

Breeding biology of Henst's Goshawk *Accipiter henstii* on Masoala Peninsula, northeastern Madagascar

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ABSTRACT

I studied the breeding biology of the endemic Henst's Goshawk *Accipiter henstii* during three breeding seasons, 1995-1997, on Masoala Peninsula, northeastern Madagascar. Breeding coincided with the end of the dry season. Five nesting attempts were documented. Nest building was from end of July to September, egg laying in September and October, incubation September to November, nestling period October through December, and post-nestling period December to February. The duration of nest construction was 53 days for a new nest and 24 days for renewal of an existing nest. The incubation period was 39 to 40 days ($n = 3$ nests). The nestling period was 44 days for 4 males ($n = 2$ nests), and the post-nestling age of dispersal was 86 to 89 days for a male and female. Overall reproductive success was 57% (number of young fledged per breeding attempt). A total of 1.14 young fledged per breeding attempt. Most reproductive losses resulted from nestling predation ($n = 5$ young) or bad weather ($n = 1$ young). I observed 145 prey items delivered and identified prey was composed of 86 birds and 26 mammals (25 being lemurs). There was a difference in prey composition between males and females, with 76 birds and 21 lemurs, respectively.

INTRODUCTION

Henst's Goshawk *Accipiter henstii* is the largest endemic accipiter on Madagascar. Little is known about this large raptor, especially its breeding biology and nesting requirements, and it is frequently confused with the recently rediscovered Madagascar Serpent-Eagle *Eutriorchis astur* (Sheldom & Duckworth 1990; Thorstrom *et al.* 1995). It is found in a wide range of forested habitat from the western dry forest to the eastern rain forest (Langrand 1990). This species is classified as near-threatened (Collar *et al.* 1994). The Peregrine Fund's Madagascar Project began working on raptors in 1991 on the Masoala Peninsula of northeastern Madagascar. One occupied Henst's Goshawk nest was found in 1991 (Borge 1993) near the Andranobe Field Station (AFS), a research site jointly run by The Peregrine Fund and Xerces Society/Wildlife Conservation Society. This pair nested in the same site in 1992. In 1993, through The Peregrine Fund nest reward programme (Watson *et al.* 1992), another occupied nest was discovered 11 km south of AFS. This pair abandoned their nest in 1994, possibly due to human disturbance within 100 m of the nest tree when forest slashing for

creating lemur traps and swidden agriculture occurred during the nest building and courtship period.

In 1995, two more nests were discovered about 25 km inland from the east coast of Masoala Peninsula in undisturbed rainforest within Masoala National Park. The two nests were approximately 12 km apart on an east to west axis. The nests were discovered when, during the incubation period, the female would leave the nest for breaks and vocalize loudly. Unfortunately the nestlings at both nests were depredated by the Madagascar Harrier Hawk *Polyboroides radiatus* during the early nestling period (Rene de Roland *et al.* 1996). In 1996, the same two nest sites were occupied again, possibly by the same birds. On the west side of Masoala Peninsula, a fifth newly discovered pair began nest construction about 6.3 km south of AFS.

In 1997, the pair observed at the west side changed its nest tree and moved to another tree about 300 metres northwest of the 1996 nest. A new pair used the tree abandoned by the 1994 pair, in which I observed that the female was different from the 1994 female.

In this paper I present information from observations at these nests on the breeding biology of the Henst's Goshawk. Important findings were the predation of nestling goshawks by the Madagascar Harrier-hawk during the periods of absence of adults from the nest, possibly due to food stress, the distribution of goshawks in Masoala forests, and documentation of goshawks feeding on lemurs.

METHODS

This bird is very noisy during the reproductive period. At the end of the rainy season on Masoala Peninsula (July), I walked within the forest edge from the early morning until late afternoon to listen for the bird's call. When I localised the call, I approached and searched the surrounding trees. After nest localisation, I looked for a good place 40-50 m from the nest tree to make observations. Observations began in the early morning at 04:30, from the nest construction until the post-nestling period. During nest construction, I recorded all adult activities (role of the male and female in nest construction, distance from the nest tree at which the adult took nest material, duration and timing of mating, distance of adult roosts from nest tree, type and quantity of prey caught by adults). During the incubation period, I observed the role of the adults, the type and quantity of prey, and the duration of the incubation period. After hatching, I observed the growth of the chick, contributions of the adults to the chick, and duration of nestling period. Each chick was followed during the post-nestling period and the activity of the young noted (distance from the nest tree, date at which they catch their own prey, behaviour relative to the adults, and duration of the post-fledging period).

RESULTS

Nest building

During 1996, I observed three pairs during the nest building period for a total of 150 h 12 min. Two pairs found in 1995 reused the same nests in 1996. Nest building in 1996 at the third, newly-discovered site spanned 53 days, from the start to finish. At the other two reoccupied sites, it took 24 days to reconstruct the previous year's nests. The male was the most active in nest building, spending 4 h 9 min (68.4%), while the female spent only 1 h 55 min (31.6%). Most of the time, nest construction activity by the male was followed by mating (nest construction by male was observed 100 times and they copulated 93 times). The average duration of copulations for all three pairs was 12.87 sec $\pm$ 2.82 (range = 7-18, n = 93). The females sometimes visited the nest to arrange the nesting material (n = 30), and was very vocal during the nest construction period. Both sexes often stayed at the nest tree from around 17:00 (observed during 14 observations from 05:00 until 18:00), and I observed mating just before sunset on 3/14 afternoon observations. Nesting material was collected at 34 $\pm$ 16 m (n = 19) from the nest tree by the female and at 31 $\pm$ 15 m (n = 74) by the male.

Egg laying

In 1995 I was not able to determine when eggs were laid because the two nests were found during the incubation period. In 1996, first eggs were laid during the dry season on 12 September, 17

September and 8 October at the three nests. In 1995, one nest (Antafofonana) had two eggs, but in 1996 and 1997 I did not disturb nesting to record the number of eggs in each nest.

Incubation

The female was the main incubator. The female allowed the male to incubate only while she fed away from the nest after prey had been delivered by the male. I observed that the female responded to the male's call as he flew towards the nest with prey. She would leave the nest upon his calling and arrival. During our observation periods, on average the female incubated for 79.5%, the male incubated for 6.1% and the nest was not attended for 14.4% of the time. The incubation period was 39 to 40 days (n = 3 nests). The female delivered fresh greenery to the nest from trees within the vicinity of the nest tree (50 times during 60 observations).

Nestling period

Only the female brooded the young and the male never brooded or fed the young. When the young were 14 days of age, the female began moving around but always remained in view of the nest. At the same time, the male captured and delivered prey items to the female. At 32 days after hatching, the females began searching for food, and when the female was not present the males delivered prey directly to the young in the nest. Nestlings were able to feed themselves after 29 days of age. At 38 days of age, the young began to move around among the nest branches, hopping and practising flying. Young males fledged at an average of 44 days of age (range 43 to 45, n = 4).

Fledgling period and dispersal

Young stayed within 100 m of the nest tree until 60 and 70 days of age, for males and females respectively. The adults fed the young at the nest until 65 days of age (n = 5 young, n = 3 nests). After 65 days of age, the young began intercepting the adults before they arrived at the nest and took prey directly from the adults. Two fledgling males from one nest competed vocally and aggressively for food upon the arrival of the adults. At 84 days of age, the young female unsuccessfully attacked an adult White-fronted Brown Lemur *Eulemur fulvus albifrons* (weight 2.3 Kg, Mittermeier *et al.* 1994) with a young on its back. At 93 days of age, I observed the radio-tagged young male catch a Madagascar Coucal *Centropus toulou* (length 45-50 cm, Langrand 1990). Natal dispersal of the radio-tagged young male was at 86 days of age and of the young female at 89 days of age.

Table 1. Prey items taken by Henst's Goshawks during the breeding seasons of 1995, 1996 and 1997.

<i>Prey type</i>	<i>Male (%)</i>	<i>Female (%)</i>	<i>Total (%)</i>
Birds	76 (52)	10 (7)	86 (59)
Mammals	4 (3)	22 (14)	26 (17)
Unidentified	23 (16)	10 (7)	33 (23)
Total	103 (70)	42 (30)	145 (100)

Food habits

I observed 145 prey delivered to females, nestlings and fledglings (Table 1). The identified prey was composed of 86 birds, 25 lemurs and one tenrec. Lemurs were mainly taken during the nestling (n = 10) and post-nestling period (n = 14). Three species of lemur were identified in the prey remains collected near and at the nests, mainly Eastern Woolly lemur *Avahi laniger*, a White-fronted Brown Lemur and an adult Small-Toothed Sportive Lemur *Lepilemur microdon*. Twice I observed an adult female delivering an adult White-fronted Brown Lemur missing its head and once an Eastern Woolly Lemur with complete body. The male delivered 76 birds and the female 21 lemurs during the incubation, nestling and post-nestling periods combined (Table 2).

Table 2. Prey deliveries by male and female Henst's Goshawks during the breeding seasons 1995, 1996 and 1997.

Breeding period	MALE			FEMALE		
	Birds	Mammals	Unidentified	Birds	Mammals	Unidentified
Incubation	23	1	9	0	0	0
Nestling	21	2	5	6	9	2
Post-nestling	32	1	9	4	13	8
Total	76	4	23	10	22	10

Reproductive success

In 1995, at one nest, two eggs in a 2-egg clutch hatched and in the second nest I observed one chick in the nest at hatch but was unsure of the clutch size (Table 3). In 1996, six young hatched in three nests and three young fledged. However, at the site that fledged two males, one fledgling disappeared during the first two weeks after fledging, at an age of 60 days, but it was not discovered whether it had an accident, suffered predation or dispersed. I observed the mortality of one young at 34 days of age, due to exposure to a long period of rain, and at another nest two young disappeared at 13 days, suggesting predation. In 1997, five young hatched in two nests and all fledged. A total of 14 young hatched and 8 fledged in the combined 1995, 1996 and 1997 breeding seasons, giving an average reproductive output of 1.14 young fledged per breeding attempt (Table 3).

Table 3: Reproductive success of Henst's Goshawks during the breeding seasons of 1995, 1996 and 1997.

Year	No breeding attempt	No of eggs	Average clutch size	No eggs hatched	No of young fledged	Fledglings/ breeding attempt	Nest success
1995	2	2a	2	3b	0 (0%)	0 (0/2)	0 (2)
1996	3	?	?	6	3 (50%)	1 (3/3)	66 (3)
1997	2	?	?	5	5 (100%)	2.5 (5/2)	100 (2)
Total	7	?	?	14	8 (57%)	1.14 (8/7)	57 (7)

a: Number of eggs documented in one nest.

b: Number of eggs hatched in two nests.

DISCUSSION

Nest building began at the end of the rainy season (last week of July) and natal dispersal occurred during the start of the rainy season (last week of January). Nest building took from 24 days (rebuilding last year's nest) to 53 days (building a completely new nest), depending on the status of the last year's nest. The breeding period from nest building to fledgling dispersal was approximately 5 months. Large raptor species have long breeding seasons, especially tropical birds, where incubation, nestling development and dependency periods are more prolonged than in temperate regions (Newton 1979). In Henst's Goshawk, the 5 months breeding period appears normal for this size of bird and the tropical environment does not appear to have prolonged the breeding cycle of this species. The breeding cycle of the congeneric, similar-sized Northern Goshawk *A. gentilis* (incubation period 35-38 days, nestling period 34-41 days, independence at 70-90 days, del Hoyo *et al.* 1994), is similar to Henst's Goshawk (incubation 39-40 days, nestling period 43-46 days, independence 86-89 days).

The nest was 70% built by the male and 30% by the female. This is comparable to the Northern Goshawk and other species of accipiter for the construction of the nest (Brown & Amadon 1989; Newton 1986). Henst's Goshawks built their nests in the early morning, similar to the Frances's

Sparrowhawk *A. francesii* (Rene de Roland, in press) and Northern Goshawk (Brown & Amadon 1989). The male and female usually departed from the nest site in the early afternoon and returned by late afternoon, when, on several occasions, I observed copulations prior to sunset. Females did nearly all the incubation except during times when they fed away from the nest and the males were allowed to incubate. During the middle of day, I observed that the female appeared to be restless, hot and stood many times at the edge of the nest with open bill. When the female left the nest during incubation breaks, she nearly always returned with sprigs of greenery collected from neighbouring trees. The greenery was always placed around the edge of the nest. I also observed this behaviour less frequently in the smaller Frances's Sparrowhawk. There are many suggestions for placing greenery around the nest edge: 1) a form of nest-sanitation for covering rotten meat and excreta, 2) boredom by a waiting female, 3) nest exchanges between incubating mates, 4) filling in the nest and consolidating its structure, and 5) advertisement announcing an occupied territory (Newton 1979). I suspect that the latter suggestion seems most plausible in the case of the Henst's Goshawk.

During the incubation period, the male was the sole provider of food and he continued this during the first few weeks of the nestling period. As the nestlings grew and were able to thermoregulate, the female began to hunt away from the nest site (32 days after hatching) and left the chicks for many hours. At two nests in 1995 (Rene de Roland *et al.* 1996), the female appeared to be food stressed and during the first few days and weeks of the nestling period was gone for 2-4 hours every day. Apparently, she was searching for food for her two nestlings and herself. On November 1995, the female at this site was observed pursuing on foot a Lesser Asian Civet *Viverricula indica* 50 m northeast of the nest tree (R. Thorstrom, pers. com.). These extended absences by the females put the nestlings in jeopardy from predation by other animals. At both nests in 1995, Madagascar Harrier-hawks were observed depredating the 1-2 week-old nestlings (Rene de Roland *et al.* 1996).

For many raptors, it has been reported that the parents decrease prey deliveries to the young to encourage them to disperse from their parents' territory (Davies 1976; Moreno 1984; Simmons 1984; Edwards 1985). I did not find this behaviour as the reason for natal dispersal in the Henst's Goshawk, because the adults always delivered prey to the young until their departure. At one nest site in 1996 (Vakoanina), the male continued to deliver prey to the young female which did not stay near her nest site. The adult male brought a subadult *Avahi laniger* and put it above an epiphyte near the nest, even after he had called for a long time and received no response from the young. The following day I climbed to the epiphyte and collected the cached lemur. Young males and females called frequently around the nest site before departure, which is similar to *A. nissus* (Frumkin 1993). Young Henst's Goshawks became independent once they were able to capture prey.

Birds were the most important prey caught by the adult male. Of six bird species identified, Blue Coua *Coua caerulea* was most frequently taken. This species is found throughout the canopy and even down to the forest floor. The Blue Coua moves from tree to tree searching for insects and lizards. The Henst's Goshawk is a sit-and-wait predator (perch hunter) in the branches of trees and I suspect that goshawks attack Blue Couas by surprise with a burst of speed. The Blue Coua is probably the most abundant large forest bird in the forests of Masoala Peninsula and hence the most common prey of Henst's Goshawks. On 3 January 1997, one adult male goshawk was observed chasing a Madagascar Wood Rail *Canirallus kioloides* on the forest floor and through dense brush, but was unsuccessful in capturing its intended prey.

White-fronted Brown Lemur and Eastern Woolly Lemur appeared to be important prey of Henst's Goshawks. Brown Lemurs are very common throughout Masoala Peninsula (Mittermeier *et al.* 1994; pers. obs.). The Eastern Woolly Lemur is a nocturnal species and it is intriguing to speculate how Henst's Goshawks might capture this species. I observed one resting on the main trunk of a tree at 09:00 in the morning. I suspect that goshawks might capture this species as it moves from its day resting place to another place if weather or another animal flushes it. Alternatively, they may be captured during the crepuscular period when they are still moving to their resting places or goshawks may actively search for resting Eastern Woolly Lemurs and capture them on their resting sites.

In spite of the abundance of prey caught by the adults, the reproductive success was very low during the three breeding seasons of 1995, 1996 and 1997. I observed 14 young hatched and 8

fledged successfully during the three-year period, with a productivity rate of 57% young fledged per breeding attempt and 1.14 young fledged per successful attempt. This 1.14 young per successful attempt is similar to reports for the Northern Goshawk, ranging from 1.4-3.1 chicks fledged per successful pair (del Hoyo *et al.* 1994). The main causes for reproductive failures were predation by another raptor (n = 3) and severe weather (n = 2).

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