The Condor 86:91–92

FIELD CONFIRMATION OF LABORATORY OBSERVATIONS ON THE DIFFERENTIAL ANTIMOSQUITO BEHAVIOR OF HERONS

JOHN D. EDMAN
JONATHAN F. DAY
AND
EDWARD D. WALKER

In the early 1970s, Edman, Kale and Webber published a series of papers (by various combinations of authors, 1971, 1972, 1974) detailing the defensive behavior of caged birds and mammals exposed to biting mosquitoes. The authors showed conclusively that, under large, outdoor, cage conditions: (1) vertebrate species differ greatly in their tolerance of mosquitoes, and (2) host defensive behavior is an important regulator of mosquito blood-feeding success. These studies emphasized herons and in 1977, Maxwell and Kale published data on the anti-insect behavior of some of the same heron species under natural conditions. While essentially confirmatory, their observations near an island rookery in the estuarine Indian River near Vero Beach, Florida, were from a location and time when mosquito annoyance was minimal.

Data presented in these previous reports support the suggestion that in different species of herons, the birds' defensive behavior against mosquitoes may be related to their foraging posture (Meyerriecks 1960:149). Active insect-eating herons (e.g., Cattle Egret, *Bubulcus ibis*) are the most defensive (repelling up to 90+ percent of attacking mosquitoes), whereas passive (i.e., stand-and-wait) fish-eating species (e.g., Black-crowned Night Heron, *Nycticorax nycticorax*) that forage in early evening are the most tolerant (allowing up to 90+ percent of landing mosquitoes to blood-engorge). Active fish-eating species such as the Little Blue Heron (*Egretta caerulea*) are somewhat less defensive than the insect-eating species; passive day-feeders such as the Green-backed Heron (*Butorides striatus*) are somewhat less tolerant than night-feeding herons. Still, the Little Blue Heron must be classified as a relatively intolerant species and the Green-backed Heron as a relatively mosquito-tolerant species. Both these herons may be found foraging in the same habitat at the same time of day—thus making field observations more comparative. We now report recent observations of these two species from the Florida Everglades, which further validate earlier laboratory observations of heron defensive behavior against mosquitoes.

We made our observations between 10:00 and 14:00 on 7–8 January 1983 at Mrazek Pond and along the Bear Lake canoe trail, both near Flamingo in the Everglades National Park. All observations were made with the aid of 8× binoculars. Owing to a warm and unusually wet December, mosquitoes (almost exclusively *Aedes taeniorhynchus* Weidemann during the day) were extremely abundant in coastal areas of the park. On shaded dikes within mangrove swamp, they landed on us at a rate often exceeding 100/min. This mosquito flies primarily during crepuscular periods (Bidlingmayer 1964), but hosts entering its shaded daytime resting habitat are opportunistically attacked by blood-hungry females.

Little Blue Herons, although not the most defensive heron studied in the laboratory, were in the group that acted most intensely against mosquitoes, preventing most attacking mosquitoes from obtaining a blood meal. In one of our previous studies, they made about 46 defensive movements per min and allowed less than 25% of 300 attacking mosquitoes to feed (Webber and Edman 1972). In the Everglades, we observed an undisturbed adult Little Blue Heron actively foraging for small fish in a shallow tidal pool under a canopy of red mangroves. During the few minutes we were able to watch this bird, both the heron and the observers were attacked by numerous mosquitoes (presumably all *Ae. taeniorhynchus*). When not chasing after and capturing fish, the bird was constantly defending itself, primarily by shaking its head, fluffing its entire plumage and using its bill to peck at and rub mosquitoes from its upper legs and body. We did not see any mosquitoes successfully engorging on this bird. In the laboratory, roosting Little Blue Herons engaged in a great deal of foot-slapping and foot-stamping behavior (Webber and Edman 1972) but these defensive behaviors were not observed in this particular field situation, presumably because the bird was foraging in water ca. 2–3 cm in depth.

Green-backed Herons were relatively tolerant of mosquito annoyance in our previous cage studies. Their defensive movements consisted mainly of mild head-shaking (63% of total defensive activity). Both the frequency (11 per min) and intensity of anti-mosquito behavior were lower than in the Little Blue Heron (Webber and Edman 1972). Over 50% of 300 attacking mosquitoes generally obtained a blood meal in these outdoor cage experiments. At the edge of Mrazek Pond, we observed for several minutes an adult Green-backed Heron fishing from a red mangrove branch just above the water. The bird crouched quietly in a striking position waiting for a fish to come within range, and it captured several fish while we watched it. Between strikes at fish, it tolerated attacks from many mosquitoes. We could see mosquitoes resting on branches around the bird as well as landing, probing, and feeding, principally on the bird's head, legs, and feet. The only defensive movement was a frequent slight sideways tossing of the head accompanied by an eye-blink that caused some of the mosquitoes sitting about the head to take temporary flight, but they soon landed and resumed probing. Mosquitoes that had started to engorge appeared undisturbed by this head movement unless they were sitting directly on the eyelid. Occasionally the bird would flip its tail but this was probably not a defensive movement. Also, the heron temporarily performed other defensive movements immediately after capturing a fish and before again assuming the watching stance. These included a more aggressive tossing of the head, rubbing the legs with the bill, and mild foot-stamping. Nonetheless, we saw many engorged mosquitoes feeding on the bird and resting on nearby vegetation.

These field observations strengthen earlier laboratory comparisons of avian defensive behavior. Furthermore, they fortify the argument that the tolerance level of different herons to mosquitoes is associated with their specific mode of foraging and the latitude for extraneous movement that is allowable without jeopardizing the rate of capturing prey.

Supported by NIH grant AI 13981.

LITERATURE CITED

BIDLINGMAYER, W. L. 1964. The effect of moonlight on the flight activity of mosquitoes. Ecology 45:87–94.

EDMAN, J. D., AND H. W. KALE. 1971. Host behavior: its influence on the feeding success of mosquitoes. Ann. Entomol. Soc. Am. 64:513–516.

EDMAN, J. D., L. A. WEBBER, AND H. W. KALE, II. 1972. Effect of mosquito density on the interrelationship of host behavior and mosquito feeding success. Am. J. Trop. Med. Hyg. 21:487–491.

EDMAN, J. D., L. A. WEBBER, AND A. A. SCHMID. 1974. Effect of host defenses on the feeding pattern of *Culex nigripalpus* when offered a choice of blood sources. J. Parasitol. 60:874–888.

KALE, H. W., II, J. D. EDMAN, AND L. A. WEBBER. 1972. Effect of behavior and age of individual ciconiiform birds on mosquito feeding success. J. Am. Mosq. Control Assoc. 32:343–350.

MAXWELL, G. R., II, AND H. W. KALE, II. 1977. Maintenance and anti-insect behavior of six species of ciconiiform birds in South Florida. Condor 79:51–55.

MEYERRIECKS, A. J. 1960. Comparative breeding behavior of four species of North American herons. Publ. Nuttall Ornithol. Club 2.

WEBBER, L. A., AND J. D. EDMAN. 1972. Anti-mosquito behaviour of ciconiiform birds. Anim. Behav. 20:228–232.

Department of Entomology, University of Massachusetts, Amherst, Massachusetts 01003. Received 23 March 1983. Final acceptance 22 July 1983.

The Condor 86:92–93

OBSERVATIONS OF BIRDS AT AN ARMY ANT SWARM IN GUERRERO, MEXICO

ERICK GREENE

DAVID WILCOVE

AND

MEG McFARLAND

Birds of various species follow army ant raids to prey upon organisms flushed by the ants (studies reviewed in Willis and Oniki, Annu. Rev. Ecol. Syst. 9:243–263, 1978). Here we report on birds seen at the raids of one colony of the army ant *Eciton burchelli* near Ixtapa, Guerrero, Mexico (17°40′N, 101°40′W). Our observations are of interest because no ant-following specialists occur this far northwest, and ant-following birds have seldom been studied in Mexico (Sutton, Condor 53:16–18, 1951 from Tamaulipas; Hardy, Condor 76:102–103, 1974 from Nayarit; Willis [pers. comm.] from Nayarit and Sinaloa).

We observed the ant colony and attendant birds from 08:00 to 17:00 on 24–25 January 1983. The study site was a semideciduous forest with a poorly developed understory on karst topography (elevation 250 m). The army ants conducted active raids from dawn until mid-day, and resumed from mid-afternoon until dark. No raiding activity took place during a mid-day "siesta" (see Schneirla, Proc. Am. Philos. Soc. 87:438–457, 1944), when the ants returned to their bivouac. To minimize disturbance of the birds, we stayed well behind or to the side of the ant swarm. The birds were foraging vigorously, and our presence did not seem to disturb them.

A total of seven species were observed feeding at the swarm over two consecutive days (see Table 1). On neither day were birds present at the swarm during the afternoon raids. Five of the six species seen one day were not present the next day, which suggests that the birds were opportunistic in their use of the ant swarms as food resources; ant-following specialists will follow a single ant swarm throughout an entire day, and over the course of many days (Willis and Oniki 1978). To the best of our knowledge, three of these species have not been previously reported at ant swarms: Lesser Ground Cuckoo, Hermit Thrush, and Wilson's Warbler. Other species of cuckoos, thrushes, and wood warblers, however have been observed at army ant swarms (Willis and Oniki 1978).

Willis and Oniki (1978) described the division of avian foraging zones around army ant swarms in Panama: a central zone (A) is richest in flushed prey and is occupied by a large dominant species; the surrounding zone (B) has fewer flushed prey and tends to be occupied by species of intermediate weight and dominance; a peripheral zone (C) is occupied by small or ground species. Although we saw no overt conflicts among species attending the ant raid, the positions and the foraging tactics of the birds differed. The Bright-rumped Attila occupied zone A, where it perched on twigs 1–3 m high and dropped to the ground to capture animals fleeing from the ants. Its prey included a gecko (approximately 10 cm in length), a large scorpion, and many spiders. The Lesser Ground Cuckoo and the Swainson's and Hermit thrushes remained on the ground in zones B and C. The Fan-tailed and Wilson's warblers perched low (less than 1 m) or hopped on the ground in zone C. Dusky-capped Flycatchers occupied zone A, where they sallied from low perches after insects and spiders on the ground. A Summer Tanager (*Piranga rubra*) perched in zone C but we did not see it take prey at the swarm.

Willis (Living Bird 5:187–231, 1966) reported that migrant birds are subordinate to resident ant-followers, as inferred from their foraging position at an ant swarm and aggressive supplantings by other birds. Over a period of four years, he documented the percentages of migrant birds at swarms of *Eciton burchelli* on Barro Colorado Island, Panama; the average percentages ranged from a high of 30% in October to near 0% in May. He suggested that further north, in the absence of specialized ant-followers, more migrants might occur at swarms of *Eciton burchelli*. The percentage of migrants at the ant raid we observed (both days combined) was indeed higher than those recorded on Barro Colorado Island by Willis (1966). Con-

TABLE 1. Birds attending the morning raids of a colony of the army ant *Eciton burchelli*, near Ixtapa, Mexico.

Species	Status[a]	Number of individuals attending the raid	
		24 Jan. 1983	25 Jan. 1983
Lesser Ground Cuckoo (*Morococcyx erythropygus*)	R	1	0
Dusky-capped Flycatcher (*Myiarchus tuberculifer*)	R or M	0	2
Bright-rumped Attila (*Attila spadiceus*)	R	1	0
Swainson's Thrush (*Catharus ustulatus*)	M	3	2
Hermit Thrush (*Catharus guttatus*)	M	2	0
Wilson's Warbler (*Wilsonia pusilla*)	M	1	0
Fan-tailed Warbler (*Euthlypis lachrymosa*)	R	1	0

[a] R = resident throughout the year, M = migrant.