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LESTER L. SHORT¹ AND JENNIFER F. M. HORNE²

ABSTRACT

In the course of studies of barbets in Kenya we were able to observe the behavior of five species of honeyguides: *Prodotiscus (insignis) zambesiae*, *Indicator indicator*, *I. variegatus*, *I. minor*, and a small species tentatively identified as *I. narokensis*. Previously unknown or little known vocalizations of four of these were recorded on tape and analyzed. Much of the behavior and many of the vocalizations occurred during interactions of the honeyguides with various species of barbets that in most cases were not breeding. A female *Indicator indicator* engaged in an encounter with *Stactolaema olivacea*, *I. variegatus* responded to playback of the small *Pogoniulus simplex* and one and at times two *I.*

minor underwent sustained interactions with three *Lybius leucocephalus*. Playback of *Lybius torquatus* duets stimulated the barbets to duet frequently, which attracted both *Indicator minor* and *I. narokensis*; some sustained interactions resulted. Our findings add to the knowledge of honeyguides, and particularly demonstrate that strong interactions with potential host species (barbets) of the nest-parasitic honeyguides occur, and may take place in the absence of breeding activity of the barbets. Various questions are raised by the observations, and playback is advocated as a technique for future investigations that may answer these questions.

INTRODUCTION

Honeyguides (Indicatoridae) long have attracted interest because some species have the habit of leading certain mammals, including man, to sources of honey (they eat beeswax, not honey), and because of the brood parasitism of all honeyguide species that have been studied so far (Friedman, 1955; Cronin and Sherman, 1976). Despite this interest, the generally inconspicuous colors and behavior of honeyguides have rendered them very difficult

to study. We do know little about such aspects of the biology of some species as their honey-guiding behavior, and their host species. Other aspects such as feeding behavior not associated with honey and beeswax, vocalizations other than the honey-guiding calls, and interactions of honeyguides with host species are virtually unknown. The most recent, detailed study (Cronin and Sherman, 1976) contributes greatly to our knowledge of the Himalayan honeyguide

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Indicator xanthonotus, (about 15 species of honeyguides are African and two are Asian) but, very few data on vocalizations were forthcoming, and their efforts to determine whether the species is a brood parasite were in vain. It is almost impossible to follow moving, non-guiding honeyguides, because they fly long distances and are often unobtrusive, perching quietly in the foliage of a tree.

We consider ourselves fortunate in having been able to observe, and to here report, some behavior of five Kenyan species of honeyguides studied during parts of 1977 and 1978. Our observations include interactions of honeyguides with other, mainly host species, and we recorded on tape and have analyzed audiospectrographically certain vocalizations of four honeyguide species. The honeyguide observations were limited because our fieldwork was concentrated on the behavior of barbets (Capitonidae) and woodpeckers (Picidae). Although they are in part fragmentary, the results obtained are significant in our view because of the limited knowledge of honeyguides noted above.

We observed the honeyguides *Prodotiscus (insignis) zambesiae* (Eastern Green-backed Honeybird), *Indicator indicator* (Greater or Black-throated Honeyguide), *I. variegatus* (Scaly-throated Honeyguide), *I. minor* (Lesser Honeyguide), and a small honeyguide, probably *I. narokensis* (Kilimanjaro Honeyguide). We describe interactions of various of these species with barbets, and include some relevant behavioral data about the barbets *Pogoniulus simplex* (Green Tinkerbird) *P. bilineatus* (Golden-rumped Tinkerbird), *Lybius torquatus* (Black-collared Barbet), *L. leucocephalus* (White-headed Barbet), and *Stactolaema (Bucanodon) olivacea* (Green Barbet). The primary site of the observations was in coastal *Brachystegia* forest within the Sokoke-Arabuko Forest (along the south margin of the "Nature Reserve" in that forest) southwest of Malindi, Kenya. The secondary site was a garden in Karen, a suburb situated about 11 miles southwest of Nairobi at 6000 feet. Observations at the former site include July 25 to August 11, 1978, and, at the latter site, at sporadic intervals in August and September 1977.

Tape-recordings were obtained using a Stellavox SP-7 tape-recorder, and a Schoeps CMT-42 condenser microphone with a 30-inch parabolic reflector. A Phillips cassette tape-recorder was used for playback purposes. Audiospectrographic analysis was conducted with a Kay Electric Sonagraph 6061-B. Observations were made through eight and 10 power field glasses. Abbreviations used throughout the text are m. for meters, sec. for seconds, and kHz. for kilohertz.

We are indebted in various ways to Mr. G. R. Cunningham-van Someren of the National Museums of Kenya, Mr. Peter Britton, Mr. and Mrs. Karl Merz, and Misses Edwina and Sybil Sassoon, Shauna Horne, and Melanie Wray for assistance in Kenya. Dr. M. L. Modha and the staff of the Kenya Ministry of Tourism and Wildlife were most helpful in securing permits, suggesting areas of study, and in other ways. Financial support of the senior author's fieldwork by the L. C. Sanford Fund of the American Museum of Natural History is gratefully acknowledged.

PRODOTISCUS (INSIGNIS) ZAMBESIAE SHELLEY

On July 30, 1978, while studying Green Barbets in Sokoke-Arabuko Forest, we were attracted to a small, thin-billed, calling bird that proved to be a tiny, pale honeyguide of the genus *Prodotiscus*, identified as the Eastern Green-backed Honeybird on the basis of its pale coloration, somewhat greenish gray above, with a gray or dusky face and dull grayish white underparts (see Forbes-Watson, 1977). This taxon generally is treated (Benson, et al., 1971; Snow and Clancey, 1978) as specifically distinct from *P. insignis* (Cassin) but the uncertainty that surrounds the taxonomy of honeyguides does not give us full confidence in this. Suffice it to say that *zambesiae* is the only taxon of *Prodotiscus* known to occur in coastal Kenya (map in Snow and Clancey, 1978). Its vocalizations were undescribed heretofore.

As the bird perched, it flitted its white outer tail feathers and uttered two series of Pa-wee-wit Calls. One of these was recorded and played to the honeyguide, which excitedly moved about in the top of the tree, and re-

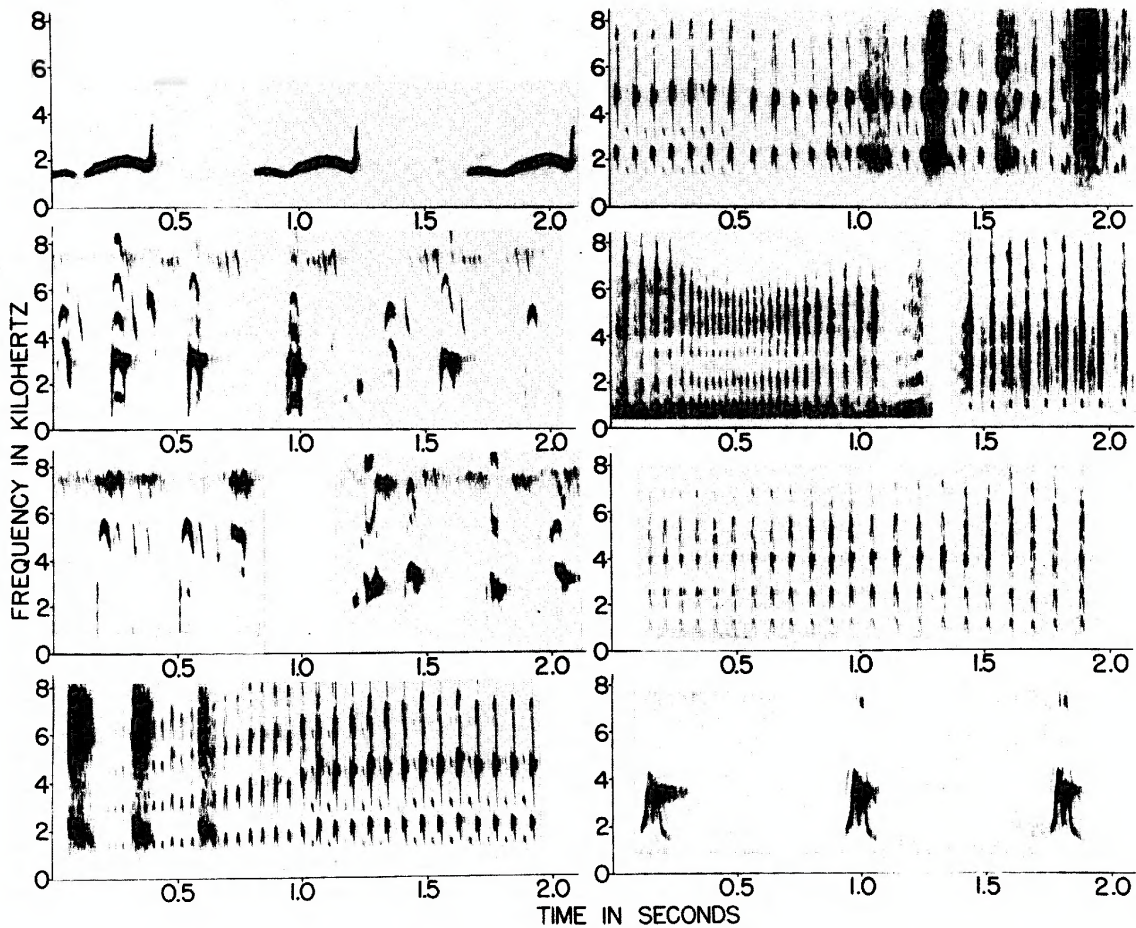


FIG. 1. Wide-band sonograms of various calls of three species of honeyguides. Left: top, last three notes of 12-note Pa-wee-wit Call of *Prodotiscus zambesiae*, July 30, 1978, Sokoke-Arabuko Forest. Second from top, section of five sec. Piping Call of female *Indicator indicator* during interactions with *Stactolaema olivacea*, showing variation of notes, Aug. 2, 1978, Sokoke-Arabuko Forest (faint notes at 7 kHz. are of insect). Third from top, two sections of different long Piping Calls of female *Indicator indicator* during encounter with *Stactolaema olivacea* showing dropping-rising, multiple-peaked and other notes (same date, site, and calling insect as in last). Bottom, first half of Trill or Rattle Call of *Indicator minor*, introduced by three noisy chatter notes of *Lybius leucocephalus* during an encounter between these species (note rising pitch of Trill Call), Sept. 29, 1977, Karen. Right: top, part of long Trill Call of *Indicator minor* interacting with *Lybius leucocephalus*, with four chatter notes of latter in last half of sonogram (note down-up-down nature of last four trill notes at right, tending toward Squeak notes, see fig. 2), same date and site as last. Second from top, fast Trill Call of *Indicator minor*, beginning and ending with a Squeaklike note, followed by a shorter slower Trill Call intermixed with faint chatter notes of *Lybius torquatus*, Aug. 3, 1978, Sokoke-Arabuko Forest. Third from top, last half of slow Trill Call of *Indicator minor* during interaction with *Lybius torquatus*, same date and site as last. Bottom, first three of eight notes of Whee-ip Call of *Indicator "narokensis,"* Aug. 3, 1978, Sokoke-Arabuko Forest.

sponded intensely by calling repeatedly for about 20 minutes.

The tape-recorded calls numbered 13 series of 5.5 to 12 sec. duration, containing seven to

18 trisyllabic "pa-wee-wit" or "p-wee-wit" notes (fig. 1). At a distance the notes can be heard only as a "wee" or "wee-w." Notes were given at about 1.4 or 1.5 per sec. with a

0.3 to 0.48 sec. internote interval. Notes are 0.395 sec. in duration (average of 22 notes). All of some 143 notes studied are essentially alike in form, but earlier notes within a series are weaker and faster, and later notes in a series are louder and slower.

As the name given the call implies, the notes have three parts. An initial, weak element, the "pa-," is sonographically a convex structure nearly horizontal, of 0.12 or 0.13 sec. duration, and with a fundamental tone of 1.5 kHz. at the greatest pitch. This is followed, after a slight drop in pitch, by a longer, louder, higher pitched (2.0 kHz.) "-wee-" element that is very similar in form to the initial element. This element gives the greater duration to longer notes, being about 0.28 sec. in such notes, and only 0.24 sec. long in shorter notes. The note generally lacks overtones, but when a faint overtone is present it shows up in this second element. The terminal element is a weak to loud, very fast and sharp vertically rising structure sonographically, rising straight upward from the second element in 0.02 sec. The pitch of this element is between 1.5 and 3.8 kHz. There are no published data on vocalizations of this species, and therefore we cannot render comparisons.

INDICATOR INDICATOR (SPARRMAN)

Information about this best-known honeyguide is provided for a female observed on August 2, 1978, in the Sokoke-Arabuko Forest site. Females are not known to utter the song of this species; they do give its chattering honey-guiding notes (we have many recordings of these, used for comparison with the notes here reported), but otherwise very few vocalizations for this sex have been heard (Friedmann, 1955). We give here our results representing new information only.

We first saw the female Greater Honeyguide at about 16:00 in *Brachystegia* forest as we were recording and playing back to a Fine-spotted Woodpecker (*Campethera cailliautii*). The honeyguide flew to a tree overhead in erratic flight then perched and looked down at us. It did not call, but watched as we played the

calls (Wik Call). The woodpecker failed to respond, and the honeyguide flew off.

We were working with Green Barbets in the same area a half-hour later when suddenly we noticed a female Greater Honeyguide, probably the same bird as that seen earlier, moving about the branches of a tree near two Green Barbets. We continued recording vocalizations of both species as they interacted. The honeyguide followed the barbets about, flitting its tail on occasion, and calling as described below in response to chattering calls and the loud "song" of the Green Barbets. The agitated barbets flew back and forth for 15 minutes, sometimes chasing and sometimes pursued by the calling honeyguide. There were more than five flight chases of the honeyguide by the barbets, and when both species landed side-by-side, low interactive notes were heard (only a few could be recorded on tape). We noted especially the heavy, fluttering audible wingbeats of the honeyguide, which is more maneuverable in flight than the barbets, and the constant and often noisy barbet bill-wiping, typical of many barbet-barbet interactions or connoting the disturbance of the barbets. Our recordings of diverse Green Barbet vocalizations over a period of nearly three weeks provided a framework for analysis of the barbet-honeyguide vocal interactions.

The vocalizations of the female Greater Honeyguide during its encounters with Green Barbets were of three basic types: a previously undescribed Piping Call, a Squeak Call, and a Chatter Call. Of these the loud Piping Call was prevalent during chases and vocal and visual displays with the barbets; the Squeak Call, only a few of which we were able to record on tape, occurred during close encounters; and the low Chatter Call either followed Squeak Calls or was used in similar situations.

The Piping Call (fig. 1) is an irregular series of loud "wit" or "weet" notes delivered in loose continuous bursts or in groups of five to 10 notes uttered at three or four notes per sec. The notes are variable in the pitch stressed (actually diverse tones are emphasized and others suppressed such that successive notes might show one, two or four points of emphasis).

Mainly, however, energy is concentrated in the first and second harmonic tones at 2.5 to 3.0 and 5.0 to 5.5 kHz., respectively. The fundamental tone peaking at about 1.5 kHz. receives little or no emphasis. Occasionally every other tone is emphasized, or even almost every tone, resulting in notes that show as many as four, five, or six overtones. As an example, one note has the dominant sound at 3.3 kHz., but the fundamental tone is strong at 1.6 kHz., and the harmonics at 4.8, 6.5 and 8.0 kHz. also are relatively strong.

Variant Piping notes occur that emphasize the terminal dropping element that then swings upward briefly, giving a concave form to the note. In this form the note shows a lower fundamental tone (1.2 or 1.3 kHz.), a dominant harmonic tone at 2.5 kHz., secondary emphasis at 4.9 and 7.5 kHz. and sometimes also at 3.5 and 6.0 kHz. Some terminal notes also have associated with them one to three separate, sharp dropping elements, descending from about 6.0 to 4.0 kHz. They appear to be derived, shortened wit notes, and their presence suggests a wit-trill form of the call as a sub-call.

Typical Piping Call notes are 0.05 sec. (0.04 to 0.06 sec.) in duration (20 notes). Variant Piping notes are 0.03 to 0.07 sec. in duration, and complex notes with as many as three of the terminal, dropping elements may be as great as 0.2 sec. in duration.

We were able to record on tape only two examples of the low, soft Squeak Call (fig. 2), which proves to occur in similar general form among at least three of the *Indicator* species we studied. The two examples occurred 2 sec. apart during a long chattering interaction with the Green Barbets. The note is sonographically banded in form, vertical, with as many as nine overtones, and a duration of 0.03 to 0.035 sec. The pitch of the fundamental tone is at 0.8 kHz. Essentially it is a peaked note with the peak occurring late in the note. The overtones are strong, and most sound is in the lower four tones. The Squeak Call sounds like a "yeah." Friedmann (1955, p. 127) mentioned a low but penetrating Squeak-like note of the male Greater Honeyguide, and screeching and (*op.*

cit., p. 130) "scream-chattering," probably of the female during (vigorous) copulations. The latter call especially may refer to the Squeak Call described here, because this call is closely associated with a Chatter Call, and because the vigorous nature of the copulations mentioned suggest an aggressive connotation similar to that seen in our cases.

The Chatter Call is a very rapid, variably short to long (up to one-half sec. or longer) vocalization composed of fast, vertical notes that are weak and difficult to distinguish sonographically. When following a Squeak Call the first few Chatter Call notes are louder (fig. 2), but still show little form, with sound at diverse frequencies. The tempo of the elements is of the order of 70 to 80 per sec. Chattering and also twittering calls have been mentioned by Friedman (1955, pp. 130, 123, respectively; see discussion above).

INDICATOR VARIEGATUS LESSON

We recorded no vocalizations of this species, but we did encounter it through playback of barbet vocalizations. In a brief incident during the mid-afternoon of August 5, 1978, in Sokoke-Arabuko Forest while conducting playback experiments with Green Barbets, we noted a Scaly-throated Honeyguide near two Green Barbets. As we took in this fact there was a rushing flight of all three birds; we could not determine which bird triggered the flights, nor could we tell which species was the pursuer and which the pursued during the following chase. At any rate all three birds flew in a large circle, close together, through the trees and out of our view.

At 10:00 on August 8, in a dense portion of the same forest we were playing back vocalizations of *Pogoniulus simplex* and momentarily having no success attracting this tinkerbird when we noticed a Scaly-throated Honeyguide peering quietly but intently at us. We played the tinkerbird's trilling call several times, and in each case the honeyguide raised its head, then moved its head from side-to-side, as if to view us better. Then it flew off. We ascribed this reaction to a casual encounter, and, since

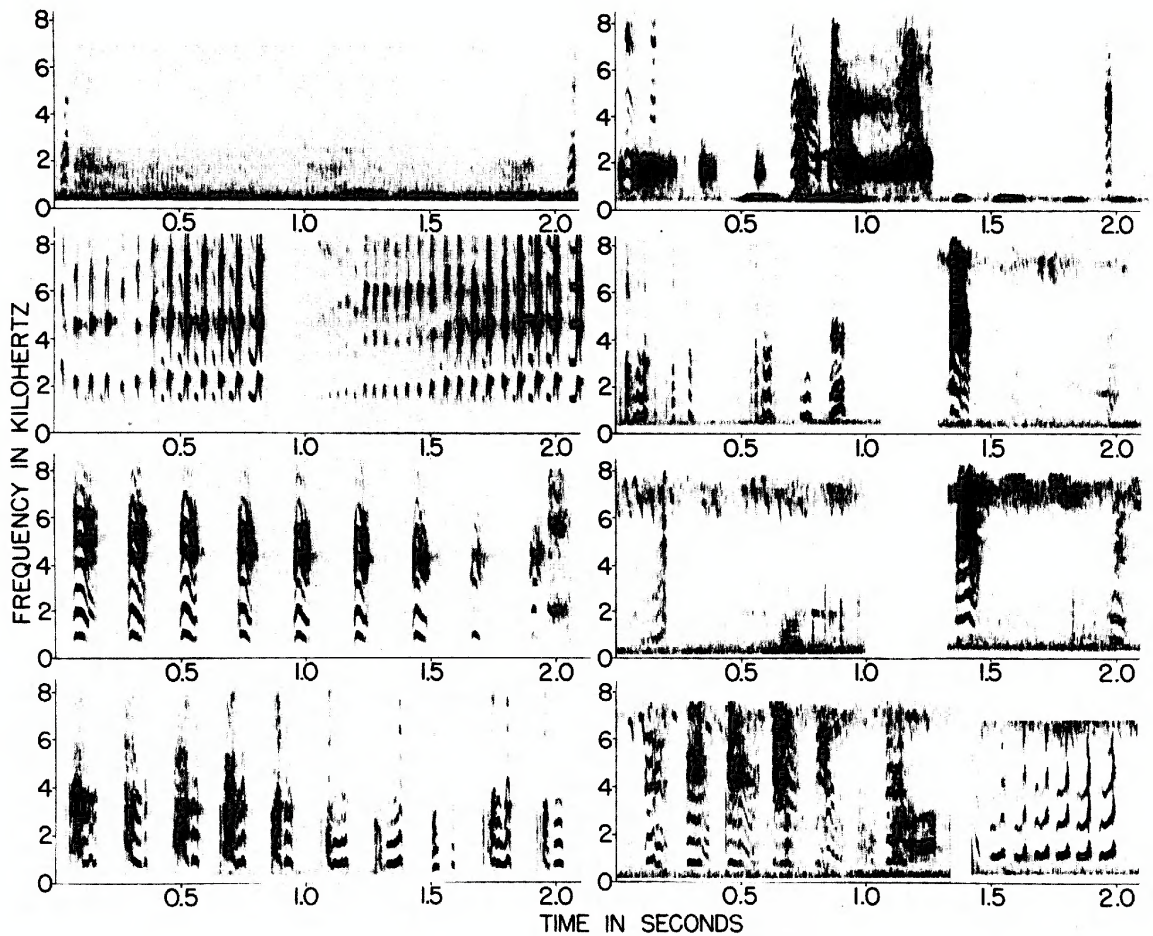


FIG. 2. Wide-band sonograms of Squeak, Trill-Squeak and Squeak-Trill calls of three species of honeyguides. Left: top, two consecutive Squeak Calls of *Indicator indicator* with weak Chatter Calls connecting them, especially prominent after first Squeak Call, all given during interaction with *Stactolaema olivacea*, Aug. 2, 1978, Sokoke-Arabuko Forest (note noisy segment cut off at base). Second from top, two Trill Calls of *Indicator minor* showing notes toward the end of each tending toward Squeak notes, during interaction with *Lybius leucocephalus*, Sept. 29, 1977, Karen. Third from top, part of Trill-Squeak Call of *Indicator minor*, notes varying from Squeak-like to Trill-like, during interaction with *Lybius leucocephalus* (one chatter note of which is shown at end of sonagram), Sept. 12, 1977, Karen. Bottom, another Trill-Squeak Call of *Indicator minor*, notes more noisy and Squeak-like than last, during interaction with *Lybius leucocephalus*, Sept. 11, 1977, Karen. Right: top, Squeak Calls, variant notes, of *Indicator minor* during interaction with *Lybius torquatus*; six tall notes are *Indicator minor*, noisy, shorter notes are of *Lybius torquatus* except for six very loud, low dove (*Streptopelia*) calls at base; variants are long and short down-up-down notes at ends, and multiple-peaked notes in center, Aug. 3, 1978, Sokoke-Arabuko Forest. Second from top, Squeak Calls of *Indicator minor*, five in number, the second and third being double-noted, Wikka-like calls, following by strong, then weak multiple-peaked Squeak Calls of *Indicator "narokensis"* (insect at top and noise across base), former Sept. 11, 1977, Karen, and latter, Aug. 10, 1978, Sokoke-Arabuko Forest. Third from top, multiple-peaked Squeak Call; then faint "ddd" trill, followed by two other Squeak Calls of *Indicator "narokensis"* directed against *Lybius torquatus*, all on Aug. 10, 1978, Sokoke-Arabuko Forest. Bottom, Squeak Series Call of seven notes followed by Squeak-Trill Call of *Indicator "narokensis"* during interactions with *Lybius torquatus*, same date and site as last.

we had had no success with the tinkerbird we shifted to playback of the Green Barbet's vocalizations, and continued working with the latter barbet in that same spot for an hour.

The Green Barbets left us at 11:00; during the previous 55 minutes, while we played back vocalizations and studied the behavior of the Green Barbets, there was no sign of a honeyguide. We decided to try again for the Green Tinkerbird, and, as we played back its trills, the same (or so we suspected) Scaly-throated honeyguide whirred in to a branch close to us, obviously agitated. We continued to play, considering it unusual that so large a honeyguide would exhibit interest in calls of such a small barbet, hardly, it seemed, a suitable host [but we later read that Friedmann (1958, p. 311), was assured by van Someren that *Indicator variegatus* indeed does parasitize nests of *Pogoniulus bilineatus*, only slightly larger than *P. simplex*] for this honeyguide. The honeyguide watched our movements, became excited, and approached us closer and closer hopping from perch to perch. It tilted its head to one side then to the other, peering at us and obviously listening closely while we played the tinkerbird's calls. It ended up barely 3 m. away from us on a branch of a shrub below our eye level, but as we played once more (perhaps too loudly) it flew off. This second incident took place over 10 to 12 minutes. We were convinced by the honeyguide's behavior that it was indeed responsive to the tinkerbird's calls.

This last episode indicated to us that frequent playback of a barbet's calls not only could elicit a strong response by that barbet, if it is responsive, but might also attract individual honeyguides that presumably are specialists in parasitizing the barbet species in question.

INDICATOR MINOR STEPHENS

Detailed observations of interactions of this honeyguide with barbets were made by Horne at Karen during August and September 1977, and we observed interactions in early August 1978, in the Sokoke-Arabuko Forest. The circumstances in the two areas differed greatly,

and we discuss these separately before analyzing vocalizations from both areas. We provide details of these results because such intense, prolonged interactions are unexpected, and are unreported in the literature.

INTERACTIONS WITH WHITE-HEADED BARBETS

These observations were obtained in the course of other activities, as time permitted. Hence, there are gaps, some critical, in the periods of observation. Prior to the observations reported, in July 1977, we were aware of excavating activities of White-headed Barbets in a large jacaranda tree in our garden at Karen. Since the site was beside the main house we ignored the barbets, hoping that without disturbing them they might nest. However, the excavating at the hole, about 4 m. up the tree in a broken, dead stub, progressed very intermittently, so we were uncertain as to its status.

At any rate, sporadic excavating still progressed in late August. On August 25, two *Lybius leucocephalus* (actually *L. l. senex*, all white below; races of this species are readily identifiable in the field) were at the hole, one tapping loudly inside, and the other perched near the entrance, which by now was sufficiently large to admit a barbet. The two barbets displayed, interacted, and called frequently [their vocalizations and displays are described fully elsewhere (Horne and Short, in prep.), and we here mention only those that pertain to interactions between barbets and honeyguides]. Tapping continued to be heard from that tree during August 26. On August 27, excavation continued and for the first time we saw three barbets at the hole; each participated in the excavating inside of the hole. That night two barbets roosted in that cavity.

There were no observations from August 29 to September 7. On the latter date, barbet excavation was minimal and that proved to be the last occurrence for 10 days. Sawdust or wood chips were removed from the hole, two birds entered at a time, there was much low calling, and courtship feeding was noted. One or more barbets now constantly occupied the hole, and all three barbets roosted together therein on

September 7. The third bird was less active than the other two, and it had difficulty entering the hole, usually last, in the evening. This is the background information about the barbets and the hole prior to the honeyguide interactions. The exact status of the hole, its use as a nest, and the presence of eggs were not fully determined, but the defense of the hole, and constant presence of a bird in it suggest that eggs had been laid by September 7. We made the following observations.

September 8: Three barbets left cavity individually between 06:40 and 06:55; one re-entered at 06:56. Honeyguide detected at 07:00, perching quietly in "nest" tree, looking on for a half-hour. No interactions, honeyguide did not approach cavity. Honeyguide identified as *Indicator minor* by conspicuous moustachial stripe and other features; later conclusively verified by sustained observations. While honeyguide was present barbet occupying hole perched with its head visible in entrance, or out of sight inside. Honeyguide ultimately left without fanfare, after observing several barbet changeovers at cavity. Barbets continued apparent breeding activities with elaborate greeting ceremonies as birds replaced each other in cavity. Changeovers occurred irregularly but frequently. One or another barbet always in hole, and one of the other barbets outside returned to vicinity of cavity every five to 10 minutes, although changeovers occurred only every second or third visit. After changeover bird that exited often remained about cavity. Three barbets continued to roost in cavity.

September 7 to 10: Barbet activities checked only casually; changeovers occurred, and there was no indication of disruption, disturbance or unusual events.

September 11: One barbet attacked and supplanted a Cardinal Woodpecker (*Dendropicos fuscescens*) that perched and called on branch over barbets' cavity. At 13:25, as Horne approached cavity, two barbets were in attendance. She heard honeyguide trill call, then one barbet flew from hole and attacked calling honeyguide, pursuing it vigorously in flight. The honeyguide swerved, twisted, and attempted to return to vicinity of cavity. The third barbet appeared; there ensued numerous, repetitive chases of honeyguide by one or two barbets. One barbet constantly inside cavity, its head visible at entrance, particularly during barbet-honeyguide interactions. Between chases, when honeyguide not near cavity, changeovers and barbet interactions continued as be-

fore. Chases continued unabated with brief pauses from 13:25 to 18:20; at least 31 chases are documented by tape notations and some long, sustained (chase-perch-chase-perch-chase) episodes with a number of separate individual chases. Honeyguide, after being chased off, eventually returned to the "nest" area. When it did so immediately following chase by barbets, it reappeared fluttering in stilted fashion, and after landing it flicked its wings and raised and lowered its partly spread (showing white tail corners) tail; but if some time had elapsed since it was last chased, it would fly in quietly. Usually its presence was detected by barbet inside hole; that barbet did not fly out to challenge honeyguide unless another of the three barbets was near, then, either barbet inside would exit and chase, or the other would pursue honeyguide. (Observations suggest that one barbet did greatest share of chasing honeyguide, although with four birds to track it often was difficult to determine prior activities of a pursuing barbet.) Both barbets and honeyguide called during chases; generally barbets were more vocal but often honeyguide uttered Trill and Squeak or Squeak-Trill calls (see below). Honeyguide displayed while Trill-Calling from a perch, upwardly flicking then lowering its partly spread tail, showing undersurface of tail and spread under-tail coverts. Its wings also were raised (flicked); it bobbed its body up and down in time with tail movements. Sometimes it flicked the tail without calling. Honeyguide also gave Trill Call in flight. By 17:00 the main pursuing barbet showed signs of fatigue or "distress." When perched between chases it constantly held its bill open. Just after 17:00 there was a changeover at the nest. Presumably barbet could rest as outgoing barbet took its place pursuing honeyguide. At 17:30 three barbets present, one in cavity, one near entrance, and one in canopy of "nest" tree. Chase ensued, after which a changeover occurred at "nest" in the presence of onlooking honeyguide. At 18:10 two honeyguides were seen; one perched quietly in "nest" tree, other was chased by two barbets. As roosting time approached, a second barbet entered nest. The third barbet then attempted to enter and as it flew toward opening a honeyguide swooped down, attacking the barbet, which then chased the honeyguide, chattering loudly to the accompaniment of trilling honeyguide. Finally, at 18:20 the third barbet entered the cavity—immediately both honeyguides flew to entrance of hole, circling excitedly about it. The barbets called; at least one barbet's head showed out of hole. The two honeyguides remained near cavity almost until dark but were unable to enter it.

September 12: At 06:20 one barbet looked out of hole; it left at 06:32, but a second barbet did not exit

until 07:10. The third bird then left and immediately the second barbet replaced it in the "nest." No honeyguides until 08:00 when one seen perched quietly high above barbet hole. No other barbets were there, and honeyguide remained watching entrance of "nest" when Horne left at 08:15. On resuming observations at 13:25 she found a single *I. minor* perched near cavity watching it. Suddenly a barbet appeared (other than that in "nest") and chased honeyguide; a second honeyguide was perching quietly low in a hedge 10 m. from the "nest." It looked on while a barbet chased the first honeyguide. Chases now especially intense, prolonged and more vocal than previously, and honeyguide exhibited more aggression, calling more frequently from a perch and occasionally attacking barbet; wing noises heard more frequently. Barbets appeared more agitated and seemed to interact more than usual with one another. There occurred a rapid changeover and outgoing barbet, calling loudly, flew out of hole and directly at honeyguide in tree (other honeyguide still looked on from hedge). After lengthy pursuit, flying honeyguide turned about and chased barbet, both birds calling loudly. Several more chases followed. When pursuing barbet finally returned to "nest" entrance, both honeyguides were present, one in tree and other still in hedge; former honeyguide called as barbet went to hole, eliciting further chasing, some by honeyguide. Honeyguide now frequently called aggressively while it perched, and sometimes barbets failed to respond. The active, aggressive honeyguide appeared agitated, and now moved about constantly, hopping from perch to perch, giving Trill Calls and tail flicking as it hopped. Some of honeyguide's aggressive calls determined to be Squeak-Trill Calls (see below). Barbet countered by becoming very aggressive; it asserted itself, calling loudly, and vigorously chasing honeyguide back and forth around garden. Second honeyguide appeared to escape detection by barbets. A Golden-rumped Tinkerbird perched momentarily near actively moving honeyguide, then flew off in haste. Honeyguide continued its activity, giving more Squeak Calls and "screechy rattle" (Squeak-Trill) calls at barbet, eliciting more intense chases. Chase after chase ensued throughout the afternoon, both species calling and honeyguide at times momentarily chasing barbet. The honeyguide frequently responded to barbets' aggressive chatter calls by calling, evoking strong responses by barbet, as if honeyguide were acting to draw barbets after it (possibly thus leaving "nest" accessible to second honeyguide). At 17:55 chases were still occurring, and second honeyguide still perched quietly. As both honeyguides watched there was a changeover, three barbets present. Another series of chases of one honeyguide (second

seemingly escaped detection) followed; chases now short and concentrated around "nest" tree, possibly reflection of honeyguide's aggression and barbet's fatigue. Intense chases often followed by interactions among barbets. As barbets interacted at 18:10, undergoing a changeover, one honeyguide (uncertain which, but one of two now disappeared) flew into their midst, tried to bypass them and enter cavity. Barbet that barely had entered hole during changeover was followed inside by fast-moving honeyguide. Although the exiting barbet had flown off directly, third barbet, still beside the hole, grasped honeyguide by tail as latter entered, and dragged honeyguide out of hole—as honeyguide was pulled out, barbet in nest could be seen holding and pushing on honeyguide from other end. Thus, honeyguide pushed and tugged out of hole, then tossed aside by the two barbets. A moment later it was back but was driven off by one of two barbets outside "nest." Remaining barbet outside hole now entered, joining one inside as roosting time approached. At 18:20 third barbet returned from chase and attempted to enter hole to roost, but was thwarted by incoming honeyguide that joined it at entrance; ingoing barbet turned about and drove off honeyguide. By 18:25 it had not returned, and an early check next morning disclosed only two barbets roosted overnight in cavity.

September 13: First barbet left "nest" at 06:35 and flew off. At 06:40 a honeyguide flew in with a barbet (probably third bird that had not roosted in hole) in close pursuit; chase joined by second barbet from direction in which bird that exited at 06:35 had flown. A changeover followed and out-flying bird then pursued honeyguide. After observational gap, Horne found a barbet in "nest" at 09:00 and one barbet continually chasing a calling honeyguide. Another and probably critical gap in observation occurred from 09:15 to 10:00; at latter time a barbet display with associated vocalizations was heard from direction of "nest," and all three barbets seen beside its entrance. In next 45 minutes no barbet entered cavity, nor were honeyguides about. Then one barbet entered hole, and shortly thereafter a honeyguide appeared in tree above and looked on; this was last appearance of honeyguide near "nest" until September 25. At 14:00 no barbets in attendance; one shortly appeared and entered. Bird in cavity seemed "restless," and moved about. It left at 15:55, and from then until 17:25 nest was unattended. Three barbets went quietly into the hole to roost between 17:35 and 17:43.

September 14: "Nest" unoccupied at 09:00; at 09:15 three barbets present, one stayed and excavated

lightly, as if "cleaning up" inside cavity and left at 09:30. In late afternoon hole was empty; two barbets nearby, one flew to hole and looked in, then flew away. The second barbet flew to cavity, entered, and faced about with its head far out of opening. These two barbets roosted; third bird appeared, but was very cautious, and it may not have entered to roost that night.

September 16: Barbets left "nest" late. There was some displaying, two birds then entered nest together, and one barbet later carried about a crushed fig fruit. Then all left the nest.

September 17: Some strong barbet interactions, intense displays at "nest," courtship feeding, and some excavation occurred for first time since September 7.

September 18: No barbets at "nest" all day; barbet displays and calls from sites about garden; displays of type associated with courtship, and with pair formation and maintenance.

September 23: Barbets still displaying frequently to each other, spending very little time inside cavity. Playback of barbet voices elicited much display calling in response. Displays intense when birds about hole, which serves as a focus for (always) two displaying barbets.

September 25: Several barbet display calling bouts triggered by playback of display calls. All display responses at jacaranda tree near "nest" hole. After one display bout an *Indicator minor* appeared; one barbet immediately shifted from display call to aggressive chatter, and immediately chased honeyguide. Six chases subsequently followed, with some calling by honeyguide and barbet. During these pursuits one barbet entered and remained in cavity. Later, honeyguide having gone, barbets engaged in further display calls and demonstrated the "nest" entrance by tapping with bill. Only two barbets appeared to roost in cavity.

September 29: One honeyguide present in morning was chased, and responded to Horne's playback of barbet display call by calling.

September 30: Marked by many display calls of barbets, absence of honeyguides, and roosting of but two barbets in cavity.

These observations are noteworthy for the persistence of the honeyguide's attention to the barbets, and for the nature of the honeyguide-barbet interactions. We note that the Lesser Honeyguide is smaller than the White-headed

Barbet, and it appeared more maneuverable, twisting and turning more abruptly during the chases. Friedmann (1955, p. 190) stated that the Lesser Honeyguide seems "indifferent to the attacks and protestations of the intended victims." Although Friedmann (1970) gave only one instance of the Lesser Honeyguide parasitizing the White-headed Barbet, on the basis of its egg in a nest ascribed to that barbet on exhibition in the National Museums of Kenya, its persistence documented herein indicates that *Lybius leucocephalus* indeed is a host of *Indicator minor*.

The status of the barbets' roosting and probable nesting cavity requires comment, as we have no proof of its status as a nest. However, close attendance there by at least one barbet during our observations, the lack of excavation and of courtship activities during the period of honeyguide visits, and lack of food in the bill of the barbets suggest that nesting was occurring, and that eggs were being incubated. The abrupt shift in behavior of the barbets on September 13, the disappearance of the honeyguides at that time, the renewed barbet "courtship" displays and some excavation activity, and the reappearance of the honeyguide late in September, taken together, indicate that something happened to the eggs of the barbets, and that they then prepared to renest in the same cavity. That something is apt to have been the destruction of one or more barbet eggs either directly by the honeyguide, or indirectly by the commotion of the barbets and honeyguide inside the nest. Accidental destruction or loss of the eggs is likely, as the barbets would not have re-initiated nesting in the same cavity if a predator or other highly disturbing event had occurred.

The barbets' activity in renesting, if that is what they were about, and reappearance of a honeyguide raise the problem of the physiological readiness of the female honeyguide (if the same individual) to lay again only two weeks after the earlier attempt. Assuming the honeyguides, or one of them, were ready to lay in early September, there were at least two consecutive days in which they failed; hence one or both presumably had to hold a ready egg or lay it elsewhere. However, Friedmann (1955,

p. 191) reported the persistent attempts of a female *Indicator minor* to enter the nest of *Lybius torquatus*, and being repeatedly driven off, even though the honeyguide proved to have tiny ova. Thus, persistent honeyguide endeavors to enter a nest may not always reflect proximate readiness to breed.

The status of the two visiting honeyguides in early September is uncertain. On September 12 both were about the barbets' nesting tree for nearly five hours, and they had been there for a while on the previous evening. At no time was there a sign of aggression between the two honeyguides, and in fact they acted in concert in jointly flying about the "nest" entrance. Were these two females simultaneously visiting the barbets, a situation unknown in the literature, or were they, as their behavior tends to suggest, a male and female (a pair, possibly) acting in concert to enable the female to lay its eggs in the barbets' nest? There is only one reported case of the latter, by Friedmann (1955, p. 146), who showed that on one occasion a male Greater Honeyguide acted in tandem with a female, being chased by the host and thus enabling the female to slip into the nest. This possible second instance of such action raises questions of how often such cases do occur, and what is the nature of the pair bond in honeyguides, previously thought to meet only for copulation (Friedmann, 1955).

INTERACTIONS WITH BLACK-COLLARED BARBETS

For more than a week we had been seeking *Lybius torquatus*, without success, in an area of *Brachystegia* forest in the Sokoke-Arabuko Forest where it was known to occur. On the morning of August 3, 1978, we at last heard a distant call (duet), the first one likely to be that of *L. torquatus*. Horne fortunately recorded a bit of that call on tape, and, so "armed," we used the playback of this duet fragment to elicit a closer barbet response with the result that we obtained excellent recordings, produced a playback tape, and were able to stimulate five or six groups of barbets to duet. Thus we were able to plot the distribution of pairs and groups in the area beside the trail along which we

worked. Once we had stimulated the barbets to sing, the level of their singing and territorial responses increased such that even without playback one could hear then duetting at least occasionally, although they had not been calling during the previous week. This relates to the honeyguides in that our playback-stimulated responses soon attracted the attention of honeyguides (*I. minor*, *I. "narokensis"*), and resulted in Black-collared Barbet-honeyguide interactions sporadically from August 3 to 10. The Black-collared Barbet is known to be one of the most frequent hosts of *Indicator minor* (Friedmann, 1955, p. 198).

August 3: At 17:40, after investigating a duet-singing pair of *Lybius torquatus*, we espied a perched honeyguide watching us. As barbets called honeyguide approached them; when they started pre-duet chatter honeyguide uttered Trill Call and barbets duetted. Following this duet the two species interacted, barbets moved to another tree accompanied by honeyguide, then gave pre-duet notes but no duet (possibly honeyguide caused suppression of duet). This happened several successive times and barbets unable to duet again until honeyguide departed; latter clearly was the medium-sized *I. minor* (see Forbes-Watson, 1977). There followed many interactions, pre-duets with honeyguide interfering, resulting in one barbet chasing honeyguide and calls as barbet supplanted honeyguide. After one chase birds winged back over us, but honeyguide was in pursuit of barbet. Interactions for seven minutes, then honeyguide disappeared; barbets resumed duetting.

August 5: We were playing back *Lybius torquatus* duets in same area, momentarily with no response, when we were "visited" briefly by a Lesser Honeyguide that perched above us, cocked its head listening to tape-recorder and then flew off.

August 6: We were playing back slightly to east, working with group of five *L. torquatus* when a Lesser Honeyguide flew toward tape-recorder. It then joined calling barbet group, was chased, sat quietly nearby through another barbet duet, and accompanied them when they flew. Barbets and honeyguide interactions at some distance, and we could not see their interactions clearly. However, barbets uttered nine straight pre-duets, some hesitant and broken, over 15 minutes without being able to complete a duet, probably due to proximity of and interaction with honeyguide. Latter then disappeared and duets resumed. Presence of so many barbets (only two barbets fully engage in a duet, usually, in this

case leaving three barbets free to face honeyguide) may have discouraged honeyguide. Honeyguide uttered only a few notes, and flitted about with tail spread.

August 10: While studying duetting *torquatus* at 08:10, following a barbet duet, a Lesser Honeyguide appeared, gave a low "prrrrit" call and chased the two barbets. Early this day we glimpsed honeyguide near same barbets, but had not identified it (it possibly might have been *I. "narokensis,"* which see). The Lesser Honeyguide now spread tail, chased, and was chased by, barbets. Suddenly we noted not one but *two* honeyguides near barbet pair but could not see them well. Barbets attempted duet, uttering one set of duet notes (instead of 11 to 14), then gave a harsh pre-duet, without continuing through to duet, but followed with full pre-duet and duet. As barbets left duet site two honeyguides accompanied them, but when they perched and continued calling near us, only one honeyguide was with them, small in size, and giving calls differing from calls of *I. minor*. This honeyguide seemed to be *I. narokensis* (possibly *I. meliphilus*, see *I. narokensis*; at any rate not *I. minor*). The Lesser Honeyguide had gone; we had tape-recorded first *minor*, then, from the ensuing episode described under that species, "*narokensis*."

We were puzzled by the honeyguide's persistence in disrupting duets, since there was no nest evident, and it seemed to have had little or nothing to gain by actions against barbets disassociated with a nest.

VOCALIZATIONS

Two vocalizations of Lesser Honeyguides were recorded on tape, from both Karen and the Sokoke-Arabuko birds. These vary and possibly more than two functional vocalizations are involved.

The Trill or Rattle Call (fig. 1) is a series of short, peaked chiplike notes given by *I. minor* when perched and in flight, during and following chases with *Lybius leucocephalus* and *L. torquatus*. Ten calls, five each from Karen and the coast, averaged 28.2 (9 to 59) notes per call delivered at 18.4 (13.3 to 28.6) notes per sec., with a duration of 1.59 (0.68 to 3.71) sec., a peak of the fundamental tone at 2.07 (1.3 to 2.7) kHz., and a duration of notes of 0.015 (0.01 to 0.022) sec. Calls start rapidly (up to 33 notes per sec.), then slow (to 13 to 14

notes per sec.); one call is fast in the middle (36 notes per sec.), and slow at the start and finish. Calls also start weaker and slightly lower pitched, usually, and become stronger and higher in pitch one-third of the way through. The Karen calls waver somewhat, rising and falling in pitch, whereas coastal calls are even; this may reflect individual, seasonal, or geographic variation, or different intensity of the accompanying encounters.

Other Trill Call characteristics include its strong harmonic tone, with dominant sound at the fundamental and first two harmonic tones, either together or in various combinations, and a spread of sound over other frequencies. On a sonagraph, notes usually are skewed toward the end, with a stronger, more prolonged terminal drop than an initial rise (the drop may descend to 1.3 kHz.). Some calls have simple inverted, V-shaped notes throughout, but most exhibit more complex notes in the loud middle and terminal parts. The complex notes show two peaked elements, a weak, lower pitched initial one, and a stronger second peak; the elements either are separate or connected. Such "double" notes are 0.05 sec. in duration and tend toward Squeak Call notes (see below). One odd call, the shortest, has the tempo equal throughout and the "legs" of the various tones of a note connecting vertically.

The loud Trill Call seems aggressive, almost challenging in connotation, and is perhaps used at greater distance than the softer Squeak Call. The Trill probably is the "noisy chattering" call of this honeyguide employed against *Lybius torquatus* in South Africa (Friedmann, 1955, p. 199).

Chases during the intense conflicts of White-headed Barbets and the Lesser Honeyguide at Karen often were marked by honeyguide Trill Calls squeaky in quality, especially when a barbet or the honeyguide approached each other. Most examples of this form of call were uttered simultaneously with long White-headed Barbet chatter aggressive calls, and the two vocalizations are sonagraphically superimposed (see example in fig. 2). We term these Trill-Squeak Calls, as the notes mainly are Squeak Call-like, but delivered as a trill. The notes may vary in form from nearly Squeaklike to

Trill-like, even within a call. They are generally longer than Trill notes and shorter than Squeak notes. Their tempo is much less than in Trill Calls, only five to seven notes per sec. Notes of 11 calls average 0.05 sec. in duration. Often they show "noise," close columns of sound at all frequencies forming vertical lines sonographically. Overtones are strong, and often the dominant tones are the third to fifth harmonic tones. The fundamental tone is at 1.0 kHz., or slightly less.

Squeak Calls are variably given singly or in irregular series (in contrast to Trill-Squeaks). At least two basic, perhaps functionally different types of notes exist, one with one or more peaks, and the other a compound or double note. The latter may be a multiple-peaked version of the first type, the elements of which have contracted; the two types do "intergrade." All the Lesser Honeyguide's vocalizations reported here are in fact easily derived from a Trill-like note. Intermediate Trill-Squeak calls indicate the interrelation of Trill and Squeak Calls, as does the occurrence of a single Squeak Call, at the end of some Trill Calls. The double type of Squeak Call note bears a close sonographic resemblance to, and is acoustically similar to, the "Wikka" notes of many woodpeckers (Short, 1971, 1972, 1973; Winkler and Short, 1978). Most Squeak Calls of both types were uttered simultaneously with barbet calls, and mark close aggressive encounters between the barbets and honeyguides.

Squeak notes (fig. 2) of the first type mentioned above sound like a "chaa," or "yaa," or "yeeah," and show a zigzag down-up-down form, emphasizing the initial drop and following peak; often the first drop essentially is lacking. Such short Squeak notes resemble closely the Squeak Call of *Indicator indicator* (fig. 2). Multiple-peaked Squeak notes have up to four connected peaks and a down-up form; overtones are prominent at least to 8 kHz. Notes are 0.03 to 0.11 sec. in duration (N=12). The fundamental tone is between 0.6 and 1.2 kHz., usually at 0.8 to 1.1 kHz. Emphasis may be on all tones equally, or between the fundamental and third harmonic, or at 3.5 to 5.5 kHz. (fourth to sixth overtones) or even 7 to 8 kHz. (overtones seven and eight). In form the note

may show a single expanded or reduced peak (which may occur initially and drop slowly), or several peaks in longer notes. One series of four Squeak notes, poorly recorded on tape, and rendered "cha-cha-cha-up," consists of three down-up-down notes emphasizing the peak, and a weak almost horizontal terminal note.

Weak double Squeak, "ta-wi" or "t-wi" notes marking close encounters combine a fast, Trill-like note, usually initially, with a longer but often contracted Squeak note of the down-up-down form (fig. 2). The double notes may be interspersed with typical Squeak Calls, and often with scattered Trill notes (possibly initial notes of double notes that lack a second part), or may be in series of up to four notes (four examples of three and four notes). In series these are uttered at seven or eight (double notes) per sec. for 0.4 to 0.7 sec. Double notes are 0.035 to 0.09 sec. in duration. The Trill-like note, whether first or last, is shorter. As do other Squeak notes, double notes show many overtones, but the dominant tones are pitched low, among the fundamental tone (at 0.7 to 1.0 kHz.) and first three overtones, and higher tones are weak; this call has the weakest high overtones of all calls of *I. minor* that we studied.

We could not perceive a difference in circumstances in which various Squeak Calls (dropping Squeak notes, short zigzag Squeak notes, multiple-peaked Squeak notes, Wikka-like double Squeak notes) were employed.

If one can assume, as we think plausible, that most, and certainly some, of these vocalizations were uttered by females seeking a host for their egg-laying, this quote from Friedmann (1955, p. 182) is appropriate: "If the *kleeu* note (i.e., the loud announcing call, not discussed by us in this report) is given only by the male, it would appear that, as far as recorded information goes, the female lesser honey-guide is wholly silent. I doubt that this is really the case, however." [!]

INDICATOR "NAROKENSIS" JACKSON

The Kilimanjaro Honeyguide was separated specifically from its sibling relative *I.*

meliphilus by Grant and Mackworth-Praed (1938), but it was not until Friedmann's (1968b) report that *I. narokensis* was widely accorded status as a species. In fact, until Friedmann (1968b), *I. narokensis* Jackson generally was regarded as a synonym of *I. meliphilus* (Oberholser), and the latter was considered only a subspecies of *I. exilis* (Cassin)! *Indicator narokensis* is similar to *I. meliphilus* (see Forbes-Watson, 1977, p. 19), being a small honeyguide (in fact, smaller even than *Prodotiscus zambesiae*) with a stubby short bill and pale underparts; we observed no streaking below, nor a loreal spot—*meliphilus* has a loreal spot (Forbes-Watson, *loc. cit.*). Unfortunately, both *meliphilus* and *narokensis* might be expected in Sokoke-Arabuko Forest. Mackworth-Praed and Grant (1952, p. 745) specifically cited Sokoke Forest and nearby Malindi for *narokensis*, but no actual localities for *meliphilus*, although mapping both species for coastal Kenya. Snow and Clancey (1978) map localities for both that indicate *narokensis* alone occurs in the Sokoke-Arabuko Forest, but Friedmann (*in litt.*) has seen a *meliphilus* specimen from near Malindi. Mackworth-Praed and Grant (1952) gave mountain bush or secondary forest at higher altitudes as the habitat for *narokensis*, but this hardly fits their own locality citations of Malindi (on the coast) and Sokoke Forest (which is not montane, or highland). We suspect that the ranges of these two sibling species interdigitate, with differences in habitat preference (*meliphilus* perhaps moist woods, and *narokensis* dry woodland) between them.

We treat these taxonomic matters because we could not collect honeyguides of this group that we observed in the dryer (*Brachystegia* forest) part of Sokoke Forest. On the basis of the field experience of Horne in separating *narokensis* from *meliphilus*; the small size, very stubby bill, lack of a loreal spot, and pale coloration of the birds observed; the limited distributional and habitat data currently available (see citations above); and examination of specimens of both species in the American Museum of Natural History we tentatively conclude that we were dealing with *I. narokensis*. Indeed, that was Horne's call ("I think we've got a

narokensis") of the first one we saw in the field. Of course, without a specimen we cannot be absolutely certain of the determination. However, further work in that area by P. Britton and others, and ultimately studies of *narokensis* and *meliphilus* with use of playback, and collecting, will corroborate our assignment of these observations to *narokensis*, or possibly switch it to *meliphilus*. Although we only tentatively ascribe our observations to *narokensis*, we stress the meager knowledge of the biology of both *meliphilus* and *narokensis*, and even of the hosts they employ (Friedmann, 1955, 1968a). The literature contains no statement about vocalizations that is ascribable to *narokensis*, and only a few comments that may apply to *meliphilus* (from outside the range of *narokensis*). Observations are summarized as follows.

August 3: While seeking *Lybius torquatus*, (just prior to first recorded duet of that barbet) on August 3, we spied a small, pale grayish green honeyguide with a stubby (thick but short) bill. It uttered a loud piping series, possibly its "song." Playback of this call brought initial strong response, but then bird flew off. Its call and circumstances of calling (not directly associated with barbets, although we had played back a partial *Lybius torquatus* duet) differed from later calls and events. This may have been a singing male.

August 10: In same general area at 07:00 a small honeyguide apparently of this species momentarily appeared near trio of duetting barbets that we had stimulated with playback tape-recordings. It perched quietly, watching them, hopped about briefly, then flew away. At 08:00 a small greenish-backed, stubby-billed honeyguide seen by Short in same tree as three barbets; apparently this also was *I. narokensis* (whether same individual or several birds were involved on 3 and 10 August is moot point). At 08:10 we were working with same barbet group when a Lesser Honeyguide appeared briefly with barbets, as described above under that honeyguide. Very shortly, two individual honeyguides were present with barbet pair (at this point third barbet disappeared, not seen again), as mentioned. After one abortive duet, and flight of two honeyguides with barbet pair, one honeyguide disappeared. That remaining with barbets was a small, stubby-billed honeyguide like that seen on August 3. From 08:15 until after 09:05, when we had to leave area, we observed this honeyguide; it persistently perched beside the

barbets, accompanying them from perch to perch as we played back barbet duets. Honeyguide followed barbets so closely that honeyguide and barbets often flew as near one another as we earlier had seen three barbets fly together. It interfered with duets, even twice getting between two barbets. Several times honeyguide headed directly toward us in response to playback of barbet duet, only to swing back to barbets when they started to respond vocally. When barbets began pre-duet calls honeyguide watched them and hopped toward them, thus often interrupting duet, and eliciting attack by presumed male barbet. Despite many chases and supplantings honeyguide continued to return to them, perch close beside them, and "tail" them like a shadow whenever they flew. When attacked honeyguide often flitted out from perch but zipped back to another, still close to the displaying barbets (often within 2 m., sometimes to ½ m.). During duet, if that ensued, fidgeting honeyguide would edge nearer to barbets, hopping from branch to branch, wings and spread tail flicking constantly, sometimes breaking up duet, as presumed male ceased duetting to assail honeyguide. Chases were noisy, both vocally and due to crashing of birds through trees, or through low brush and shrubs. After a chase pursuing barbet and honeyguide at times noted perched but a few cm. apart, barbet with bill agape, in apparent distress, as honeyguide perched quietly, seemingly none the worse for the attacks. Once honeyguide, perched near its attacker, nonchalantly reached to one side and appeared to pick an insect from air. Second barbet followed pursuit at times, and perched near attacking barbet and honeyguide, but seemed not to get more involved than that. There were several reversals of chases, one barbet chasing honeyguide into undergrowth, but reappearing in a moment with honeyguide in close pursuit. We could terminate a chase by playing back barbet duet; barbets would approach us, perch nearby, and begin a duet—but more often than not honeyguide followed barbets, and was perched beside them before duet was underway. During 50 minutes of observation there were at least 15 chases of honeyguide, some with several sub-chases. Initially barbets could not duet effectively, giving abnormal pre-duets interruptedly lasting as long as 5 sec. (versus the normal one to two sec.) and often punctuated by honeyguide calls, some of which we were able to record. Gradually barbets were able to duet, but duets or pre-duets or both were shortened. Many pre-duets seemed to be elicited by presence of honeyguide. Both barbets obviously agitated, performing display movements at odd intervals rather than accompanying pre-duet, and facing away from each other more than normally.

Barbets chattered aggressively in response to Squeak and Squeak-Trill calls of "narokensis." Once honeyguide stopped in tree occupied by noisy glossy starlings (*Lamprocolius corruscus*), and called in an apparent reaction to starlings, then flew after barbets. There ensued more chases of honeyguide by barbet, and some vice versa. When we departed honeyguide was perched at same height as the barbets, but 2 m. from them, as barbets uttered a full duet, followed by their chattering and the honeyguide's Squeak-Trill Call.

We wondered at the persistence of the honeyguide near "singing" barbets unassociated with a barbet nesting cavity, and with no obvious sign of breeding. Possibly habituation of the barbets to the honeyguide might later facilitate the honeyguide's endeavors to enter the barbets' nest.

The vocalization uttered on August 3 by an apparent Kilimanjaro Honeyguide not closely associated with barbets, and apparently a "song," or "announcing" call was a piping series of fast "whee-ip" or "whee-p" notes. A single call we recorded on tape is a partial series of eight notes uttered in 6.1 sec. (tempo 1.3 notes per sec.). The double-peaked notes are 0.11 to 0.12 sec. in duration and 0.67 to 0.75 sec. apart. Sonographically they (fig. 1) are loud with a gradual rise, two sharp, successive peaks, and a gradual drop. The first peak is higher in frequency than the second; the peaks are but 0.035 sec. apart. The fundamental tone contains most of the sound, peaking at 4.4 (first peak) and 3.8 (second peak) kHz. throughout the call. There is a weak harmonic tone (above 8 kHz., first peak, and at 7.0 to 7.4 kHz., second peak). The Whee-ip Call resembles the song-call of *I. minor*, described by Friedmann (1955, p. 181) as a 10- to 30-note series of one-toned, monotonous "faintly throaty *kleeu* or *peew*" sounds, the initial note of which may be double ("*klee-eu*" or "*pe-ew*"). The Whee-ip Call of *I. "narokensis"* is loud, almost double-noted, and has the sharp second peak not suggested in the above description of the song-call of *I. minor*.

Interactive calls, presumably aggressive, of *I. "narokensis"* were recorded only on August 10, and possibly represent but one individual. These basically are Squeak Calls (see *I. indica-*

tor, *I. minor* above), of three distinct types, a single-noted Squeak Call, a Squeak Call series, and a distinctive Squeak-Trill Call. No Trill Call resembling that of *I. minor* was heard, nor any Wikka-like or double-noted Squeak Calls resembling those of *I. minor*.

The Squeak Call in its single-noted "cheek" or "chek" form (fig. 2) bears close resemblance to the Squeak notes of *I. minor* (fig. 2), but is pitched higher and exhibits fewer harmonic tones (seven) in "*narokensis*" than in *minor* (eight or nine), and it is shorter in duration. Five examples, three of them weak, come from close interactions with *Lybius torquatus*. Notes are 0.05 to 0.09 sec. in duration with nearly equally dominant tones throughout. They are peaked, the peak occurring initially or by the middle of the note (a variant note has an initial peak and four peaks following it). Noisy vertical components are visible sonographically near the end of most notes. The fundamental tone is at 1.0 to 1.2 kHz, with seven overtones between 2.2 and 7.9 kHz.

We obtained only one sample of the Squeak Call Series, uttered during the interactions with *Lybius torquatus*, from one of several series. The sample contains seven notes given at an even tempo of six per sec. with notes closely resembling Squeak notes, but longer, 0.08 to 0.11 sec. The call recorded sounds like "Chee-chee-chee-chee-chee-ch-cheowa." Notes have one or several peaks and tend to be horizontal sonographically. There is some resemblance to the Trill-Squeak Calls of *I. minor* but the notes of "*narokensis*" are full Squeak notes with no Trill tendency. The fundamental tone (at 0.8 to 1.1 kHz.) and first overtone (1.6 to 2.4 kHz.) are strong, but harmonics three to five approach those in emphasis, and other tones also are prominent. These calls preceded barbet pre-duets and duets when the honeyguide was in proximity to the barbets; they seem aggressive in connotation.

The Squeak-Trill Call, represented by five sonographed examples (fig. 2), is a distinctive series of four to seven notes delivered in 0.3 to 0.5 sec. at a tempo of 12 to 17 notes per sec. It seems to replace the Trill Call of *I. minor*. Notes start weakly and are fast, gathering strength, duration and pitch during the call.

The calls are a chittering or "yi-yi-yi-yak" uttered at *Lybius torquatus*, and in one case at starlings. They may degenerate into fast, weak, chattering trills ("ddddd") not at all like the Trill or Trill Squeak calls of *I. minor*. Notes sonographically are peaked, inverted V-shaped structures early in a call, but tend to develop an initial horizontal or dropping element in later notes. Their dominant fundamental tone at the peak is 1.3 to 1.95 kHz., with overtones one and two moderately strong, and weaker or no higher overtones. We were unable to ascertain fully the differences in circumstances among this honeyguide's interactive calls (all those other than the announcing Whee-ip Call), although the Squeak-Trill seems to be employed at a distance more than are the aggressive calls.

DISCUSSION

Our observations raise a number of questions and problems. When a female honeyguide intends to lay an egg, or eggs, it ought to have picked a suitable nest, or several possible nests. This may explain the appearance of honeyguides near or at holes that may contain nests. We wonder, however, at the physiology of egg-laying involved when a female honeyguide is prevented from laying, not just on a given morning throughout a day (see Friedmann, 1955, p. 190), but for two or even three days? Is the egg laid, and dumped on a given day, whether or not the honeyguide successfully enters a host's nest? Or can the honeyguide hold an egg for a period of time as in some cuckoos (Lack, 1968)? The persistence of the (presumed) female Lesser Honeyguide at the White-headed Barbets' nest suggests that no other potential host nests were available to her. And her accompaniment by a presumed male suggests that he was not busily occupied with several females seeking his attention. The accompaniment of a male and a female in an attempt to enter a host's nest previously documented for *Indicator indicator* is suggested herein for *I. minor*, and raises the question of whether or not males of these honeyguides are entirely promiscuous, as generally held (Friedmann, 1955; Lack, 1968).

More difficult to evaluate is the attraction of

honeyguides, here documented for *I. variegatus*, *I. minor*, and *I. "narokensis,"* to singing or calling individuals or pairs of prospective host species, and their persistence in closely approaching the displaying or singing birds, despite repeated, vigorous attacks. Ancillary to these problems, and noteworthy in its own right, is the matter of playback-induced singing activity of barbet species such that the barbets approach a level of singing that may be typical of the (early) breeding season. Can this approach be used to stimulate the barbets toward physiological readiness to breed, and can such enhanced singing activity, coupled with extensive playback of barbet vocalizations, also trigger breeding activity in the honeyguides? These problems would merit investigations through the use of extensive playback experiments. The questions we raise cannot now be answered.

The attraction of honeyguides for singing barbets was unexpected and has not previously been reported. We are uncertain as to why the honeyguides approach singing barbets and seem excited by them. If honeyguides were simply gathering information about breeding activity, hence nest location, one might expect them to perch inconspicuously, watching the barbet from a distance. Habituation is one possibility to which we have alluded above, i.e., if the barbets get sufficiently used to the honeyguide, the latter might find it easier to sneak into their nest. However, the barbets seem as persistent as the honeyguides in vigorously and repeatedly attacking the latter, even though the usually heavier barbets appear to tire more easily. There is no reason to assume that breeding barbets would not attack a honeyguide as fiercely (or more so) about a nest as when approached by honeyguides while singing. The attacks by White-headed Barbets on the Lesser Honeyguide were as strong the second day as on the first, and they attacked it as vigorously when it suddenly reappeared in late September as they did in the major incident earlier in that month. Also, in some cases, helper barbets are present during the honeyguide-barbet incidents, and these helpers may gain valuable experience from watching the paired adults or adult male attack the honeyguide. This experience may fa-

cilitate their future recognition of honeyguides, and aggressiveness toward them, and could be detrimental to honeyguides when the helper becomes a breeder later in its life. There is another possibility—could the attention of the honeyguide to singing barbets, and even its noisy interactions with the barbets serve to attract male (or possibly female) conspecific honeyguides, for mating purposes? The loud calls of the barbets, interspersed honeyguide calls, and noisy chases could serve as manifestations of breeding activity (of honeyguide females or males, and of host barbets) to widely spaced honeyguides. However, this seems an energetically wasteful and potentially hazardous means of announcement and mate attraction for the honeyguides. It is likely that females of the parasitic viduine finches are stimulated both by songs of their host estrildine finches and by the songs of their own species, males of which vocally mimic the estrildines (Payne, 1973). However, these parasitic birds have a very different social system and strong sexual dimorphism, so the situation is not comparable with that of the honeyguides and barbets.

Given that the honeyguides, for some reason, are attracted to songs and duets of their host species, why then are they persistent to the point of risking injury? This question is in the same category as that of a female *I. minor* fighting to gain entrance into a *Lybius torquatus* nest when the honeyguide's ovary was not in breeding condition (Friedmann, 1955, p. 191). Far more data are needed to provide an answer to this question. Considering the sustained nature of some of the interactions, one might wonder if the notoriously tough skin of honeyguides reflects as much their difficulties with the strong bills of their many barbet and woodpecker hosts as the minimizing of the stings of bees in securing the beeswax on which honeyguides feed.

The documentation of the aggressive vocalizations we have provided ought to be supplemented through studies of honeyguide-host and honeyguide-honeyguide interactions. We have shown that playback is useful in stimulating barbets, and thus in attracting honeyguides. Some may care to use playback of various, especially common hosts or of honeyguide-host

interactions as a means of attracting honeyguides and in eliciting displays, including vocalizations. It would be useful to extend our limited observations. Are the distinctive Squeak Calls in one or another form common to all species of *Indicator*? What interspecific differences exist in Trill and Squeak interactive calls? Are these calls used aggressively between honeyguides? And what functional differences exist among the calls in any honeyguide's repertoire? These and many other questions remain about the honeyguide vocalizations, in addition to the important matters pertaining to honeyguide-host relations. We are aware that many aspects of the biology of honeyguides remain to be investigated before we can even frame some questions properly, but we hope the unusual observations reported herein will stimulate studies of honeyguides along lines appropriate to ultimately achieving the answers to these questions.

Further elucidation of these problems is bound to shed light on the taxonomy of honeyguides, particularly on such critical subjects as the interrelations of the small species of *Indicator* (Friedmann, 1968b) and the relations of the two species of Asian honeyguides to certain African species (Friedmann, 1976). It is premature to draw taxonomic inferences at this state of our knowledge of honeyguide behavior. With a view to future studies that may treat the taxonomy of the order Piciformes, we note that some honeyguide displays, such as the side-to-side swinging of the head, and bobbing movements of the head, and also tail-spreading, have close counterparts in woodpeckers and also in barbets. Further, the Trill Calls of honeyguides, and especially the very Wikka-like Squeak Call variant of *Indicator minor* bear strong resemblances to woodpecker vocalizations (see citations under *I. minor*; the Squeak Calls of species of *Indicator* show general similarities to woodpecker Squeak-like calls). Our observations of honeyguides, barbets, and woodpeckers tend to confirm the close systematic relationship of these families (respectively, Indicatoridae, Capitonidae, Picidae) reflected in their current classification within the Piciformes.

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