

feeding methods are used more frequently. When hunting animal food, they usually move slowly through the foliage or sit on a branch, moving their head from side to side. When they detect a prey they suddenly dart forward, seize it while hovering, and then return to a convenient perch against which they may beat the prey to immobilize it before swallowing. The most common method of picking fruits is to pluck it while hovering on the wing.

Of the 32 feedings recorded, 19 (60%) were on invertebrates, 1 (3%) was on a vertebrate, and 11 (37%) were on fruits (Table 1). The food items taken consisted of spiders (Araneae), insects (Odonata, Orthoptera, Coleoptera, Lepidoptera, and other unidentifiable insects), a lizard (*Anolis*), and fruits, particularly *Ficus*. Stomach contents of a male becard a local resident collected on 20 April 1970 and gave me consisted solely of *Ficus* fruits.

While much work needs to be done to complete our knowledge of its niche utilization pattern, a comparison of the results obtained for the Jamaican Becard with the results obtained by Skutch (ibid.) for the Central American Cotingidae indicate that the food and foraging pattern of the Jamaican Becard is more flexible and diverse than many of the mainland species, including in its repertoire combinations of patterns found in different Cotingidae, but not usually encountered in any single species. This niche expansion is probably related to the absence of similar species and the depauperate nature of the Jamaican avifauna in comparison with similar-sized mainland areas.

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The vocal repertoire of male American Woodcock.¹—One of the most interesting and spectacular acts in the life history of the American Woodcock, *Philohela minor*, is the courtship ritual of the male, which he carries out at dusk and dawn from open tracts of land known as "singing grounds" (Mendall and Aldous 1943). The male woodcock makes four principal sounds during his courtship performance: a buzzing "peent" call preceded by a barely audible "tuko," both given while on the ground and a vocal "chirping" during the aerial flight which is accompanied by a mechanical "twittering" produced by the wings. In addition a "cackle" is occasionally given in flight as a warning to invading males (Mendall and Aldous 1943, Pitelka 1943, Sheldon 1967). Our objective was to prepare spectrograms of all sounds emitted by woodcock on singing grounds.

We recorded all calls with battery powered Norelco Carry-Corder '150' cassette tape recorders and used 24-inch parabolic reflectors (C. W. Torngren Co., Somerville, Massachusetts) with 6-inch focal lengths to increase microphone sensitivity and directionality. Recording distances varied from 10 to 50 feet. Recordings were processed through a Kay Electric Company Sona-graph, Model 6061-B, using the wide band pass filter and FL-1 circuit.

While the vocal repertoires of several game species have been analyzed spectrographically (Ellis and Stokes 1966, Williams 1969, Heinz and Gysel 1970), no spectrographs of all known sounds male woodcock emit on singing grounds (Figure 1) have ever before been prepared. Peterson and Bartholomew (1969) state "overt

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responses of animals to vocal signals can be objectively described, but the information transferred from emitter to receiver can only be inferred." Therefore the function or significance of woodcock calls can be verified only through experiment, and the following discussion is speculative.

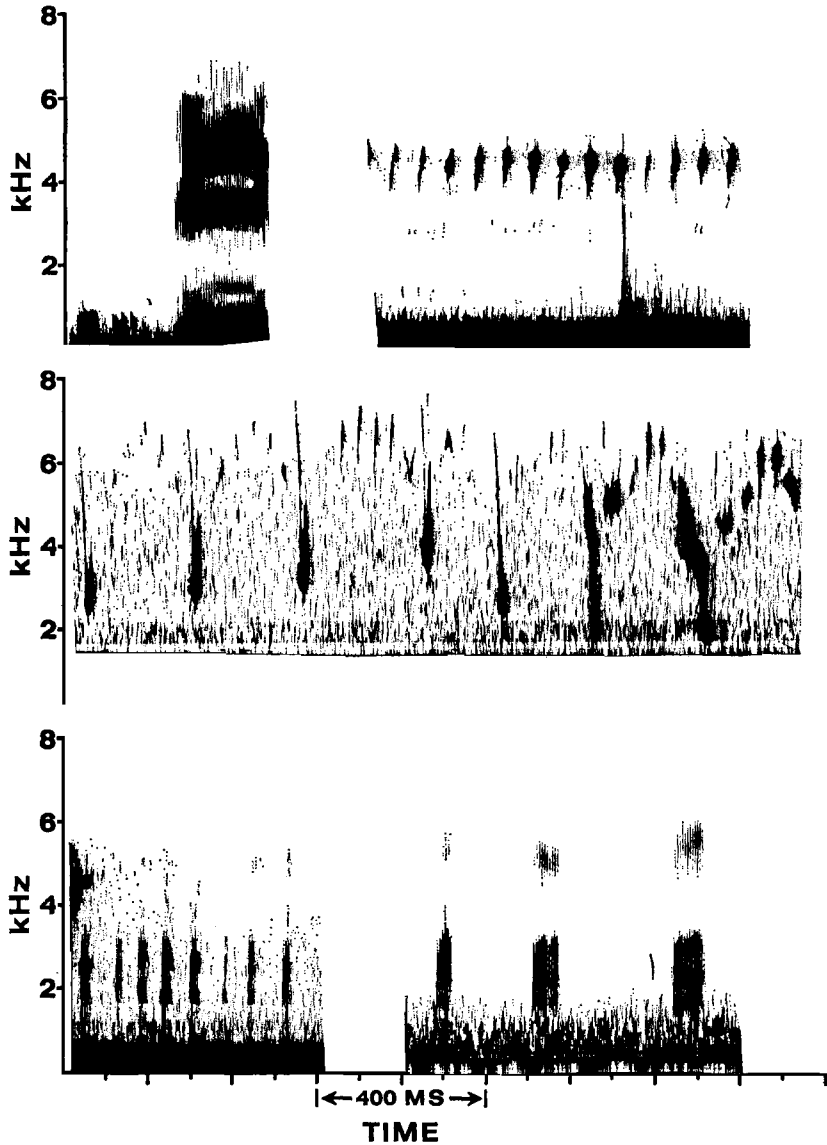


Figure 1. Repertoire of sounds emitted by male woodcock on singing grounds. Top, "Peent" preceded by "tuko" (frequency about 1 KHz), wing twitter; middle, descent "chirp"; bottom, "cackle" and "quack."

The "peent" note appears to be one of advertisement, announcement, and warning (Pitelka 1943) emitted on the ground at dusk and dawn because visual cues would be ineffective (Sheldon 1967). It has been suggested that the barely audible "tuko" that precedes each "peent" is a note of invitation and solicitation given prior to and after copulation (Pitelka 1943). At times the "tuko" note is given alone (Mendall and Aldous 1943), especially when a female is present on the singing ground or if the male is disturbed, as when a beam from a flashlight is thrown upon him. I (D. R. B.) have often been in full view of a courting male and heard him utter a series of "tukos" before taking off. Thus one might speculate that the "tuko" note has dual functions: (1) invitation and solicitation and (2) an agonistic attack-escape connotation that is often associated with courtship behavior.

Pitelka (1943) suggested that the "chirp" notes uttered in the flight song function in territorial advertisement, but may also function in intimidation. Sheldon (1967) thought that the male woodcock's territory included the area encompassed by his flight and that the male advertises himself to females by his silhouette in the sky and by sounds such as the "chirp."

The "twitter" portion of the flight song is mechanical and caused by air rushing through the three notched or attenuate outer primary feathers (Pitelka 1943, Mendall and Aldous 1943, Sheldon 1967). No function has been postulated.

The "cackle" appears to be a warning note uttered by a male while assaulting an intruder or when invading a neighbor's territory and trying to displace him (Pitelka 1943, Mendall and Aldous 1943, Sheldon 1967).

Sheldon (1967) reported that females alighting in fields in summer sometimes uttered a "quack" call. He also said that he had no certain evidence of males emitting the call. This call was recorded on a singing ground near Core, West Virginia on 22 April 1972 and was identified by William Goudy, who has had considerable experience with woodcock vocalizations. On 22 April 1972, two birds were "peenting" about 100 feet apart. Bird A took off and flew over bird B and uttered the characteristic "cackle" call. Bird A landed about 50 feet from bird B and again started to "peent." Bird B responded to this territorial encroachment by uttering a series of loud "quacks." While nightlighting woodcock on late summer alighting fields in Canaan Valley, West Virginia, the call was emitted on one occasion from birds in an area of extremely high density (W. K. Igo, pers. comm.). From these two examples one might apply an aggressive or a courtship nature to this call. A comparison of a spectrogram of the "quack" call to the "cackle" shows a great deal of similarity (Figure 1). The main difference between the two calls is that the "quack" note is of longer duration and the interval between notes is longer. As only one recording was made of the "quack," its apparent similarity to the "cackle" warrants further investigation.

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"Woodpecking" by a Red-throated Barbet.—While barbets (Capitonidae) are well-known to excavate nesting cavities, usually in dead trees, to my knowledge no one has reported them foraging in a woodpeckerlike manner. On 15 February 1972 at Pasoh (the International Biological Program's rain forest study site), Negeri Sembilan, Malaya, I watched a Red-throated Barbet (*Megalaima mystacophanos*) "woodpecking" for 20 minutes on a stub 1½ m thick and 15 m tall. Most of the trunk was devoid of bark, but a few pieces still hung on. The exposed tree surface was hard enough for the pecking to make a noise; indeed it was the tapping of a presumed woodpecker that led me to the stub. To my surprise, I found no woodpecker tapping, but a male Red-throated Barbet braced against the tree with its legs, but not appressing its tail to the tree surface. The barbet pecked in slow bursts of 2 to 4 or 5 taps, excavating small pits in the wood. From at least six of nearly a dozen of these pits it extracted an insect, apparently squirming larvae. While I watched, the bird worked its way gradually upward, with lateral movements to both sides, covering in all an area of perhaps 4 square meters. Its repeated success in securing prey and the zest with which it increased its efforts when it apparently sensed a subsurface insect made it clear that the barbet actually was foraging, and not fortuitously obtaining insects while prospecting for a nesting or roosting site. Red-throated Barbets normally feed on ripening fruits, such as figs (*Ficus* sp.). I saw no other woodpecking by this, or any other barbet, but I did flush another individual of this species from a low dead stub where it seemed unlikely to be excavating a cavity. I am uncertain of the regularity of "woodpecking" in this barbet.

I was impressed also by the woodworking activities of a Yellow-crowned Barbet (*Megalaima henrici*) excavating a presumed nesting cavity on the underside of a limb bearing leaves (hence partly alive) in a tall live tree on 10 April 1972 at Kuala Lompat (Krau Game Preserve), Pahang, Malaya. The bird had no difficulty hanging upside down and maintaining its hold as it carved out a cavity without appressing its tail to the limb. This is not an example of woodpecking, but it seems likely that this barbet has that capability. Most of the 70 or so species of barbets excavate their own nesting cavities, but in my experience their nesting sites usually are in well-rotted wood (some nest in termitaria, and others utilize abandoned woodpecker holes; Wetmore 1970, *Smithsonian Misc. Coll.* 150: 496). As Wetmore (*ibid.*: 492, 502) has noted, most excavating barbets bite into and pull out pieces of rotten wood, rather than "chiseling" out pieces of (rotten or unrotten) wood as do picids. This action of barbets causes little noise, and thus one is attracted to barbet nests less often than to woodpecker nests under