J. Field Ornithol., 65(2):258-264

THE FOOD HABITS OF SYMPATRIC *CICCABA* OWLS IN NORTHERN GUATEMALA

RICHARD P. GERHARDT[1]
Raptor Research Center
Boise State University
Boise, Idaho 83725 USA

DAWN MCANNIS GERHARDT AND CRAIG J. FLATTEN
The Peregrine Fund, Inc.
5666 West Flying Hawk Lane
Boise, Idaho 83709 USA

NORMANDY BONILLA GONZÁLEZ
El Parque Nacional Tikal
El Peten, Guatemala

Abstract.—The food habits of eight breeding pairs of Mottled Owls (*Ciccaba virgata*) and a single nesting pair of Black-and-white Owls (*C. nigrolineata*) were studied in Tikal National Park, Guatemala. Both species captured large insects, including beetles (primarily scarabaeid, curculionid and cerambycid), grasshoppers (Orthoptera; Acrididae), and cockroaches (Orthoptera; Blattidae). There was little overlap in the vertebrate component of the diets of the two species; Black-and-white Owls fed on bats (especially *Artibeus jamaicensis*), whereas Mottled Owls ate small rodents (including *Oryzomys fulvescens* and *Sigmodon hispidus*). One hundred percent of Black-and-white Owl pellets contained insect exoskeletal material; 73% contained bat fur and/or bones. Ninety-eight percent of Mottled Owl pellets contained insect matter, whereas 56% contained vertebrate remains.

LOS HÁBITOS ALIMENTICIOS DE LECHUZAS DEL GÉNERO *CICCABA* EN EL NORTE DE GUATEMALA

Sinopsis.—Los hábitos alimenticios de ocho parejas de *Ciccaba virgata* y de una pareja de *C. nigrolineata* se estudiaron en el Parque Nacional de Tikal, Guatemala. Ambas especies capturaron insectos grandes, tales como escarabajos (principalmente escarabeidos, curculiónidos y cerambícidos), saltamontes (Orthoptera: Acrididae), y cucarachas (Orthoptera: Blattidae). Se halló poco solapamiento en el componente vertebrado de la dieta de estas dos especies: *C. nigrolineata* se alimentó de murciélagos mientras que *C. virgata* se alimentó de roedores pequeños (inclvyendo *Oryzomys fulvescens* y *Sigmodon hispidus*). Todos los egagrópilos de *C. nigrolineata* contenían material exoesqueletal de insectos; 73% contenía pelaje y/o huesos de murciélagos. Noventa y ocho por ciento de los egagrópilos de *C. virgata* contenían material de insectos y 56% contenía restos de vertebrados.

The foot habits of owls of the genus *Ciccaba* are not well known. Detailed accounts of prey and feeding behavior have been reported for only *Ciccaba woodfordii,* the sole Old World representative of this genus (Harvey 1977, Steyn and Scott 1973). New World *Ciccaba* inhabit Neotropical forests where they are mostly unstudied (Burton 1973), and knowledge of their food habits has come from isolated observations and from stomach content analysis of a few collected specimens (Buchanan 1971, Burton 1973, Marshall 1943, Wetmore 1968).

[1] *Current address: The Peregrine Fund, Inc., 5666 West Flying Hawk Lane, Boise, Idaho 83709.*

The Black-and-white Owl (*C. nigrolineata*) inhabits humid lowland and foothill forests from southern Mexico to northwestern Venezuela and northwestern Peru. The literature for this species is limited mostly to brief anecdotal descriptions and accounts of individuals (Grossman and Hamlet 1964, Land 1963, Smithe 1966).

The Mottled Owl (*C. virgata*) is believed to be the most numerous and widespread wood owl of the neotropics and subtropics. Its range extends from Chihuahua and Sonora, Mexico to northern Argentina and southern Brazil (Peterson and Chalif 1973), and it has been reported as far north as Hidalgo County, Texas (Lasley et al. 1988).

The Black-and-white Owl is the larger species, with body mass reported as 440–500 g (Burton 1973), whereas the male and female captured in this study had body masses of 435 and 536 g, respectively. Mottled Owls have been reported to weigh between 176–305 g (Burton 1973, Voous 1988). In this study, seven adult males had a mean body mass of 239.7 ± 13.3 (SD) g (range = 220–256 g), and nine adult females had a mean body mass of 335.6 ± 13.7 g (range = 308–366 g). The Black-and-white Owl is considered uncommon to rare throughout its range (Peterson and Chalif 1973, Stiles and Skutch 1989), and our observations show this is true in northern Guatemala as well. The Mottled Owl is quite abundant in this same area (Gerhardt 1991a,b).

As part of a comprehensive study of Neotropical raptors in Tikal National Park, Guatemala (Burnham et al. 1988), we studied the food habits of a single nesting pair of Black-and-white Owls during three consecutive breeding seasons, 1989–1991. During 1990–1991, we simultaneously studied the feeding habits of eight pairs of breeding Mottled Owls.

STUDY AREA

The 576 km^2 Tikal National Park is located in the Department of Peten in northeastern Guatemala (17°13′N, 89°38′W). Physiography of this region is low rolling hills of eroded limestones ranging to 250 m above sea level. Surface water is limited to rain-filled ponds and extensive wooded swamps called bajos, which are flooded during the wet season (July–January). The tropical climate is considered relatively dry with an average annual precipitation of about 1400 mm. Mean temperatures range from 10 C on cool nights to 28–35 C during the day (Smithe 1966).

Vegetation is semideciduous tropical dry forest (Holdridge 1957), and grows in dense, continuous stands in undisturbed areas. Predominant forest types include climax, wooded swamp, and transition zone (Lundell 1937). Topography and the degree of inundation during the wet season largely determine the distribution of forest types. The more common climax forest grows on better-drained, higher areas where tall trees (to 50 m) generally form a continuous, multi-tiered overstory and relatively thin to moderate understory. Major tree associations are characterized by zapote (*Manilkara archas*), ramon (*Brosimum alicastrum*), and caoba (mahogany, *Swietenia macrophylla*). Wooded swamp grows on poorly-drained,

flat bajos where trees are generally less than 15 m tall, overstory is mostly non-existent, and understory is a dense growth of small trees, thorny shrubs and vines. Palo tinta (*Haemotoxylum campechianum*) characterizes the major tree association. Transition zone forest grows on moderately-drained ground between climax forest and wooded bajo, where tree height, overstory and understory density are intermediate between these forest types. Escoba palm (*Chrysophila argentea*) and botan palm (*Sabal* sp.) characterize transition zone forest.

METHODS

As part of a breeding biology and home range study, we located 13 Mottled Owl and four Black-and-white Owl nests, and followed a single Black-and-white Owl male and seven Mottled Owl males with radio-telemetry. Data on food habits were gathered by observing prey deliveries or exchanges during nest observations or radio-tracking, and by analyzing pellets that were collected daily under diurnal roosts. Also, we collected a small number of fresh prey remains after climbing to nests. Although radio-tracking greatly facilitated the location of diurnal roosts, we were frequently able to find the roosts of other Mottled Owls that were not radio-tagged.

Quantification of prey was based on pellet analysis, because prey remains and direct observations yielded so few data. As it was not possible to count the number of prey individuals in pellets, we determined frequency of occurrence by dividing the number of pellets in which each prey taxon was found by the total number of pellets (Marti 1987).

Analysis of the diets of both species was made difficult by several factors. Nests were kept quite clean, and we rarely found prey remains. Moreover, pellets were discarded at some distance from nests, and adults apparently carried off pellets regurgitated by the young, as none were found in or below nests. More importantly, pellets disintegrated quickly in the tropical forest, and little remained after a single day. As only chitinous remains of insects are found in pellets (Marti 1987), soft-bodied insects would be detected only through direct observation.

RESULTS

Mottled Owls.—We found the following items in Mottled Owl pellets: coleopterans (Scarabaeidae, Curculionidae, and Cerambycidae), orthopterans (families Acrididae and Blattidae), anole lizards, the rice rat, *Oryzomys fulvescens,* the cotton rat, *Sigmodon hispidus,* and a small, unidentified bat.

Of the 52 pellets (or parts thereof) that we collected, 23 (44%) contained only insect parts, and only one (2%) failed to contain at least some insect exoskeletal material. Insects found most commonly in pellets were scarabaeid beetles and acridid grasshoppers, with cockroaches and both curculionid and cerambycid beetles found less frequently. These were generally represented by intact legs; beetle elytra were typically broken into small bits. Twenty-six (50%) of the pellets contained bones and/or fur

of rodents. The majority of these belonged to rice rats and cotton rats. Lizard mandibles were found in two pellets, and the jaw of a small bat was found in one pellet. Thus, while insects were found in nearly all pellets, vertebrates were represented in 56% of pellets.

We found nine items as prey remains in Mottled Owl nests. These included a large snout beetle (Coleoptera; Curculionidae), two cockroaches (Orthoptera; Blattidae), a treefrog (*Hyla* sp.), a ranid frog, a lizard (*Anolis* sp.), a big-eared climbing rat (*Ototylomys phyllotis*), a rice rat (*Oryzomys fulvescens*), and the feathers of a small, unidentified bird. We observed Mottled Owls catching or carrying a katydid (Orthoptera; Tettigoniidae) and two rice rats.

Mottled Owls typically hunted in dense climax forest and exclusively at night. Low perches were commonly used, and most of the rodents captured were terrestrial species. One male, whose home range included human habitations, spent time hunting rats near kitchen facilities.

Black-and-white Owls.—We collected material from 73 pellets from under the roosts of the radio-tagged male and his mate. All pellets contained some insect exoskeletal material, and 19 (26%) consisted only of insect matter. Fifty-three (73%) of the pellets contained fur and/or bones of chiropterans. Only when some portion of the skull was included were we able to identify the species of bat eaten. Of 21 skulls identified, 13 were fruit bats, *Artibeus jamaicensis,* five were black mastiff bats, *Molossus ater,* two were wrinkle-faced bats, *Centurio senex,* and one was a tent-making bat, *Uroderma bilobatum.* We found rodent prey in but two pellets; one pellet contained the mandibles of a small rat, probably *Oryzomys fulvescens,* and the other contained a single rodent incisor. Although feathers were found in nine pellets, in four of these they were from the owl itself. Thus, five pellets (7%) contained feathers of unidentified bird prey. Also present in 10 (14%) of the pellets were seeds of *Psidium* sp., which we believe to be from bat stomachs.

All of the insects identified in Black-and-white Owl pellets were coleopterans or orthopterans. Scarabaeid beetles were the most commonly identified insects, and were represented by legs, elytra, pronota and head capsules. Subfamilies of scarabs included Scarabaeinae (dung beetles), Geotrupinae (earth-boring dung beetles), Melolonthinae (June beetles), and Dynastinae (unicorn beetles). Snout beetles (Curculionidae) were identified from elytra and from head capsules. Long-horned beetles (Cerambycidae), less commonly found, were represented by fragments of elytra and by their heads, whereas hydrophilid beetles were identified by the sharp spine of the metasternum. Short-horned grasshoppers (Orthoptera; Acrididae) were found infrequently, with the femur and tibia remaining intact, and cockroaches (Orthoptera; Blattidae) were represented by fragments of their pronota.

Black-and-white Owls hunted exclusively at night. We observed the radio-tagged male hunting on numerous occasions, particularly in the semi-open area near one of three ponds within his home range. He generally perched 2–5 m in height on a branch or post near the water's

edge. From this perch, the owl flew short distances after beetles and bats. On one occasion, he was observed flying after a bat through the forest; this chase was somewhat longer than other observed prey capture attempts, and the bat eluded his pursuer.

Black-and-white Owl nests were checked much less often than those of Mottled Owls, and the only prey remain found was from a fruit bat, *A. jamaicensis*.

DISCUSSION

Females of both species performed all of the incubating and brooding. Thus, for most of the period of this study, males did all of the hunting. When not incubating or brooding, however, females often roosted with their mates, and we could not attribute pellets to one or the other with any certainty. Nonetheless, the majority of pellets found in this study, for both species, were cast by males.

It is noteworthy that Mottled Owls were found to be highly dimorphic (Gerhardt 1991b) and that the pair of Black-and-white Owls was only slightly less dimorphic. Thus, males and females of each species might be expected to capture different sizes or taxa of prey. Our results should therefore be interpreted with the caveate that they largely represent the food habits of males. Furthermore, we found several major taxa at nests that were unrepresented in pellets. This may be due to their not being preserved in pellets. Another possibility, however, is that certain prey types are fed preferentially to nestlings and that pellets found at the diurnal roosts of males may not accurately characterize the diet of a family of owls.

Although quantitative analysis of their diet is therefore somewhat problematical, it seems clear that Mottled Owls are primarily insectivorous. Vertebrate remains are likely to be better preserved in pellets than are arthropod parts, and any bias in pellet analysis should be towards overestimating the proportion of vertebrates in the diet. Despite this bias, 44% of all pellets collected contained only insect parts, and all but one pellet contained at least some insect material. Clearly, insects are the principal component, by numbers, of the diet of Mottled Owls in our study area.

The isolated observations and stomach content analyses of other researchers also identify insects and small rodents as principal prey of Mottled Owls (Buchanan 1971, Burton 1973, Wetmore 1968). Burton (1973) reported reptiles as prey of this species, and Wetmore (1968) recorded a small snake among observed prey items in Panama. Lizards are not specifically reported, nor are frogs. Wetmore (1968), however, recorded a salamander as Mottled Owl prey, and Burton (1973) reported that the diet includes small birds. Buchanan (1971) identified the heteromyid rodent *Heteromys anomalus* as a prey species in Trinidad.

Black-and-white Owl pellets contained mostly coleopterans and chiropterans. Pellets, however, do not necessarily reflect the entire breadth of the diet, nor are the prey found in pellets likely to be represented in

direct proportion to the relative frequency of their being ingested. Specifically, bones, fur and beetle elytra are more likely to appear in pellets (less likely to be digested) than are the body parts of soft-bodied insects. Indeed, Burton (1973) mentions tettigoniids and cicadids as prey items of Black-and-white Owls although we did not identify either of these soft-bodied insects in the pellets we collected. Nonetheless, it is clear that insects and bats are typical prey of these owls.

Again, our results are in agreement with the few previously published reports. In El Salvador, Marshall (1943) collected a male whose stomach contained grasshoppers and two bats, and he collected a female that had been hunting grasshoppers. Burton (1973) described the diet of Black-and-white Owls as including bats and large insects (beetles, tettigoniids and cicadas). In Venezuela, Ibañez et al. (1992) collected pellets from beneath the roosts of a pair of these owls during a 5-wk period. These pellets contained the same general taxa of prey, but bats and birds represented a much larger proportion of the prey numbers. This latter finding may be an artifact of the short duration of the sampling season, rather than a real difference between owls in the two study areas.

There is both overlap and divergence in the prey of the sympatric species of *Ciccaba* in Tikal. Ninety-eight percent of Mottled Owl pellets and 100% of Black-and-white Owl pellets contained insect remains. Both species fed on scarabs, short-horned grasshoppers, snout beetles, long-horned beetles and cockroaches. Black-and-white Owls also took hydrophilid beetles, whereas Mottled Owls ate katydids. Only 56% of Mottled Owl pellets contained vertebrate remains, whereas vertebrate parts were found in 73% of Black-and-white Owl pellets. There was, moreover, little overlap in this vertebrate component of the diets. Only one Mottled Owl pellet contained bat remains; lizard mandibles were represented in two pellets, and rodent parts were found in 50% of the pellets. In contrast, all of the vertebrate remains in Black-and-white Owl pellets were chiropteran, except for a pair of small rodent mandibles, a single rodent incisor, and a few small feathers.

ACKNOWLEDGMENTS

This research was conducted as part of the Maya Project of the Peregrine Fund, Inc., and we thank the people, trusts and foundations that support this organization. Funding was also provided to RPG by Boise State University and by the Frank M. Chapman Memorial Fund and the American Museum of Natural History. Assisting in data collection were Israel Segura, Apolinario de Jesus Mendoza, Cristóbal Mateo Morales, Edi Rubí Martinez López and Miguel Angel Vásquez Marroquín. We would also like to thank Sr. Rogel Chi Ochaeta of Tikal National Park for his support and cooperation. Jim Thomason of the Florida Museum of Natural History (University of Florida) aided in identifying the *Ototylomys phyllotis*. M. Ross Lein, Al Dufty, Jim Munger, Pete Bloom, Jeff Marks, Carl Marti and Ken Yasukawa made helpful suggestions on the manuscript.

LITERATURE CITED

BUCHANAN, O. 1971. The Mottled Owl *Ciccaba virgata* in Trinidad. Ibis 113:105–106.

BURNHAM, W. A., J. P. JENNY, AND C. TURLEY. 1988. Progress report, 1988. Maya project: investigations of raptors and their habitats as environmental indicators for

preserving biodiversity and tropical forests of Latin America. The Peregrine Fund, Boise, Idaho. 53 pp.

BURTON, J. A. (ed.). 1973. Owls of the world. E. P. Dutton and Co., Inc., New York, New York. 216 pp.

GERHARDT, R. P. 1991a. Response of Mottled Owls (*Ciccaba virgata*) to broadcast of conspecific call. J. Field Ornithol. 62:239–244.

———. 1991b. Mottled Owls (*Ciccaba virgata*): response to calls, breeding biology, home range, and food habits. M.S. thesis. Boise State Univ., Boise, Idaho.

GROSSMAN, M. L., AND J. HAMLET. 1964. Birds of prey of the world. Clarkson N. Potter, Inc., New York, New York. 496 pp.

HARVEY, J. F. 1977. The return of the Wood Owls. Bokmakierie 29:54–55.

Holdridge, L. 1957. The vegetation of mainland Middle America. Proc. 8th Pacific Congr. 4:148–161.

IBAÑEZ, C., C. RAMO, AND B. BUSTO. 1992. Notes on food habits of the Black-and-white Owl. Condor 94:529–531.

LAND, H. C. 1963. A collection of birds from the Caribbean lowlands of Guatemala. Condor 65:49–65.

LASLEY, G. W., C. SEXTON, AND D. HILLSMAN. 1988. First record of Mottled Owl (*Ciccaba virgata*) in the United States. Amer. Birds 42:23–24.

LUNDELL, C. L. 1937. The vegetation of Peten. Carnegie Inst. of Wash., Washington D.C., Publ. No. 478.

MARSHALL, J. T. 1943. Additional information concerning the birds of El Salvador. Condor 45:21–33.

MARTI, C. D. 1987. Raptor food habits studies. Pp. 67–69, *in* B. G. Pendelton, B. A. Milsap, K. W. Kline, and D. A. Bird, eds. Raptor Management Techniques Manual. Nat. Wildl. Fed. Tech. Ser. No. 10, Washington, D.C.

PETERSON, R. T., AND E. L. CHALIF. 1973. A field guide to Mexican birds. Houghton Mifflin Company, Boston, Massachusetts. 298 pp.

SMITHE, F. B. 1966. The birds of Tikal. Natural History Press, Garden City, New York. 350 pp.

STEYN, P., AND J. SCOTT. 1973. Notes on the breeding biology of the Wood Owl. Ostrich 44:118–125.

STILES, F. G., AND A. F. SKUTCH. 1989. A guide to the birds of Costa Rica. Cornell Univ. Press, Ithaca, New York. 510 pp.

VOOUS, K. H. 1988. Owls of the Northern Hemisphere. MIT Press, Cambridge, Massachusetts. 320 pp.

WETMORE, A. 1968. The birds of the Republic of Panama, Part 2. Smithsonian Misc. Coll. Vol. 150.

Received 5 Apr. 1993; accepted 17 May 1993.