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POSTFLEDGING NEST DEPENDENCE PERIOD FOR BALD EAGLES IN FLORIDA

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Abstract: We studied the postfledging dependency period in bald eagles (*Haliaeetus leucocephalus*), a little studied but important period in the life cycle of avian species. Bald eagles in Florida had a postfledging dependency period of 4–11 weeks (15–22 weeks old). The length of the dependency period did not vary by year of study, sex, number of fledgings, timing of fledging, or hatch order ($P > 0.05$). Mean distance fledglings ranged from the nest increased with age, but they were observed in the nest or nest tree throughout the postfledging dependency period. Distance from the nest did not vary by sex, number of fledglings, or timing of fledging ($P > 0.05$). Over 80% of the fledgling observations were within 229 m of the nest. The boundary of the primary protection zone specified in the bald eagle habitat management guidelines for the southeastern United States is 229 m. Restrictions on human disturbance around nest sites should remain in place during the postfledging dependency period because of the close association of fledglings with the nest site. Restrictions also should be flexible because of the varying length of the dependency period.

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For many avian species, the postfledging period is not well understood or studied, yet it is an important period in the life cycle. Many raptors are dependent on their natal nest site or their parents for a lengthy period of time after fledging (Newton 1979, Bustamente 1993). Postfledging periods have been determined for relatively few raptors, partly because of the difficulty of finding young after they move from the immediate vicinity of the nest (Newton 1979). In general, however, offspring of larger species remain dependent longer than offspring of smaller species. Typical postfledging periods are 2–3 weeks for small falcons and accipiters, 5–10 weeks for buteos and large kites, and up to several months for most large eagles and vultures (Newton 1979).

A few studies have examined the postfledging dependency period of bald eagles (Gerrard et al. 1974, Harper 1974, Kussman 1976, McCollough 1986, Hunt et al. 1992), but sample sizes generally were small (n = 2–18 fledglings). Most of these studies were conducted at northern latitudes where populations tend to have a synchronized nesting period during spring and

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early summer (Stalmaster 1987). In contrast, Florida bald eagles have an extremely protracted nesting season spanning 5–6 months during fall and winter, with egg-laying occurring from late October through early March (Wood and Collopy 1993). Consequently, the period of postfledging dependence may be more variable or prolonged.

Management emphasis and protection for bald eagles often are focused on nest sites (U.S. Fish and Wildlife Service 1987) because disturbance at nest sites can decrease productivity (Gerrard and Bortolotti 1988). In the southeastern United States, the bald eagle habitat management guidelines (U.S. Fish and Wildlife Service 1987) specify a primary protection zone with a boundary range of 229–457 m; in Florida, the boundary is set at 229 m. Protection guidelines for nest sites remain in effect until young fledge. To determine if the bald eagle habitat management guidelines are adequate for fledglings, more information is needed about the postfledging movements and nest-site dependence of fledgling bald eagles prior to their first migration.

We conducted a study of fledgling bald eagles using a 2-fold approach. We collected extensive data on radiotagged fledglings and supplemented these data with intensive observations of patagial-tagged fledglings. Our specific objectives were (1) determine the length of time fledgling eagles were dependent on parents and the nest site prior to migration, and (2) determine spatial use of the nest site prior to migration.

STUDY AREA

Our study area (about 1,800 km^2) in north-central Florida included southern Alachua, northern Marion, southwestern Putnam, and northeastern Levy counties, south of Gainesville. Approximately 50 pairs of bald eagles nest in the area annually. The study area contains 340 bodies of open water ranging from 0.4 to 2,702 ha ($\bar{x}$ = 12.6 ha) in size, as well as numerous marshes and wet prairies (Wood 1992). Hartman (1978) provided detailed descriptions of marshes and wet prairies, which also are classified as palustrine persistent emergent wetlands (Cowardin et al. 1979). The primary habitat types available included pine (*Pinus* spp.) woods (27%), hardwoods (13%), baldcypress (*Taxodium distichum*) swamp (4%), freshwater marsh (12%), open water (7%), grassland-pasture (18%), shrub (11%), and developed (8%) (Wood 1992).

METHODS

Banding and Radiotagging Procedures

From 1987–91, 8–9-week-old eaglets were removed from nests by experienced tree climbers and lowered to the ground for banding and measuring. We banded nestlings on the right leg with U.S. Fish and Wildlife Service (USFWS) aluminum rivet bands (size 9). We also attached wrap-around patagial markers made of Herculite fabric (Young and Kochert 1987) on the right wing for individual identification of fledglings during intensive observations. Each tag was yellow with a green shape indicating the year and a white 2-digit number indicating the individual. (Use of any trade names in this paper does not constitute endorsement by the Department of Interior.)

During 1987–90, we fitted 40 nestlings (26 M, 18 F; Wood 1992) with radiotransmitters. Solar transmitters with rechargeable nickel-cadmium batteries (Telemetry Systems, Mequon, Wisconsin, USA) were backpack mounted with 1 cm wide tubular teflon ribbon (Balley Ribbon Mills, Balley, Pennsylvania, USA). To prevent loss of the package, all 4 harness ends were sewn together at 1 point on the breast with nylon thread. Mass of each transmitter package was approximately 55 g or about 1% of the mass of a typical fledgling. Transmitters also were equipped with a mercury activity switch that facilitated locating individuals. A change in the signal pulse indicated when birds were moving rather than stationary.

We measured bill depth, length of foot pad, and length of the eighth primary of each nestling. Bortolotti (1984) determined that bill depth and length of foot pad were the 2 best indicators of sex for bald eagle nestlings, and length of the eighth primary was the best measure for estimating age. At nests with 2 chicks, we estimated hatch order using length of the eighth primary. All field procedures used in this study were approved by the University of Florida animal care and use committee.

Extensive Radiotracking Surveys

From 1987 to 1990, we monitored 40 radiotagged fledglings until they left the study area. We used a Telonics (Telonics, Mesa, Arizona, USA) receiver-scanner and H-antennas mounted on the wing struts of a Cessna 172 or 152 to locate fledglings at least once per week. We

supplemented aerial locations with occasional ground tracking via a hand-held H-antenna. For each telemetry location, we recorded data on date, time, location, activity, habitat, and association with other eagles. Fledglings were considered to have initiated migration when they could not be located within the study area.

We considered the postfledging dependency period to begin when young were approximately 11 weeks old because exact fledging dates (when young left the nest) often could not be determined. The postfledging period ended when fledglings migrated from the nest site.

Intensive Observations

Because telemetry locations of fledglings were limited to approximately 1 observation per individual per week, we also conducted intensive observations on 4 patagial-tagged fledglings at 2 nests (AL32A and MR17D) in 1991. These intensive observations provided more detailed information on movement patterns at the nests and were collected more frequently to allow us to validate the results from the extensive telemetry data.

Nest AL32A had 1 female and 1 male nestling, while nest MR17D had 2 female nestlings. Nest AL32A was in a pine tree in a 57-ha pasture with a few scattered pine trees. Nest MR17D was in a pine tree in a small patch of mixed pine and hardwoods (0.7 ha) surrounded by small patches of pasture, marsh, and woods. Observations began when nestlings were approximately 9 weeks old. At nest AL32A, observations of fledglings continued until the young left the natal area; they appeared to have initiated migration at that time. At nest MR17D, the patchy landscape made it difficult to follow the movements of fledglings; observations were discontinued approximately 5 weeks postfledging, but prior to migration.

We observed the 2 eaglets at each nest site for 2 consecutive half days each week to document spatial use of the nest area prior to dispersal. This resulted in 1 full day of observations per week. The observation day lasted from about 1300 to just after dusk, and then continued the following morning from just before dawn to about 1200. We conducted scan samples (Altmann 1974) every 15 min; data collected included location (measured from topographic maps with a 46-m grid), activity (excercise, fly, feed, perch, soar) of each fledgling, and number of adults present. We used the gridded topographic maps to calculate the distance each fledgling was located from the nest during each 15-min scan sample.

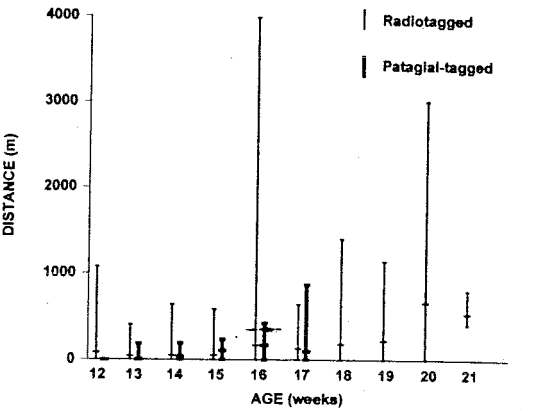

Fig. 1. Mean distance radiotagged (n = 40) and patagial-tagged (n = 4) fledgling bald eagles ranged from their natal nest by weeks of age in northcentral Florida, 1987–91. Bars are minimum and maximum distance.

Statistical Analyses

For radiotracking data, we used a paired t-test to determine if hatch order influenced length of the postfledging dependency period. We used Student's t-tests to compare length of the dependency period by sex, number of nestlings in the nest (1 or 2), and timing of fledging (peak or late; Wood and Collopy 1993). We used analysis of covariance (ANCOVA) to examine mean distance to the natal nest for sex, number of nestlings in the nest (1 or 2), and timing of fledging (peak or late). The ANCOVA model included log-transformed values of distance as the dependent variable and age as the covariate. We used linear regression to examine log-transformed values of distance from the nest in relation to age of fledglings at the intensively monitored nests. All statistical tests were considered significant at $P < 0.05$ and were completed with SAS (SAS Institute 1987).

RESULTS

Radiotracking Data

Each radiotagged fledgling (n = 40) was located 2–22 ($\bar{x}$ = 8) times for a total of 292 locations. Fledglings typically perched at or near their natal nest up to 21 weeks old (Fig. 1). The mean distance from the nest ranged from a low of 41 m at 13 weeks old to a high of 663 m at 20 weeks old. Fledglings ranged farther from the nest with increasing age ($F_{1,288}$ = 35.56, P

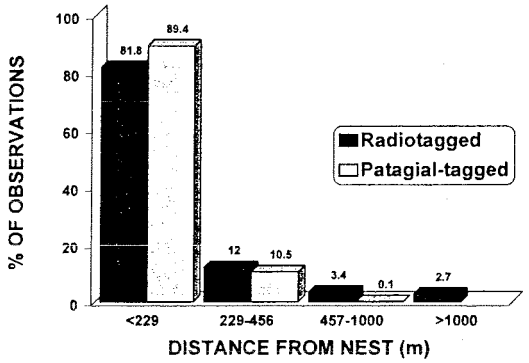

Fig. 2. Percentage of observations for radiotagged and patagial-tagged fledgling bald eagles within 229-m and 457-m nest protection zones in northcentral Florida 1987–91.

Table 1. Distance (km) radiotagged fledgling bald eagles were located from their natal nest prior to initiation of migration in northcentral Florida, 1987–90.

Variable	n[a]	$\bar{x}$ (km)	SE	F[b]	P
Sex					
Female	110	0.12	0.06		
Male	182	0.18	0.06	1.63	0.20
Number of fledglings					
1	104	0.05	0.02		
2	186	0.22	0.07	1.77	0.18
Timing of fledging[c]					
Peak	121	0.19	0.08		
Late	169	0.12	0.05	0.33	0.56
Total	292	0.16	0.05		

[a] n = total number of telemetry locations.
[b] Analysis of covariance (ANCOVA) performed on log-transformed data with age as the covariate.
[c] Peak = first 75% of all clutches laid within a breeding season; Late = last 25%.

< 0.001) but still were located in the nest or nest tree throughout the postfledging dependency period (Fig. 1). The maximum distance we located radiotagged fledglings from their natal nests ranged from 404 m to 4 km ($\bar{x}$ = 427 m, n = 40). Only 12 fledglings during 6% of the 292 telemetry locations (Fig. 2) ranged >457 m (the boundary of the secondary protection zone) from their natal nests before initiating migration. The majority of observations (82%) were within the 229-m primary protection zone; only 4 individuals ranged >1 km. Accounting for age, mean distance that radiotagged fledglings ranged from the nest was not related to sex, number of fledglings, or timing of fledging (Table 1).

Of the 202 locations of perched fledglings, we observed 45% in the nest, which indicated their reliance on the nest site. Only 9% of the locations were of fledglings in flight; fledglings were never observed foraging. Adults were present throughout the postfledging dependency period and were observed during 25% of the observations.

Fledglings remained in the natal area until 18 weeks old (range = 15–21) for 4–11 weeks postfledging. Length of the the postfledging dependency period did not vary by year ($F_{3,156}$ = 0.64, P = 0.60). The duration of the postfledging dependency period also did not differ significantly by sex, timing of fledging, number of chicks in the nest, or order of hatch (Table 2).

Intensive Observations

Patagial-marked fledglings were in sight during 772 of the 887 scan-sampling periods (229

Table 2. Mean age (days) of radiotagged bald eagles at the end of the postfledging dependency period in northcentral Florida, 1987–90.

	n	$\bar{x}$	SE	Minimum	Maximum	t	P
Sex							
Female	17	125	2.3	112	151	−1.09[a]	0.28
Male	23	129	2.6	104	153		
Timing of fledging[b]							
Peak	22	126	2.4	108	153	0.54[a]	0.59
Late	18	128	2.8	104	145		
Number of fledglings							
1	13	127	3.6	108	151	−0.10[a]	0.92
2	27	127	2.1	104	153		
Order of hatch							
1	11	124	3.5	104	145	−1.70[c]	0.12
2	11	131	3.5	115	153		
Total	40	127	1.8	104	153		

[a] Student's t-test.
[b] Peak = first 75% of all clutches laid within a breeding season; Late = last 25%.
[c] Paired t-test.

Table 3. Weeks of age at end of postfledging dependency period for bald eagles from populations throughout North America.

	n	$\bar{x}$	Median	Minimum	Maximum	Source
Saskatchewan	18			19	20	Gerrard et al. (1974)
Minnesota	2	19.5	19.5	18	21	Harper (1974)
Minnesota	8	22	22	19	29	Kussman (1976)
Maine	18	20	20	17	21.5	McCollough (1986)
California	15	16		14	17	Hunt et al. (1992)
Florida	40	18	18	15	22	Wood (1992)

of 310 for MR17D, 543 of 577 for AL32A). Fledglings were not out of the observer's sight until 14 (MR17D) and 16 (AL32A) weeks old.

Fledglings were first observed away from the nest tree when approximately 13 weeks old (Fig 1). Fledglings continued using the nest tree until they were 16 (MR17D) and 17 (AL32A) weeks old, at which time they had dispersed from the study area (AL32A) or observations had been discontinued (MR17D). Distances that fledglings were observed from the nest increased with age ($r^2 = 0.30$, $P < 0.001$; Fig. 1); however, they were located in the nest or nest tree during 19 of the 20 observation days. Most observations (89.4%) were within the 229-m primary protection zone (Fig. 2). The farthest distance we observed a patagial-marked fledgling perched from either of the 2 nests was 0.9 km. We considered this a low estimate, however, because those at nest AL32A were lost from view on a few occasions while soaring, and those at nest MR17D were lost from view in the dense trees.

We recorded 5 basic behavioral activities during 769 scan samples for the 4 fledglings under observation: exercise, fly, feed, perch, and soar. Fledglings spent most of their time perched (88.0%). They were most often located in the nest tree, either in limbs adjacent to the nest (38.8%) or in the nest itself (19.7%). They spent little time flying or soaring (1.2%) and were never observed hunting or scavenging. Adults provided prey throughout the postfledging period at nest AL32A (Wood 1992). Adults were present throughout the postfledging dependency period and were observed during 29.6% of the observations.

DISCUSSION

Postfledging periods for raptors tend to vary more among the individuals of a population than do the incubation and nestling periods (Newton 1979). Bald eagles show a similar pattern. A 35-day incubation period and a nestling period of 11–12 weeks consistently has been observed across individuals and populations. However, the postfledging dependency period varied more for individuals in southern populations than in northern populations (Table 3). For example, Saskatchewan bald eagles, the most northern population, had little variation in the duration of the postfledging dependency period, probably because the short breeding season in Saskatchewan tends to synchronize breeding (Gerrard and Bortolotti 1988). In general, northern populations tend to have a more synchronized nesting period (Stalmaster 1987), which likely reduces variability among individuals. In contrast, Florida bald eagles have a nesting season that spans 5–6 months (Wood and Collopy 1993), which results in young fledging from mid-March to late May (Wood 1992). Consequently, fledglings face a broad range of environmental conditions that influences food availability and likely increases variability in length of the dependency period.

Although the mean length of the postfledging dependency period for bald eagles in Florida, the southern extreme of their breeding range, was similar to that for populations in more northern latitudes, the minimum length was longer in northern populations (Table 3). This difference suggests that food availability is more variable in southern populations, where periods of high food abundance can allow fledglings to reach migration condition more quickly. In Maine, supplemental feeding resulted in a minimum length of the postfledging period less than that of other northern populations (McCollough 1986), also suggesting that food availability strongly influences length of the postfledging dependency period.

In Maine, nestling bald eagles fledged over a 34-day span (11 Jul–14 Aug; McCollough 1986); in Florida, fledging occurs over a longer time span. Radiotagged birds in this study fledged from about 25 March to 27 May, a 63-day span. We originally hypothesized that young fledging

later in the breeding season would leave the study area more quickly due to decreased food abundance and more extreme temperatures (Wood 1992). However, timing of fledging did not affect the length of the postfledging dependency period.

Fledglings focused their activities at or very near their natal nest, particularly early in the postfledging period. Both radiotagged and intensively monitored fledglings often were perched in the nest or nest tree. Generally, fledglings remained in very close proximity to their natal nest site and gradually ranged farther from the nest until they initiated migration. However, they returned to their natal nest each day and continued to spend time there until they migrated. Gerrard et al. (1974), Kussman (1976), McCollough (1986), and Hunt et al. (1992) reported similar results.

As we observed in our study, Harper (1974), Kussman (1976), McCollough (1986), and Hunt et al. (1992) found that fledgling eagles relied almost exclusively on their parents for food. Further, these studies found that fledglings exhibited no active hunting behavior before initiation of migration. Kussman (1976) and Hunt et al. (1992) reported occasional scavenging of carrion by fledglings, but the adults were the primary source of food throughout the postfledging dependency period. Consequently, disruption of adult prey delivery patterns could negatively influence fledglings. Fledglings of relatively few raptors besides bald eagles (e.g., accipiters [*Accipiter* spp.] and honey buzzards [*Pernis apivorus*]) are known to take little or no food for themselves during the postfledging dependency period (Newton 1979). In contrast, for most raptor species, the postfledging period is important for development of hunting skills (Newton 1979, Weathers and Sullivan 1989, Bustamente 1993).

MANAGEMENT IMPLICATIONS

The bald eagle habitat management guidelines (U.S. Fish and Wildlife Service 1987) specify a primary protection zone with a boundary range of 229–457 m from any bald eagle nest used for breeding in the southeastern United States. Residential, commercial, or industrial development, tree cutting, logging, and use of chemicals toxic to wildlife are prohibited in this zone. Unauthorized human entry is restricted during the breeding season. In Florida, the primary zone boundary is set at 229 m, and development occasionally is permitted within this zone. Both radiotagged and patagial-marked fledglings focused their activity at or near the nest site, particularly early in the postfledging period, with >80% of the locations within the boundary of the 229-m primary zone.

Of greater importance is the length of time that restrictions are enforced. Currently, protection from disturbance extends only until young fledge. Restrictions on human disturbance around nest sites, however, must include the time fledglings remain dependent on the adults and the nest site, to approximately 18 (range = 15–22) weeks old. Restrictions also should be flexible because of variability in the length of the dependency period. Limited human activities (e.g., feeding cattle, observation from a vehicle) did not appear to disturb adults or fledglings at the 2 nests observed intensively. We suggest, however, that high levels of disturbance near a nest when fledglings still are dependent on adults may prevent adults from supplying adequate amounts of food to dependent young or cause premature dispersal of young before they can build up adequate food reserves. Migration is energetically demanding, particularly to young and inexperienced birds. Further, Hunt et al. (1992) reported that fledglings from California traveled without foraging during migration. Similarly, A. Jenkins (Sutton Avian Research Center, personal communication) found that fledglings from Oklahoma did not forage during the initial stages of migration. Consequently, fledglings in less than optimum physical condition when initiating migration may be less likely to survive the energetic demands of migration.

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