LITERATURE CITED

CARTER, J. H., III, R. T. STAMPS, AND P. D. DOERR. 1983. Status of the Red-cockaded Woodpecker in the North Carolina sandhills. Pp. 24–29 *in* Proceedings of Red-cockaded Woodpecker symposium II (D. A. Wood, ed.). Fla. Game and Fresh Water Fish Comm. and U.S. Fish and Wildl. Serv., Tallahassee, Florida.

LENNARTZ, M. R. AND R. F. HARLOW. 1979. The role of parent and helper Red-cockaded Woodpeckers at the nest. Wilson Bull. 91:331–335.

———, R. G. HOOPER, AND R. F. HARLOW. 1987. Sociality and cooperative breeding of Red-cockaded Woodpeckers, *Picoides borealis*. Behav. Ecol. Sociobiol. 20:77–88.

LIGON, J. D. 1970. Behavior and breeding biology of the Red-cockaded Woodpecker. Auk 87:255–278.

U.S. FISH AND WILDLIFE SERVICE. 1985. Red-cockaded Woodpecker recovery plan. U.S. Fish and Wildlife Service, Atlanta, Georgia.

WALTERS, J. R. 1990. Red-cockaded Woodpeckers: a "primitive" cooperative breeder. Pp. 67–101 *in* Cooperative breeding in birds: long-term studies of ecology and behavior (P. B. Stacey and W. D. Koenig, eds.). Cambridge Univ. Press, Cambridge, England.

———. 1991. Application of ecological principles to the management of endangered species: The case of the Red-cockaded Woodpecker. Annu. Rev. Ecol. Syst. 22:505–523.

———, P. D. DOERR, AND J. H. CARTER, III. 1988. The cooperative breeding system of the Red-cockaded Woodpecker. Ethology 78:275–305.

C. REED ROSSELL, JR. AND JACQUELINE J. BRITCHER, *U.S. Dept. of the Army, Directorate of Public Works and Environment, Endangered Species Branch, Fort Bragg, North Carolina 28307.* (Present address CRRJr: *Environmental Studies Program, Univ. of North Carolina at Asheville, Asheville, North Carolina 28804.*) *Received 6 Aug. 1993, accepted 17 Jan. 1994.*

Wilson Bull., 106(3), 1994, pp. 559–562

Wing-flashing in mockingbirds of the Galápagos Islands.—Wing-flashing is a conspicuous, stereotyped behavioral pattern of Northern Mockingbirds (*Mimus polyglottos*) that is used during foraging (Hailman 1960) and in the presence of potential predators (Hicks 1955, Selander and Hunter 1960). Its evolution and function are unclear, but study of the behavior among related species may suggest answers. In addition to the Northern Mockingbird, wing-flashing has been reported for the Gray Catbird (*Dumetella carolinensis*; Batts 1962, Michael 1970), Tropical Mockingbird (*M. gilvus*; Haverschmidt 1953, Whitaker 1957), Bahama Mockingbird (*M. gundlachii,* Aldridge 1984), Long-tailed Mockingbird (*M. longicaudatus,* Bowman and Carter 1971), Patagonian Mockingbird (*M. saturninus,* Halle 1948), the mockingbirds (*Nesomimus* spp.) of the Galápagos Islands (Hundley 1963, Bowman and Carter 1971), Socorro Mockingbird (*Mimodes graysoni*; Curry and Martínez-Gómez, pers. comm.), and Brown Thrasher (*Toxostoma rufum*; Laskey in Sutton 1946, Tomkins 1950, Thomas in Whitaker 1957, Michael 1970). Unfortunately, these reports are often incomplete and frequently fail to mention the context in which the behavior occurred. We describe two incidents of wing-flashing in the Hood Island Mockingbird (*Nesomimus macdonaldi*) of the Galápagos Islands.

On 23 May 1990 at 09:40 on Isla Genovesa (Hood Island) in the Galápagos Islands, Burtt, Porter, and Waterhouse noticed a snake (*Dromicus biserialis*) lying in an opening

between four *Cryptocarpus* bushes. The ground was hard and sparsely covered with short grass. The snake, which was about 60 cm long, was extended lengthwise in four loose curves. As we watched, an adult mockingbird ran toward the snake from under a bush to the snake's left. The mockingbird ran about 1 m and stopped about 25 cm to the left of the snake's head. When running, the mockingbird extended its wings horizontally with the primaries parallel to the body. The tail was held horizontally and was not fannned. When the mockingbird stopped, it folded its wings against its body, then suddenly and partially fanned them out from the body and up at a 45° angle. The motion lacked the brief hitch seen in the wing-flash of the Northern Mockingbird, and the hand remained folded so that the primaries remained parallel to the body. The tail was slightly raised and fanned 30° to the left and right of the center line. The wing-flash lasted less than a second. At no time did the bird crouch as if to fly. The mockingbird then hopped clockwise around the head of the snake to a point midway along the right side of the snake's body and about 12 cm away. The snake remained stationary. The mockingbird cocked its head to one side and then the other several times, always looking at the snake. During this examination its wings were folded against its sides. The snake now moved toward the bush to its right and the mockingbird hopped beside the snake. Just as the snake went under the bush the mockingbird delivered a peck toward its tail. We do not know if contact was made. After the peck the mockingbird turned 180° and hopped back to where the snake had lain, oriented toward the position the snake had occupied, and gave three wing-flashes in about 10 s before hopping to a nearby bush where it perched for several minutes.

On 19 May 1992 Swanson was studying displays of lava lizards (*Tropidurus delanonis*) on Isla Genovesa by presenting model lizards to resident individuals when a mockingbird approached a model, wing-flashed, and pecked the model. The mockingbird continued to wing-flash and attack for several minutes until Swanson removed her model and ended observations. On at least one wing-flash, the mockingbird raised its wings to about 80° above the horizontal, but in all other respects the behavior was exactly as described above. The lizard models were about 20 cm long.

These are the first descriptions of wing-flashing and its context in the Hood Island Mockingbird. Hundley (1963) described wing-flashing in the Chatham Mockingbird (*Nesomimus melanotis*), a brief comment by Curry (1986) suggests that the behavior occurs in the Galápagos Mockingbird (*N. parvulus*), and Bowman and Carter (1971) state that wing-flashing occurs in all four species of mockingbirds from the Galápagos Islands, but provide no descriptive or contextual details.

Given that wing-flashing occurs in at least eleven species of mimids belonging to five genera, the behavior would appear to be a primitive characteristic. Only one species, the Northern Mockingbird, has conspicuous markings that emphasize the wing motion, which suggests that the Northern Mockingbird's white wing patches evolved after the evolution of wing-flashing. However, unlike the Northern Mockingbird, which raises and fully extends its wings in a series of "hitches" (Hailman 1960), the Hood Island Mockingbird raises its wings in a single motion and the primaries remain folded. Similarly, Hundley (1963) observed that wing-flashing in the Chatham Mockingbird ". . . lacked somewhat the 'one-two-three,' drill-like precision of our northern species . . ." and that the wings were raised only slightly above the horizontal. Thus the action pattern of the Northern Mockingbird with its full extension of the wing and its "hitches" appears more exaggerated and more mechanical than the displays of mockingbirds that lack conspicuous white wing patches, for example the Hood Island Mockingbird. We conclude that the wing motion evolved first, that the white patches, which dramatize the motion, evolved secondarily, and that the patches selected for evolutionary exaggeration of the wing motion. Such positive feedback between behavior and color pattern occurs in the wood-warblers where aerial displays occur in many

species, but wingbars and tailspots are associated with the most dramatic aerial displays (Burtt 1986). White wing patches may have evolved in mockingbirds to emphasize the wing motion of other action patterns (e.g., jump-song). Nonetheless, the evolution of conspicuous patches would select for exaggerated wing-flashing, whether the behavior functioned to signal conspecifics or startle prey (Hailman 1960).

The function of wing-flashing is unclear, but its context appears consistent across species. In the Northern Mockingbird wing-flashing occurs when birds encounter strange objects or unexpected movements or noises (Horwich 1965). In these situations, which may occur when confronting prey (Hailman 1960) or a passive predator (Selander and Hunter 1960), the mockingbirds are wary but not completely frightened. When suddenly confronted with a snake, the Hood Island Mockingbird gave a wing-flash but gave no additional wing-flashes while the snake remained stationary. This is similar to a snake attack by the Northern Mockingbird (Hicks 1955), except for the three wing-flashes given by the Hood Island Mockingbird after the snake's disappearance. However, the incident observed by Hicks ended when he chased the snake away so we do not know what the Northern Mockingbird might have done after the snake's departure. Presentation of models to Northern Mockingbirds (Horwich 1965) elicited frequent and persistent wing-flashing as did presentation of Swanson's lizard models to the Hood Island Mockingbird. Thus the context of wing-flashing in the Hood Island Mockingbird appears to be similiar to the context of the more conspicuous, dramatic wing-flashing of the Northern Mockingbird.

Acknowledgments.—We discussed our observations with G. A. Colwell, A. J. Gatz, and D. C. Radabaugh who also commented on the manuscript. R. Breitwisch, R. L. Curry, and J. P. Hailman provided additional comments on the manuscript.

LITERATURE CITED

ALDRIDGE, B. M. 1984. Sympatry in two species of mockingbirds on Providenciales Island, West Indies. Wilson Bull. 96:603–618.

BATTS, H. L. 1962. Wing-flashing motions in a catbird. Auk 79:112–113.

BOWMAN, R. I. AND A. CARTER. 1971. Egg-pecking behavior in Galapagos mockingbirds. Living Bird 10:243–270.

BURTT, E. H., JR. 1986. An analysis of physical, physiological, and optical aspects of avian coloration with emphasis on wood-warblers. Ornithol. Monogr. 38:x + 126.

CURRY, R. L. 1986. Galápagos Mockingbird kleptoparasitizes centipede. Condor 88:119–120.

HAILMAN, J. P. 1960. A field study of the Mockingbird's wing-flashing behavior and its association with foraging. Wilson Bull. 72:346–357.

HALLE, L. J. 1948. The Calandria Mockingbird flashing its wings. Wilson Bull. 60:243.

HAVERSCHMIDT, F. 1953. Wing-flashing of the Graceful Mockingbird, *Mimus gilvus*. Wilson Bull. 65:52.

HICKS, T. W. 1955. Mockingbird attacking blacksnake. Auk 72:296–297.

HORWICH, R. H. 1965. An ontogeny of wing-flashing in the mockingbird with reference to other behaviors. Wilson Bull. 77:264–281.

HUNDLEY, M. H. 1963. Wing-flashing in the Galápagos Mockingbird. Auk 80:372.

MICHAEL, E. D. 1970. Wing flashing in a Brown Thrasher and Catbird. Wilson Bull. 82: 330–331.

SELANDER, R. K. AND D. K. HUNTER. 1960. On the functions of wing-flashing in mockingbirds. Wilson Bull. 72:341–345.

SUTTON, G. M. 1946. Wing-flashing in the mockingbird. Wilson Bull. 58:206–209.

TOMKINS, I. R. 1950. Notes on wing-flashing in the Mockingbird. Wilson Bull. 62: 41–42.

WHITAKER, L. M. 1957. Comments on wing-flashing and its occurrence in Mimidae with uniformly colored wings. Wilson Bull. 69:361-363.

EDWARD H. BURTT, JR., JULIE A. SWANSON, BRADY A. PORTER, AND SALLY M. WATERHOUSE, *Dept. of Zoology, Ohio Wesleyan Univ., Delaware, Ohio 43015.* (Present address BAP: *Dept. of Zoology, The Ohio State Univ., 1735 Neil Ave., Columbus, Ohio 43210.*) *Received 26 July 1993, accepted 17 Jan. 1994.*

Wilson Bull., 106(3), 1994, pp. 562–563

Tree nesting by Wild Turkeys on Ossabaw Island, Georgia.—In the spring of 1988, seven Wild Turkey (*Meleagris gallopavo*) poults were found either wandering or stunned near the base of a large live oak (*Quercus virginiana*) on Ossabaw Island. Ossabaw Island is a 10,117 ha barrier island consisting of approximately 4775 ha of uplands, with the remaining acreage consisting of salt marsh. A detailed description of plant communities of Ossabaw is given by Johnson et al. (an ecological survey of the coastal region of Georgia, U.S. Govt. Printing Office, 1974). The live oak had a diameter at breast height (dbh) of approximately 1.2 m. At about 2.4 m high several limbs originated, forming a large crotch covered with resurrection fern (*Polypodium polypodioides*). Examination of the tree crotch revealed a nest containing eggshells from hatched poults. Some poults had injuries from the fall, but most appeared to be in good health. During the spring of 1989, a Wild Turkey hen was observed incubating 11 eggs in the same tree. All 11 eggs hatched. The hen was observed at the base of the tree calling to the poults. Three poults jumped out of the tree and followed the hen away from the nest. The remaining eight poults in the tree were abandoned. A Wild Turkey also was observed nesting in the same tree in 1990. Poults were not seen during or after hatching; however, eggshells from several turkey eggs were recovered from the nest during mid-July, 1990. The tree was not used during the 1991 nesting season. Evidence of a turkey nest in a second live oak also was found on Ossabaw Island during the summer of 1988. The tree had a dbh of 1.8 m and a crotch at about 1.5 m. Wild Turkey eggshells were found in the mat of fern in the tree crotch and at the base of the tree. Wild Turkey nesting was not detected in the tree during the 1989, 1990, or 1991 nesting seasons.

Although the Wild Turkey is a ground nester (Williams, The book of the Wild Turkey, Winchester Press 1981), above-ground nesting of two Wild Turkey hens in North Carolina was described by Cobb and Doerr (Wilson Bull. 101:644–645, 1989). Unlike Ossabaw, the nests were in old growth water tupelo (*Nyssa aquatica*)/bald cypress (*Taxodium distichum*) backswamp. Also, the North Carolina nests were on a log (65.5-cm tall) and a stump (1.4-m tall) compared to live trees on Ossabaw. Cobb and Doerr (1989) pointed out that above-ground nests they observed had the advantage of being above the normal field of view of ground predators. In addition, the nests were less likely to be destroyed by flooding.

Three hypotheses may explain tree nesting by Wild Turkeys on Ossabaw Island. Feral hogs (*Sus scrofa*) (>24.7/km^2) and raccoons (*Procyon lotor*) (>4.0/km^2) both occur on Ossabaw (Fletcher et al., J. Wildl. Dis. 26:502–510, 1990). Tree nesting may be an attempt to prevent nest depredation by these species. Additionally, high populations of deer and exotic browsers and grazers have greatly reduced understory nesting cover (Johnson et al. 1974), limiting suitable ground nesting sites. Last is the availability of trees large enough and with suitable configurations to accommodate a turkey nest. Few places exist where trees similar to the size and shape of the live oaks on Ossabaw are accessible to nesting Wild Turkeys.

Acknowledgments.—This project was funded by the Georgia Dept. of Natural Resources,