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SUNRISE, SUNSET, AND THE SONG OF THE CARDINAL

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The purpose of this study was to determine the relationship in time between the rising and setting of the sun and the first and last songs daily of the Cardinal, *Richmondia cardinalis*. The time in which this study was made was from April 1 to April 30, 1960. Preliminary observations were made in March in order to determine the general times of the first and last songs of the day. Observations were made every two to four days in April. The site of study was an area of three to four square blocks surrounding the 900 block in Ohio Street, Lawrence, Douglas County, Kansas. The radius of this area was the maximum distance from the site of observation at which the song of a Cardinal could be heard. In the morning the first song and those occurring five to ten minutes after the initial song were noted; in the evening all songs given within thirty to forty-five minutes of the final song were usually recorded.

Sunrise and the first morning song.—Figure 1 (upper) shows the relationship between the time of sunrise and the first song of the day of the Cardinal, in the month of April. There is a clear indication that the time of day of the first song is related to the time of sunrise. The chart shows that, as the sun rose earlier, the first song of the Cardinal occurred at a correspondingly earlier time in the morning.

The time of the first song of the Cardinal preceded sunrise by approximately ten minutes. By plotting a curve ten minutes earlier than the curve showing the time of sunrise (Fig. 1, upper), the new curve is seen to be essentially the same as a curve fitted by eye to the mean time of occurrence of first morning songs. None of the first morning songs deviated more than three minutes from the time plotted by this curve for any given day. The range of deviation appears to be remarkably small; the sensory receptors that receive the stimuli, and which ultimately induce the first song, are sensitive enough that each day songs are given within the same six-minute period, seven to thirteen minutes before sunrise.

Sunset and the last evening song.—Figure 1 (lower) depicts the relationship between time of sunset and last daily song of the Cardinal. The last daily songs of the Cardinal bear only a crude relationship to times of sunset throughout April. Yet, as the sun set later in time, the birds tended to sing later in the evening. The relationship is not so clear as that between the first morning song and sunrise, but it is clear that early in the month no songs occurred later than 6:45 p.m., while by the end of the month the last song was recorded at 7:15 p.m., a full half-hour later. From Figure 1 it appears as though the curve of the time of sunset is nearly a curve around which the times of last songs fall. This indicates that, by and large, the last songs occurred about sunset, not a definable period before or after.

Perhaps the strict adherence to a specific time of first song in relation to sunrise and the much looser adherence to a specific time of last song in relation to sunset can be explained in this manner: Some diurnal rhythms of other animals have as the main stimulus in maintenance and timing of that rhythm the first light perceived in a day, or in a comparable, but experimental period. If it is possible to attribute the primary stimulus of song, in this instance, to the light perceived before sunrise and a secondary influence due to the diminishing light in the evening, one might expect that a distinct and

sharp response would be given to the rising sun and a more indefinite and broad response would be given to the setting sun.

Relationships of songs with weather.—There were days when Cardinals were observed to not begin singing until much later in the morning or to cease singing earlier

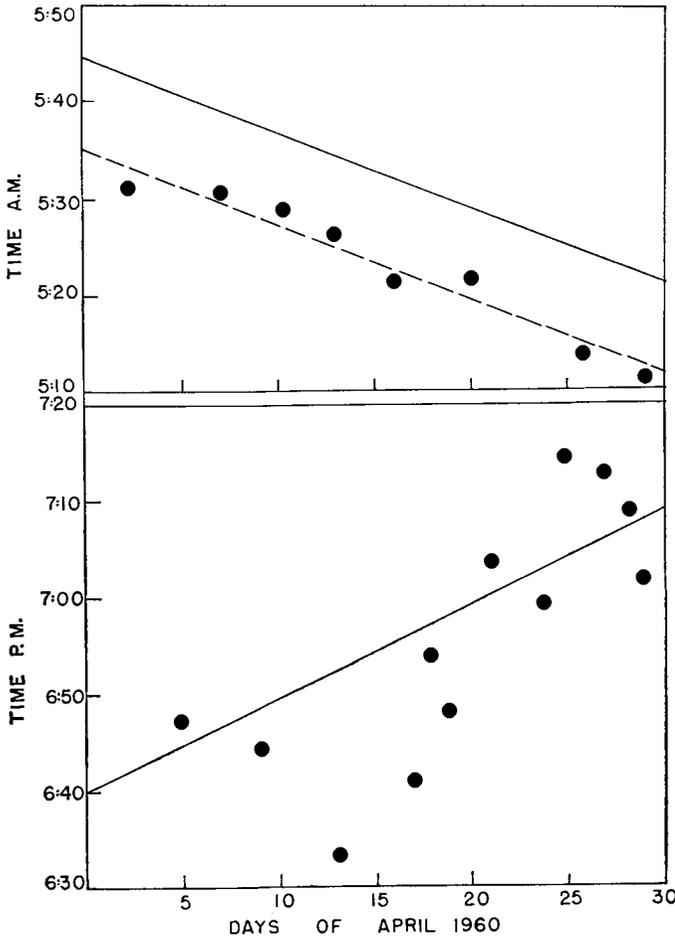


Figure 1. *Upper:* The relation of the time of sunrise to first morning song of the Cardinal. Time of sunrise (—), taken from the World Almanac, 1960, and the Kansas City Times newspaper, April 29, 1960; time of sunrise less ten minutes (---); earliest song is shown by heavy black dot. *Lower:* The relation of the time of sunset with last evening song of the Cardinal. Time of sunset (—), taken from the World Almanac, 1960, and the Kansas City Times newspaper, April 29, 1960; last evening song is shown by heavy black dot.

cloudy with a storm imminent." There is in these notes an indication that in inclement weather the usual responses of the Cardinal to sunrise and sunset may be modified, probably owing to the influence of clouds on light conditions.

Department of Zoology, The University of Kansas, Lawrence, May 29, 1960.

Nestbuilding of the Bell Vireo.—Nestbuilding activities of the Bell Vireo (*Vireo bellii bellii*) commence in early May in northeastern Kansas. Data are available from other areas, but these have been incomplete and consequently have led to an inaccurate picture of the role of the sexes in construction. Nests are difficult to find owing to their

placement in dense shrubbery, and most reports perforce have resulted from the fortuitous discovery of completed or partly-built nests. The present report is based on data collected from May 10, 1959, through June 26, 1959, and May 3, 1960, through May 15, 1960, on the grounds of The University of Kansas Laboratory of Aquatic Biology, one-half mile west of Lawrence, Douglas County, Kansas. A total of 17 hours was spent exclusively observing phases of nest-construction of 9 nests built by 4 different pairs.

OBSERVATIONS AND DISCUSSION

The selection of the nesting site is a function of the female, but the male attends her closely with song. The pair flies from tree to tree, the female usually a few feet in front of the male. In the course of foraging, the female frequently stops to inspect lateral and terminal forks on low-hanging branches. This procedure is repeated until a satisfactory nest-site is located. Selection of the site may require up to two days for the first nest, but thereafter as little as two hours can be involved. The actual site is a small fork, either lateral or terminal on a branch from 18 inches to 28 inches above the ground in an Osage orange, elm, honey locust, poplar, coral berry or dogwood.

It was formerly thought by some workers that the female built unaided (Pitelka and Koestner, 1942); however, Nice (1929) had indicated earlier that the male occasionally helps the female. Hensley (1950) and Mumford (1952) further substantiated participation by the male. My observations have revealed not only that nestbuilding involves both sexes but that a definite division of responsibility exists. The male builds the hoop on the first day. The female accompanies the male on about every 20th trip to the nest. Ordinarily she does not accompany the male as he gathers nesting material, but, rather, she forages in the vicinity of the nest. The construction of the hoop consists of arranging pieces of grass around the fork and binding them in place with spider silk. Concomitant with this activity is the hanging of wads of cottony, plant material from the hoop. Individual wads are emplaced with a pecking and twisting movement of the head.

Early on the second day of work the female begins to participate and usually within an hour she has taken over all duties of construction. From this time on the male, singing almost continuously, accompanies the female as she gathers material and builds. Her initial project is the shaping of the basket. This requires about five hours, and the female employs a variety of techniques in this period, including weaving of the grasses and leaves with the bill, emplacement of wads of material with motions similar to those utilized by the male, trampling of the bottom, and repeated turning around within the basket to mold it.

Lining the basket takes the most time. Lining begins on the third day and overlaps the beginning of egg-laying on the sixth day. This phase of building involves primarily the trampling of the bottom and the insertion of strands of lining material. To accomplish this the female, while standing on the edge of the nest, inserts one end of a piece of grass, hops into the nest and, as she slowly turns around, she affixes the remainder of the grass stem until it is completely coiled around the interior of the basket.

Nesting material is gathered within the territory, from as near as two inches to as far as two hundred feet from the nest. Each trip to the nest, whether by the female or the male, is heralded by the song of the male, and a definite route is followed. The nesting material consists of rootlets, dead leaves, grasses, bark, spider silk, and spider egg sacs.

Nestbuilding is intimately associated with courtship and construction is often interrupted by epigamic displays by the male. It seems that the early construction activities of the male, interspersed with brief, but vigorous, periods of courtship, arouse a tendency toward nestbuilding in the female. The inception of actual nestbuilding in the female coincides with the completion of the suspension apparatus by the male.

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Jon C. Barlow, Museum of Natural History, The University of Kansas, Lawrence, June 4, 1960.

REVIEWS

A Field Guide to the Birds of Texas.—Roger Tory Peterson. The Texas Game and Fish Commission, Austin, and Houghton Mifflin Company, Boston. 1960. xxx + ii + 304 pp., 20 figs. in text, 60 pls. Price \$3.00 (obtainable only from Texas Game and Fish Commission, Austin, Texas).—This book is one of the rareties of any age, the real bargain. Because bargains can be either or both high in quality and low in price, it should be emphasized that this one is both. The Texas Game and Fish Commission has absorbed some of the costs of production and Mr. Peterson has easily outdone his previous North American efforts, particularly in the text.

The book is comprised of prefatory remarks (chiefly acknowledgments of assistance from persons and sources, a list nearly matching Texas in size), and a map of Texas showing cities and eleven named areas of reference to occurrence of birds (chiefly arbitrary and for convenience, but nevertheless showing certain fundamental relationships to physiographic, vegetational, and faunal distribution), an introduction concerning places to find certain birds in the state, a section on how to use the book, the "checklist," the accounts of species, an appendix on "accidentals" and species of hypothetical occurrence, one on extinct and unsuccessfully introduced species, one on silhouettes, and an index to vernacular and Latin names. Aside from the curious fact that the map is printed in two parts separated by eleven pages including the table of contents, the book is wholly praiseworthy.

It is in the material descriptive of families and the paragraph for each species headed "Where found:" that information new to the Peterson bird guides will be found. The standard, brief remarks concerning gross familial characteristics useful in field identification are preserved, but added are sentences concerning food, total distribution, and number of species in the world, in North America, and in Texas. In the paragraph on distribution of any species, the total range is outlined, distribution and status in Texas is given, and the habitat is briefly characterized; for those species breeding in Texas nestsite and number and color of eggs is added. An enormous amount of good, not necessarily over-generalized, information is thus added in these additional remarks. The business of field identification, in text and figure, is naturally predominant and the reason for being of the book, but reference to those other matters is now conspicuous.

Kansans particularly should note that the geographic coverage is of an area heretofore in part a virtual no-man's-land as far as field guides have been concerned, owing to the westerly, easterly, and southerly avifaunal elements that find peripheral distribution in this region. Texas, to be sure, is more of a meeting ground for diverse avifaunas than is Kansas; Kansans nevertheless deal with a heterogeneous assemblage of birds and previously have had to carry more than one field guide if they wanted to be able to check the identity by sight of all birds encountered in a day's work. Now, with suitable cryptic annotations, this guide to birds of Texas can be made to serve the needs of Kansans who watch birds. No one in the mid-continental United States should knowingly be without this book.—Richard F. Johnston.

Fall Field Trip.—Meet Sunday, October 2, 9 a.m., Quivira Natl. Wildlife Refuge, 12 mi. N Stafford. You must advise Frank Robl (Box 338, Ellinwood; JO 4-2754) if you plan to attend. Overnight accommodations available in Great Bend. Field trip at Kansas City cancelled.

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