A REVIEW OF BIRD POPULATION STUDIES

by

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TABLE OF CONTENTS

INTRODUCTION

The study of bird populations is receiving the increasing attention of ornithologists. At the present time methods of this study are still in the process of development.

Wishing to undertake a study of the bird population in the vicinity of the University of Michigan Biological Station, I searched the present literature on birds for a satisfactory method. I became increasingly impressed by the dearth of methods and the need of a workable procedure.

In this paper I am presenting a summation of my findings and offering a description of the most satisfactory method so far devised.

IMPORTANCE OF BIRD CENSUS WORK

In the spring of 1914 the United States Biological Survey started an inquiry for definite information on the numbers, distribution, and relative abundance of breeding birds. This information is important to them because of the value of birds to agriculture, the formulation of regulations for protection of game and other birds, and to determine the effect of such laws. Cooke (1923, p.2), assistant in biological investigations of the Biological Survey mentions many problems which may be solved by bird censuses:

1. The number of birds per acre found on different habitats.
2. The relative abundance of birds in the whole country and in different life zones.
3. The distribution of birds and the centers of abundance.
4. The effect of altitude, latitude and water on bird numbers.
5. Fluctuations in the abundance of certain species.
6. The effect of protection.
7. Effects of change in environment as evidenced especially on farms by irrigation and clearing of land.
8. Determination of adequate laws.
9. Whether birds as a whole or certain species are increasing or decreasing.

The problem of adequate protection is recognized by Dice (1930, pp. 23-24) when he states: "We suspect that much of the decrease in the numbers of game and song birds is due to the destruction or alteration by man of the natural habitats. Any information bearing on relative importance for the birds of the various kinds of habitats will be of value in determining policies leading toward the preservation and en-

couragement of the bird fauna."

In America many censuses are needed, especially on both cultivated and wilder parts of farms, isolated pieces of woodland, continuous woodland, irrigation projects especially in the west where the land is changing from desert to farm land, all types of marsh land, and special areas such as city parks, cemeteries, and bird sanctuaries. (Cooke, 1927)

TYPES OF BIRD POPULATION STUDIES

There are two general types of bird population studies which may be made: the population of a certain zone, locality, or habitat; the population of an individual species. In the past much more attention has been given to the latter than to the former. However, a study of world population has been made on only one species and one subspecies: namely, the gannet and the St. Kilda Wren (Fisher, 1932, p. 92). In America the numbers of such game birds as the Bob-white, Ruffed Grouse, Prairie Chicken, California Quail, and the Hungarian Partridge have been estimated. Studies have also been made on the Song Sparrow, Marsh Hawk, and Horned Lark. (ibid., p. 95)

Various methods have been used in the past for estimating both the population of a single species and of a zone or habitat. Some of those described by Lack (1937, pp. 373-374) and Fisher (1939, pp. 95-99) are listed here.

1. The direct count--a census on breeding birds defined as "an exact and complete enumeration of birds that actually nest within the boundaries of a selected tract of land." (Cooke, 1927, p.1) The only

reliable method of making such a bird census is to count all the occupied nests in a limited area. Naturally such a count would be made at the height of the breeding season when eggs or young are in the nest. From this count the birds per acre or per 100 acres could be figured. (Lack strongly urges that a uniform unit of birds per power of ten acres be adopted by Britain and America in place of birds per acre.) (Lack, 1937, p. 3) This is a valuable method but difficult and time consuming.

2. The Vague Method. This method is widely used by field workers. Fisher defines the terms used in this method as: "rare" when numbers find their way into the observer's list--usually one's or two's; "common" when the watcher begins to lose count; and "abundant" when the watcher is bewildered. (Fisher, 1939, p. 96)

3. Sampling. Various ways of taking a "sampling" have been used: a sample tract used to calculate the whole; a sample count used as a fraction of the whole (as counting the number per unit area for dense sea birds); a count of the number of birds to alight on a certain area in a fixed time; the use of a sample strip of land such as was used by Breckenridge in counting the breeding Marsh Hawks in Minnesota. The disadvantage of this method is that even a uniform habitat is subject to marked variations in bird life. Also such factors as food, predators, disease, and climatic conditions affect the bird population.

4. Photographing. This is used to count birds which nest in dense colonies.

5. Singing Males. The counting of the singing males of a certain area is now considered a poor method as the non-breeding males frequently sing more than the breeding males.

6. The Rope Method. This method is for use in the open country.

Two people tied together by a heavy rope traverse the given area. The rope is allowed to drag so it will flush any nesting birds.

7. Breckenridge's Method. (1935, pp. 195-197) Breckenridge marked out another method suitable for open plains or slightly rolling country with sparse timber and brush. Using a square mile of the latter type of land he laid out four parallel line North-South and four parallel East-West lines three hundred and fifty strips apart. He then transversed the section along these compass lines recording the species and the distance in steps from the compass line each one was flushed. From this he figured the birds per acre and found it to be somewhat low.

8. Flight Lines. For inaccessible colonies of Kittiwakes counts were made on flight lines at feeding times.

9. Transects.

a. at sea. In this method the birds seen on a chosen section of a voyage or on the whole voyage are counted.

b. on land. Transects on land may be taken from a train or on foot. The latter method is a traveling census through the same types of habitat giving the relative abundance of birds. A vertical census has been used in equatorial forests in order to find the birds present at different heights.

Of all these various methods, the studies of regional distribution (as would be secured by the traveling census mentioned above) is considered the most useful--even more useful than studies of single species. It gives the relative proportion of various species and thus is more important biologically than a single count. In the single count, facts of biological importance are not arrived at unless the studies are repeated over a number of years, months, weeks, days, or hours, according

to the problem. (Fisher, 1939, p. 100)

USE OF RAUNKAIER'S LAW OF FREQUENCE

Jean M. Linsdale of the Museum of Vertebrate Zoology of the University of California at Berkeley has been interested in this problem of relative abundance of birds for several years. He has published several papers on the frequency of occurence of birds in certain areas, his first study being published in 1928. He suggests the following requirements for any method presenting the frequency of birds:

1. Simple calculation
2. A by-product of field work
3. Expressed concisely and easily represented graphically
4. Proper evaluation, given to the more frequent species
5. Limitation of area to give environmental uniformity
   (Linsdale, 1932, pp. 221-226)

Dice also stresses the importance of a uniform habitat. He considers the relative abundance in each kind of habitat of a region much more valuable than the relative abundance of the whole region.

In looking for a method that would meet the above requirements, Linsdale was the first to apply Raunkaier's Law of Frequence to bird study, using time units (days) instead of space units (quadrats). Leslie Kenoyer had previously suggested its use on animal population studies. (Kenoyer, 1927, p. 346) Raunkaier, a Danish botanist,

based his law on eleven different pieces of botanical work carried on by himself and others in different parts of Europe. The procedure used was to lay off circular plots of equal area on areas of uniform vegetation. Using at least 25 plots (or quadrats) the number of species on each plot were counted. The law simply states that the "percentage of frequence of a given species is the percentage ratio which the plots on which the species occurs bears to the whole number of plots taken." (Kenoyer, 1927, p. 343) For example, in taking the frequence of the species on 25 plots, the number of plots on which any one species is found is divided by 25. If a species is found on each plot, the frequence is 100% (25/25); if it is found on 5 plots, the frequence is 20% (5/25); if found on one plot, 4% (1/25). In making a number of such surveys, it was usually found that the species of least frequence were the most numerous. As one proceeds to the greater frequences, the number declines steadily until the highest frequence is reached, at which point it increases slightly. To express this in a formula, Raunkaier let A, B, C, D, and E represent frequences from 1-20 percent, 21-40%, 41-60%, 61-80%, and 81 to 100% respectively. The distribution of the frequences could then be expressed $A>B>C \gtrless D<E$. The law was tried with insects and with microörganisms in hay infusions and found to hold true.

Linsdale points out several advantages of the use of Raunkaier's Law with birds:

1. It gives a more nearly correct impression of the relative abundance of birds than any other method.

2. It makes it possible to analyze the composition of the bird population.

3. It makes it possible to compare the population of one locality

with that of other localities and regions. (Linsdale, 1932, p. 226)

4. Over a period of time birds are likely to be observed on a certain area on the number of occasions which parallel their numbers on the area. (ibid., p. 225)

There are, however, certain errors inherent in this method. Nocturnal birds and birds of a retiring and secretive nature are likely to be slighted, while birds that proclaim their presence vociferously as the Kingbird and the Blue Jay will be given a much higher frequence. Birds that go in large flocks may be given too low a frequency as it is improbable that one would see s flock on numerous occasions. The number of birds seen is also definitely affected by the weather conditions. Thus on a windy day when it is difficult to hear, many birds that are present will not be recorded. Variations and limitations in the distribution of attention of the observer will also have some effect on the accuracy of the frequences. While one is observing one kind of bird, another may be hopping around in a tree close by. In spite of these opportunities for error, the method just described is to the writer's knowledge the most accurate method that has been worked out at the present writing.

The study of bird populations involves three factors: numbers, habitat, and ecological relationships. These factors should be considered simultaneously where possible. Weaknesses in population studies have been due to failure to consider all of these factors at one time. Lack (1937, pp. 369-395) bears out this statement when he cites the following three causes for the failure of bird census work to contribute little of value to the study of animal population problems:

1. Underlying ecological problems have been overlooked.

2. The studies have been made on areas greatly modified by human activities.

3. The studies have been made on areas containing a variety of habitats.

In the future then it is of great importance that habitat be given due consideration in any study of bird population.

From this brief survey I have found that bird population study is still in its infancy. Raunkaier's Law of Frequence offered the most satisfactory method for my particular problem and I believe it would prove highly accurate under most circumstances.

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