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PREDICTING FREQUENCY OF MOCKINGBIRD CALLS USING THE WEATHER

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Abstract.—In this study, Northern Mockingbirds (*Mimus polyglottos*) in Norman, Noble, and Hall Park, Oklahoma, were observed for frequency of singing. Weather data were collected for times corresponding to singing observations. Data included temperature, dewpoint, wind speed and direction, and altimeter setting. Predictor variables were compared with data for mockingbird song using Poisson regression. About 37% of the variability in song frequency was accounted for by a Poisson model using temperature, east-west wind speed, and north-south wind speed as predictors. The level of prediction only increased to 43% when dewpoint, wind direction, and time of day were included as predictors.

Introduction.—Much folklore centers on the relationship between birds and weather, based on the notion that weather influences bird behavior

(Terres 1980). My interest in the subject stems from observing the behavior of Northern Saw-whet Owls (*Aegolius acadicus*) during time spent as a birder in Wisconsin. Wisconsin birders have noted that owl responses during autumn to taped calls were affected by warm vs. cold advection patterns. Advection is an increase or decrease in temperature caused by the wind blowing in warmer or colder air, respectively. In particular, cold advection is associated with an increased response to taped calls (J. Smith, pers. comm.).

Birds are able to sense temperature in their beaks and on their tongues (Schwartzkopff 1973); temperature also has a wide range of physiological and behavioral effects. For example, a harsh winter can inhibit gonadal recrudescence (rebuilding of the gonads in the spring), while a mild winter promotes recrudescence (Wingfield 1993). This process is easily measured because an increase in plasma testosterone leads to increased singing (Nottebohm 1975). Unfortunately, while a relationship between plasma testosterone and temperature has been found in domesticated birds, a similar correlation has yet to be found in wild birds (Wingfield 1993).

In this paper, I summarize findings of a study wherein the singing of a common resident of Oklahoma, the Northern Mockingbird (*Mimus polyglottos*) (Oklahoma Birds Records Committee 2000), was observed relative to weather. My objectives were to: 1) determine the effect of varying weather conditions on mockingbird calling frequency and 2) examine associations between weather parameters and calling rates.

Methods.—The most direct approach to determine effects of weather on bird song is to record how frequently birds call during various weather conditions. I listened to Northern Mockingbirds in Norman, Hall Park, and Noble, Oklahoma, from February to April 2002. Observations took place in urban and residential habitats. Most observations were taken between sunrise and sunset. All observations were also taken $\leq$ 25 m from an observable mockingbird to ensure of all the calls were audible. Calling data were collected for 1 individual per observation.

Mockingbirds imitate a variety of sounds of varying lengths and make imitations with a varying number of repetitions. Therefore, each imitation was counted as a single call. Number of calls that each mockingbird made was divided by the number of minutes the mockingbird called to calculate a standardized rate of calling for comparison among observations of differing lengths.

Surface-level weather data were downloaded from the University of Oklahoma School of Meteorology computer server. Those data came from the Automated Weather Observing System (AWOS) in Norman, Oklahoma, the closest AWOS to the observations of mockingbird calling. Data for wind speed (knots), wind direction (degrees), temperature (C), dewpoint temperature (C), and surface pressure (in millibars) were entered into a database. The correlation coefficient (r) of temperature with pressure was -0.82, so pressure was not used as a predictor variable in models of call rates. A final set of 6 variables was tested as predictors of mockingbird calling, including temperature, dewpoint temperature, east-west wind speed, north-south wind speed, wind direction, and time of day.

Poisson regression was used to model variability in mockingbird calls. Poisson regression assumes that data follow a Poisson distribution, given by $f(x)=e^{-q}*q^{x}/x!$, with the mean and variance being equal to q (Tamhane 2000). A distinct advantage of assuming a Poisson distribution was that the model generated no negative values, a valid assumption with count data. An additional benefit of Poisson regression is that as the mean in count data increased, the variance also increased, because the mean and variance are equal to each other in a Poisson distribution (Tamhane 2000).

Results and Discussion.—Mockingbird calls were counted during 27 observations. Weather conditions during observations included unseasonably cold (temperatures below freezing, snow on ground, strong northwest winds) to warm spring-like weather (temperatures ≥ 25° C, moderate southeasterly winds, sunny skies), rainy conditions, and most weather conditions intermediate between these extremes.

A simple Poisson model using only temperature, east-west wind speed, and north-south wind speed was the first model applied to the data. Temperature accounted for 11.7% of the total deviance, east-west wind speed accounted for 14.7% of the deviance, and north-south wind speed accounted for 10.3% of the deviance. Thus, all 3 variables accounted for approximately equal amounts of the deviance in calling rates. Overall, 37% of the total deviance in mockingbird calling data was explained by these 3 predictor variables.

A 6-variable Poisson model also was tested. None of the added independent variables significantly improved upon the 3-variable model. The 6-variable model explained 43% of the total deviance in calling rates compared with 37% in the 3-variable model. The 3 original variables accounted for 9–12% of the deviance in this model, while the 3 additional variables only accounted for 2–5% of the deviance. Specifically, contributions from dewpoint temperature and wind direction were about one-half as much as those of the original variables, while almost none of the variance in mockingbird calls could be accounted for by time of day. Thus, under similar weather conditions, a mockingbird would sing about as much at 0600 h as it would at 1800 h.

Conclusions.—Overall, a 3-variable Poisson model did the best in accounting for calling rates of mockingbirds. Although the 6-variable Poisson model explained a slightly higher amount of the deviance in singing rates, I did not find the difference to be sufficient to justify the extra model terms. This determination was based on residual errors of competing models. Because components of the Poisson model corresponding to surface winds made a strong contribution toward explaining deviance, there also could be a relationship between advection patterns and mockingbird calling.

Northern Mockingbird singing appears to be sensitive to a number of weather-related parameters. With the Northern Mockingbird being one of the more common species in Oklahoma, it makes a good model for further quantitative study into avian weather-sensing abilities.

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First record for the Bronzed Cowbird in Oklahoma.—We observed a Bronzed Cowbird (*Molothrus aeneus*) on a bird feeder at the house of Esther Israel in Keyes, Cimarron County, Oklahoma, on 18 May 2003. Using binoculars (8.5 x 42 Swarovski and 10 x 40 Zeiss) and a spotting scope (27 x 82 Kowa), we were able to observe its glossy black plumage, heavy bill, short tail, stocky shape, red eye, and neck ruff, which it flared several times during the 15 min. we observed it from 1830h.