TEMPERATURE AND RELATIVE HUMIDITY IN RELATION TO THE ENDING OF THE EVENING SONG OF BIRDS[1]

PAUL R. ELLIOTT

GEORGE PEABODY COLLEGE FOR TEACHERS, NASHVILLE, AND RICHARD HARDY MEMORIAL SCHOOL, RICHARD CITY

For some time, American and European investigators have attempted to ascertain the relation of bird songs to meteorological factors. These students have usually limited their study to one particular phase of singing, such as, morning song, evening song or night song. Some of the most important work in this field is reviewed by Shaver and Walker (1930).

In studying the awakening song of various birds in Washington, D. C., Allard (1930) found that the first notes were sung in the morning between the time of astronomical twilight and sunrise. He concluded that light was the factor involved, but in his study no attempt was made to measure the actual amount of light present at the beginning of the song. He also concluded that temperature relations appeared to play a very minor part in the first morning song.

In Tennessee, three studies of evening song, one of evening calls, and one of morning bird song have already been made. Miss Ruby J. Walker (1929) and Tait (1930) studied the relation of evening song ending to light intensity. Hieatt (1931) studied evening bird calls in relation to light intensity, and Mrs. Emily Barry Walker (1928) made a study of the awakening song of birds in relation to light and other factors. In only one of these studies, that of Miss Gladys O. Walker (1929), has temperature and relative humidity been considered. She points out in reviewing previous work that very little has been done on the subject. The conclusions from her study were that temperature and relative humidity appeared to have no relation to the time at which birds stopped singing in the evening.

Later, using the same data on the Mockingbird, Shaver and Walker (1930) found that temperature played a significant role in determining the time at which the Mockingbird stopped singing in the evening, the coefficient of correlation being $.57 \pm .07$. When Shaver and Walker (1930) discovered the existing relation between the ending of the Mockingbird's song and temperature, they were considering all temperature variations and treating their data statistically.

In this study, it was decided to collect data on a greater number of birds' songs and over a longer period than that used by Shaver and Walker (1930) to find out whether or not the evening song of each species is affected by either temperature or relative humidity. The

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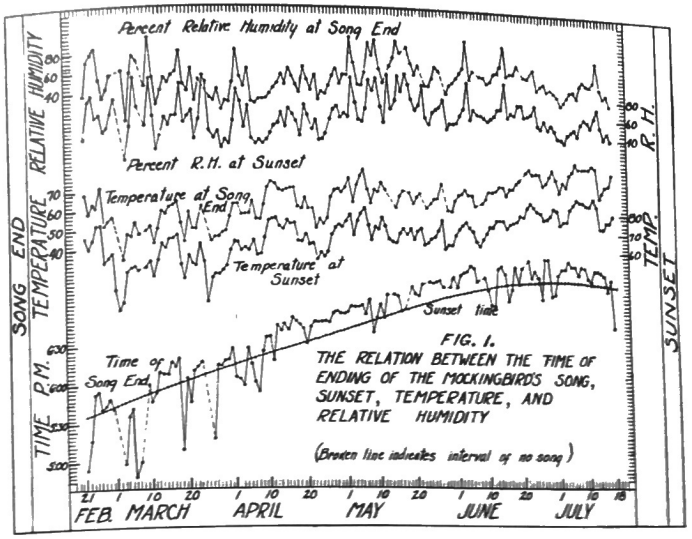


FIG. 1. THE RELATION BETWEEN THE TIME OF ENDING OF THE MOCKINGBIRD'S SONG, SUNSET, TEMPERATURE, AND RELATIVE HUMIDITY (Broken line indicates interval of no song)

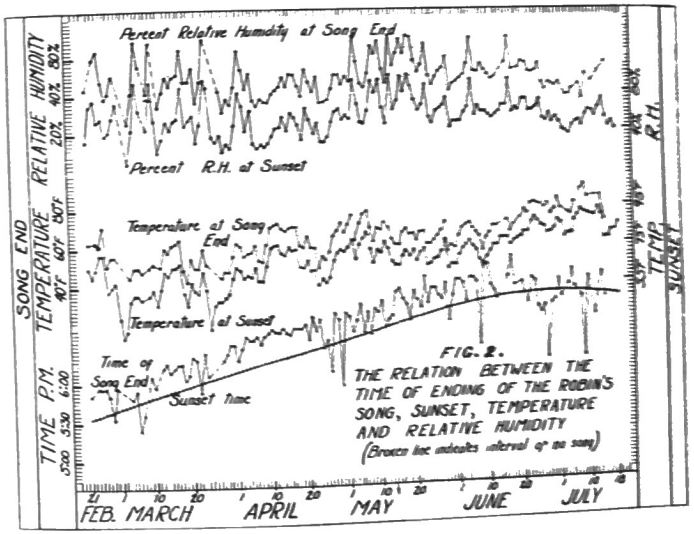


FIG. 2. THE RELATION BETWEEN THE TIME OF ENDING OF THE ROBIN'S SONG, SUNSET, TEMPERATURE AND RELATIVE HUMIDITY (Broken line indicates interval of no song)

writer is greatly indebted to Miss Blanche Tait for assistance in collecting the field data and to Mrs. Paul R. Elliott for help with the mathematical calculations.

The evening song in this study is defined as the last song of the day, and is usually sung during the twilight period. The birds considered were only those of the diurnal group.

Daily observations were started on February 21, 1930, and continued through July 18, 1930, covering a period of 147 days.

The study was made in an open section southeast of the Psychology Building on the campus of George Peabody College for Teachers, Nashville, Tennessee.

The daily observations started each evening about one hour before sunset and continued until after dark, or about fifteen minutes after the last song ended.

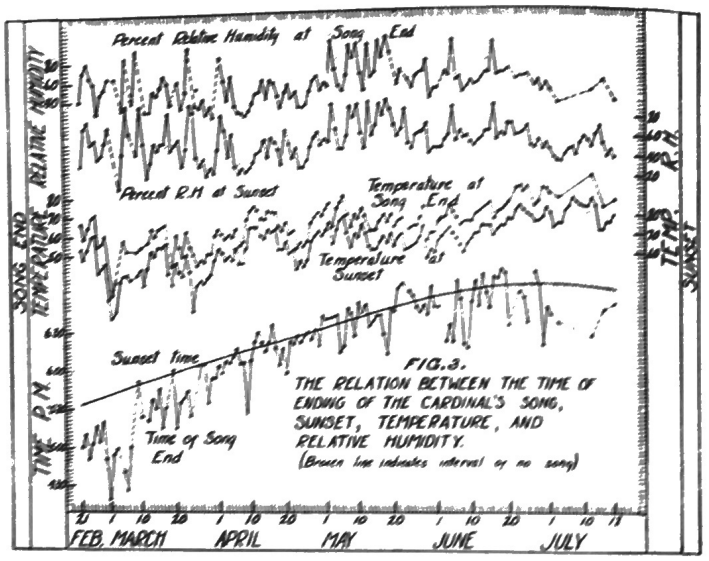


FIG. 3. THE RELATION BETWEEN THE TIME OF ENDING OF THE CARDINAL'S SONG, SUNSET, TEMPERATURE, AND RELATIVE HUMIDITY. (Broken line indicates interval of no song)

With the aid of a watch, which was checked daily with Western Union time, the exact time of every song end was recorded in the field notes.

At intervals of fifteen minutes the wet and dry temperatures were taken with standard Fahrenheit thermometers at a height of three feet above the ground. The thermometers were shaken before reading to minimize radiation and insolation effects and read to five-tenths of a degree.

The last song of each species was taken from the daily field notes, and the wet and dry temperatures at the time of the song ending were computed by interpolation, assuming that the temperature change within fifteen minutes was a straight line.

The percentage of relative humidity at the ending of the songs was determined from the wet and dry bulb thermometer readings by the psychrometric tables by Marvin (1915).

Sunset time was obtained from the records of the Nashville Weather Bureau.

Of the twenty-seven birds whose evening songs were recorded during the period of field work, the nine which sang the greatest number of times, namely, the Mockingbird, Robin, Cardinal, Chipping Sparrow, Wood Thrush, Mourning Dove, English Sparrow, Catbird, and Carolina Wren were selected and studied in detail.

It was found after a preliminary study that the problem was not one in which the Class Aves could be treated as a unit, but that it would be

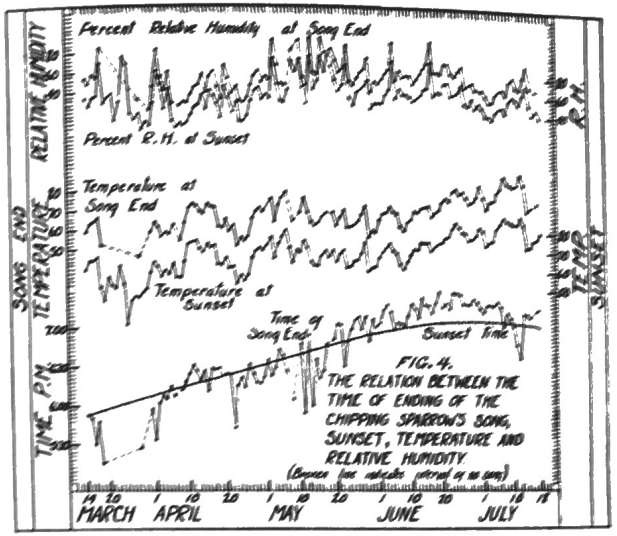


FIG. 4. THE RELATION BETWEEN THE TIME OF ENDING OF THE CHIPPING SPARROW'S SONG, SUNSET, TEMPERATURE AND RELATIVE HUMIDITY. (Broken line indicates interval of no song)

necessary to establish relations for each species separately. This species variation is also pointed out by Shaver and Walker (1931) and Hieatt (1931). Considering this fact, separate graphs were plotted for each of the nine birds studied to show the relation of time, temperature and relative humidity, at the time of song ending, to temperature and relative humidity at sunset time. (Figs. 1-9).

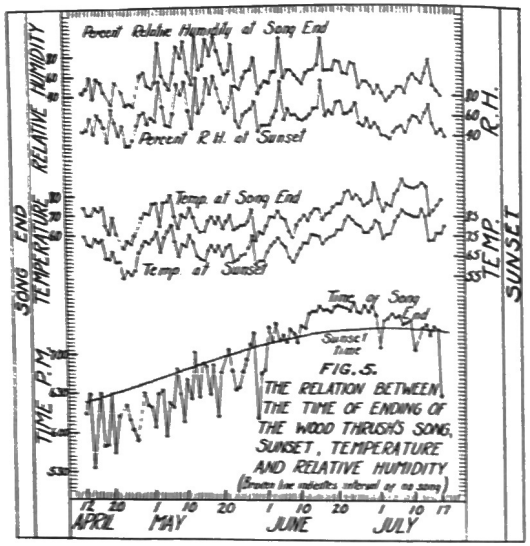
With the Mockingbird (Fig. 1) it is easily seen that, in general, the time of song ending parallels the sunset time. In most cases the evening song of this bird ended later than the time of sunset. Relative humidity and temperature at the song end time are also shown in relation to these conditions at the time of sunset, but no relation is apparent from the graph.

With the Robin (Fig. 2) the same parallel between time of song ending and sunset time is readily seen. Here also it is not possible to discover from the graphs any relation between relative humidity, temperature and song ending time.

Similar comparisons indicated no relation in the case of the Cardinal (Fig. 3), the Chipping Sparrow (Fig. 4), the Wood Thrush (Fig. 5), the Mourning Dove (Fig. 6), the English Sparrow (Fig. 7), the Catbird (Fig. 8), and the Carolina Wren (Fig. 9).

In order to determine further the relationships existing, a statistical analysis—that of comparison by means of the product-moment correlation coefficient—was employed. This method of computing the correlation is given by Shaver and Walker (1930). The probable error was obtained by the method given by Garrett (1926).

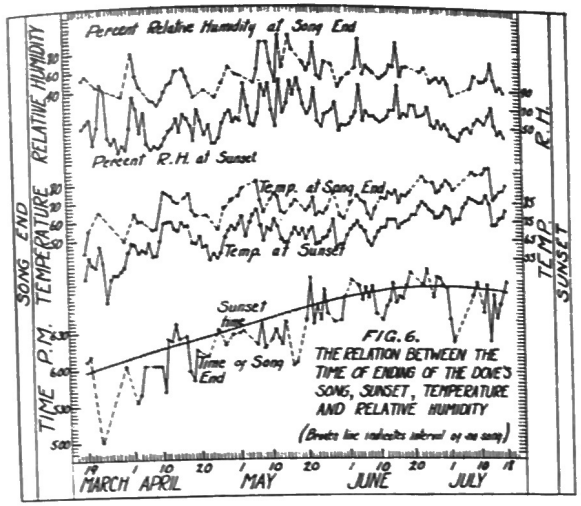
The results of this method are shown in table 1, but some explanation will assist in interpreting the results. A correlation coefficient may be

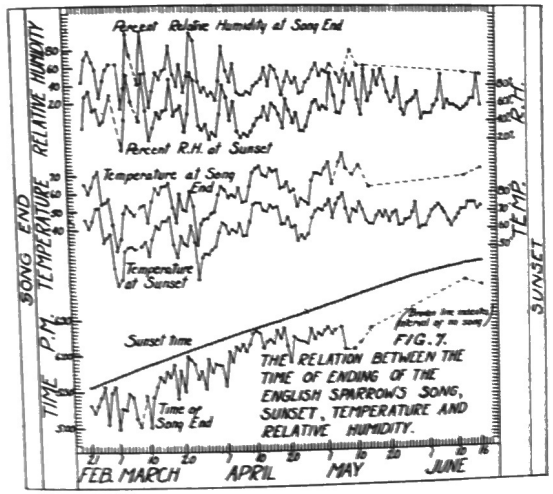


either positive or negative. A perfect positive correlation is expressed by a coefficient of + 1.00 and a perfect negative coefficient by — 1.00. The absence of any relation or correlation will give the coefficient 0. It follows then that any coefficient from 0 to + 1.00 will show a positive relation while a coefficient from 0 to — 1.00 will show a negative relation. The value of a correlation depends largely on two conditions: (1) that the probable error be small and (2) that the number of cases be large.

From the graphs and the high positive coefficients obtained in correlating the time of song ending with the time of sunset, it is easily seen that there is a tendency for birds to stop singing in the evening at a time which closely parallels the time of sunset. It must be noted that sunset time varies from day to day; it being 5:34 P. M. on

February 21, and 7:08 P. M. on June 29. This indicates that whatever the factor or factors may be which cause the birds to cease their evening song, they are closely related to the time of sunset.





Since this relation was apparent, it was decided to compute other correlations using temperature at the ending of the song as one variable, and the minutes before or after sunset as the other. The time before sunset was regarded as negative and the time after sunset as positive.

In the same way, relative humidity and time were compared. The results of these correlations are given in table 1, columns 2 and 3.

Considering the Mockingbird, which during the period of observation sang a total of 137 evenings, the correlation of temperature at song end with minutes from sunset is .85 ± .02. This is regarded as being very high and signifies that the Mockingbird on warm days sings later after sunset than it does on cold days. This substantiates the results obtained on the same bird by Shaver and Walker (1930) where a like correlation with the same factors gave a coefficient of .57 ± .07. The

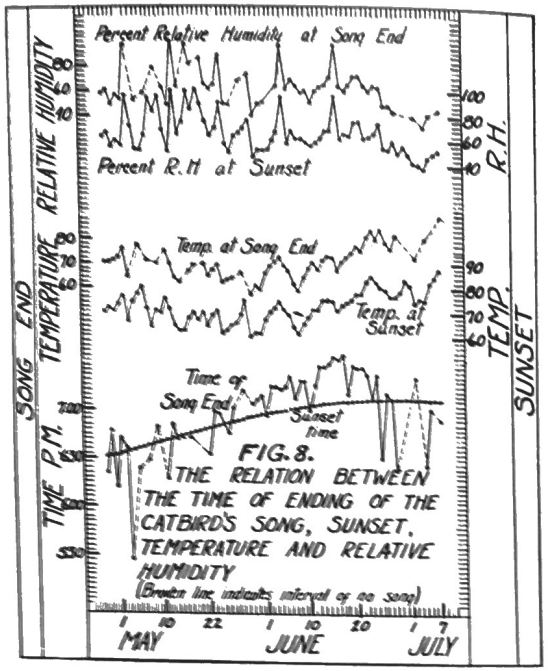


FIG. 8. THE RELATION BETWEEN THE TIME OF ENDING OF THE CATBIRD'S SONG, SUNSET, TEMPERATURE AND RELATIVE HUMIDITY (Broken line indicates interval of no song)

difference in the coefficients may be due to their work being based on only 37 days observations during the winter and early spring season whereas this study involved 147 days during the spring and the first half of the summer.

For relative humidity, the coefficient was .005 ± .06. This indicates that relative humidity has no relation to evening song ending in the case of the Mockingbird.

In a like manner the evening song of the Robin was studied. The value of the coefficient for temperature in the case of the Robin was — .24 ± .06. Although the coefficient is hardly high enough to be of much value, it indicates that the Robin prefers cool days, since on these days its song ends later after sunset. With relative humidity, the

correlation was — .001 ± .06 which shows that this factor is not significant in this connection.

The ending of the Cardinal's song shows no relation with either temperature or relative humidity. The temperature coefficient, .00002 ± .06 is very low.

The temperature coefficient for the Chipping Sparrow, .31 ± .06, shows a slight relation, but with relative humidity gave — .07 ± .06 which is of no significance.

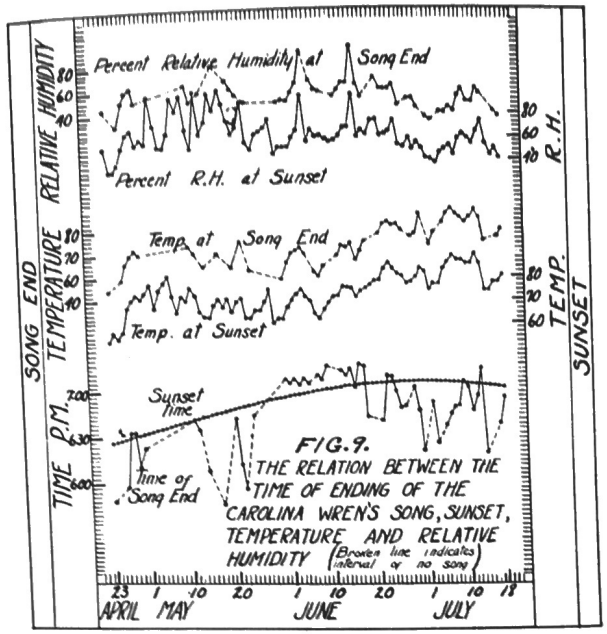


FIG. 9. THE RELATION BETWEEN THE TIME OF ENDING OF THE CAROLINA WREN'S SONG, SUNSET, TEMPERATURE AND RELATIVE HUMIDITY (Broken line indicates interval of no song)

Like the Chipping Sparrow, the Wood Thrush with a temperature correlation of .37 ± .06 shows some relation, while the relative humidity correlation of .03 ± .07 is of no value.

Correlating the end of the Mourning Dove's song with temperature gave .03 ± .08 and with relative humidity gave — .08 ± .07, both coefficients too low to be of any significance.

The song of the English Sparrow when correlated with temperature gave a coefficient of .11 ± .08 which is not significant. When correlated with relative humidity it gave — .34 ± .07 which shows a slight tendency for this bird to sing later when the relative humidity is low.

The Catbird's song when compared with temperature gave — .20 ± .08 and with relative humidity gave .26 ± .08. Though very

low, the correlation means that most of the time the Catbird sings later when the temperature is low and relative humidity is high.

The Carolina Wren also showed a negative correlation when compared with temperature; it being — .16 ± .09, while with relative humidity it gave .30 ± .08.

Although the coefficients for the Catbird and Chipping Sparrow are quite low, the correlations indicate that both birds respond alike to temperature and relative humidity changes.

The Yellow-billed Cuckoo, which is commonly called the Raincrow, does not show a measurable effect when the time of song ending is

TABLE 1

The Correlation Coefficients Between the Ending of Bird Songs, Sunset, Temperature and Relative Humidity

Name of Bird	Time of Song End From Sunset with				Time of Song End with Time of Sunset		Number of Days Bird Sang Out of a Total of 147 Days
	Temperature		Relative Humidity				
Mockingbird	.85	±.02	.005	±.06	.88	±.01	137
Robin	—.24	±.06	—.001	±.06	.82	±.02	128
Cardinal	.00002	±.06	—.05	±.06	.84	±.02	125
Chipping Sparrow	.31	±.06	—.07	±.06	.88	±.01	110
Wood Thrush	.37	±.06	.03	±.07	.89	±.01	95
Mourning Dove	.03	±.08	—.08	±.07	.83	±.02	80
English Sparrow	.11	±.08	—.34	±.07	.87	±.02	79
Catbird	—.20	±.08	.26	±.08	.79	±.03	58
Carolina Wren	—.16	±.09	.30	±.08	.79	±.04	53
Yellow-billed Cuckoo			.22	±.11			33

compared with relative humidity. This coefficient of .22 ± .11 is so low that the question arises as to the desirability of using the common name, Raincrow, for this bird.

With the exception of the Mockingbird, none of the correlations are high enough to make a definite statement that their song ending is dependent on either temperature or relative humidity. Since these factors are only slightly related to most of the birds studied, some other factor, probably light or some physiological condition of the bird determines when the song shall cease.

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