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Running Head: WING-FLASHING

Abstract

The purpose of this study was to describe the form and location of wing-flashing behavior in mockingbirds and to identify differences in flashing between young and adult birds through film analysis techniques and observation. Subjects consisted of 50 mockingbirds from the University of Richmond campus. Analyses of the data suggested that there were three types of wing-flashes based on degree of wing extension. Flashes were most likely to occur in direct sunlight and in grass. No significant differences in the form of flashes between adult and juvenile mockingbirds were found. It is hoped that this study will provide insight into the function of wing-flashing in mockingbirds.

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Wing-flashing, operationally defined as the prolonged extension of the wings followed by the rapid return of the wings to the bird's sides when the bird is on a substrate, usually appears in young birds on the tenth or eleventh day after hatching (Horwich 1965). Horwich (1965) concludes that wing-flashing is an innate balancing movement because captive fledglings too young to feed themselves exhibit the behavior. The birds in Horwich's study had little or no opportunity to learn the behavior from other birds.

In young birds, wing-flashing is associated with unfamiliar situations, such as the first time a fledgling sees a squirrel or tires to capture its own prey, but the behavior ultimately becomes associated with foraging in adult birds (Horwich 1965, Hailman 1960). Sutton (1946), Selander and Hunter (1960) suggest that wing-flashing is an alarm reaction performed in conflict situations. Selander and Hunter (1960) conclude that wing-flashing evolved as a social signal and has acquired a food gathering function secondarily.

Different hypotheses concerning how wing-flashing helps mockingbirds catch insects exist. Gander (1931) proposed that wing-flashing exposes the bird's white wing panels, alarming insects and forcing them to reveal themselves. This hypothesis assumes that the birds feed on insects that react to the behavior. If Gander's proposal is valid, it follows then that the mockingbirds' diet will be composed primarily of insects that respond to wing-flashing. There is little or no evidence to support this idea. Also, other species of birds which lack white wing panels exhibit wing-flashing behavior (Tompkins 1950, Haverschmidt 1953, Whitaker 1957). Grinnell (1924) and Allen (1947) suggest that the wing panels act as reflective devices, allowing the birds to see the insects more easily. The birds would have to flash toward the sun to reflect the maximum amount of light on the substrate and to see the insects more clearly. Allen, however, reports instances of wing-flashing in the absence of direct sunlight (Tompkins, 1950). A third hypothesis is that wing-flashing casts a shadow that alarms insects and forces them to reveal themselves (Hailman 1960). This hypothesis also assumes that the mockingbirds flash in sunlight.

Although there are many theories about the function of wing-flashing, few data have been collected about the form of the behavior, such as the relative positions of the head, tail, and wings. The purpose of this study is to describe the from and location (e.g. substrate and illumination) of wing-flashing behavior in mockingbirds and to identify differences in flashing between young and adult birds through film analysis techniques and observation. It is predicted that there will be differences in the form and location of wing-flashing between young and adult birds. It is hoped that analyses of these from differences will provide insight into possible functional differences in wing-flashing between mockingbirds of different ages.

Methods and Materials

Subjects consisted of approximately 50 mockingbirds from the University of Richmond campus. Territories were located by observing adult bird behaviors including territoriality and nest building. Nests were checked approximately every other day and, if possible, egg-laying dates were recorded. If young birds were in the nests, estimates of their ages were made based on feather development (Horwich 1966). Nests were surrounded on three sides by most nests suspended by 10'½" electrical conduit pipes anchored into the ground. When the adults had temporarily left the nest, the nets were set up. The nets were erected before dawn to reduce their visibility and because the birds were often on the nest early in the morning. Adults were caught when they attempted to return to their young, and nestlings (approximately seven days old) were captured after the adults had been caught.

Nestlings and adults were banded for individual identification using U. S. Fish and Wildlife bands and unique combinations of colored plastic leg bands. Weight measurements to the nearest gram were taken as a secondary measurement of age and health at the time of banding using a small plastic bag and a Pesola scale.

Estimates of subcutaneous fat content were also made as an indicator of health.

The sex of each adult mockingbird was identified by the presence or absence of a brood patch or cloacal protuberance. Wing chord measurements were also taken as a secondary indicator of sex of the adult birds. The young mockingbirds could not be sexed by external characteristics. The birds were released at the completion of the measurements.

The behaviors of banded fledglings and adults of known age (approximately 10 days to two years) were observed in the field from dawn to dusk from late May to late August. Temperatures ranged from approximately 25 - 35° C, and observations were discontinued in inclement weather. Observations were recorded on Super 8 mm film with a Canon Super 8 automatic zoom electronic movie camera (10-time zoom lens, f/1.4 fastest speed, 18 frames/sec.). Distances between the researcher and a given subject while filming ranged from approximately 1 to 10 meters.

The film was developed and copied. Sequences containing flashes were cut and mounted on 2x2 plastic slide mounts. Each frame of a given flash sequence was included. The slides were projected on a wall, and the outlines of the birds were traced on paper. From the projections, the angles and relative positions of the tail, wings, and head in each frame were measured. In the side views of the birds, all angles were measured from the birds' feet and the substrate (see Figure 1-A). In the front views of the birds, angles were measured between the head (tip of the beak) and the radius/ulna-carpals joint, and between the tail and the wing tip (see Figure 1-B). The time required for each flash sequence was calculated.

Results

Approximately 44 wing-flash sequences were observed. The film analyses showed that wing-flashing could be classified into three categories.

The first type of flash occurred when the stationary bird raised its wings above the body. The humerus-radius/ulna joint (elbow) and the carpal-radius/ulna joint (wrist) were fully extended, as shown in Figure 2.

Insert Figure 2 about Here

This flash, hereafter called the full flash, was broken down into four main stages. In the first stage the wings were at the bird's sides. In the second stage, the wings were partially extended. The wings reached their maximum extension in the third stage, and in the fourth stage the wings were again at the bird's sides.

In a front view of the full flash, the average angles between the bird's head and the bend of the wing were 120, 111, 80, and 120° for the first, second, third, and fourth stages, respectively. The average angles between the tail and the wing tip were 0, 30, 90, and 0° for the first, second, third, and fourth stages, respectively.

In a side view of the full flash, the average angles between the wing and the feet or substrate were 50, 56, 60, and 49°, respectively for the four stages. The angle between the tip of the beak and the substrate remained constant at 45°, and the tail was constantly aligned with the head so that a straight line was formed. The head and the tail did not move during this flash sequence. This flash required approximately one second to complete.

In the second type of flash, the bird raised the elbow joint slightly. The elbow and the carpals were only partially extended, and the wing was not raised above the body. This flash, referred to as the half-flash, required approximately 2/3 second to complete.

In the third type of flash, the elbow joint was elevated slightly and the wings remained folded, as shown in Figure 3.

Insert Figure 3 about Here

This flash, referred to as a shrug, was broken down into three stages. In the first stage the wings were at the bird's sides. In the second stage, the bend of the wing was slightly elevated, and in the third stage, the wings were at the bird's sides.

In a side view of the shrug the average angles between the sing and the substrate were 32, 40, and 31°

for the first, second, and third stages, respectively. The average angle between the tip of the beak and the substrate remained constant at 25° during the three stages, and the average angle between the tail and the beak remained constant at 165°. The head and the tail did not move during this flash. The shrug required approximately 1/3 second to complete.

In the full and half flashes and shrugs the angles and relative positions of the head, wings, and tail were fairly constant for both young and adult birds. Differences in from between age groups were the same as differences among birds of a given age.

Of the 44 flashes that were analyzed, 32 were by adults and 12 were by juveniles. Seventeen of the adult flashes were full flashes, and seven of the juvenile flashes were shrugs. Twenty-seven of the adult flashes occurred during foraging runs; four of the juvenile flashes occurred during foraging runs. Eighty-four percent of the total number of flashes occurred in direct sunlight; 16.0% occurred in the shade. Of these flashes, 70.5% occurred on grass and 29.5% occurred on brick or asphalt walkways. These data are shown in Table 1.

Insert Table 1 about Here

Discussion

Analysis of the film indicates that mockingbirds exhibit three types of wing-flashes. In each type of flash, the birds are stationary. The first two flash types, the full and the half flash, consist of four primary stages. In the first stage or preparation stage, the wings are at the bird's sides. The second stage is an intermediate stage in which the wings are raised . The second stage is passed through quickly, and is followed by the third stage in which maximum extension is reached. In the full flash the wings are raised above the body, and the elbow and the wrist are fully extneded. In the half-flash, the wings are not raised above the body: the elbow is raised slightly and the wrist is only partially extended. In the fourth stage of both the full and the half flashes, the wings have returned to the bird's sides. In both flashes, only the bird's wings move; the head and tail positions remain constant throughout the flash.

There are three stages in the third type of flash or shrug. In the first stage, or preparation stage, the wings are at the bird's sides. In the second stage, the elbow is elevated slightly and the wings remain folded. In the third stage, the wings have returned to the bird's sides.

In each of the three types of wing-flashing, more time is required for the wings to reach maximum extension from the preparation stage than for the wings to return to the bird's sides after maximum extension. Thus, the time intervals between the stages are unequal.

The half-flash and the shrug appear to be incomplete versions of the full flash. There are no significant differences in the form of flashing between adult and juvenile mockingbirds. This supports Horwich's (1965) conclusion that the behavior is innate. It is unlikely that young birds learning the behavior by observing other birds could match the adults' flashes this precisely at their young age. This finding also suggests that the young birds do not use flashing as a balancing movement.

Analyses of wing-flashes in this study reveal that flashes are more likely to occur in direct sunlight than in shady areas. This observation is consistent with the findings of Hailman (1960). Also, flashes were more likely to occur on grass than on brick or asphalt walkways. This finding is logical since grass tends to hide prey more than walkways do. Therefore, the capture of insects in grass would require extra effort such as wing-flashing.

Observations made during this study suggest that there may be differences in the function of wing-flashing in adult and juvenile mockingbirds. Adults most often exhibited full flashes and these occurred during foraging runs. Juveniles were more likely to exhibit shrug flashes than full or half-flashes. These shrugs were not usually followed by attempts at food gathering. These data suggest that young birds use wing-flashing for purposes other than foraging or that the young birds have not yet perfected wing-flashing techniques. Adults probably use wing-flashing as a technique to increase foraging success. How wing-flashing helps the birds to catch insects is not known. The white wing panel theory (Gander 1931), the reflective device theory (Grinnell 1924, Allen 1947), and the shadow theory (Hailman 1960) need to be more thoroughly tested.

The descriptions of the form of wing-flashing behavior in this study will provide a common ground from which researchers studying wing-flashing in the future can work. It is also hoped that this work will provide some insight into how wing-flashing fits into the behavioral repetoire of mockingbirds and how it compares with similar behaviors in other birds.

The similarities in form and the differences in location of wing-flashing between adult and juvenile mockingbirds also provide insight into the function of wing-flashing in mockingbirds. Also, knowledge of location and time of year of the behavior may give some clues about what insects are present in an environment and when they are present.

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Table 1

Components of the Analyzed Wing-Flashes

A. Number of Occurrences:

	Total	Full	Half	Shrug	Associated with Foraging
Adult	32	17	11	4	27
Juvenile	12	2	3	7	4

B. Total Percentage of Occurrences:

Direct Sunlight	Shade
84.0	16.0
Grass	**Walkways**
70.5	29.5

Figure Captions

Figure 1-A. Angle measurements from a side view of the bird.

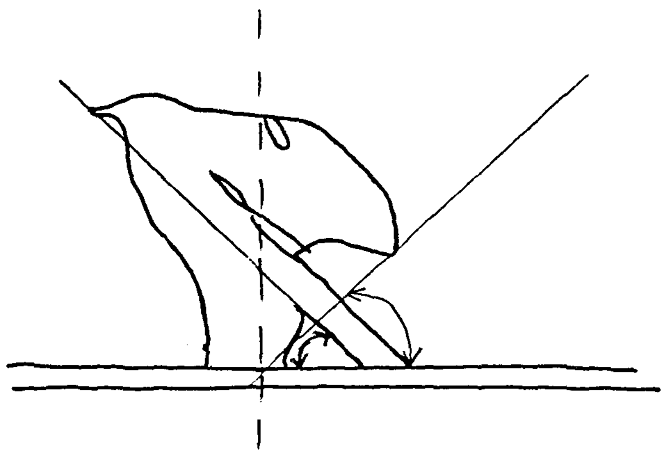
Figure 1-B. Angle measurements from a front view of the bird.

Figure 2. Maximum extension in the full flash.

Figure 3. Maximum extension in the shrug.

Figure 1

A.



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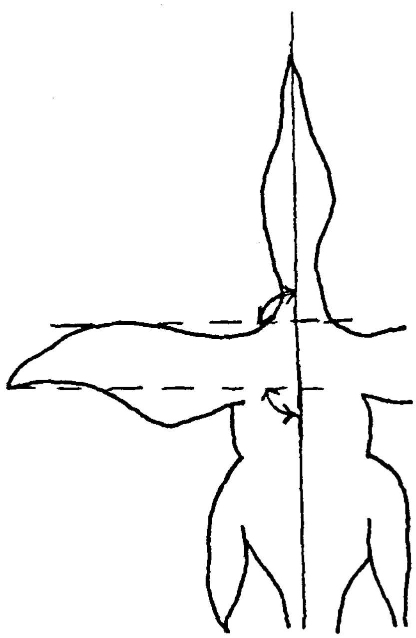
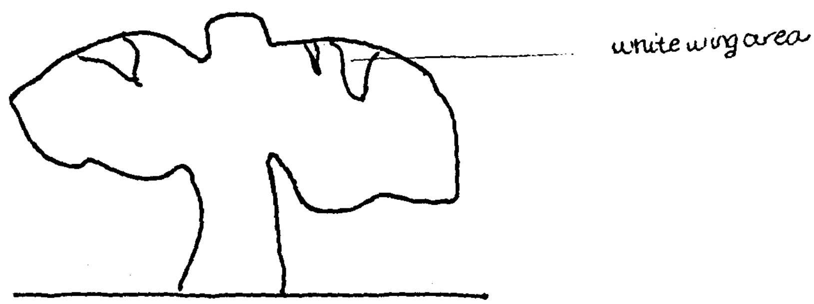


Figure 2



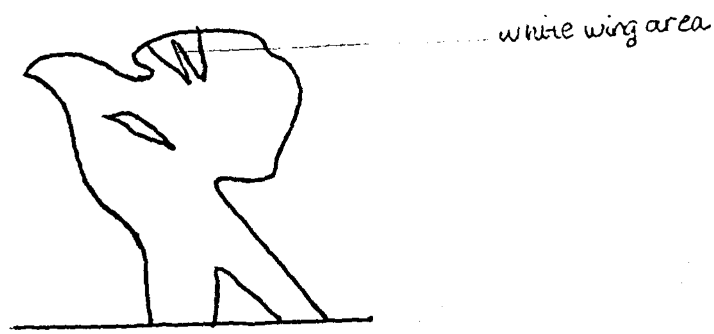


Figure 3