Meyburg, B.-U. & R. D. Chancellor eds. 1989
Raptors in the Modern World
WWGBP: Berlin, London & Paris

Restoring Nesting Bald Eagle *Haliaeetus leucocephalus* Populations to the Southeastern United States

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ABSTRACT

To test the feasibility of recycling wild pairs as a method of producing eagles for restoration projects and as a first step in restoring populations of the endangered Southern Bald Eagle, whole clutches were taken from wild nests in northern Florida during two breeding seasons. Most donor pairs re-laid and fledged young at a rate not significantly different from controls. Specialized equipment and methods were developed for protecting and handling developing eggs which were transported to Oklahoma. Forty-seven of 52 eggs were hatched after incubation by bantam hens and modified commercial incubators.

Techniques to prevent imprinting and siblicide in totally hand-reared eagles were developed. Six chicks died, four from a probable vitamin B-1 deficiency caused by a diet of mostly fresh-frozen fish. The remaining chicks were released by hacking in Oklahoma, Georgia, Alabama and Mississippi. A third year of this project is under way at the present time.

INTRODUCTION

The national symbol of the United States, the Bald Eagle (*Haliaeetus leucocephalus*), was declared "endangered" in March 1967, and those eagles south of the 40th parallel north received protection under the Endangered Species Act of 1973 (16 U.S.C. 1531-1543). In 1978 the species' status was changed to endangered throughout the co-terminous U.S. except for five states where it was designated as "threatened". This move was prompted by drastic declines in its population and productivity throughout most of the U.S. including most of the south-eastern states. The reasons for its decline included habitat destruction (Shapiro *et al.* 1982), human disturbance including shooting (Locke 1982) and, most significantly, environmental pesticide contamination which caused Bald Eagles to lay eggs with thin shells that subsequently broke. This ultimately resulted in reduced reproductive success and declining population size (Ratcliffe 1967; Hickey & Anderson 1968; Anderson & Hickey 1972).

In order to restore its numbers, the U.S. Fish and Wildlife Service (USFWS) created teams of specialists to devise regional recovery plans for the species. A recovery team for 12 south-eastern states (excluding Oklahoma) was appointed and their plan approved (Murphy *et al.* 1984). Even though Oklahoma is under the aegis of the Northern States Bald Eagle Recovery Plan (Grier *et al.* 1983), its optimal Bald Eagle habitat is contiguous with eagle habitats of the south-eastern states.

The South-eastern States Bald Eagle Recovery Plan's objective is to change the species' status from endangered to threatened in the states of its concern (Murphy *et al.* 1984). The criterion by which the team will judge this objective is the documentation of 600 occupied breeding areas over at least 75% of the eagle's historic range, contingent on reproductive success being greater than 0.9 young per occupied nest, greater than 1.5 young per successful nest and at least 50% of the nests successful at raising a minimum of 1 young, all over a three-year period or longer (Murphy *et al.* 1984).

One step in the plan is to "re-establish the historic breeding continuity and supplement reduced populations through translocation where necessary" (Murphy *et al.* 1984:18), and it is this relocation and supplementation task which the George Miksch Sutton Avian Research Center (GMSARC) is conducting.

METHODS

It is known that many raptor species will lay second, and sometimes third, clutches if a previous clutch is taken early during incubation (Newton 1979). However, documentation of this phenomenon for Bald Eagles was lacking except for a few unpublished anecdotes. GMSARC proposed to the recovery team and the Florida Game & Fresh Water Fish Commission that Bald Eagle recycling be attempted on an experimental basis to provide eagles for translocation efforts already under way in several south-eastern states. If recycling occurred, this could provide eagles for translocation without negative impacts on the donor population.

Although a population decline had occurred in many areas of Florida to perhaps only 50% of historic levels (Robertson & Robertson in Murphy *et al.* 1984), this state still had an estimated 350 pairs nesting annually with about 250 successfully producing young (Nesbitt in Murphy *et al.* 1984). Thus Florida was considered the best site for egg collection. Healthy Bald Eagle populations outside the south-east, such as in Alaska and the Great Lakes states, can and have been used as translocation sources for eagle releases (Nye 1983); however, birds from Florida should be better adapted to the habitat and climate of the south-eastern U.S.

In 1984 GMSARC began preparing to undertake the first collection of eggs from Florida for transportation to its facilities in Oklahoma, where they would be incubated, reared and released by hacking throughout the south-east.

The locating of active eagle nests, mapping these, monitoring nesting progress and obtaining landowner permission to take eggs were carried out by Dr. Michael Collopy and his associates at the University of Florida (Collopy & Bohall-Wood, this volume). Dr. Collopy was also responsible for following the nesting progress and productivity of control and experimental pairs to determine whether the latter recycled and how their productivity compared with that of control pairs.

Because the incubation facility and collection sites were over 1,000 miles apart, methods and equipment had to be developed to safely collect eggs in Florida and transport them to Oklahoma, all the time keeping them at the proper incubation temperature and humidity and protecting them from damage. To lower eggs from the nest and transport them to the nearest road, we constructed a 6" diameter polyvinylchloride (PVC) tube fitted with three 4" thick foam rubber inserts to protect the eggs. The PVC tube was constructed with a wooden bottom and a hinged, latching lid. Each insert had a hole the shape of a Bald Eagle egg, but slightly smaller, cut from its centre with an electric knife. Slots at each side of the egg hole were cut to admit a person's fingers so that the eggs could be inserted and removed. Another layer of 1/2" foam rubber was placed on top of the last insert stacked inside the PVC tube before the lid was latched. After collection and insertion into the tube, the eggs were then taken to a waiting vehicle. This carried a 110-volt gasoline powered generator which ran a field incubator. Eggs were never handled without the use of a dust mask over the handler's face and rubber surgical gloves to prevent the transfer of skin oils and bacteria. Before receiving eggs, the PVC tubes and all incubators were fumigated with formaldehyde, using the methods given in Weaver & Cade (1983).

Field incubators were constructed with the help of K. Vasudevan by placing a Turn-X incubator manufactured by Marsh Farms (now Lyon Electric) inside a covered plastic container. The turning mechanism and incubator base were removed and a round wooden template with holes the shape of, but slightly larger than, Bald Eagle eggs cut out of it was mounted 1" above the bottom of the container. On top of the template were placed, in order, a piece of 1/2" foam rubber with egg

holes, a piece of 2" mesh (stretched measure) netting, the eggs (situated over the template holes), a second piece of netting and a plastic template with egg holes. These were all secured to the wooden template with quick-release fasteners. The result was that the eagle eggs would be securely suspended in the incubator by the nets and not touch anything else. The incubator top was placed over this assembly and the container lid closed. The electronic control circuitry of the incubators, lab and field, required a surge guard to protect it from being destroyed by inadvertent generator overvoltages. The incubator was pre-set to maintain the desired temperature, monitored with a mercury thermometer marked in 0.2° C increments which was inserted from the outside next to the eggs. Accurate temperature control required the replacement of the stock temperature control knob, a five-turn potentiometer, with a ten-turn potentiometer. A clutch of eggs was loaded into the running field incubator, driven to a nearby highway to a motorhome and transferred to a lab incubator after the eggs' length, breadth and weight were measured. During the trip the temperature was regulated by cycling the incubator's fan and heater element on and off once the desired temperature was reached by means of an external switch plugged into the incubator cord. Road vibrations and bumps were cushioned by holding the incubator off one's lap when necessary.

Originally the field incubators were constructed with a removable layer of polyurethane insulating foam around the outside of the Turn-X incubator top and inside the round container; however, the usually warm temperatures encountered in Florida during the breeding season obviated the need for this.

The lab incubator in the motorhome was a modified Marsh Farms Roll-X incubator. Its temperature control knob was replaced with a ten-turn potentiometer for finer temperature control and backed up with an emergency overheat shot-off and alarm system operated by a Robbins-type thermometer (Weaver & Cade 1983). The egg-turning grid on the Roll-X was replaced with eggcrate foam glued onto a sheet of composite board backed with a layer of flat 1" foam rubber. Eggs were placed in pockets on the eggcrate foam created by tearing out individual bumps of foam. The incubator contained one or two plastic tubs of distilled water to raise the relative humidity to desired levels (ca. 60%), measured by a dial hygrometer. For transportation back to Oklahoma it was carried on a box full of soft, spongy fibre placed on a person's lap in order to cushion the eggs from road vibrations and bumps.

On arrival at GMSARC the eagle eggs were put under sitting bantam hens. Experience has shown that natural avian incubation for the first week increases the hatchability of raptor eggs (Weaver & Cade 1983).

The hens were induced to become broody by increasing their photoperiod by exposure to artificial daylengths of 16 hr light/ 8 hr dark about three weeks before eagle eggs were collected. Eggs laid by the hens were removed and replaced by simulated plastic eagle eggs. Each hen was usually given a maximum of two eagle eggs to incubate. The hens were locked in their nest boxes by a wire-screened door and released twice daily to defecate, feed and drink. The locked doors were necessary to prevent fighting between competing hens, which might cause egg breakage (Weaver & Cade, 1983). When the hens were off, a terrycloth washcloth was placed over the eggs to retain their heat.

Measuring and weighing of each egg at collection allowed us to determine the calculated fresh weight, length of previous incubation and predict the pipping date using formulas similar to Burnham (1983). We obtained the fresh weight of ten eggs laid by captive eagles at the Patuxent Wildlife Research Center (R. Gable, pers. comm.) and calculated an egg coefficient (Kw in Burnham, 1983) of 0.0005459 to determine calculated fresh weight and other egg statistics.

Each egg was weighed to the nearest 0.1 g daily to determine its weight loss which was plotted on a graph. Our target weight loss was 15% + or - 3% of the calculated fresh weight from laying to pipping (33 d). If an egg lost too much or not enough weight while being incubated under hens, we moved it to a lab incubator. This was the same converted Roll-X incubator mentioned above except that a turning grid was installed to automatically turn the eggs. We modified the turners so that the eggs were placed on a wire mesh, laid flat and rolled instead of tilted after the manner of B. Walton (pers. comm.). Each egg was rolled through a minimum of 90° hourly. Different relative humidity incubators were created by varying the number of plastic tubs of distilled water in the incubators, and the eggs' daily weight loss was regulated by moving them between incubators of different humidities as required to maintain the optimal 15% weight loss. Desired incubation temperature was 99.5° (99.0°-100.0°)F.

At pip, eggs were no longer turned and were transferred to a Roll-X incubator with a terrycloth towel floor covered by gauze where the eagles were allowed to remain until hatched and dry.

For the first week after hatching, while their vision appears to be minimal, eaglets were fed and observed without regard to their being able to see humans. After the first week, steps were taken to isolate them from people. From one day of age they were fed with a rubber puppet fashioned to look like an adult eagle head so as to imprint them on the image of an adult Bald Eagle. After two weeks puppet feeding was decreased to once a day and ceased at four weeks, when the eaglets could self-feed on ground-up food placed in plastic bowls in their tubs. At five weeks they were fed whole-body food so they could learn to tear it apart. It was not unusual for them to cease gaining weight temporarily while becoming adept at tearing food.

When the eaglets had to be handled, if being weighed for example, the handler dressed in a coverall constructed of camouflage material that had no neck, arms or legs and hung loosely to the ground. This "ghost costume" had a fabric screen in front of the handler's eyes to prevent the eaglet from seeing them. After the first week, eaglets were put behind a partition that had ports covered with canvas through which they were fed with the puppet and one-way glass windows through which they could be observed unseen.

For the first three weeks the eaglets were kept on rubber pads which contained circulating water heated to ca. 100°F. The water temperature was regulated by a control module and the pad so arranged that the eaglet could crawl to or away from it and thus thermoregulate itself (Weaver & Cade 1983). As the eaglets grew older the water temperature in the pads was gradually reduced, and they were usually moved to a tub with grass or gravel substrate at three weeks old. Eaglets that were too hot or cold gave a discomfort call and assumed body positions like those described for Peregrine Falcons (*Falco peregrinus*) (Weaver & Cade 1983). At four weeks old they were moved to unheated rooms.

Each eaglet from the age of one to six weeks, was kept in an individual 26" diameter tub 10" high to prevent aggression and possible siblicide. Nonetheless, an eaglet could at times intimidate a submissive neighbour and cause it to stop feeding. At six weeks the eaglets were moved outdoors into a half-roofed communal chamber and exposed to ambient temperatures.

During our first season we fed the eaglets mostly fresh-frozen fish (farm-raised catfish, *Ictalurus* sp.) with vitamin and calcium/phosphorus supplements and occasionally poultry. Four out of 17 died and post mortems carried out by the Oklahoma Animal Disease Diagnostic Laboratory (OADDL) at Oklahoma State University failed to find any obvious cause or even clearcut symptoms. Following inquiries with various zoos and other avian institutions we began to suspect that the frozen fish diet was the cause of a vitamin B-1 (thiamine) deficiency. Feeding frozen fish can cause thiamine deficiency to a degree that even vitamin supplementation could not compensate, as experimentally demonstrated in Herring Gulls (*Larus argentatus*) by Gilman (1978) and known to occur in marine mammals fed a fish diet (Geraci 1974). We ceased feeding frozen fish and have not experienced any similar eaglet deaths since. The diet we use now consists mostly of Japanese quail, domestic rabbit, venison and laboratory rat. The carcasses are prepared by being partly eviscerated (large intestines), having hard parts such as feet and beaks removed, deplumed or depiliated to a large extent, and supplemented with vitamins, calcium/phosphorus and 0.9% saline solution. Fish are now only fed fresh and after the eagles are six weeks or older and finished with body growth.

At eight weeks of age the eagles were put in hack towers (see Sherrod *et al.* 1982 for detailed methods) and released at 11 weeks.

RESULTS

Table 1 compares our incubation, rearing and hacking success for our first two seasons. Hacking of GMSARC-raised eagles was conducted by the Alabama Division of Game and Fish, the Georgia Game and Fish Division, the Gulf Islands National Seashore in Mississippi as well as GMSARC in Oklahoma.

Table. 1. GMSARC Bald Eagle hatching, rearing and hacking success.

	84-85	85-86	Total or (Mean)
No. of eggs	18	34	52
No. fertile	17	33	50
Percent fertile	94.4	97.1	(96.2)
No. hatched	17	30	47
Percent of fertile eggs hatched	100.0	90.9	(94.0)
No. reared to hacking age	13	28	41
Percent reared to hacking age	76.5	93.3	(87.2)
No. successfully hacked	12	28	40
Percent of hatched hacked	70.6	93.3	(85.1)
% fertile eggs resulting in hacked birds	70.5	84.8	(80.0)

We are currently (March 1987) in the midst of our third season of raising eagles. We encountered one problem in hatching eggs that seems to have been caused by bacterial contamination of clutches in the wild. Preliminary results show that the control pairs which laid eggs close to the same time at which we took our first group of 20 eggs are experiencing a high rate of incubation failure (Collopy, pers. comm.). We were unable to hatch about half of the 20 eggs collected in the first group and some chicks were hatched with bacterial infections and did not survive. Diagnosis at the OADDL isolated many different omnipresent bacterial species as the disease agents. Many of the eggs that were collected were nest-stained in contrast to those from other years, indicating that the eggs laid early in this season might have gotten wet and allowed ambient bacteria the opportunity to invade. At present we have produced 20 eagles, almost all at release age, from 35 eggs.

In July 1987 we will be meeting with the various organizations involved to plan the 1987-88 season, and we hope to be able to increase the collection of eagle eggs from this experimental level to operational levels of 100/year.

ACKNOWLEDGEMENTS

Extensive co-operation with our project was received from the Florida Game and Fresh Water Fish Commission; the Oklahoma Department of Wildlife Conservation; the state game and fish agencies of Georgia and Alabama; the U.S. Fish and Wildlife Service---especially Sequoyah National Wildlife Refuge; the National Park Service; and the University of Florida.

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