

## A PHOTOGRAPHIC AND BEHAVIORAL GUIDE TO AGING NESTLING NORTHERN GOSHAWKS

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**Abstract.** Observations of behavioral and morphological development of nestling Northern Goshawks (*Accipiter gentilis*) were collected during three nesting seasons at 20 goshawk nests in northern Arizona. A photographic record of a single nestling goshawk's development was made. I combined descriptions of age-specific behaviors exhibited by nestlings with descriptions and photographs of nestling morphological development to construct an aging guide for nestling Northern Goshawks. Adult goshawk behaviors that relate to nestling age are also provided.

**Key Words:** *Accipiter gentilis*; age guide; nestling development; nestling behavior; Northern Goshawk.

Accurate estimates of the ages of nestling raptors are important for scheduling banding (Fyfe and Olendorff 1976) and assessing productivity (Moritsch 1983a, b; Steenhof 1987, Young and Kochert 1987). Photographic guides to morphological changes that occur as nestlings age have been developed for Prairie Falcons (*Falco mexicanus*), Red-tailed Hawks (*Buteo jamaicensis*), and Ferruginous Hawks (*B. regalis*) (Moritsch 1983a, b; 1985), but are unavailable for most species.

Because the behavior of young raptors is correlated with age (e.g., Ellis 1979), descriptions of age-specific behaviors coupled with pictorial and verbal descriptions of morphological changes provide a more robust guide to aging nestling raptors. In addition, the behavior of the adult female changes with the age of nestlings and may be useful in evaluating nestling ages.

Schnell (1958) provided a written description of the development of nestling Northern Goshawks (*Accipiter gentilis*) at a single nest. Observations of nestling development from several nests may provide a better understanding of the age ranges over which behavioral ontogeny occurs. I provide a photographic and behavioral guide to estimating the age of nestling Northern Goshawks.

### STUDY AREA AND METHODS

The study was conducted on the North Kaibab Ranger District (NKR D), Kaibab National Forest, Coconino County, Arizona. The NKR D is an area of approximately 259,000 ha located on the Kaibab Plateau in northern Arizona. A detailed description of the study area is provided in Boal and Mannan (this volume).

Nest observations were conducted at 20 Northern Goshawk nests on the NKR D during the nesting seasons of 1990, 1991, and 1992. Information on the morphological and behavioral development of nestling goshawks was collected during 1539 hours of observation ( $\bar{X} = 76.8$  hour/nest  $\pm 19.3$  [SD]). These observations were made from blinds located on the ground or in trees a mean distance of 53 m ( $\pm 17.6$ ) from the nest trees. Observation periods began in the afternoon

and continued until sundown, resuming at dawn until the time of initiation the previous day.

Photographs used in this guide are of the largest of 3 nestlings in a nest that was not part of my study, but was being used in a concurrent telemetry study (Bright-Smith and Mannan, this volume). I estimated the date of hatching as 20 June, based on behaviors exhibited by the nestlings and the adult female. I took photographs at 5-day intervals, starting with 5 days of age and continuing until 20 days of age.

At 18 days the adult female disappeared from the nesting area. Radio telemetry indicated the adult male goshawk remained in the nest area during the following

TABLE 1. GLOSSARY OF TERMS USED IN TEXT AND FIGURES

Auricular	The area of the invisible ear opening just posterior to the eye
Brancher	A young raptor that has left the nest but not the nest tree
Coverts	Small contour feathers of the wings and tail
Crown	The top of the head
Fledge	When a young bird leaves the nest tree of its own volition for the first time
Nape	The back of the head below the occipital portion of the skull
Pin feather	A growing feather that is encased in sheathing
Primaries	The outer flight feathers of the wing
Rapid peering	Rapid movement and readjustment of the head while visually focusing on an object
Remiges	Primary and secondary wing feathers
Rectrices	Tail feathers
Scapulars	Feathers located in the shoulder region
Secondaries	Inner flight feathers of the wing
Sheathing	Wax-like keratinous material that encases and protects newly developing feathers
Talons	The feet and claws of a hawk

days, but nest observations revealed that he did not care for the nestlings. At 20 days of age, the largest nestling, a male, attacked his siblings. He killed and cannibalized one sibling and forced the other to leave the nest and fall to its death (Boal and Bacorn, in press). The surviving nestling was removed from the nest and transferred to a wildlife rehabilitator for care. A photographic record was continued during captivity at 2-day intervals from 25 days of age to 39 days of age. Photographs of this bird were combined with the observational data from the other nests to provide this guide.

Table 1 contains a glossary defining morphological and behavioral terms used in describing ages of nestlings.

## RESULTS

When a goshawk nest area is entered by humans during the first 5 days following hatching, adult females show a strong tendency to remain on their nests. Afterwards, females typically flush from nests, perch in nearby trees while vocalizing, and possibly make low passes at intruders. Adult male goshawks are rarely seen in the nest area except during food deliveries. After deliv-

ering food to the female away from the nest, males will often visit the nest briefly during the first 10 days following hatching.

It is difficult to determine the presence of nestlings prior to approximately 4 days old. At about 4 days of age nestlings begin attempting to defecate over the nest rim, and their presence is evidenced by minute specks of white excrement on the nest rim but not on the ground below the nest (Fig. 1). At about 9 days white-wash globs will be present on the branches and the ground below the nest (Fig. 2).

Nestlings remain totally white in their first natal down until 14–17 days when the gray second natal down and flight pin feathers begin to appear (Fig. 3). Scapular and covert feathers start emerging between 19 and 22 days (Fig. 4). Rapid and noticeable feather development begins at 24–26 days. At this age, scapular and covert feathers are visible, and the auricular area is covered with small black feathers (Fig. 5). At 28–30 days, dark feathers appear along the nape, but the crown is still downy. Feathering is also apparent along the

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FIGURE 1 (*top left*). Goshawks at 4–7 days post-hatching. *Morphological Characteristics*: Nestlings are small (approximately 13 cm long) and covered in white natal down. *Behavioral Characteristics*: Nestlings lie prostrate and usually out of view below the nest rim. Occasionally the tops of their heads may be seen, especially when the female is feeding them. Nestlings are poorly coordinated and move by scooting motions with the body in contact with the substrate. Nestlings may give whistle-like beg calls during feeding. Nestling hawks are able to excrete over the nest rim starting at 4–5 days old. Small dime-sized specks of white excrement may be visible on the sticks of the nest or against the tree trunk, but usually not on the ground. The adult female is almost continuously present and always broods the nestlings at night. She tends to remain motionless on the nest rather than flush and give the alarm call when the nest is approached.

FIGURE 2 (*bottom left*). Goshawk at 9–12 days post-hatching. *Morphological Characteristics*: Nestlings are 15–18 cm long and covered in white down. *Behavioral Characteristics*: Nestlings are most often lying in the nest cup out of view. Primary movements are to position themselves to be fed or to defecate over the nest rim. Movements are by scooting motions. Nestlings possess good head coordination when feeding, but are weak and often use their wings for balance and support when moving. Nestlings are able to excrete with greater power. Whitewash specks are numerous and obvious on the ground and branches below the nest. The adult female is usually present and broods the nestlings at night. She tends to flush from the nest and give the alarm call when the nest is approached.

FIGURE 3 (*top right*). Goshawk at 14–17 days post-hatching. *Morphological Characteristics*: Nestlings are approximately 20–23 cm long and have molted into their second natal down, which has a gray, woolly appearance. Auricular area is still downy. Pin feather development of the remiges and rectrices is apparent, especially when the wings are extended upward. As much as 1 cm of the feather may have erupted from the pin feather sheaths. *Behavioral Characteristics*: Nestlings are able to walk on their tarso-metatarsus while extending their wings for balance. They may stand for brief moments and look about the nest area. Nestlings begin making preening motions at their breast and wings.

FIGURE 4 (*bottom right*). Goshawk at 19–22 days post-hatching. *Morphological Characteristics*: Auricular area behind and below the eye is developing as a dark patch of small feathers. Remiges and rectrices are erupting from pin sheaths and contrast markedly with the body down. Greater coverts, upper tail coverts, and scapular feathers are starting to emerge and appear as dark dots against the body down. Close observations of the ventral feather tracts reveal dark pins beneath the down. *Behavioral Characteristics*: Nestlings can walk on their feet and usually do not use their wings for balance. They will stand for longer periods and preen. Nestlings rapidly flap their wings for short periods (3–5 seconds), especially following feeding. Nestlings may attempt to peck their own bites of food when the female is feeding them.





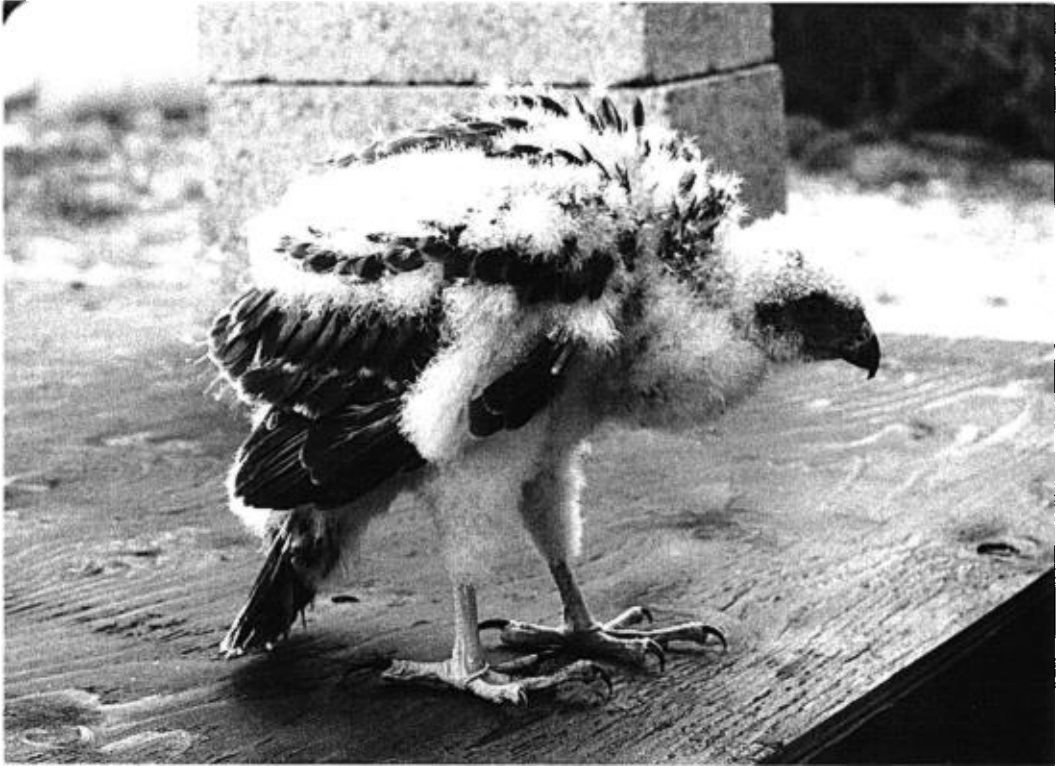


FIGURE 5. Goshawk at 24–26 days post-hatching. *Morphological Characteristics:* Auricular area is now covered with small black feathers. The head and neck are still downy, but sheathed feathers may be seen beneath the down. Scapular feathers and wing coverts are visible and contrast against the natal down. Feathers of the ventral tracts start emerging and under tail coverts may also appear. Nestlings are approximately  $\frac{1}{2}$  adult size. *Behavioral Characteristics:* Nestlings stand on the nest rim and observe the nest surroundings. They spend a great deal of time preening and wing flapping. Nestlings start stretching their feet and legs and making fists of the talons. They may start grabbing nest twigs with their feet. Nestlings may successfully feed themselves if the food has no skin or has been opened up by an adult. The adult female is usually in the nest area but does not brood or shelter nestlings at night except during wet or unseasonably cold weather.

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FIGURE 6 (top right). Goshawk at 28–30 days post-hatching. *Morphological Characteristics:* Dark feathers emerge along the nape, but the crown is still downy. Covert and scapular feathers fill in the upper wing and back areas. Breast feathers are filling in along the ventral tracts but the middle of the breast and belly is still downy. The under and upper tail coverts and legs are predominately downy, but a few feathers may be present. *Behavioral Characteristics:* Nestlings spend much of their time preening, and begin scratching their heads with their talons. Foot grabbing of nest twigs and other objects increases. Nestlings are very attentive to their surroundings and pay attention to adults exchanging prey away from the nest. Rapid peering and sleeping while standing are new behaviors exhibited during this stage. The adult female is rarely at the nest but is in the nest area and becomes defensive when the nest area is entered.

FIGURE 7 (bottom right). Goshawk at 32–34 days post-hatching. *Morphological Characteristics:* Dark feathers have emerged on the crown and are beginning to emerge at the corner of the mouth. The back and dorsal side of wings are 90% feathered. The breast is filling in with feather growth but is still downy in the center and on the belly. The undertail coverts have filled in and feathers will be emerging on the thighs. The underwing area is still downy. Rectrices are about  $\frac{2}{3}$  adult length. *Behavioral Characteristics:* Nestlings readily feed themselves when the female is not present and may fight aggressively over food. Nestlings will vigorously beat their wings while hopping and running across the nest. Nestlings may start branching at about 34–35 days.





sides of the breast (Fig. 6). At 32–34 days dark feathers emerge on the crown, and feathering of the legs is visible (Fig. 7). Body feathering is nearly completed at 36–38 days, but downy areas persist on the sides of the neck (Fig. 8). At 40 days the only visible down is along the underside of the wings (Fig. 9).

## DISCUSSION

Moss (1979) described weight gain in nestling sparrowhawks (*A. nisus*) as being initially slow for 4–6 days, followed by a 10-day period of rapid weight gain, and then a return to slow weight gain. Though the periods will vary with different species, this is the general pattern of growth in nestling raptors. Food shortages can depress weight gain in nestling raptors (Newton 1986). Food deprivation during the 18–20 day age period may have affected negatively the growth and development of the photographed nestling. However, I estimate the nestling goshawk experienced food deprivation near the end of the rapid weight gain period (Moss 1979). Potential depression of the nestlings' development may have been minimized by the timing of the food shortage and the constant food supply provided by the rehabilitator. Fault bars, a likely side effect of food deprivation and stress, were not observed in the nestlings' rectrices after feather growth was complete (C. Van Cleeve, Icarus Foundation, pers. comm.). The photographic record agrees with the observational data of nestling development collected at the other nests used in this study.

Reported fledging ages of nestling goshawks are variable. Reynolds and Wight (1978) found that nestling goshawks in Oregon fledged at 34–37 days. Newton (1979) reported goshawks fledged at 40–43 days, and Brown and Amadon (1968) reported nestlings fledging as late as 45 days. Variation in fledging ages may be related to nestling condition, geographical location, or different definitions of branching and fledging. I

define 'branching' as when a nestling leaves the nest but remains in the nest tree, and 'fledging' as when a nestling first leaves the nest tree on its own volition. Reynolds and Wight (1978) found that male nestlings develop and fledge earlier than females. In northern Arizona, male nestlings usually fledged at about 38 days (range = 36–40 days), whereas female nestlings fledged at 39–42 days.

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## LITERATURE CITED

- BOAL, C. W., AND J. E. BACORN. In press. Siblicide and cannibalism at Northern Goshawk nests. *Auk*.
- BROWN, L., AND D. AMADON. 1968. Eagles, hawks and falcons of the world. Country Life Books, London, U.K.
- ELLIS, D. H. 1979. Development of behavior in the Golden Eagle. *Wildl. Monogr.* 70:1–94.
- FYFE, R. W., AND R. R. OLENDORFF. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. *Can. Wildl. Serv. Occas. Pap.* No. 23.
- MORITSCH, M. Q. 1983a. Photographic guide for aging nestling Prairie Falcons. USDI Bur. Land Manage., Boise, ID.
- MORITSCH, M. Q. 1983b. Photographic guide for aging nestling Red-tailed Hawks. USDI Bur. Land Manage., Boise, ID.
- MORITSCH, M. Q. 1985. Photographic guide for aging nestling Ferruginous Hawks. USDI Bur. Land Manage., Boise, ID.

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FIGURE 8 (top left). Goshawk at 36–38 days post-hatching. *Morphological Characteristics:* Nestling bodies are approximately 90% feathered, but downy areas remain along the side of the neck, in the thighs, and in the underwing covert area. Usually a tuft of down remains just above the cere on the otherwise feathered head. Rectrices are approximately  $\frac{3}{4}$  full length. *Behavioral Characteristics:* All nestlings will be branching and some of the males may fledge from the nest tree. Nestlings/fledglings will fight aggressively over food at the nest but will still accept being fed by the adult female. Nestlings/fledglings will food beg for long periods.

FIGURE 9 (bottom left). Goshawk at greater than 40 days post-hatching. *Morphological Characteristics:* Nestlings/fledglings appear fully feathered, but downy areas persist along underwing coverts. This is only visible when the wings are spread. The crop will also appear downy when the bird is gorged. Rectrices are still slightly short of full length. *Behavioral Characteristics:* Males should be fledged and females will usually fledge by 42 days old. Fledglings can often be located when they food beg from different locations in the nest stand. At about 45 days the adults will begin providing food at locations away from the nest.



- MOSS, D. 1979. Growth of nestling Sparrowhawks (*Accipiter nisus*). *J. Zool., Lond.* 187:297-314.
- NEWTON, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, SD.
- NEWTON, I. 1986. The Sparrowhawk. T&AD Poyser Ltd., Staffordshire, U.K.
- REYNOLDS, R. T., AND H. M. WIGHT. 1978. Distribution, density, and productivity of accipiter hawks breeding in Oregon. *Wilson Bull.* 90:182-196.
- SCHNELL, J. H. 1958. Nesting behavior and food habits of goshawks in the Sierra Nevada of California. *Condor* 60:377-403.
- STEENHOF, K. 1987. Assessing raptor reproductive success and productivity. Pp. 157-170 in B. A. Giron Pendleton, B. A. Millsap, K. W. Cline, and D. M. Bird (eds.), Raptor management techniques manual. Natl. Wildl. Fed. Sci. Tech. Ser. No. 10.
- YOUNG, L. S., AND M. N. KOCHERT. 1987. Marking techniques. Pp. 125-156 in B. A. Giron Pendleton, B. A. Millsap, K. W. Cline, and D. M. Bird (eds.), Raptor management techniques manual. Natl. Wildl. Fed. Sci. Tech. Ser. No. 10.