time, the parents were standing on the nest and offering food to the young. On 9 April one of our adult eagles picked up and partially ate what appeared to be a dead eaglet. Two young remained in the nest on the following day. Although the first two eaglets were most aggressive towards each other at about the time the third egg hatched, we don't know that the dead eaglet was the last to hatch or that its death was the result of fratricide.

Herrick (1932b) observed an older nestling attacking its younger nest mate; the younger nestling died at about 20 days of age. Dixon (1909) mentioned a case where the smallest of three nestling Bald Eagles being raised in captivity was killed by its nestmates. Ingram (1959) reported that fratricide is common among nestling eagles; he could not correlate the behavior with a lack of food. Gordon (1955) found that an older Golden Eagle (*Aquila chrysaetos*) nestling will repeatedly attack and often kill its younger nest mate.

Food placed in the pen after the young hatched was immediately picked up by the male and transferred to the nest. The actual feeding of the young was usually performed by the female. On 10 April, when the pair and their young were observed nearly continuously from 08:30 until 16:10, the young were fed three times at about 11:00, 12:50, and 14:30. Excess food items were often left on the nest.

The largest nestling was seen preening its down on 18 April when only 2 weeks old. The two nestlings were first seen standing in the nest on 29 May, and by 12 June were spending the day on perches connected to the nest, but returning to the nest to be fed. On 28 June, 85 days after the first eaglet hatched, we removed the fledged young from the high grass beneath the nest. Work being performed near the pens may have caused the young to prematurely fly from the nest, although Herrick (1924) found that two eaglets had left an Ohio nest after spending about 71 and 74 days in it. However, he computed the time spent in the nest after assuming the eaglets hatched following a 29-day incubation period rather than the normal 35- to 36-day period.

At fledging, the eagles weighed 3639 g and 4671 g, less than the average weights of 18 immature Bald Eagles collected in Alaska by Imler and Kalmbach (1955). They found an average weight of 4014 g for males and 5089 g for females. A captive-reared male Alaskan Bald Eagle weighed 4508 g at 74 days of age (Stewart 1970).

SUMMARY

A 7-year-old female Bald Eagle from Alabama was paired with a 4-year-old Alaskan male in a large flight pen during December 1969. Both birds were free of physical defects when originally placed in the pen but the female was blind in one eye prior to the 1973 breeding season.

Nesting first occurred during 1971 when at least two eggs were laid; all but one, which showed no sign of embryonic development after being incubated for 56 days, were broken by the adult birds. Two of three eggs laid in 1972 hatched. Both young died a few days after hatching following a period of inclement weather. Three eggs were laid and hatched during 1973. Antagonism between the nestlings was observed soon after hatching and may have been responsible for the unobserved death of one nestling, two days after the third young hatched. The two remaining young were raised by the adult birds and eventually left the nest 85 days after the first egg hatched. Incubation periods for the 1972-73 clutches averaged 35 days. No renesting attempts were made by the eagles during the 3-year period.

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REQUEST FOR INFORMATION

Least Terns.—As part of our research on the California Least Tern (*Sterna albifrons browni*), we are seeking information on (1) the location of breeding colonies in Baja California, Mexico, and (2) the migration routes and wintering areas of the subspecies. We would appreciate hearing of any Baja California observations of Least Terns, and of any records of Least Terns along the Pacific coast of Mexico, Central America, and South America from September through March. Please send your information to: Sanford R. Wilbur, U.S. Fish and Wildlife Service, 1190 E. Ojai Avenue, Ojai, CA 93023.