THE NESTING SEASON OF BIRDS IN DONIPHAN COUNTY, KANSAS

WITH TWO ILLUSTRATIONS

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The analysis of the nesting season of birds near Oroville, California, by Mr. W. B. Davis, in this issue of the CONDOR (pp. 151-4) has prompted me to place on record a comparable lot of information dealing with the same subject in another part of the United States, namely, near the townsite of Geary, Doniphan County, Kansas. Various features of the latter survey have already been reported upon as follows:

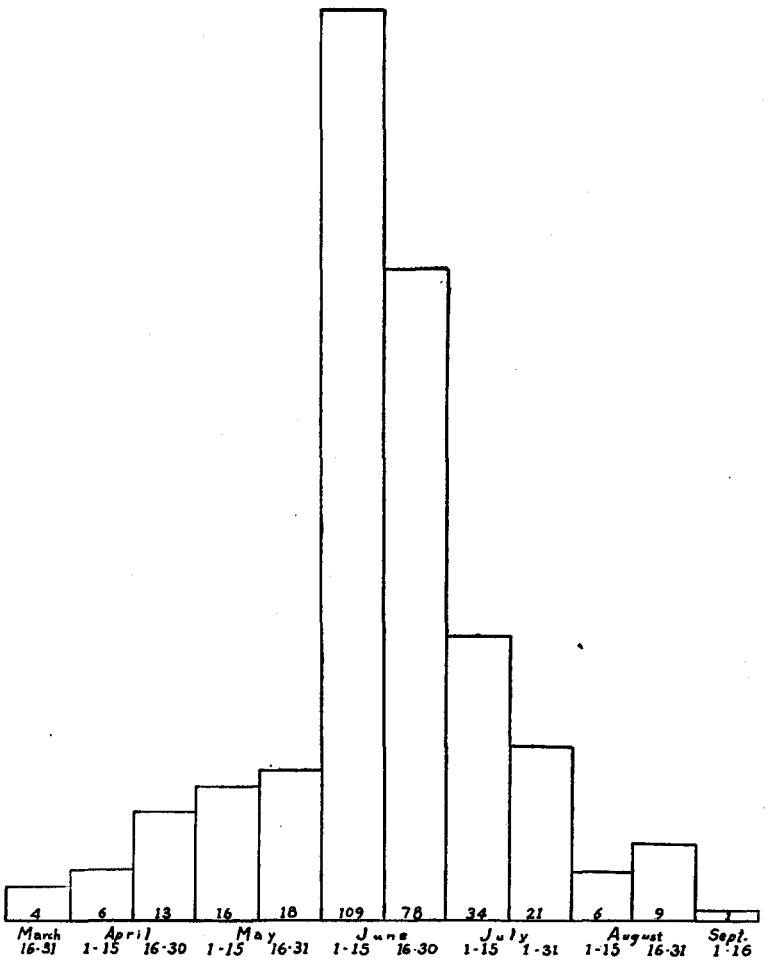

Fig. 30. CHART SHOWING NUMBERS OF OCCUPIED BIRD NESTS FOUND IN EACH TWO-WEEKS PERIOD FROM MID-MARCH TO MID-SEPTEMBER IN DONIPHAN COUNTY, KANSAS.

general accounts of the birds were given in the University of Kansas Science Bulletin (18, 1928, pp. 517-626); analysis of relations between plants and birds (*ibid.*, pp. 499-515); relative frequency of occurrence, CONDOR (30, 1928, pp. 180-184); environmental relations, Wilson Bulletin (40, 1928, pp. 157-177).

The two stations, Oroville, California, and Atchison (8 mi. from Geary), Kansas, which mark the locations of the areas studied and which have weather recording stations that furnished records of climate, are located at 39° 29′ N. 121° 36′ W. and 39° 33′ N. 95° 10′ W., respectively. In other words they are at nearly the same latitude but they are approximately fourteen hundred miles apart from west to east. The two areas are both under 1000 feet altitude, the California one being under 500 feet. Work was done at the Kansas locality between 1921 and 1925, but most of the records were obtained in two seasons. The California records show 333 nests of 51 species and the Kansas records, 315 nests of 57 species.

The chart (fig. 30) and tabulation of nests found in northeastern Kansas show that the nesting season extends from the middle of March to the middle of September. These limits would probably be extended by the addition of more observations, but it is not likely that the peak of nesting shown for the first two weeks of June would be shifted by more examples, no matter how extensive.

A rough classification of the nests according to their height from the ground gives an indication of the type of nester best suited for the general region. The following are the classes of heights distinguished and the number of nests found in each: under 2 feet, 30; 2 to 5, 85; 5 to 7, 43; 7 to 10, 35; 10 to 12, 17; 12 to 15, 18; 15 to 20, 20; 20 to 25, 16; 25 to 30, 10; 30 to 35, 3. Total, 277 nests. Thirty per cent or more than one-fourth of these nests were at heights between two and five feet from the ground.

The distribution of the nests by habitats is notable because of the close parallel between the numbers of nests and the numbers of species observed in the same types of habitat. In the following list of ten of the habitat divisions recognized are shown (1) the number of nests found and (2) the number of kinds of birds recognized in the same type of habitat at some time of the year. Typha, 14, 26; salix-populus, 74, 101; creek-bottom, 20, 80; bluff, 98, 109; sprouts, 10, 11; orchard, 9, 21; road, 23, 43; pasture, 10, 16; yard, 36, 51; buildings, 13, 14.

TABULATION OF NESTS FOUND IN DONIPHAN COUNTY, KANSAS

Species	Number of nests	Earliest date	Latest date	Estimated date for fresh eggs
Green Heron	1	June 5, 1923	.....	May 15
Turkey Vulture	1	June 6, 1923	.....	May 1
Cooper Hawk	2	June 7, 1922	June 11, 1922	May 15
Red-tailed Hawk	1	March 31, 1923	.....	April 1
Bob-white	1	June 10, 1922	.....	May 15
Mourning Dove	22	April 22, 1924	July 18, 1923	May 15
Yellow-billed Cuckoo	27	June 9, 1922	Sept. 9, 1923	June 15
Long-eared Owl	1	March 30, 1924	.....	March 15
Whip-poor-will	1	June 14, 1923	.....	June 1
Chimney Swift	2	July 16, 1923	July 18, 1923	June 15
Ruby-throated Hummingbird	10	June 4, 1923	August 5, 1922	June 15
Northern Flicker	1	June 10, 1923	.....	May 1
Red-bellied Woodpecker	1	April 29, 1923	.....	May 1
Red-headed Woodpecker	5	June 8, 1923	August 21, 1922	June 1
Hairy Woodpecker	1	April 29, 1923	.....	May 1
Downy Woodpecker	5	May 12, 1923	June 8, 1922	May 15
Kingbird	3	June 17, 1922	June 23, 1922	June 1
Phoebe	5	April 15, 1923	June 5, 1923	May 1
Acadian Flycatcher	2	June 14, 1922	June 26, 1923	June 15
Wood Pewee	4	June 21, 1922	July 13, 1923	June 15
Tree Swallow	4	June 7, 1923	June 13, 1922	May 15
Rough-winged Swallow	1	May 18, 1924	.....	June 1

Species	Number of nests	Earliest date	Latest date	Estimated date for fresh eggs
Barn Swallow	2	June 9, 1922	June 8, 1923	June 1
Blue Jay	8	April 20, 1924	June 16, 1922	May 15
Crow	7	March 31, 1923	June 11, 1922	April 15
Black-capped Chickadee	5	April 14, 1923	June 9, 1922	May 1
Tufted Titmouse	3	May 19, 1923	June 28, 1923	May 15
Western House Wren	6	June 9, 1922	July 11, 1923	June 15
Carolina Wren	7	April 21, 1924	August 28, 1923	May 15
Prairie Marsh Wren	1	May 30, 1924	.....	June 15
Catbird	5	June 7, 1923	July 16, 1923	June 15
Brown Thrasher	8	May 29, 1924	July 18, 1923	June 1
Robin	7	May 13, 1923	July 16, 1923	May 15
Wood Thrush	9	June 4, 1923	August 9, 1922	June 1
Bluebird	7	April 14, 1923	July 16, 1923	May 15
Blue-gray Gnatcatcher	4	June 4, 1923	June 19, 1922	June 15
White-eyed Vireo	1	June 29, 1923	.....	June 15
Bell Vireo	8	June 5, 1923	June 17, 1922	June 15
Red-eyed Vireo	6	June 7, 1923	August 23, 1921	June 15
Prothonotary Warbler	5	June 12, 1923	June 23, 1922	June 15
Yellow Warbler	2	June 7, 1923	June 8, 1923	June 1
Kentucky Warbler	1	June 30, 1923	.....	June 1
Maryland Yellow-throat	3	June 7, 1923	June 12, 1923	June 1
Yellow-breasted Chat	10	June 5, 1923	July 19, 1923	June 15
Yellow-headed Blackbird	1	May 30, 1924	.....	June 15
Red-winged Blackbird	14	May 29, 1924	June 14, 1922	June 1
Orchard Oriole	5	June 3, 1923	July 16, 1923	June 15
Baltimore Oriole	7	June 4, 1923	June 26, 1922	June 15
Bronzed Grackle	1	June 17, 1923	.....	June 1
Scarlet Tanager	1	June 15, 1922	.....	June 15
Summer Tanager	3	June 21, 1923	July 15, 1923	June 15
Cardinal	38	April 20, 1924	July 19, 1923	May 15
Rose-breasted Grosbeak	2	June 13, 1923	June 17, 1923	June 15
Indigo Bunting	18	June 8, 1923	August 23, 1922	June 15
Dickcissel	6	June 9, 1922	August 23, 1923	June 15
Lark Sparrow	1	June 9, 1922	.....	June 1
Field Sparrow	2	June 14, 1922	July 18, 1923	June 1

SUMMARY OF RECORDS OF BIRDS AND CLIMATE IN DONIPHAN COUNTY, KANSAS, AND BUTTE COUNTY, CALIFORNIA.

Temperature in Fahrenheit. Precipitation in inches. Kansas weather records from Atchison and Leavenworth; California records from Oroville.

	January	February	March	April	May	June	July	August	September	October	November	December	Summary
Kansas													
Days of field work	6	11	9	14	15	40	16	42	20	12	9	6	200
Number of species noted	41	42	64	95	124	106	73	114	121	62	59	34	196
Most species in one day	27	25	45	46	78	61	41	56	64	34	36	25	78
Nests found	—	—	4	19	34	187	55	15	1	—	—	—	315
Mean temperature	25.4	31.6	40.8	54.4	64.6	73.4	78.0	76.2	67.4	56.0	41.5	32.6	53.5
Precipitation	1.10	1.37	1.87	2.92	4.49	5.15	4.22	4.21	3.58	2.42	2.09	1.38	34.80
California													
Nests found	—	8	43	174	103	5	—	—	—	—	—	—	333
Mean temperature	46.8	50.6	54.3	59.5	66.1	74.5	80.2	78.6	73.0	65.4	55.9	47.8	62.7
Precipitation	6.22	4.22	4.03	1.80	1.50	0.37	0.03	0.01	0.74	1.46	3.18	4.89	28.33

Turning to a more direct comparison of the nesting seasons of the birds in the two areas it is noticed first that the shapes of the two column diagrams are closely alike but that they come at different times of the year. In the Kansas locality the peak of the nesting season comes during the first two weeks of June and it is at least six weeks later than the California one, in the last half of April. These diagrams

appear to show beyond any reasonable doubt that the difference in time of nesting here represented is a true one and not merely the consequence of personal peculiarities in methods of making or recording observations.

One difference in the records, of possible significance, is that Mr. Davis' dates in every case represent time of finding fresh eggs, while mine are indicative merely of occupied nests. After closely examining the whole lot of records with this point in mind I have reached the conclusion that about as many nests were found in stages of construction as were found with young so that the final averages are comparable fairly with the California records.

I might point out that my concern here is with the nesting season of all the species as a composite fauna and not an analysis of single species. The results of these two types of enquiry might differ, but preliminary studies of single species and of closely related ones indicate that single species in the two localities show the same sort of difference in nesting season as does the whole bird population.

Any attempt to analyze the nesting seasons at these two localities and to interpret the differences in time, involves an understanding of the factors which determine the time of nesting. Several ways of approaching this problem have been tried by laboratory and field workers. Usually each worker has dealt with only a single factor, with the result that single elements have been emphasized as though they represented the chief or only influences in the problem. One fault connected with many of these explanations is the intolerance of many of their proponents toward other possible explanations. Circumstances which might be thought of as important to consider in the present comparison involve the following: genetic factors in species represented; conditions in the winter homes of the birds; altitude; rainfall; temperature; photoperiodism; food supply.

As a basis for approaching this problem previous work on the physiology of reproduction in birds and other vertebrates seems to indicate that the seasonal cycle of egg laying results from the genetic constitution of each species, which determines the manner of response to external, and seasonally variable, factors. These factors appear to influence the activity of the reproductive system through the complex and interrelated system of endocrine glands. Furthermore, the bulk of the information seems to point to the pituitary as the organ most directly concerned in coordinating the internal rhythm with external factors.

As to temperature Tollenaar (1922, abstract in Exp. Sta. Rec., 48, 1923, p. 172), who worked on several kinds of wild birds over a four year period designed to show the influence of food supply and temperature on egg production during the different years, observed that the beginning of the laying period varies with different species, but the time of beginning was somewhat correlated with the previous 10-day temperature, and more closely correlated with the temperature from January 1 to the time of laying. Possibly a slight over-emphasis of the effect of temperature was given by Rowan by the comment (Proc. Boston Soc. Nat. Hist., 39, 1929, p. 202) that "the spring recrudescence of the gonads of birds is universally attributed to rising temperatures."

Rowan's own views can be expressed by quoting (*op. cit.*) his summarized statement that "it has been shown that the rhythm of the reproductive organs of the Junco (and several other species) can be interrupted almost at will by appropriate manipulation of the lighting conditions." He added that these organs "appear to show a remarkable dependence on the lighting conditions" but that "increasing periods of compulsory exercise in almost complete darkness substituted for light increases will effect recrudescence of the organs in similar manner. . . . It is therefore suggested

that the light increases in reality afford the birds the opportunity of increasing exercise and that this is the crucial factor in inducing the development of the gonads."

The investigations by Rowan, Bissonnette, and others appear to demonstrate that phenomena connected with the changing length of day in spring in temperate lati-

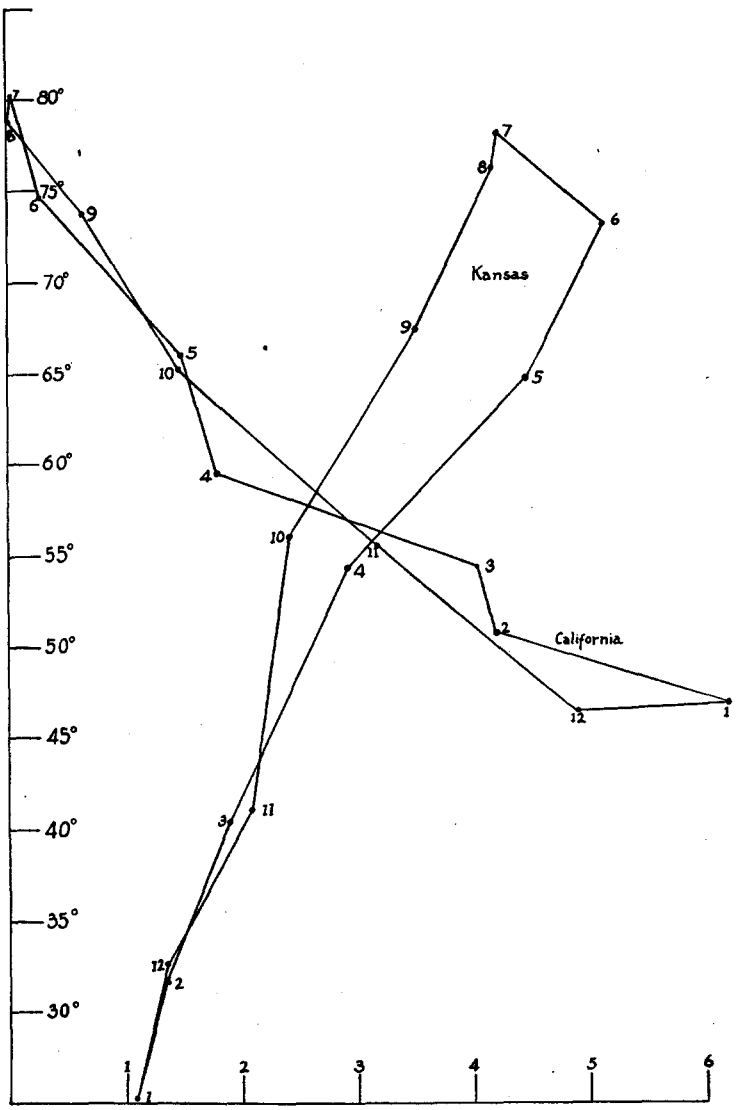

Fig. 31. HYTHERGRAPHS FOR OROVILLE, CALIFORNIA, AND NORTHEASTERN KANSAS (LEAVENWORTH AND ATCHISON). TEMPERATURE IS REPRESENTED IN DEGREES FAHRENHEIT, PRECIPITATION IN INCHES. NUMBERS BESIDE POINTS ON THE FIGURES DESIGNATE MONTHS OF THE YEAR.

tudes are important in establishing the time of nesting. If the time of beginning of the breeding cycle were entirely or even largely determined by length of day, we might expect birds in the same latitude to have closely similar calendars of breeding activities. The circumstance that the two present examples represent the nesting

seasons of localities at the same latitude offers an opportunity to test the applicability of this theory and to compare effects of photoperiodism with other factors. The difference in the seasons in this comparison must be due to some factor other than the one connected with light changes.

Climates of the two regions are represented by hythergraphs in figure 31. Examination of these graphs in connection with the diagrams of the nesting seasons brings the suggestion that when the birds are beginning to nest in California the weather in Kansas is much too cold to favor nesting activities and at the peak of the season in Kansas the heat and drouth in California are not conducive to nesting. That these conditions are really unfavorable for nesting follows from Mr. Davis' suggestion of a positive correlation between availability of food for young birds and time of nesting. The availability of food whether of animal or plant material seems to be obviously and rather directly dependent upon favorable climatic conditions. Abundance of plant growth and the insects which depend upon it requires warmth and moisture in combination.

Apparently in the two localities here dealt with the birds nest when forage conditions are best even if this comes six weeks later in one place than in the other and contrary to the expectation that the equality in advance of day-length might prescribe a common nesting season for both places. However, this condition need not be accepted as a denial of the effectiveness of the photoperiodic factor, but rather as an example of a way in which that effectiveness may be modified. In this case the modification seems to be mainly the result of varying climates which are determined by positions of the localities on the continent. It happens here that for an indicator of favorable time for nesting, graphs representing climate (precipitation and temperature) serve better than the advance in length of light periods as measured by chronological advance of season.

Museum of Vertebrate Zoology, University of California, Berkeley, April 21, 1933.