OBSERVATIONS ON THE BREEDING BIOLOGY OF KINGBIRDS

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The principal purpose of this paper is to suggest methods for handling miscellaneous observations on birds' nests, using those of Eastern Kingbirds (*Tyrannus tyrannus*) as examples. A variety of problems in the breeding biology of birds require data from many nests for their solution. These problems include variation in clutch-size within one season, from place to place, and from year to year, as well as time of maximum nesting and per cent hatch. The accumulation of adequate data to clarify these problems is slow because a large number of nests must be observed at frequent intervals. Some species, because of rarity or secretiveness, may never be known in detail.

However, it is possible, with proper caution, to use less complete observations to indicate whether a species appears to fit the general conclusions about other species derived from very extensive studies. In any event, gross differences may often be detected by analysis of a small number of observations.

A little reflection will make it apparent that analysis of a problem occurs by a series of refinements of handling of data. Suppose we ask the question, "Does the clutch-size of Eastern Kingbirds decline during the breeding season?" A crude answer can be given by merely noting that clutches found in June usually have 4 eggs while those in July usually have 3 eggs. A more refined answer can be given by analyzing statistically a number of clutches to determine the significance of the differences in each month. A still more refined answer can be given by waiting until many hundreds of nests have been found and analyzing the clutch-size for each day. Other refinements may then be explored, such as grouping for temperature and age of bird.

A compromise, however, can be made between the crude answer and the ultimate refinements by using the type of miscellaneous data accumulated by most bird watchers in their ordinary activities. These data are frequently adequate to indicate whether or not the breeding biology of a species agrees with that of other species. In other cases these data may suggest that a particular species merits a detailed study of some aspect of its breeding biology.

For a variety of reasons nests found by bird watchers may be examined only once or twice. At present data thus obtained lie unused in notebooks in spite of the fact that limited conclusions can be drawn. Consider, for example, clutch-size. It is perfectly obvious that a clutch in a nest observed only once is imperfectly known. However, if the eggs are warm the clutch is being incubated. The observer may assume it to be complete, but some eggs may have been removed by a predator or by cowbirds. But this same objection can be made to studies in which the nest is observed daily because a predator might remove the last egg of a clutch between the time it is laid and the time the observer arrives. The difference in accuracy is merely a matter of degree. A slight overestimate will occur because 2-egg clutches will often be considered incomplete and hence omitted. Therefore, it is permissible to use such miscellaneous observations for the detection of gross changes.

The observations to be analyzed for breeding are the pertinent data for each nest: date, place, number of eggs or young, location as to height and type of tree or site, and any other special points. An arbitrary rule may be established that if the young are hatching (for example, 2 eggs and 2 young), the nest may be counted as having eggs, not young (4 "eggs" in this case). The data should be organized into tables of frequency distributions.

A problem at once arises in the dating of the clutch, since one common objective is to find out whether or not a decline occurs during the breeding season. From one record an observer knows merely that the clutch was begun, for passerine birds, within about 16 to 20 days prior to the date of observation. On the average clutches are completed about 6 to 8 days before found. Thus, a clutch found on July 2 might be listed for the first half of July, although the chances are good that it was completed in late June. However, barring the vagaries of random sampling, the same errors will occur for other half months and the clutches will be on the average listed according to the actual time sequence. The average size of clutches therefore, relates to a time about 6 to 8 days before the eggs were found.

Table 1

Nesting Data on Kingbirds

	Period of time[1]			
	Last half of June	First half of July	Last half of July	Totals
Number of eggs	39	50	12	101
Nests with 2 eggs	0	(2)	0	(2)
" " 3 "	1	10	4	15
" " 4 "	9	4	0	13
Total nests	10	16	4	30
Mean number of eggs	3.9	3.3[2]	3.0	3.5[2]
Per cent[3]	33	53	14	....
Number of young	4	64	18	86
Nests with 0 young	0	2	3	5
" " 1 "	0	1	1	2
" " 2 "	0	0	1	1
" " 3 "	0	9	5	14
" " 4 "	1	9	0	10
Total nests	1	21	10	32
Mean number of young	4.0	3.1	1.8	2.7
Per cent[3]	3	66	31	....

[1] A nest was assigned to the time period in which it was found (see text).
[2] The two nests with 2 eggs were excluded because it was known that magpies had destroyed some eggs.
[3] The percentage of total nests with eggs or young found in the respective periods.

RESULTS FOR KINGBIRDS

Observations of nests were obtained in the neighborhood of Flathead Lake, in western Montana in the four summers from 1950 to 1953, inclusive. The data in table 1 are grouped by clutch-sizes and number of young per nest according to the half month in which the nest was found. It is at once apparent that the clutch-size declined in the observed sample. The peak of laying is about July 1 (subtracting 8 days from the midpoint of the first half because incubation is 16 days). The peak percentage of nests with young is clearly later than the peak for nests with eggs. The number of young per nest also declines as the season progresses. The probability of hatching can be obtained by dividing the number of young per nest by the eggs per clutch or $2.7/3.5 = 0.8$.

A number of flaws are at once apparent. For example, the two clutches of two eggs had almost certainly lost some eggs to magpies. Perhaps some of the 3-egg clutches had, also. The five nests with no young were known to have lost all their young because two observations were made at suitable intervals. Other empty nests were found but could

not be used since it was not known whether young had flown or had been destroyed. The estimate of hatch refers really only to "successful" nests, that is, to nests in which at least one egg hatches. Unsuccessful nests can rarely be distinguished from nests from which the young have flown.

The statistical significance of these differences has not been examined because the numbers are too small to establish a difference if it exists. The type of conclusions to be drawn below permit this omission.

Some other observations merit mention. Half of 70 nests were over water. The heights of the nests are given in table 2. The mean is 4.3 yards and 50 per cent were less than 3 yards above ground (or water). The species of tree was recorded for 54 nests of which 21 were in thorn trees, 10 in willows or alders, 5 in poplar, 4 in juniper, 3 in apple, 2 in locusts, 2 on light poles, 2 on houses, 1 on a fence post, 2 on a pile of boards, and 1 each in rose bush, box elder, and cherry. The frequency of thorn trees is a reflection of their abundance along water. The site was noted in 65 cases of which 33 were out on a limb, 14 were on a dead stub in the water, 10 were in crotches and the rest in bushes, light poles, etc.

Table 2

Height of Eastern Kingbird Nests Above Ground

Yards	Nests	Cumulative Per cent
0	4	5.6
1	15	26.6
2	15	47.7
3	5	54.7
4	5	61.7
5	8	72.9
6	4	78.5
7	4	84.1
8	3	88.3
9	4	93.9
10	4	99.5
	71	

The critical point in a discussion of data of this type is the care in drawing conclusions. For example, these data are not expected to establish that clutch-size in Eastern Kingbirds declines as the season progresses but they do show that in one sample the size declined in about the same way as has been established for several thoroughly studied species such as the American Goldfinch (Stokes, Wilson Bull., 49, 1950:107–127). Hence, it can be concluded that the chances are good that clutch-size in Kingbirds declines about the same as in other species. Or, to say it another way, this sample agrees with the type of decline found in other species and that nothing unusual, such as an increase, is to be expected in this species in this region. Similarly guarded statements may be made about the time of the peak of laying and the per cent hatch.

As stated in the introduction, the crudity of the data permits only crude conclusions but these may be adequate for present purposes. This method is no substitute for thorough studies but would permit a rapid survey of species and places in respect to several problems of breeding biology and would suggest important species or problems for intensive study.

A check on the method may be made by comparing the results of a thorough study

with those from miscellaneous observations. For this purpose the detailed study of American Robins (*Turdus migratorius*) by Howell (Amer. Midl. Nat., 28, 1942:529-604) can be compared with the nest records on file at the Patuxent Research Refuge. I am indebted to Dr. Howell for a tabulation of his original data and to Mr. Chandler Robbins for guidance in the use of the nesting cards. The data are tabulated in table 3 for comparison. The dates are calculated in two ways so that allowance can be made for later initiation of breeding in New York than in Maryland where three nests were found before April 15.

Table 3

Clutch-size of Robins in Maryland and New York[1]

Dates	Maryland		New York		Dates	Maryland		New York	
	Number of nests	Mean Clutch size	Number of nests	Mean Clutch size		Number of nests	Mean Clutch size	Number of nests	Mean Clutch size
April 1–15	3	3.33	0	.....	April 1–30	15	3.40	23	3.70
April 16–May 15	36	3.50	43	3.68	May 1–31	54	3.54	38	3.50
May 16–June 15	37	3.48	25	3.36	June 1–30	20	3.24	11	3.36
June 16–July 15	14	3.14	7	3.14	July 1–31	2	2.50	3	3.00
July 16–31	1	.....	0	.....					
Total	91	3.42	75	3.52		91	3.42	75	3.52

[1] The data are grouped in two ways; see text.

A decline in clutch-size is apparent in both sets of data, demonstrating that at least in this case a carefully collected set of data (New York) shows the same trend as a miscellaneous set of data (Maryland).

The table raises some interesting questions. It will be noted that the average number is very similar by dates in New York and in Maryland except at the start. Yet the breeding season is shorter in New York. The question can be asked, "Do Robins at different latitudes lay the same number of eggs on the same dates?"

Another set of questions arises from a consideration of clutch-size. The New York average is larger (but not significantly; S.D. $= 0.58$ for each, $P = .72$) than that from Maryland. It is generally accepted that birds lay larger clutches in the northern part of their range than in the southern. The present data permit no conclusions but merely raise questions. Note that the clutches for April 1–15 in Maryland averaged only 3.33. A low initial clutch-size has been found for several species. Is it possible that the reason clutch-size is frequently smaller in southern than in northern areas lies in the early beginning of the breeding season in southern areas at a time when clutch-size is small?

The discussion of these aspects has been prolonged to emphasize the fact that miscellaneous data of the type every bird-watcher has in his notebooks can be very useful for raising questions about breeding biology and starting study to obtain answers. Also, in particular the discussion of the data on the American Robin shows that a number of important results could be obtained from a large number (400 each) of nests from two areas.

I am indebted to the Montana State University Biological Station for the opportunity to collect the data on kingbirds.

SUMMARY

Nesting data for Eastern Kingbirds collected from 1950 to 1953, at Flathead Lake, Montana, indicate that a decline in clutch size may occur during the breeding season. The mean number of eggs in 30 nests was 3.5 and the mean number of young in 32 nests was 2.7. Half of 70 nests were over water and half were placed at a height of less than three yards. Problems and methods of interpretations of limited data are discussed.

A comparison of results of complete data for American Robins in New York (Howell) with miscellaneous data for this species from Maryland shows that the method gives reasonable results in this case. Also a number of interesting problems concerning the clutch-size of robins is suggested.

Division of Vertebrate Ecology, The Johns Hopkins School of Hygiene and Public Health, Baltimore, Maryland, January 17, 1955.