

Breeding Biology of the Sunbittern (*Eurypyga helias*) in Costa RicaBRUCE E. LYON¹ AND MICHAEL P. L. FOGDEN²¹*Program in Ecology, Evolution and Behavior, Department of Biology, Princeton University, Princeton, New Jersey 08544-1003 USA, and* ²*Apartado 10165, San Jose, Costa Rica*

The Sunbittern (*Eurypyga helias*) inhabits tropical swamps and mountain streams from southern Mexico to Brazil. It is the sole member of the family Eurypygidae, one of several unusual and poorly studied gruiform families, and its breeding behavior is therefore of special interest. Although they frequently breed in captivity (Coimbra Filho 1965, Frith 1978, Wennrick 1981) and one nest in the wild has been described (Skutch 1947), the breeding behavior of wild Sunbitterns remains undocumented. We describe the nesting behavior of wild Sunbitterns and document the incubation behavior, chick development, parental care patterns, and feeding behavior. We also describe three nest sites.

Study area.—We studied a pair of Sunbitterns along the Peñas Blancas River, on the Caribbean slope near Monteverde, Costa Rica (10°20'N, 84°41'W; elevation 600 m) from late April to mid-June, 1985. The Peñas Blancas River is a fast-flowing mountain river that begins only 15 km upstream from our study site. The river flows through a bed of gravel and boulders, and is flanked on both sides by steep, forested hills that abut the river bed. For much of the year the river is shallow (0.5–1.5 m deep), but heavy, prolonged rains can transform it into a wall of water that gouges out a new river course and in the process removes vegetation growing in the river bed and occasionally trees from the river bank.

We found the first nest (A) on 27 March and observed this nest from 20 April to 12 June, when the only surviving chick fledged. Extrapolating back from hatch date (13 May) with a 27-day incubation period (Wennrick 1981) indicates that we began observations only a day or two after incubation had begun. During incubation, we observed the nest daily (except for 1 day) between 20 April and 13 May. For 10 consecutive days we observed the nest continuously for several hours to determine the pattern of incubation. On other days, we made numerous spot checks to determine the identity of the incubating bird. Each adult was recognizable by subtle differences in plumage; one had much wider white facial stripes and more numerous white spots on the wing coverts (hereafter Bird 1).

During the nestling period, we observed the nest for several hours daily (except for 2 days) for a total of 162 h of observations. The birds habituated quickly to our presence and we were able to make observations from two blinds 4 and 7 m from the nest. This permitted us to distinguish between the two adults, as well as to identify most prey items brought to the nest. Fogden identified many prey items to species. Most prey items that we were unable to identify dur-

ing nest observations were later identified from photographs.

In early May we found an old, weathered nest (B) and a second nest (C) that contained two small chicks (estimated to be 2 and 4 days old on 4 May). No observations were made at Nest C and the chicks disappeared between 4 and 6 May.

Nest sites.—All three nests were built in trees growing at the edge of the river and all nests were placed over land, not water, as reported by Skutch (1947). All were platforms of mud and leaves saddled on horizontal or slightly sloping branches (3–10 cm wide). Nest A was 4 m up in a *Urera* tree (Urticaceae) on a long, slightly sloping branch, 2 m from the edge of the river. The nest tree grew out of a small cliff that formed a natural "corner" in the river. Although well-shaded, the nest was visible and not hidden by vegetation.

Nest B was 200 m downstream from Nest A, 2 m up in a small tree at the edge of the river at a point where the forest abutted the river. Dense vegetation around the nest made it inconspicuous. Nest C (Fig. 1) was 6.5 km upstream of Nest A. It was 3 m up in a large tree, on a nearly horizontal branch 5 m from the river edge. The nest was well-hidden by foliage on all but one side, and was exposed to morning sunshine.

Incubation behavior.—Nest A was only partially completed when found and we did not see any Sunbitterns in the area for the next 5 days. When we returned on 17 April, an adult was on the nest incubating two eggs. Clutch sizes of two and three have been reported for Sunbitterns in the wild (Skutch 1947, Riggs 1948, Wetmore 1965), but captive birds often lay a single egg (Bartlett 1866, Coimbra Filho 1965).

The adults shared incubation duties equally. During the first half of the incubation period, each adult incubated continuously for 2 days. We observed 5 of these bouts from 21–30 April. During the last 12 days of incubation, the birds usually incubated for 1 day each. Four incubation changeovers that we observed, or knew to take place within a short time interval, all occurred in the morning: at 0505, before 0530, between 0545 and 1000, and at 1050.

Incubation was interrupted occasionally when the sitting bird stood to roll the eggs. When standing, the bird's tail always swayed back and forth slowly while the head and breast remained motionless. This behavior appears to be characteristic of Sunbitterns (Peterson and Chalif 1973) and we saw it whenever the birds stood on the nest, the ground, or rocks in the river.

The extended incubation bouts may function to re-



Fig. 1. Nest C with two young chicks, 4 May 1985.

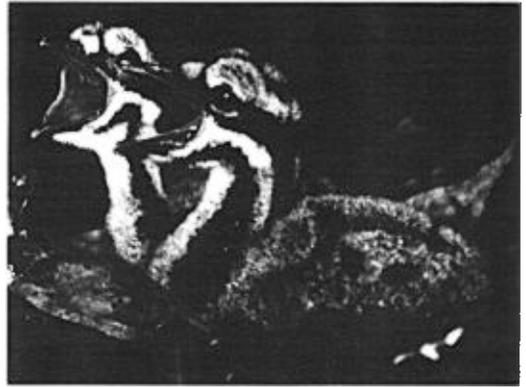


Fig. 2. Chicks at two stages of the nesting cycle. Age in terms of the older chick: Top, 3 days. Bottom, 21 days.

duce the risk of nest predation. Sunbitterns are large birds and feeding in the open river habitat may make them especially vulnerable to predators that find nests by following adults back to their nests. Ringed Kingfishers (*Ceryle torquata*), which also feed and nest along tropical rivers, have nearly continuous 1-day incubation stints (Kendeigh 1952).

Chick development and behavior.—The first chick hatched at 0900 on 13 May. The parent took the two eggshells and, after washing them in the river, returned to the nest and tried to feed them to the chick. After several unsuccessful attempts to feed the chick, the adult ate one shell and dropped the other in the river. The second chick hatched <24 h later, between 1200 on 13 May (when last seen as an egg) and 0945 on 14 May (when it was completely dry). There was a greater size difference between the chicks at Nest C, which suggests that the hatch interval there was closer to 48 h.

The newly hatched chicks were downy with open eyes. Their plumage was light brown, marbled with black lines (Fig. 2). On their first day, the chicks could not stand but were able to defecate over the edge of the nest, in a manner similar to nestling raptors. They defecated outside the nest throughout the nestling period, and the nest remained free of droppings. For the first 3 or 4 days, the chicks had trouble eating very large prey items (frogs and lizards), but by day 5, these large prey items were no longer a problem. By day 7 the chicks stood well and flapped their wings occasionally. By this time the chicks clearly differed in size. On day 9, the chicks first showed the characteristic Sunbittern tail-waving motion. On day 12, the primary and secondary feathers were 2 cm out of the sheaths of the large chick, and they emerged on the smaller chick 3 days later. At this point the large chick was twice the size of the smaller one, which seemed to no longer be growing, although its plumage was developing normally. On day 21 (Fig. 2), the larger chick began to practice startle displays, by flashing its wings open and pirouetting across the nest. It continued this behavior throughout the re-

mainder of the nestling period, most frequently after being fed. Both chicks also displayed when startled by passing butterflies or falling leaves. They also began to preen with a distinctive method we also observed in the parents. The tail was used as a comb and was run back and forth several times between each of the primaries and secondaries.

The small chick disappeared during the 21st night. Recent heavy rains had caused the river to rise slightly less than a meter, so that the river flowed under the nest and presumably washed away the chick when it fell from the nest. The slow growth and disappearance of the small chick did not appear to result from brood reduction due to sibling competition (Lack 1968). The chicks did not compete aggressively for food and never stole food from each other. The parents appeared to feed the chick closest to the side of the nest where the adult landed and the chicks did not jockey for this "preferred" position. The demise of the small chick may, instead, have been due to its frequent inability to eat dobsonfly larvae (Neuroptera), which made up nearly half the diet (Table 1). The larvae often locked their pincers onto the chick's gape and could not be swallowed.

On day 22, the remaining chick began to call in a

TABLE 1. Prey items delivered to nestling Sunbitterns.

	Bird 1	Bird 2	Total
Anurans			
<i>Eluetherodactylus</i> sp.	5	2	7
<i>Bufo coniferus</i>	1	—	1
<i>Smilisca</i> sp.	1	1	2
<i>Rana warschewitschii</i>	1	3	4
Unidentified frogs	5	5	10
Tadpoles	12	14	26
Fish			
Unidentified fish	4	3	7
Lizards			
<i>Norops lionotus</i>	2	3	5
<i>Ameiva festiva</i>	1	1	2
Crabs			
	19	23	42
Insects			
Dobsonfly larva	41	56	97
Diptera	3	—	3
Odonate larva	1	1	2
Lepidopteran larva	1	1	2
Scarab beetles	3	—	3
Katydids	1	—	1
Unidentified insects	—	1	1
Annelids			
	1	—	1
Total	102	114	216

loud "wheoo" whenever it could see a parent returning with food. These calls were very loud and were easily heard above the roar of the river, which was now a raging torrent. From day 26 to fledging on day 30, only one parent (Bird 2) attended and fed the chick. The other parent was seen nearby on day 27, but did not visit the nest.

The chick fledged at 0950 on day 30 and disappeared downstream with the adult. We found the adult and chick an hour later about 100 m downstream. The chick was 5 m up in a small tree overhanging the river and was being fed by the adult. We did not make further observations.

Parental attendance of the chicks.—During the first week, the chicks were attended and brooded almost continuously (Fig. 3A). The parents attended the chicks alternately for ca. 1-h bouts. While one adult attended, the other foraged. Attendance time dropped steadily during the second and third weeks, and by the fourth week, the remaining chick was left unattended most of the time (Fig. 3A). During the first 2 weeks, the chicks were normally brooded whenever a parent was present, but only the small chick was brooded during the third week.

We observed several displays by the attending parent when the foraging adult returned to the nest. Normally, when the attending adult noticed the foraging bird returning with a prey item, it bobbed its

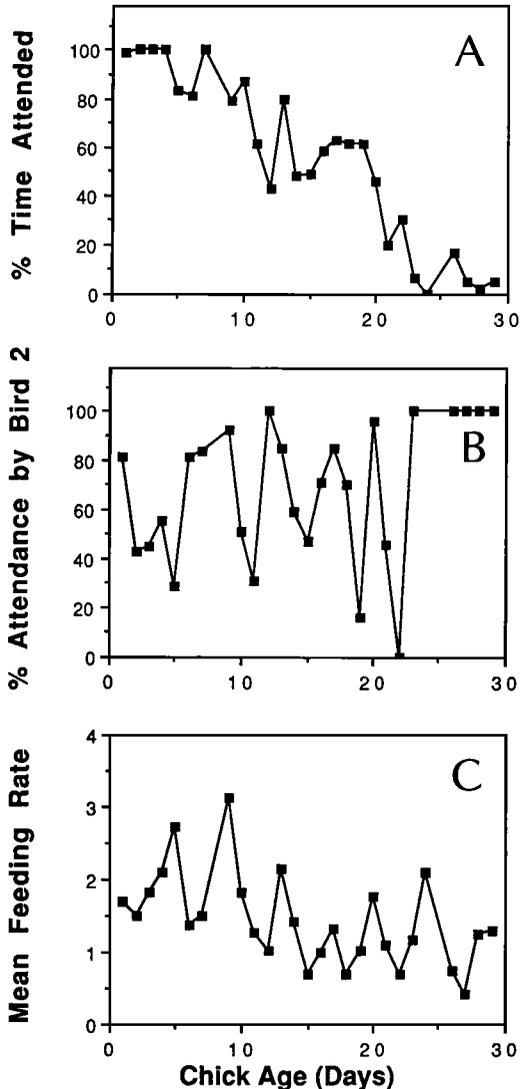


Fig. 3. Parental attendance and feeding rates in relation to chick age. (A) The proportion of time a parent was present at the nest. (B) The proportion of the total attendance time performed by Bird 2. (C) Mean food delivery rate to the nest (prey items per hour).

head up and down in a choking motion. Less frequently (10 times), the attending bird greeted the returning bird with a "begging" display (Fig. 4) that resembled the begging behavior of the chicks (Fig. 5). The adult raised its tail high into the air, stretched its neck horizontally, and gave a loud wailing cry. Rarely (4 times), the attending bird displayed to the returning adult by puffing its throat out, making gulping motions, and giving a call similar to the typ-



Fig. 4. Displays given by the attending adult upon the return of the foraging adult. Top. Display resembling the begging behavior of the nestlings. Bottom. Rarely, the attending bird puffed out its breast and made gulping motions.

ical pipping call, but slower and lower pitched (Fig. 4).

Although the parents shared in all aspects of parental care, there were quantitative differences. Bird 2 attended the chicks for 63% of the total attendance time observed (82 h), and was more attentive than Bird 1 on 18 of 26 days (Fig. 3B). Bird 1 performed a broken-wing distraction display along the river bank the first three times we flushed it from the nest, but Bird 2 never gave the display. Bird 2 was also tamer than Bird 1, and slightly less colorful. In a captive pair of Sunbitterns, the male was more colorful (Wennrick 1981), which suggests that Bird 1 may have been the male.

Food and foraging behavior.—The parents invariably brought single prey items to the nest during each visit. We identified 216 of the 230 prey items observed (Table 1). Dobsonfly larvae accounted for 45% of the items, frogs and tadpoles 23%, and crabs 19%. The proportion of all items, except anurans, remained constant in the diet throughout the nestling period. During the first week, anurans accounted for 45% (34 of 76 prey items) of the nestling diet, but in the following 3 weeks they accounted for only 4, 8, and 20%,



Fig. 5. Begging behavior of the chicks (Day 19).

respectively. This decline may have resulted from a reduction in anuran breeding activity. Frogs were conspicuous during the first week of the nestling period, but not later.

The overall feeding rate also decreased as the nestling period progressed (Fig. 3C). During the first 2 weeks an average of 1.81 prey items were brought to the nest each hour, compared with 1.10 during the last 2 weeks (Mann-Whitney $U = 157.5$, $P = 0.0012$, $n = 13, 14$). The water level in the river rose during the last 2 weeks of the nestling period, and this probably reduced adult foraging success.

All prey items except crabs were brought to the nest intact. Crabs were brought in with some or all legs removed. When the parents returned to the nest with food, the nestlings adopted a begging posture, with tails raised (Fig. 5). Prey was always taken from the parent's bill and swallowed whole. If a prey item was dropped accidentally onto the nest, it remained there until the adult picked it up and offered it to the chicks again. If a prey item was dropped onto the ground below the nest, the parent flew down and retrieved it.

The adults often washed prey items before bringing them to the nest. They dipped the prey items repeatedly into the water, and in some cases shook them vigorously under water. They washed prey in small stagnant pools close to the nest, rather than in the river. We observed 22 washings: 4 frogs, 1 fish, 1 lizard, 3 crabs, and 13 dobsonfly larvae. All types of prey items were washed, and roughly in the proportions they represented in the total diet. Many of the prey items eaten may have bitter secretions that can be removed by washing. For example, many frogs have bitter skin secretions (Duellman and Trueb 1986) and dobsonfly larvae have a foul odor (pers. obs.),

and may have a bad taste, too. All prey items rejected by the chicks were thoroughly rewashed before being offered again. Rejected dobsonfly larvae were shaken vigorously for 1 or 2 min when being washed, which supports the idea that washing serves to remove distasteful secretions.

The adults occasionally hunted for prey close to the nest. They normally hunted in the water or among the boulders at the edge of the stream. On land at the water's edge, the birds constantly turned leaves over to capture crabs and frogs. To hunt for dobsonfly larvae, the birds walked slowly upstream in the water and stopped when they presumably saw a larva move under the water. They then poised with their head motionless for up to 2 min before stabbing at the larva. They were able to capture dobsonfly larvae even in very fast-flowing water. Occasionally, the birds hunted in the forest as much as 100 m from the river, and usually returned with terrestrial crabs.

Use of the startle display.—The adults frequently gave a startle display on the nest when we moved too suddenly or approached too close to the nest (2–3 m). The sudden opening of the wings to expose the brightly colored false eyes was usually accompanied by a loud grating squawk. One of the adults gave a startle display from the nest when an immature Crested Eagle (*Morphnus guianensis*) landed 30 m from the nest. The eagle remained for a minute, and flew off. Rarely, a startle display was given on the ground, but only when approached too closely as they were returning to the nest with prey.

It is not clear why Sunbitterns have evolved such a spectacular startle display, complete with counter-shaded false eyes (Frith 1978). Observations of startle displays given away from the nest suggest one possible explanation. On three occasions we observed the adults display when startled by large falling leaves while hunting in the open along the river. We suggest that hunting along streams at considerable distances from the protective cover of vegetation might leave Sunbitterns relatively vulnerable to surprise attacks from large forest raptors. For a large bird feeding in the open, a startle display may provide a better alternative than attempting to flee to distant cover.

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