

in open situations, but they are aggressive birds and hence able to survive in situations where hairies and downies might not.

*Acknowledgments.*—I would like to thank Richard N. Connor and Harlo H. Hadow for helpful comments and criticisms.—LAWRENCE KILHAM, *Department of Microbiology, Dartmouth Medical School, Hanover, New Hampshire 03755. Accepted 24 June 1978.*

*Wilson Bull.*, 91(2), 1979, pp. 338–344

**Breeding activities of Waved Woodpeckers in Surinam.**—Species of the essentially neotropical woodpecker genus *Celeus* range from Mexico to northern Argentina (there is 1 Asian representative, *Celeus brachyurus*). Due to generally sparse distribution, shyness, and relatively non-vocal habits, and for some species, a deep forest habitat, this group is 1 of the least known of neotropical picid genera. Nests are known for the Pale-crested Woodpeckers (*C. lugubris*) (Short, Amer. Mus. Novitates 2413:1–37, 1970; Short, Bull. Amer. Mus. Nat. Hist., 152:253–364, 1973b) and the Chestnut Woodpecker (*C. elegans*) (French, A Field Guide to the Birds of Trinidad and Tobago, Livingston Press, Wynnewood, 1970:270); for these and all other species only casual observations of biology and behavior have been published.

I studied Waved Woodpeckers (*C. undatus*) from 20 March to 15 May 1977 at the Raleigh Falls Nature Reserve, a 56,000 ha area on the Coppename River about 100 km south of its termination on the Atlantic coast of Surinam. Most observations were made on the southernmost tip of Foengoe Island, a small island within the reserve mostly covered with “high river bank forest” and partially cleared for houses and a grassy airstrip. The canopy layer of the forest was typified by a *Mouriri* sp., with emergents *Jacaranda copaia*, *Inga alba*, and *Ceiba petandra*, and understory dominated by the spiny palm *Astrocargum sciophilum*. Second growth of the disturbed areas around the forest edges was dominated by *Cecropia surinamensis* and *C. sciadophyllus*.

Surinam’s climate is tropical, and heavy rains begin between mid-April and mid-May and extend to August. Hatching of the young I studied seemed to have been synchronous with the onset of the rainy season.

I made observations at a Waved Woodpecker nest for 4–6 h a day for 47 days from about 20 m away, using 7 × 35 binoculars. Sightings of Waved Woodpeckers in the forest were otherwise rare because of their tendency to forage high in the dense forest canopy.

*Vocalizations.*—The 1 vocalization heard continually from the Waved Woodpeckers was a very distinctive disyllabic call: a rising, liquid note followed by a descending, more guttural one, the entire call approximately 1.25 sec in duration. The physical process involved in vocalizing could be seen as each of the woodpeckers leaned out of the nest hole to call its mate. The first part of the call was accompanied by a lurching forward and raising of the crest, and the second syllable brought a relaxation of this swelling movement. Another vocalization, heard but once, was a chattering given in alarm during a brief encounter with a woodcreeper (*Dendrocolaptes* sp.).

Although both male and female Waved Woodpeckers reportedly drum (Haverschmidt, *Birds of Surinam*, Livingston Press, Wynnewood, 1968), the difficulty in sighting them prevented observation of their drumming. From time to time I heard drumming which may have been of this species in the vicinity of the nest excavations.



FIG. 1. Above, nest; below, nest-site of a pair of Waved Woodpeckers.

TABLE 1  
NEST ATTENDANCE BY MALE AND FEMALE WAVED WOODPECKERS

Minutes spent excavating or guarding the hole			
Date	Observation period	Male	Female
28 March	225	110	50
29 March	225	140	40
30 March	280	125	50
31 March	240	30	0
2 April	240	180	50
(Totals)	1210	585 (48.34%)	190 (15.70%)

Minutes spent incubating during daylight hours						
Dates	06:00-10:00		10:00-14:00		14:00-18:00	
	Male	Female	Male	Female	Male	Female
6-8 April	120	120	0	240	130	140
9-11 April	20	190	0	240	190	70
12-14 April	60	170	0	200	120	90
(Totals)	200	480	0	680	440	300

Male total\*: 640 (29.62%) Female total: 1460 (67.59%)

\*The male also spent from 18:30 to 06:00 in the hole each night.

Frequency at which nestlings were fed						
Dates	06:00-10:00		10:00-14:00		14:00-18:30	
	Male	Female	Male	Female	Male	Female
23, 24, 22 April	1	1	1	1	3	2
25, 27, 28 April	2	1	1	1	0	1
29 April; 2, 3 May	1	1	1	1	0	2
(Totals)	4	3	3	3	3	5

Male total: 10 Female total: 11

*Nest excavation and defense.*—On 26 March the sound of persistent pecking led me to the excavation of these Waved Woodpeckers. The hole was about 5 m up in a live *Guarea kunthiana* which was about 18 cm in diameter at the level of the excavation (see Fig. 1). The nest cavity was already large enough for either pair member to sit inside of it while working on the inner walls. During the next week, the male Waved Woodpecker spent more time at the hole than the female during the morning, when all observation took place (Table 1).

From 27 March to 3 April, the pair spent progressively less time excavating, and the

attendant bird spent more time sitting quietly inside the hole. At first it perched on the inner rim and looked out of the entrance, and by 1 and 2 April, long periods of time passed as each pair member perched inside the excavation, appearing at the hole entrance every 1 or 2 h. I could occasionally still hear sounds of excavating from the cavity.

I checked the nearly finished excavation at dusk on 26 and 27 March to determine at what point 1 of the pair would begin roosting overnight in the hole. A male Guianan Toucanet (*Selenidira culik*) used the excavation as a roost. He arrived to roost at 18:35 each of the 2 evenings, perched momentarily on the rim of the hole, and poked his bill and head in several times before popping in head first. After entering, he looked out of the hole for a few min before retreating further down, presumably for the rest of the night.

On 30 March, the male Waved Woodpecker spent the night in the hole for the first time. He entered at 18:00 and was there when the toucanet came in at 18:15. Over the next 10 min the toucanet put his head down into the hole again and again, sometimes leaning into it up to his wing coverts, and delivering repeated jabs toward the woodpecker inside. A few squawks came from the male woodpecker. Within 6 min the toucanet left and another male toucanet (I could see the first perching about 20 m away) approached the hole—and after poking into it several times actually entered the excavation. I heard scuffling and squawking and the toucanet emerged in ca. 1 min to fly off again. The other 1 then returned to the hole and was putting his head inside again when I approached and clapped my hands. The 2 intruders flew toward the nearby clearing, and by 18:30 neither had returned. Meanwhile the woodpecker had stuck his head out of the hole, his bill slightly open as though panting, before retreating for the night. He then continued using the nest as his nightly roost through the duration of my study.

Thus it appears that these woodpeckers are in competition with the toucanets for excavations. Similar instances of competition between woodpeckers and ramphastids have been described, for example, between Pale-billed Woodpeckers (*Campephilus guatemalensis*) and Collared Aracaris (*Pteroglossus torquatus*) in Guatamala (Kilham, Auk 94:774-775, 1977), and between Crimson-crested Woodpeckers (*C. melanoleucos*) and Collared Aracaris in Panama (Kilham, Wilson Bull., 84:28-47, 1972). I also have seen crimson-crested harrassed and displaced from roost holes by Chestnut-eared Aracaris (*P. castanotis*) in eastern Peru.

*Courtship and communication during nest excavation.*—There seemed to be a close bond between the members of the Waved Woodpecker pair. This was characterized not only by cooperation in nest-building and in the sharing of parental duties, but also by frequent vocal exchanges as the woodpeckers alternately excavated and guarded the hole. After a period of 1 or 2 h in the hole, the occupant leaned out and called; the mate most often answered immediately and/or flew in to perch on the outer rim of the hole. If the mate did not appear in a few min, the bird in the hole continued to call up to 25 or 30 times, and then eventually flew from the hole.

When the mate did arrive, it usually looked into the nest several times then waited, perched outside, until the bird inside emerged and left; the arriving bird then slipped in head first. Several times, however, the bird inside appeared reluctant to leave, and both ended up in the hole at once. The pair would then appear at the entrance, sometimes taking turns at looking out, and sometimes squeezing to peer out together. Once both birds were inside the hole for 40 min; part of the time the male excavated on the bottom while the female looked out.

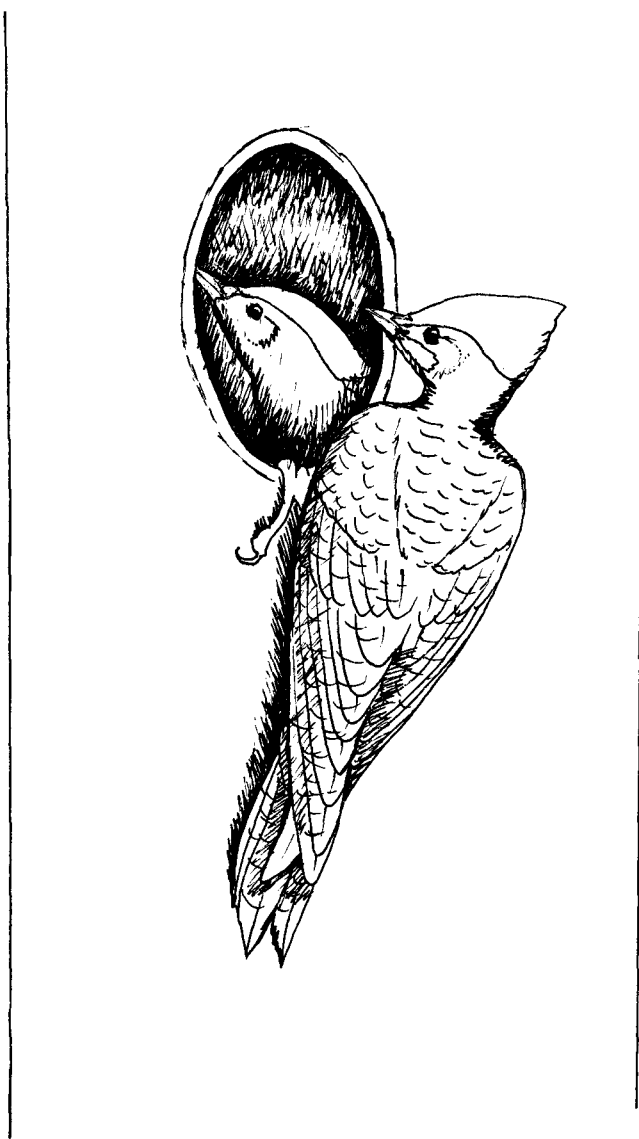


FIG. 2. Tapping upon the inner rim of the nest hole by the female Waved Woodpecker as the male is perched outside.

It was also at the time of changing places at the nest hole that I observed 1 form of courtship display. As the male flew in to land on the rim, the female began tapping rapidly and softly at the inside rim, a gesture identical to the demonstration tapping (termed "Drum-tapping" by Kilham [Condor 61:337-387, 1959]) described for several

species of woodpeckers (Blume, Vogelring 27:65-74, 1958; Kilham, op. cit.; Kilham, Wilson Bull. 84:28-47, 1972). I did not see the male tapping in this manner (see Fig. 2).

On 29 March it appeared that copulation nearly took place before a woodcreeper disrupted the pair. At 07:15 I heard 2 Waved Woodpeckers calling back and forth to each other near the nest hole. The male soon landed on the outer rim of the hole, continuing to exchange vocalizations with a second woodpecker nearby. After 2 min and 7 vocal exchanges, the male flew toward the other. I located the pair less than a min later about 12 m up in a partially dead tree. Here they exchanged calls in rapid succession, the female compressing herself horizontally while perching on and perpendicular to a thin branch, the male approaching slowly from below her. These postures are similar to those I have seen in other woodpecker species (Pileated Woodpecker [*Dryocopus pileatus*], Lineated Woodpecker [*D. lineatus*], and *Campephilus melanoleucos*) immediately preceding coition. Suddenly, however, a woodcreeper (species?) flew at the male and the 2 woodpeckers chattered as they excitedly flew away. Within 40 min the female had returned to the hole, and for the rest of the morning the pair alternated at guarding it as usual.

During each of the next 3 days the pair spent several morning hours away from the nest while their vocal exchanges and what I judged to be their drumming could be heard in the treetops nearby. Because of the apparent copulation attempt and the timing of breeding activities, I imagine that the matings were then taking place away from the nest excavation.

*Incubation.*—I presume eggs were laid around 3 April, as this was the first day that no excavation whatsoever was heard, and the male sat quietly out of sight for the entire 4½ h of observation. From this day on, the woodpecker pair vocalized rarely, changed places at the nest quickly and silently, and each spent longer periods than before at a time—up to 4 h or more—out of sight in the hole.

Starting 6 April, observations were systematized so that all daylight hours were covered over a period of 3 days. The following pattern emerged (see Table 1): the male spent the night in the hole, and remained there for several hours after daylight, when the female replaced him. She usually spent through midday and early afternoon in the hole. They changed places again for shorter periods in the late afternoon, with the female taking the last shift before the male came in to roost for the night, between 17:30 and 18:30.

*Nestlings.*—I left the nature reserve on 15 April and returned on 23 April. By this time the woodpeckers were feeding nestlings, of which subsequent observations suggested there were 2. The feeding duties were shared by the parents throughout the day (Table 1). They apparently fed the young by regurgitation as I never saw live prey in the bill of a parent. Skutch (Auk 65:225-260, 1948) noted that such long intervals at which the young are fed are indicative of regurgitative feeding. The male and female alternated in their visits and usually the feeding parent left with a fecal sac in its bill.

On 25 April an aboreal snake entered the nest hole by approaching along the trunk above. A faint chattering could be heard while the snake was in the hole. It emerged 3 min later, coming out little by little over a period of 8 min, its middle swollen from its swallowed prey. Once starting down the tree trunk, it left quickly.

By 26 April, the remaining nestling's chattering was loud enough to be heard plainly from my observation spot. The 1 young began calling as soon as the parent bird landed on the tree. After the parent entered the hole there was silence for about 15 sec, doubtless as food was transferred, then chattering began again and continued for up to 3 min after the parent left. The parents continued to feed the remaining nestling until

3 May when again the same species of snake entered the hole and swallowed the small woodpecker. I had not seen the snake entering the hole but caught it after it had left the nest. The snake was collected and the nestling and snake preserved.

Charles Myers of the American Museum of Natural History identified the snake as *Pseustes poecilonotus polylepsis* (AMNH 115650, Herpetology). The nestling (AMNH 7633, Ornithology), examined by Lester Short of the same institution, was about 12 days of age, had the eyes opened, and the egg tooth essentially gone. Well developed "heel" pads were evident. Feathers of the capital tract were moderately developed; the dorsal tract was but slightly feathered except on the upper back before dividing into lateral extensions that met above the uropygial gland; the ventral tract was well developed as was the femoral tract; and the crural tract was but slightly developed. Tail feathers coming in and out of the sheaths were the rectrices and a row of coverts above and below them. Wing feathers well developed and considerably out of the sheaths were the remiges, the greater coverts, some of the next row of coverts, the alular feathers, the feathers along the front of the wings, and the humeral feathers. Primary 1, but not primary 2 was much abbreviated (for discussion of abbreviated inner primaries of woodpeckers see Chapin [Auk 38:531-552, 1921] and Sibley [Auk 74:102-103, 1957]); the first primary was but  $\frac{1}{3}$  the length of the other primaries, including the sheath, the projecting feather out of the sheath was but  $\frac{1}{3}$  the length of the other primary feathers emerged from their sheaths, and in length and its small diameter, the first primary was the size of smaller greater covert feathers.

*Interaction with other species.*—Apart from the instance described earlier, I saw the Guianan Toucanets at the hole twice more during the study period. On 11 April the 2 males came to the hole at 13:50 while the female Waved Woodpecker was incubating. One toucanet perched at the rim and poked his head in several times before I chased them away. At 15:00 on 26 April, while there was a single nestling in the hole, a toucanet came to perch and probe into the hole; again I chased him away.

Other interspecific interactions not previously mentioned included 2 instances when a Chestnut Woodpecker (*Celeus elegans*) landed on the nest tree and approached the hole (it left within 7 sec), after which the Waved Woodpecker inside merely appeared at the entrance momentarily before retreating back into the hole. After the second nestling was taken by the snake, the parent woodpeckers were not seen at the hole again. Neither they nor the toucanets roosted in the hole thereafter.

*Acknowledgments.*—This study was supported by a 1976 Thomas J. Watson Fellowship. I am indebted to Lester L. Short for his suggestions regarding the study, as well as for his description of the nestling woodpecker and comments upon the manuscript, to Lawrence Kilham for his suggestions regarding revisions, and to Charles Myers for his identification of the snake. I also thank J. P. Schulz and Henri Reichart, of the STINASU division of the Surinam forestry service, for their assistance while I was in Surinam. Fritz von Troon of STINASU and Marc G. von Roosmalen aided in identification of trees and in forest type description. Finally, I thank Paul K. Donahue for assistance with the woodpecker drawing and for his suggestions on the manuscript.—PATRICIA O'BRIEN, *Department of Psychology, University of Connecticut, Storrs, Connecticut 06268. Accepted 19 June 1978.*