NOTES ON THE BEHAVIOR OF THE COSTA RICAN SHARPBILL (*OXYRUNCUS CRISTATUS FRATER*)

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ABSTRACT.—The Costa Rican Sharpbill (*Oxyruncus cristatus frater*) is a chunky bird of stolid demeanor, with rapid and jerky movements. Males apparently form exploded leks of 3–4 birds, advertising their lek territories by singing a high, thin, wiry, descending trill from conspicuous perches high in the canopy of precipitous, mid-elevation rain forest. The singing (and probable breeding) season extends from late February or March to late May or early June. The bright vermilion crest of the males is erected during intense aggressive interactions but not during singing. Probable courtship is described, but we were unable to observe copulation. We also describe a probable flight display of unknown significance. Sharpbills employ varied foraging tactics and take both fruit and animal prey. The sharp-pointed bill is used to pry open rolled leaves, undehisced fruits, and tufts of moss and epiphytes. The Sharpbills' bill and foraging appear to represent a unique specialization within the great tyrannine suboscine radiation of the New World tropics and a striking convergence with the family Icteridae in particular. *Received 18 January 1982, accepted 31 August 1982.*

THE Sharpbill (*Oxyruncus cristatus*) is a wide-ranging but extremely poorly known suboscine, generally placed in its own monotypic family. Five apparently disjunct races have been described over its broad distribution from Costa Rica to Paraguay, with the peculiarity that the northernmost and southernmost forms are more similar to each other than either is to the intervening forms (Chapman 1939). The northernmost race, *O. c. frater* Sclater and Salvin, has been recorded from Bijagua, in the Cordillera de Guanacaste of northern Costa Rica, south to Veraguas, Panamá, principally on the Caribbean slope but with one specimen each from San José and Santa María de Dota, on the Pacific slope (Slud 1964, Wetmore 1972). From specimen records and his two observations of the bird in Costa Rica, Slud (1964) considered it a bird of heavily forested regions in the cool and very humid portions of the subtropical belt, where it occurred in the canopy and in tall trees at the forest border. He noted it foraging in dense foliage at medium heights in the trees, clinging upside-down while feeding on small berries. We know of no other substantive published accounts of *O. c. frater* in life, and there are very few of any of the other races. Wetmore (1972) describes the body proportions, pterylography, and stomach contents of two *O. c. brooksi* he collected in Darién, Panamá, while E. Eisenmann (cited in Ridgely 1976) ascribes to *O. c. cristatus* of Brazil "a long-drawn high thin whistle that gradually slides down in pitch." Also, we have recently received a short account by T. H. Davis of the behavior of *O. c. hypoglauca* of Suriname (in litt.), which will be discussed below in connection with our observations of *O. c. frater*.

In this paper we describe the song, singing behavior, and probable social system of *O. c. frater*, including a flight display and a possible courtship vocalization. We also present observations on foraging and other behaviors, some of which appear to shed light on the species' chief morphological peculiarity, its sharp-pointed bill. Our observations of Sharpbills were made in Parque Nacional Braulio Carrillo, Provincia de San José, Costa Rica, chiefly in the vicinity of "La Montura," a house beside the road (under construction) from San José to Guápiles, in the Atlantic lowlands. Except for a narrow strip of devastation along the road itself, the area is heavily forested; the terrain is exceedingly precipitous (see Fig. 3). Most observations were made at an elevation of about 1,100 m, near the top of a steep-sided ridge that separates the Río Patria watershed on the west from that of the Río La Hondura to the east. The general area falls in the Premontane Rain Forest life zone of Holdridge (1967). Between

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late June 1980 and early April 1982, Stiles made a total of 18 visits of 1–5 days' duration to La Montura, accumulating some 18 h of observations on singing Sharpbills plus numerous observations on foraging and other behaviors. Whitney watched singing Sharpbills for about 8 h on 17–18 March and 4 April 1982 at La Montura and briefly observed other behaviors there and elsewhere on the same dates.

General Appearance and Behavior

In life, Sharpbills appear chunky and short-legged, about the bulk of a kingbird (*Tyrannus*) but with a relatively smaller head and bill and a shorter tail (Fig. 1a). The upperparts are olive green, with two yellowish wingbars; the underparts are pale yellow, the breast and sides heavily spotted with black. The feathers of the head and throat are flecked or scaled with blackish. Those of the sides of the crown are tipped black (more broadly in males) and obscure a bright erectile median crownpatch, which in the male is bright vermilion, having more and longer feathers than the paler orange patch of the female and forming a conspicuous crest when fully erected. The iris of singing males appears reddish, the bill and feet grey; there may be a sexual difference in iris color, because a bird that visited a song perch of a male and was tolerated by him in the vicinity had an orange iris and was almost certainly a female (see below). The other notable sexual difference involves the outermost (tenth) primary: in males, but not females, the barbs of the basal two-thirds of the outer web are stiffened and recurved, giving a saw-toothed effect not unlike that of the outermost primary of male *Stelgidopteryx* swallows. Notwithstanding these differences, the sexes are too similar in appearance to be safely distinguished in the field under any but the most favorable circumstances.

Sharpbills usually perch erectly and rather stolidly, often sitting in the same spot for minutes at a time (although looking alertly about). When they do move, their movements are abrupt and jerky, with heavy hops and jumps in foliage or fast, direct flights between trees. The normal flight consists of bursts of fast, shallow wingbeats alternating with short level glides. The birds usually alight in dense foliage, where they may sit quietly or progress by short hops and flights upward and outward

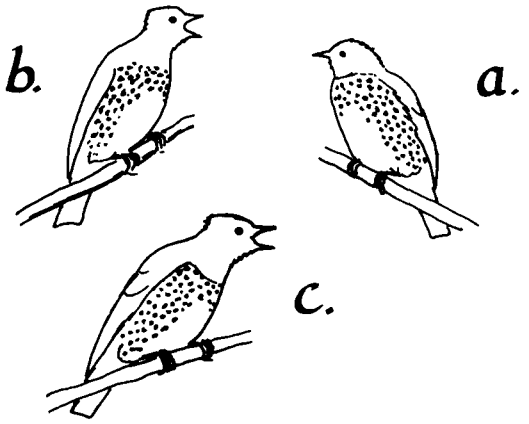

Fig. 1. Some postures of the Sharpbill, drawn from 35-mm slides. a. Normal perching posture. b. and c. Singing male.

to the edge of the canopy. Even when perched in plain sight, Sharpbills are often difficult to observe, owing to their inconspicuous colors and sluggish demeanor. The Sharpbill's stolid manner was most evident on one of the few occasions when Stiles saw a male's crest (partly) raised. This occurred when a male flew from his song perch to join a furious aggregation of tanagers, honeycreepers, warblers, and hummingbirds that were responding by vigorous mobbing behavior to Stiles' whistled imitations of the call of the Highland Pygmy-Owl (*Glaucidium jardinii*). Flying rapidly into a nearby tree, the Sharpbill hopped swiftly up to a perch in dense foliage and sat for several minutes peering incessantly about, partly raising and lowering its crest several times. Its sluggishness contrasted strikingly with the active flitting of the other birds, its silence with their excited scolding.

Sharpbills are solitary birds under most circumstances. Singing males only exceptionally tolerate other individuals, probably females (see below), near their song perches. We have never seen any lasting association between two Sharpbills nor any indication that the singing areas of males are also nesting areas. In our experience, foraging Sharpbills are also seen singly, although they may associate loosely with mixed-species flocks, particularly those canopy flocks organized around parties of tanagers (*Chlorospingus ophthalmicus* and/or *Tangara* spp.). Sharpbills seem to join flocks that remain for some time in the same spot rather

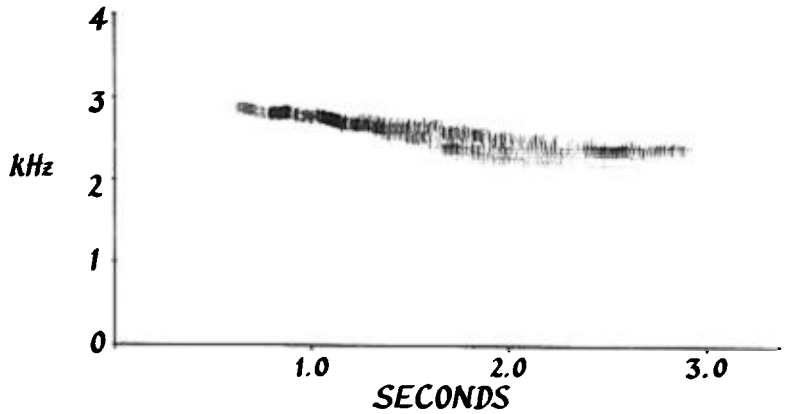

Fig. 2. Sonagram of the song of the Sharpbill, recorded 22 March 1981 on a Uher 4000-L recorder. Sonagram prepared by J. W. Hardy.

than moving with the flock for considerable periods. Davis (in litt.) reports that Sharpbills in Suriname regularly join and follow mixed-species foraging flocks.

Song and Singing Behavior

The most conspicuous vocalization of the Sharpbill at La Montura is a high, thin, wiry, descending trill sounding like "eeeeuuuurrr," with a rather cicada-like quality. The sonagram (Fig. 2) shows the trill to have a duration of about 2.5 s; it commences at a frequency of about 3 kHz, descends to about 2.5 kHz, and has a fine structure of about 65 syllables/s. Vocalizing birds usually perch on dead or thinly foliaged branches projecting conspicuously out of the canopy, about 15–30 m above ground (Fig. 3). Each bird seems to use a small number (ca. 3–5) of such perches regularly, within a radius of 50–100 m; the calling areas of adjacent birds do not overlap, and in fact the birds appear to defend them (see below). The only vocalizing birds that we could observe closely definitely had the vermilion crown-patch of the male Sharpbill; because the behavior of all calling birds seemed similar, we conclude that all such birds were probably males. The loudness, stereotypy, and persistent delivery from conspicuous, defended perches of this vocalization convince us that it represents the territorial advertising song of the species. A similar vocalization was heard from Suriname Sharpbills by Davis (in litt.), who reached a similar conclusion regarding its function.

The singing season of the Sharpbill at La Montura is from late February or early March to late May or early June. In 1981, Stiles heard no Sharpbills singing on 8–9 February, but they were in full song by 13–15 March. In 1982, he heard only very sporadic singing on 17–19 February, but by 17–18 March Whitney found them in full song. Song was still frequent on 22–25 May 1981 but was not heard on 1–5 July (nor on 29 June–4 July 1980). The singing season is almost certainly synonymous with the breeding season, as nearly all small canopy-dwelling birds (except hummingbirds) at La Montura breed during these months (Stiles unpubl. data).

In both 1981 and 1982, the number of singing males at La Montura varied from 3 to 4 on different dates; their territories were arranged in a loose cluster on both sides of the ridgetop (Fig. 4). Most of our observations of song and social behavior were of the male whose territory included the ridgetop itself, hereafter called the "ridgetop male" (although in the absence of banded birds we cannot be certain that the same individual was involved in both years). The arrangement of territories varied somewhat between years, although many of the same song perches were used in both (evidently sometimes by different males). In 1982, a dead treetop some 40 m northeast and slightly below the house was a regular song perch of the ridgetop male and proved exceptionally favorable for observation; most of the significant social interactions seen involved this perch and its vicinity. (In 1981 this tree was alive, bore thick foliage, and was not used as a song perch.) No other singing Sharpbills were located in the

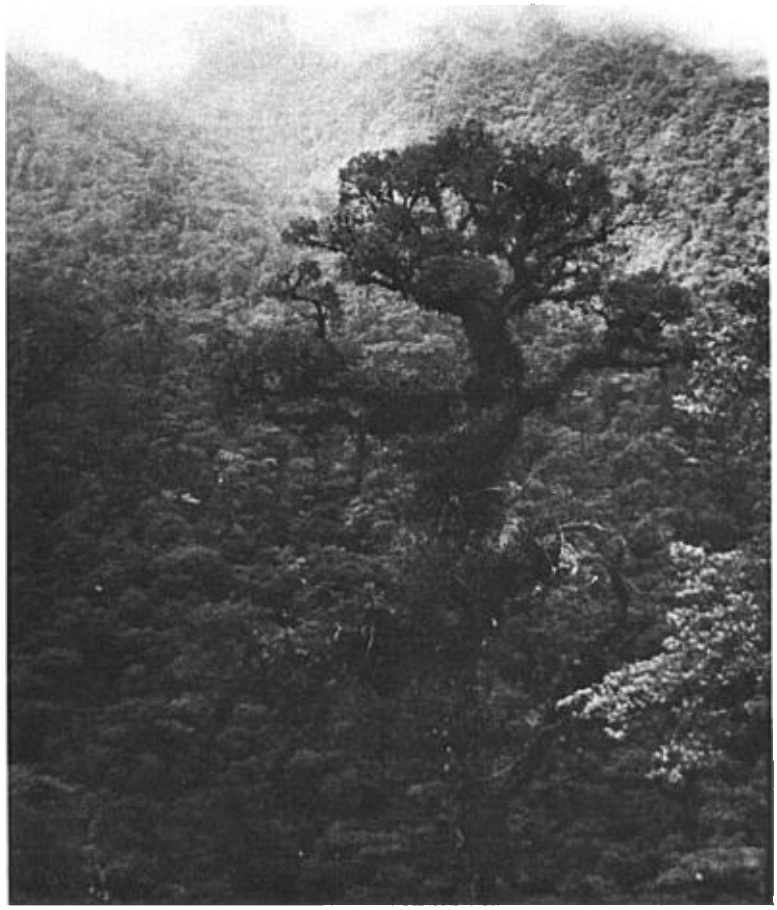

Fig. 3. Forest at La Montura, including two song perches of the ridgetop male (1981): the dead branch in the extreme upper left of the large (ca. 25-m) tree at center, and the uppermost diagonal branch of the smaller (ca. 17-m), thinly foliaged tree at the extreme right. Photo taken looking southwest across the road into the Río Patria drainage; note the steepness of the terrain and the quantity of moss and epiphytes in the large tree at center.

La Montura area, despite repeated visual and auditory searches along several kilometers of roadside and study trails.

The singing posture of the perched bird was characteristic: it stretched its neck forward, fluffing its head feathers and opening its bill wide (Fig. 1b, c). The vermilion crown-patch was never exposed during singing; indeed, the feathers often appeared so tightly appressed as to form a concavity in the center of the crown. During periods of active singing, the ridgetop male gave an average of about two songs per minute (interval between songs 15–58 s, mean 31 s for 17 successive songs at about 1300 on

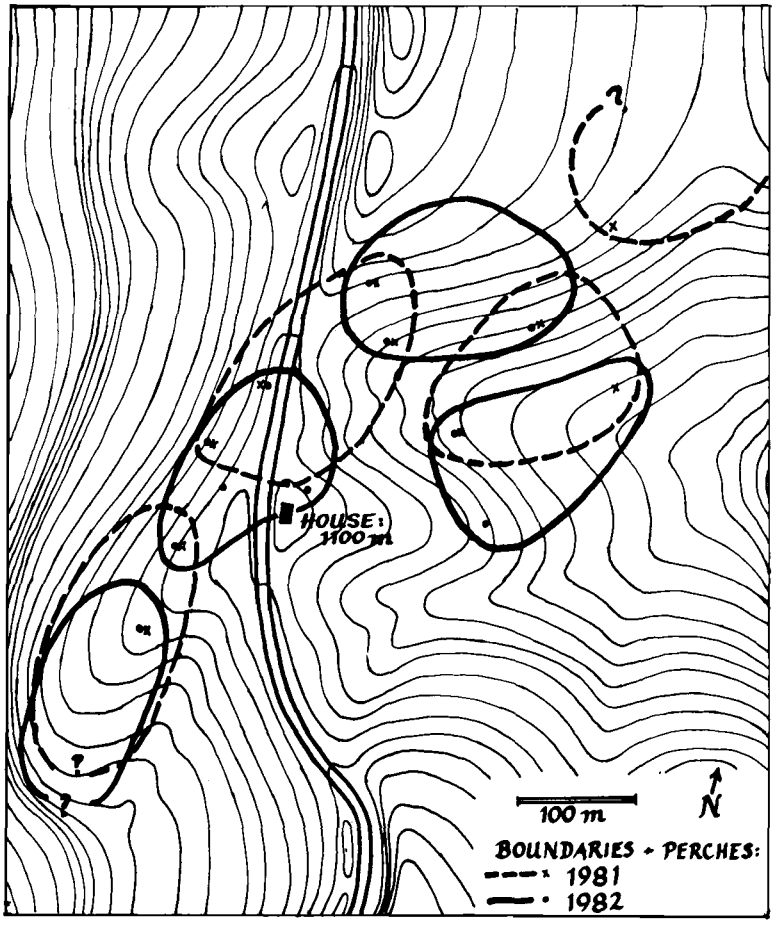

Fig. 4. Approximate locations of territories and song perches of Sharpbills at La Montura in 1981 and 1982. Contour interval about 10 m; note extreme steepness of terrain.

21 March 1981). A typical song bout contained about 10 songs (mean 10.7, range 3–21 for 11 bouts on 21 March and 16 April 1981); generally, the ridgetop male changed perches one or more times during a song bout (mean number of consecutive songs from a perch 3.8, range 1–9 for 8 bouts on 16 April 1981). About 10% of the songs were given from perches other than the regular song perches (in the case of the ridgetop male, many songs were given from two *Clusia* feeding trees immediately behind the house). Often the ridgetop male was answered by, or sang in response to, other singing males on either side of the ridge. During the height of the singing season, the Sharpbills sang most consistently around midday (ca. 1000–1400). During clear weather, the ridgetop male spent 40–80% of his time on his song perches during these hours and foraged largely within sight of them. Even at these times, however, he was often absent for 5–15 min at a stretch. A briefer and less intense period of singing usually occurred at 0540–0700; during the rest of the day, singing was highly sporadic. Periods of heavy rain often disrupted this schedule; during the very rainy observation period of April 1981, the birds did not sing at all on some days.

The only instance in which markedly different singing behavior was observed occurred at about 1530 on 4 April 1982, some 8 km north of La Montura, at an elevation of about 700 m. Whitney observed a lone Sharpbill perched on a small dead limb near the top of a tall (ca. 20 m) tree at the edge of a clearing. This bird's song seemed slightly higher-pitched, thinner,

and shorter than the songs of the La Montura birds but was easily recognizable as that of a Sharpbill. After giving a song, the bird sat silently on its perch for 3–4 min, then suddenly launched into a strange, rapid, fluttery flight in which the wings quivered while the tail pumped sharply downward as the bird flew directly across the clearing. While in mid-flight, the bird jerked its head up slightly, opened its bill wide, delivered one song, and continued flying until lost from view behind a tree, after which it could not be relocated. The song given in flight sounded exactly like that which the bird had just given from a perch. No possible mechanically produced sounds were heard during this peculiar flight, so the function of the serrations of the male's outer primary remains unknown. We have never seen such a flight display at La Montura and cannot divine its significance at present. Whitney found no other Sharpbills in this area, nor had either Stiles or Whitney seen or heard any in several visits during the 1981 singing season. Unfortunately, a landslide blocked access to this area in May 1982.

AGGRESSIVE AND COURTSHIP BEHAVIOR

We rarely saw a male on his song perch interacting closely with another Sharpbill and estimate that the ridgetop male on his song perches was quite alone for at least 95–98% of the time. On several occasions Stiles saw this male give what appeared to be a stylized double wing-stretch, snapping his wings half open horizontally, holding the pose for a second or so, then snapping them shut. Such movements occurred more often during a bout of singing back and forth with another male, but Stiles was unable to determine whether or not the males were in visual contact. Certainly no other Sharpbill was detected close to the male's song perch on such occasions, and we do not know the function (if any) of this apparent display.

Nevertheless, two types of social interactions centered about the males' song perches were observed: aggressive interactions, evidently involving two males, and what appeared to be female visits leading to courtship. At least some of the departures of the ridgetop male from his territory were evidently for the purpose of interacting with other males. At about 1130 on 21 March 1981, some 2 min after this male had flown east down the hill toward another singing male, Stiles saw two Sharpbills burst out of a tree some 75 m below the road, locked in combat. The fluttering, grappling birds dropped about 10 m and separated; one flew off to the east, and the other, evidently the ridgetop male, flew to a tree just below the road and perched, his crown-patch fully erected into a flaming crest. He gradually lowered his crest and after a minute or so began to sing while hopping about in dense foliage. Finally, he flew to one of his regular song perches and sang for several minutes, during which time he was answered several times by the bird to the east. On three other occasions, Stiles saw another Sharpbill fly in and land near the song perch of the ridgetop male, who without further ado launched himselt at the intruder and chased it out of sight. Twice he remained out of contact for several minutes, but after one such incident on 18 February 1982 he returned within 30 s with crest partly raised, but quickly lowered it and sang. All of these interactions were entirely silent.

We observed two possible instances of courtship. During the morning and early afternoon of 18 March 1982, Whitney frequently noted the presence of a second Sharpbill foraging in the trees adjacent to the ridgetop male's song perch below the house. This second bird appeared to be ignored on most occasions, but once the male flew to join the other bird in a tree 15 m away. Here the two birds perched very close together on a mossy limb some 12 m above the ground and out of Whitney's direct line of sight. At least one of the birds repeatedly gave a soft, descending chatter of 6–10 syllables that reminded Whitney of a vocalization of *Leptopogon amaurocephalus*. After several repetitions of the chatter, one bird left the tree and flew out of sight, followed 2 s later by the other. Following this, the ridgetop male did not return to his song perch for about 10 min. On 5 April 1982, Stiles twice saw a Sharpbill fly in and land on the ridgetop male's song perch below the house while the male was absent near midday. This individual differed from the ridgetop male in that its iris was orangish and it appeared to have less fluffy crown feathers; it perched silently while looking actively about. On the first occasion, this bird flew off after about 5 min without the male having put in an appearance. On the second occasion, at 1245, the ridgetop male flew directly in and

supplanted this bird on the song perch but did not chase it. The second bird flew into a tree some 20 m away and appeared to forage. After singing twice, the male flew into the same tree and perched in dense foliage, apparently close to the other bird but out of sight. Stiles heard several bursts of soft, high-pitched, thin, descending chatters in the next 15–20 s (evidently the same vocalization heard by Whitney); then the birds apparently left the tree heading east or northeast out of Stiles' line of sight. Some 5 min later the ridgetop male flew into a *Clusia* tree behind the house, approaching from the east; after foraging briefly, he flew to his song perch and sang. During the next 1.5 h, no other Sharpbill was seen in his territory. The male's apparent tolerance of these birds near his song perches and the occurrence of a distinct type of vocalization when the two birds were in close contact strongly suggest that these visitors were females and that the interaction observed was courtship. Unfortunately, both of the chattering interactions occurred in foliage too dense for us to see precisely what occurred, although the interaction certainly did not appear to be aggressive.

The nature of these interactions, plus the lack of any long-term association between two Sharpbills, leads us to conclude that the cluster of male territories functions as an exploded lek. Aggressive interactions around song perches between lek males in *Phaethornis superciliosus* and other lek species (Stiles and Wolf 1979 and included references) are strikingly similar to the aggression seen in Sharpbills. The only nonaggressive interactions between Sharpbills seen were the presumed courtships described above, which resemble male-female interactions seen on the exploded leks of some Cotingidae (Snow 1972, 1977). No sign of nesting activity was ever seen in the males' territories, and the fact that the males were apparently continuously present throughout the supposed breeding season argues against any lasting pair bond being formed: in those tyrannine suboscines where a pair bond is formed, the males may not build the nest or incubate but they do help to feed the young (Skutch 1960, 1969). Although the ridgetop male's territory contained several fruiting trees (more in 1981 than in 1982), we saw no overt defense of the trees per se, and our data strongly suggest that much feeding occurred off territory. In Suriname, Davis (in litt.) found clusters of 3–4 singing birds (presumably males) separated by distances of 1–2 km and also concluded that they were exploded leks.

Foraging Behavior

We observed several kinds of foraging behavior by Sharpbills, both for fruits and for arthropod prey. On various occasions we watched a Sharpbill hop deliberately along a moss-laden branch well up in the canopy and probe with the bill into tufts of moss or small epiphytes, sometimes prying small cushions of moss, etc. away from the branch to peer beneath them. The birds also sometimes clung to the sides of branches to peer beneath, like big, slow-moving tanagers (*Tangara*, etc.), again apparently poking and probing into the moss tufts on the branch undersides. Occasionally, Stiles has seen Sharpbills make short, rather clumsy looking sallies, presumably to pluck prey from nearby foliage; such sally-feeding is common in some South American populations of the species (M. P. Fogden pers. comm.) On 3 October 1981 Stiles, T. Moermond, and J. Denslow watched a Sharpbill forage for over 10 min. This bird was deliberately inserting its fine-pointed bill into the tips and edges of tightly rolled young *Clusia* leaves and apparently opening up the leaves by gaping with the bill, often hanging acrobatically in the process. Once it gobbled up something that evidently had been hidden in the rolled leaf. The bird also practiced this technique on rolled dead leaves as we watched. On 20 December 1981 Stiles watched a similar bout of foraging at the rolled young leaves of a strangler fig (*Ficus*) well up in the canopy. The spiders and their egg cases found by Wetmore in Sharpbill stomachs could well have been procured by the poking and prying techniques described here.

Sharpbills were also observed taking fruit on numerous occasions. Sometimes they took small berries (Ericaceae, Loranthaceae, etc.) as described by Slud (1964). The most frequent fruit-foraging we saw, however, was at trees bearing arillate fruits, especially *Hampea appendiculata* (Tiliaceae) and *Clusia oblanceolata* (Guttiferae). The ridgetop male regularly foraged at one *Hampea* and three *Clusia* trees within 100 m of his favorite song perch. In each case, the bird hopped swiftly but heavily in the foliage, grasping the twig and hanging upside-down while inserting the point of its bill into the pods or husks of fruits that were just be-

ginning to dehisce and in which the aril was not yet fully exposed. Prying open the pod, the bird would swallow one or more of the arillate seeds before leaving the fruit. The seeds are evidently regurgitated later, as Stiles found several of the black, shiny *Hampea* seeds under the male's favorite song perch. A number of other birds eagerly eat the arillate seeds of both *Hampea* and *Clusia*, including toucanets, thrushes, tanagers, and flycatchers, such that when we observed them, these trees had very few open fruits with uneaten seeds at any one time. The ability of the Sharpbill to exploit these fruits before they open fully may well give it an advantage in potential competition for them.

It would thus appear that the Sharpbill's sharp bill serves the function of a wedge in prying open rolled leaves and dehiscing fruit and perhaps in prying up tufts of moss, etc. on branches. Strikingly similar pry-and-gape foraging behavior has been well documented in various similarly "sharp-billed" members of the family Icteridae (e.g. Skutch 1954) and in *Vermivora chrysoptera* and *V. peregrina* of the Parulidae (Slud 1964, Morton 1980, Tramer and Kemp 1980). In the forest canopy at La Montura, several other species forage in somewhat similar ways, but we have seen none that duplicates the range of pry-and-gape tactics employed by Sharpbills. The icterids *Cacicus uropygialis* and *Zarhynchus wagleri* regularly pry into moss and epiphytes on branches and (*Cacicus*) rolled dead leaves, especially of palms, but we have not seen them take fruit. The barbet *Eubucco bourcierii* regularly probes rolled dead leaves (cf. Slud 1964), but we have never seen it open rolled young leaves of *Clusia* or *Ficus* or dehiscing fruits. The same applies to the much smaller *Vermivora* warblers, which are probably unable to handle the tough, leathery *Clusia* leaves or take fruits with seeds as large as those of *Hampea* in any case.

Conclusions Regarding Sharpbill Relationships

The Sharpbill's sharp bill and associated foraging behavior would appear to represent a unique specialization in the great cotinga-manakin-flycatcher radiation of the Neotropics. Other aspects of its morphology and biology are perhaps less unusual among its putative relatives in the Cotingidae and Tyrannidae. Sharpbills resemble certain of the larger members of the Cotingidae in their general body proportions and singing behavior and probably in their social system (cf. Snow 1970, 1972, 1977; Wetmore 1972). Their spotted plumage is highly unusual but approached by some other cotingids like *Pipreola* and *Laniisoma*. On the other hand, the concealed reddish crown-patch, modified primary, and flight display somewhat recall certain tyrannids. More information is required to evaluate other known or suspected anatomical peculiarities of Sharpbills properly, such as pterylography, jaw and leg muscles, etc. The nesting habits of Sharpbills remain undescribed, and knowledge of their behavior is still very fragmentary. For the present, it seems safest to continue to recognize the Oxyruncidae as a monotypic family until more data become available.

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The **Frank M. Chapman Memorial Fund** gives grants in aid of ornithological research and also postdoctoral fellowships. While there is no restriction on who may apply, the Committee particularly welcomes and favors applications from graduate students; projects in game management and the medical sciences are seldom funded. **Applications for projects in 1983 should be submitted not later than 15 February; prospective applicants and advisors should note there will shortly be a change in the Chapman meeting and deadline schedule.** Application forms may be obtained from the **Frank M. Chapman Memorial Fund Committee, The American Museum of Natural History, Central Park West at 79th St., New York, New York 10024.**

Chapman grants during 1982, totalling $40,453 with a mean of $499, were awarded to: Jonathan L. Atwood, Speciation in the Black-tailed Gnatcatcher (*Polioptila melanura*) complex; James C. Bednarz, Cooperative polyandry in the Harris' Hawk; Craig W. Benkman, Food availability, foraging efficiency, and the regulation of crossbills (*Loxia*) in eastern North America; Thomas K. Bicak, Food resources and foraging behavior of Long-billed Curlews (*Numenius americanus*) in western Idaho; David Edward Blockstein, Reproductive behavior and parental investment in the Mourning Dove, *Zenaida macroura*; Sharon Ann Brady, Effect of habitat size on the breeding and wintering ecology of the Ovenbird (*Seiurus aurocapillus*); Gregory S. Butcher, Sexual differences in the color and behavior of the Northern Oriole; William J. Carmen, Juvenile dispersal, flocking behavior, and habitat use in the California Scrub Jay (*Aphelocoma coerulescens californica*); John H. Carothers, Foraging efficiencies in a nectar-feeding guild of Hawaiian honeycreepers at a common food source; Ralph V. Cartar, Incubation behavior of the White-rumped Sandpiper (*Calidris fuscicollis*); Michael D. Carter, Social organization and parasitic habits of breeding Bronzed Cowbirds (*Molothrus aeneus*); Christine Copenhaver, Experimental analysis of decision making in hummingbirds: the effect of resource distribution on territory defense; Robert L. Curry, Evolution and ecology of communal breeding in Galápagos Mockingbirds; William James Davis, Significance of vocalizations in the Belted Kingfisher (*Megaceryle alcyon*); Carlos A. Delannoy, Breeding biology and ecology of the Puerto Rican Sharp-shinned Hawk (*Accipiter striatus venator*); Kim Craig Derrickson, Analysis of the Mockingbird (*Mimus polyglottos*) vocal repertoire for behavioral and situational correlates and seasonal trends; David F. DeSante, Stability and dynamics of a subalpine breeding bird community; Robert Jack Dowsett, Conservation plan for the relict evergreen forests of Malawi and investigation of bird populations therein; Paul J. DuBowy, Optimal foraging, resource partitioning, and community structure of western North American Anatini; Patrick J. Dugan, Investigation of the information-center hypothesis in tree-nesting herons; Bonita C. Eliason, Mating system, parental care, and individual reproductive strategies in the Blackpoll Warbler, *Dendroica striata*; Keith William Emmerson, Bird community of the laurel forest of Tenerife (Canary Islands); Robert C. Fleischer, Host choice by individual female Brown-headed Cowbirds; Frank B. Gill and Douglas Wechsler, Evolution of avian mating systems: breeding biology of a promiscuous tropical flycatcher, *Mionectes oleagina*; Steven M. Goodman, Avifaunal survey of the central Egyptian eastern desert; Kathleen Diane Groschupf, Song repertoires and singing behavior of Rufous-winged and Cassin's sparrows: functional significance of diverse singing strategies in *Aimophila* sparrows; Lise A. Hanners, Development of social behavior in Laughing Gull (*Larus atricilla*) chicks; Linda Heald, Behavioral plasticity in a Tyrannid flycatcher: effects of environmen-

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