Nocturnally Singing Northern Mockingbirds Orient Toward Lights

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I. Introduction

Male Northern Mockingbirds (*Mimus p. polyglottos*) often sing after dark during the breeding season. Casual observations suggest that mockingbirds tend to face their ventra toward lights while singing at night. However, this could be artifactual: human observers may simply notice them more often when they are facing lights because this orientation illuminates their white underparts. Whether mockingbirds truly show such a tendency needs to be assessed systematically. In addition to adding to our scant knowledge of mockingbird nocturnal behavior, confirming that mockingbirds face lights while singing at night may help explain their diurnal tendency to face the sun when the sun is low in the sky (Justice, 1996). In both situations, mockingbirds illuminate their lighter underparts and cast shadows on their darker upperparts.

Three theories may explain the tendency of mockingbirds to face the sun. First, orientation may play a role in communication. Facing the sun illuminates the white underparts and enhances the dorsoventral contrast, making the bird more conspicuous. Facing away from the sun shadows the white underparts and diminishes the dorsoventral contrast, making the bird less conspicuous (see Thayer [1909], Kiltie [1988], and Justice, Justice, & Joyner [2000] for detailed discussion of this theory). Thus, the function of orientation may be regulation of conspicuousness, which should influence communication with conspecifics (Justice, in prep).

Second, orientation behavior may be involved in thermoregulation. Precisely how sunlight on the feathers affects body temperature is complex. The reflection, absorption, and transmission spectra of the feathers, the positioning of the feathers in relation to the incoming light and to each other, and the effects of movement and wind on the boundary layer must all be considered. However, it is probably safe to say that, in general, sunlight hitting gray-black wings folded over brownish-gray upperparts is going to have a different effect on body temperature compared to sunlight hitting the white downy feathers on the ventrum.

Third, birds may orient themselves to the sun in an effort to regulate exposure to ultraviolet (UV) radiation (Burtt, 1979). UV radiation may have both physiological benefits (being involved in vitamin synthesis in some animals) and costs (damage to DNA). Mockingbirds' dorsal feathers probably absorb more UV radiation than their ventral feathers, so their orientation with respect to the sun may reflect efforts to balance the costs and benefits of exposure.

The brightest nocturnal light sources are typically streetlights, walkway lights, billboard signs, etc. These lights do not produce significant amounts of heat or UV radiation, especially compared to sunlight. Thus, a switch from facing the sun diurnally to nondirectional orientation at night would suggest that thermoregulation and/or UV exposure are significant factors in orientation toward the sun during the day. However, if mockingbirds face bright lights at night, this suggests that communication may be a significant factor in both nocturnal and diurnal orientation.

II. Methods

Study Sites, Times, and Conditions. During the 2000 breeding season, data were collected on 16 mockingbirds in Greenville, NC and two mockingbirds in Murfreesboro, NC. Data collection began as soon as nocturnal singing began (mid-April) and ended when nocturnal singing became rare (mid-June). All data were collected between 2030hr and 2345hr. Wind speed was measured by a Davis Instruments anemometer and was minimal during data collection (range 0.0 – 1.2 m/s). Temperature ranged from 15.6° - 25.4° C.

Sampling Method. Observers listened for singing mockingbirds while walking or driving. Only after hearing song did a search for the singing bird begin. This ensured that the sample was not accidentally biased toward mockingbirds in more visually conspicuous orientations (see Justice, Justice, & Joyner [2000] for a related technique). Only males were sampled, because females do not sing during the breeding season. Many birds were located almost immediately, without a flashlight; for others a diligent search was carried out with a flashlight. Although some birds required up to 30-40 minutes to find, only three singing birds were never found. Given that all sampled birds were singing on or near college campuses, it is unlikely that the presence of an observer was unduly bothersome to the bird; indeed, most birds sang throughout the search process. To avoid sampling the same bird more than once, observers did not return to an area where data had been collected. The size of the area avoided was at least three times the size of a typical mockingbird territory.

Measures. Once a bird was found, the observer recorded the date, time, temperature, location, wind speed from several directions, and the compass direction in which the bird was facing. The observer then mapped out the surrounding light sources using an Extech Instruments light meter set on the fast response for 0.0 – 199.9 Foot-candles (Fc). The light sensor was adhered to the sight guide of the compass, and the observer pointed the light sensor in 16 evenly spaced compass directions (0°, 22.5°, 45°, and so on). When possible, the observer mapped the light sources from the point on the ground directly underneath the song perch. Otherwise, for example, if the observer could only get to within 3m of this point, the observer walked a 3m-radius circle around the point. Because light intensity decreases exponentially with distance and the radii of the traversed circles varied from bird to bird, the actual number of foot-candles recorded could not be compared between birds. Instead, all analyses used within-bird comparisons of illumination at various angles.

III. Results

Compass Direction. While not the focus of the present research, the data allowed for the opportunity to examine whether mockingbirds tend to orient in a particular compass direction. Certainly if such a tendency were present, it would affect the outcome of the present study. The compass orientations of the 18 mockingbirds sampled for this study are plotted in Figure 1. Using North as 0°, the mean direction $\bar{\phi} = 60.5°$ and the angular deviation s = 79.06°. There was no significant directional preference: mean vector length $r = 0.048$, Rayleigh test $p > 0.90$ (circular statistics were calculated using the techniques described in Batschelet [1981]).

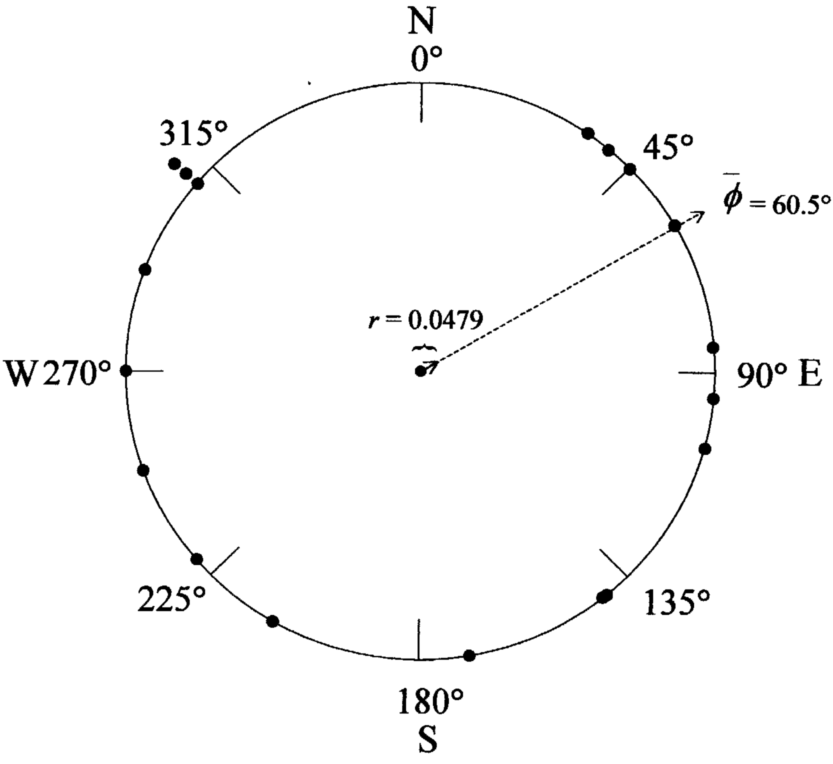

Figure 1. Compass orientations of the mockingbirds sampled for this study are represented by dots (●) on the circle. $\bar{\phi}$ = mean vector angle, r = mean vector length.

Intensity of Dorsal vs. Ventral Illumination. For 14 birds, the light they were facing was more intense than the light from which they were facing away. Three birds showed the opposite pattern, and one had equally intense lights from the directions of its dorsum and ventrum. Collapsing the latter two categories, the binomial $p < 0.02$ ($x = 14$, $n = 18$, null proportion = 0.50). Thus, there was a significant tendency to have the ventrum illuminated by more intense light than the dorsum. Even if the three birds that were never found were all counted as having more intense light on their dorsum (the more cryptic orientation), the binomial probability remains low ($p = 0.095$, $x = 14$, $n = 21$)

Orienting Toward the Most Intense Light Sources. As described above, light intensity was measured from 16 evenly spaced directions. For this analysis, the number of directions from the one in which the bird was facing to the one with the most intense light was counted. Thus, if the bird were facing in the direction from which the most intense light was coming, it scored zero. If the bird were facing one direction over from the most intense light, it scored one. If the bird were facing the opposite direction of the most intense light, it scored eight. The results are plotted in Figure 2. Of the 14 birds with more intense light on their ventra compared to their dorsa, 13 scored zero or one and 1 scored four. Scores of zero, one, or two may be considered to be facing the most intense light because these orientations will illuminate most of the ventral surface. Comparing $n = 13$ scores of zero or one with $n = 1$ score between three and eight, binomial $p < 0.001$ ($x = 13$, $n = 14$, null proportion = 0.33).

IV. Discussion

The data above suggest that mockingbirds singing at night during the breeding season 1) do not tend to face in any particular compass direction, 2) tend to maintain a higher light intensity on their ventra compared to their dorsa, and 3) do so by facing toward or near the direction from which the most intense light is coming.

It is unlikely that thermoregulation or regulation of exposure to UV is involved in this behavior because of the low amounts of heat and UV that could be acquired from an artificial light at even a short distance. Communication is a better explanation. At night, mockingbirds would be much more conspicuous when their ventra are intensely illuminated compared to their dorsa. This was readily apparent to human observers, and thus might also be true for other animals with similar or better visual systems.

The information being transmitted via a conspicuous orientation, the recipients of this information, and how they respond to it remains unknown. One thing that must be considered is that all mockingbirds in this study were singing when measured, and singing is a conspicuous behavior in the auditory channel. One the one hand, orientation may complement the auditory conspicuousness of the song by making the singer visually conspicuous as well. For example, if song is used for mate attraction, orientation may provide or

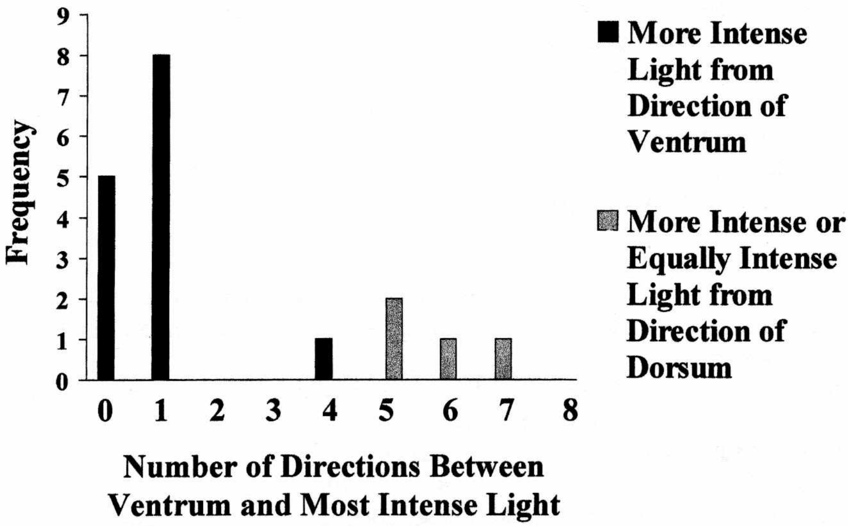

Figure 2. N = 14 mockingbirds were oriented so that the light on their ventra was more intense than the light on their dorsa (black bars). These also tended to be facing the most intense light source available (scores of 0 or 1). N = 4 mockingbirds were oriented so that the light on their dorsa was more intense than or equally intense as the light on their ventra (gray bars).

enhance important visual cues for the female. The same may be true of facing the sun during the day, although thermoregulation and UV exposure are likely to play a role in diurnal orientation. On the other hand, orientation may compensate for the auditory conspicuousness of song, which may alert both diurnal and nocturnal aerial predators to the presence of potential prey. If predators keep light sources at their backs to illuminate potential prey, then mockingbirds may face light sources to detect such predators. Even if such an orientation makes the bird conspicuous, the early detection of a predator may be so advantageous that the conspicuousness of the orientation becomes moot. However, this paper specifically examined orientation of the ventrum, not the beak or eyes. If illuminating the white ventrum increases conspicuousness, then it seems a better antipredation strategy would be to direct the ventrum away from light sources and turn the head to search for predators; this allows for crypsis of the body while the eyes are searching. Future investigators could use experimental manipulations of light sources and/or the color of the ventrum to address some of these hypotheses.

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