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## DEVELOPMENT OF YOUNG GOSHAWKS

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THE nesting habits and development of the young of the Goshawk (*Accipiter atricapillus*) are apparently less well known than is the case with either of the other two North American accipitrines. The following account is based largely on a single bird, but it has been carefully checked by Dr. R. M. Stabler, who has also raised a female goshawk from the nest, and has observed the development of another owned by a friend. The developmental stages of the three followed the same sequence and lasted the same lengths of time within a few days at most. My experiences in raising 33 nestling hawks of other species, and in following the development of siblings of the captives in the wild in nine nests, indicate that the physical and psychological schedule followed by normal and well-fed young hawks of the same species and sex is subject to very slight variation, whether the birds are captive or wild. The only sexual difference consists in a slightly slower development of the females, which may spend a day or two longer in the nest and, in the case of the Duck Hawk, may become independent of their parents as much as a week later than their brothers. Even Bent's (1937: 125–142) generally excellent account contains several questionable statements. These may be taken up in order:

"The young apparently remain in the nest about four weeks . . ." The Dixons' (1938) interesting study shows that the young remain in the nest about 42 days, or 6 weeks.

"The young . . . are fed at very infrequent intervals." The Dixons too believed that the young were fed little and seldom towards the end of their period in the nest (though they observed them to be heavily fed when younger). This idea is not borne out by examination of specimens. Young hawks deprived of food for unusual periods during the growth of rectrices and remiges show very distinct marks of weakness across the feathers, which falconers call "hunger streaks" or "hunger traces."

A young female Goshawk that I took from a nest in Nevada on July 2, 1939 (Bond, 1940) was obtained in the morning before the parents fed her, and I was unable to give her a meal until about 1:00

P.M. A marked hunger streak developed from this delay in feeding. The streak was wider and stronger than any of those on the skins in the Museum of Vertebrate Zoology. Of course, the time of the last meal of the previous day is not known, so the actual time without food is uncertain also. Later, when the bird was well feathered and able to fly (though the flight and tail feathers were still growing) slight hunger streaks developed on days when she was fed only morning and evening, with a maximum waking period without food of only about 9 hours. Since only about 10 per cent of the immature Goshawks in the Museum of Vertebrate Zoology, Berkeley, California, show minor hunger streaks, it would appear that in the wild some 90 per cent of the young are fed at least three times a day, and practically all young at least twice a day, *every day,* not only in the nest but for an appreciable period after they are able to fly.

Bent says of the Goshawk, "When between three and four weeks old, it is fully fledged, except that the last of the down persists on the belly and neck. It leaves the nest at about this stage." If by "fully fledged" is meant that all of the feathers are grown in all the way, the statement is obviously erroneous. The young birds cannot fly till they are about six weeks old, but it is long after this that the feather growth is completed. My young bird could with great effort make a level flight of perhaps 15 feet on July 14, at which time comparison with Dixon's photographs would indicate that she was about 40 days of age, but feather growth was not complete until about August 10, when she was between 65 and 70 days old. Even if (as is possibly the case) she developed a little more slowly than a wild bird would have, she can hardly have been delayed over a week, so that it appears that young female Goshawks are not fully fledged until they are about 9 weeks of age, at least.

Throughout Bent's book, and indeed in most life history accounts of hawks, there are statements about many of the species, that at a given stage or age the young "leave the nest," and the reader gains the impression from these statements that the young leave the nest once and for all at this time, though Bent says of the Northern Red-shouldered Hawk, "They begin by climbing out on the branches and, perhaps, returning to the nest at night," and quotes Bendire on the Mexican Goshawk: "The young . . . were out of the nest the following day but returned to it at night." I believe this is a very common practice among tree-nesting hawks. Herrick (1924 and elsewhere) observed that young Bald Eagles return to the nest, and I have found young of Bald Eagles, Golden Eagles, Cooper Hawks, and Western Red-tails back in the nest a day or more after they have "left" it. Hawbecker (1940) found the same true of White-tailed Kites. Young European accipitrines (*Accipiter gentilis* and *A. nisus*) were known to the falconers as "branchers" when they left the nest by day and hopped and

climbed about the trees while still incapable of extended flight (Bert, 1891).

My young Goshawk gave evidence that returning to the nest was normal behavior. She was provided with a high-sided cardboard box of about the diameter of the nest, in which excelsior and twigs were placed. She soon learned to climb out of the box, though with some difficulty, and spent much of the day wandering around the large room in which she was kept. At first she clambered back into the box every evening and went to sleep there. In scrambling into or out of the box, she did not use her beak, parrot fashion, as I have sometimes seen young Cooper Hawks do. The night of July 13 (39 days old) she slept on a coil of rope beside the box, which was much more like a natural nest than the box and its contents, and continued to use it till the night of July 21 (47 days old), after which she always slept on a perch. This is hardly a proof, but it is certainly an indication that the young may return to the nest at night for at least a week after first flying from it.

Until August 7, when she was about 64 days old, the bird spent considerable, though diminishing, periods during the day resting in a prone position. After that date this behavior was not noted. Whether wild young rest in this position on the ground, in the nest, or on large limbs of trees I do not know, but I see no reason to suppose that this habit in my bird was exceptional (though it may have been protracted) and it may indicate occasional use of the nest by wild young during the day for some time. In the prone sleeping position, the young Goshawk rested on its tarsi, which were splayed out at an angle of some 15 degrees, and on the sternum. The feet were loosely closed, and the wings drooped, so that the outer joint rested on the ground. The head was turned back on either side and partly concealed under the wing on that side. The daytime prone resting position was the same, except that the head was held up.

During the first few nights that my bird slept on a perch she rested on both feet, but later she slept standing on only one foot with the other drawn up under the feathers. The head was turned back and partly concealed under the scapulars. She slept on either foot, but more often the left than the right, and turned her head back on either side. She also held her food with the left foot more often than with the right, and thus appeared to be somewhat "left-handed."

The developmental behavior of young Raptores is exceedingly interesting (see especially Sumner, 1934, and the papers in his bibliography), and many of their activities and reactions change almost from day to day. I have not had the opportunity of observing the first month of development of Goshawks, but young of the related Cooper Hawk begin by being mildly interested in an intruder and may show a desire to be fed if their crops are not full, and sometimes even when they are.

They show little or no evidence of fear until about the time they are able to stand easily (about 15 days in the Cooper Hawk). At this stage a definite fear reaction appears, and for two or three days young birds which I observed have crowded to the far side of the nest from an intruder and cowered there. In a few minutes the reaction "runs down" and the young settle back into the nest. Within a day or two of the fear reaction, and perhaps sometimes concomitant with it (Sumner, 1929), there develops what I have come to call the "stabbing reaction" that causes the young birds to strike or "stab" at an intruding object with the foot. The object is subjected to a momentary hard grasp and the foot is withdrawn. A crouched position, very similar to that of the fear reaction, is often assumed when the "stabbing reaction" is manifested, but whereas in the former case, the bird gives somewhat the effect of shrinking from an expected blow, in the latter one may be reminded of a tom cat getting ready for battle.

The nest from which I took my young bird contained, in addition to the female, a male that was apparently three or four days older than his sister; an addled egg found in the nest probably was laid between the two that hatched, unless Goshawks lay at greater intervals than other hawks of like size. The younger female exhibited the "stabbing reaction," but this, when it failed to discourage me, was quickly succeeded by the simple fear reaction, and she backed to the extreme edge of the nest and very nearly fell out. The older male, although he assumed the "cowering" position and maintained it as long as my companion and I were in sight, showed no fear, and, far from retreating, was most aggressive, "stabbing" at anything that came within reach. The female on the other hand, after a little gentle handling, lost both reactions, unless she was threatened by a sudden motion, whereupon the fear reaction returned. The term "reaction," as here used, refers to what are doubtless chains of several reflexes, some of which may be conditioned. When either of the young birds was seized by the leg or feet, it first attempted to struggle free, and tried to bite only after an appreciable interval.

Defense reactions of young and adult hawks of all species with which I am familiar usually subside quickly if they have no apparent success. If the hand is seized or bitten and (as a natural result) quickly withdrawn, the bird will clutch or bite all the harder and try to do it again. If instead, by wearing a glove or by fortitude, the hand is kept quiet and not even tensed, the hawk usually lets go within a few seconds. In other words, the reaction seems to require more or less continuous stimulus.

## Feeding

Immediately after removal from the nest the young bird took food readily from the hand. If given a larger piece of food than usual, she

would attempt to swallow it, but if it would not go all the way down, she would open her beak and shake her head until it dislodged. Occasionally she picked it up and tried it again, but usually she turned her attention to me and waited for another piece. Even if the piece was small enough to be swallowed, but was dropped for some other reason, she usually did not pick it up. It was not until July 10, when she was about 36 days old, that she first put her foot on a piece of meat and tore off mouthfuls with her beak after the normal fashion of an adult, and it took about a week more for her to become adept at it. The common falconine trick of picking up a small object in one foot to lift it to the mouth for swallowing or further tearing (Bond, 1936: 73–74) has never been observed in my Goshawk, nor in the various Cooper and Sharp-skinned Hawks that I have had. Feather development was appreciably more advanced in this Goshawk when she learned to feed by herself than is usually the case with young Cooper Hawks taken from the nest and raised the same way.

### Killing Reaction

Accipitrine hawks kill their prey with a clutch of great power that drives the talons deep into the flesh of the prey. The clutch may be maintained for several minutes after the prey ceases to struggle, but if the first clutch is ineffective it may be relaxed, the foot moved slightly and the clutch repeated. Though the initial clutch is usually made with both feet, the feet subsequently are moved alternately, or at least one at a time, so that the prey is never released. After some of the skin or plumage has been removed from the prey with the beak, the killing clutch is relaxed and ordinary feeding begins. My Goshawk first showed the killing reaction in response to moving food on July 27 (about 53 days old). This reaction seldom was evoked by pieces of beef unless they were thrown on the ground or pulled about on a string. It was produced fairly often, however, by dead sparrows or mice even when they were fed on the glove in the usual way. If the bird had been fed on beef for several days and then killed a rabbit, even though she was very hungry she would cuff the rabbit about and "kill" it repeatedly, sometimes for 15 minutes or more before starting to eat (see below under "Play"). Dr. R. M. Stabler (MS) writes that his adult female Goshawk, when merely standing on his fist will exert instantaneous, terrific pressure when he makes a squeak like a dying mouse. My own bird had no such reaction to sounds. The killing reaction seems quite possibly a development of the "stabbing reaction."

### Bathing

On July 23, I tethered the Goshawk (about 49 days old) by a small, quiet stream for the first time. She jumped off her perch, and, apparently by chance though perhaps purposely, landed in about three inches

of water where she stood quietly for perhaps 30 seconds. She then let her belly feathers droop loosely into the water, put her head down and tasted it a few times, and then proceeded to bathe substantially like any passerine or other bird. She has spent as much as 20 minutes standing in the water and going through the bathing motions five to eight times in that period. Stabler (MS) says that his Goshawk "has stood in her bath upwards of an hour—even in February. The Peregrines leave it immediately when actual bathing is over—they never 'soak.'" This was near Philadelphia. When the water was deep enough, my bird waded in till the water came about half way up her breast. She frequently ducked her head entirely under the water. The stimulus to bathe is at least partly tactile, since she would go through part of the motions when made to stand in a few inches of water with her hood on (thus being entirely blindfolded), but the completely dis-

Figure 1. Immature female Goshawk in typical pose of playful curiosity. (Photograph by R. M. Stabler, of his bird.)

played bathing reaction seems to be largely a response to visual stimulation, as Sumner (1934) found with the Golden Eagle. Stabler (MS) states that he has "had young Accipiters go through the ducking and body-stooping movements when showered with a watering-pot; or even do it on a bare floor at the mere sight of a sister sloshing about in a bathing pan." The stimulus that causes a hawk to cease bathing, leave the water, and begin to dry and preen herself may be body chill, but this is only a guess.

## Play

Some of my Goshawk's activities may be described as play, though the term might not stand analysis in all cases. In addition to cuffing a dead bird or mammal about as described above, she always launched an attack upon her perch each time she was put on it for the day. She would leap into the air a foot or two and seize the perch in her feet, only to leap again, often coming down facing the other way. This seems quite distinct from the wing exercises of young raptores in the nest; it was the attack on the perch with the feet that was important. She also frequently gave the cackle of the adult. This sort of play usually kept up for 10 or 15 minutes. Stabler (MS) reports an extensive repertory of play activities by his Goshawk. She often launches a violent attack on a leaf, stick, or pebble. Both birds seize small objects in their beaks and toss them back over their heads.

When my hawk had been fed and was standing on my glove she frequently fluffed her feathers out a little and let her eyelids droop slightly and would then begin to bite gently at the edge of my coat, the buttons, button holes, a pencil in my breast pocket, my handkerchief or my hair. When she got a good grip on something with her beak, she would often bite quite hard and pull toward her. When she did this, she almost invariably pulled the nictitating membranes at least part way across her eyes. This action of the nictitating membrane is the same as that observed when she wiped her beak after a meal. She frequently succeeded in removing my handkerchief from my pocket, whereupon she might either drop it, or step on it and begin to tear it with her beak. When she was in the mood, a strange object, or even my fingers, at about the level of her feet or over her head would often cause her to turn her head nearly upside down as if to see it the better.

These generalized play activities I have not observed in wild hawks more than a few weeks old, that is, after they have scattered and are on their own. This may be because of difficulties in observation, or it may be exaggerated and prolonged in a bird with its "feeling pent up" by captivity. Stabler (MS) reports no diminution of play by his bird, now nearly five years old.

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