little more than 3 birds per 100 of population. The chance of a return a year later is the square of the chance of the first arrival which is 0.0011 on the average. Under the stated assumptions a bird once captured has only one chance in 31 of returning. It would be easy to pick cases giving much lower rates of return. Our example makes no allowance for deaths which will decrease the chance of any designated bird returning without appreciably altering the chance of its being banded.

We may summarize our conclusions in another way by distinguishing four classes of passages from one place to another.

Class A — The distance is covered in one jump. Ex. 100.

Class B — The distance is covered in very few jumps of equal or nearly equal length. Ex. 49 + 51.

Class C — The distance is covered in few jumps of very unequal length. Ex. 98 + 2.

Class D — The distance is covered in several jumps of nearly equal length. Ex. 25 + 25 + 25 + 25.

If the distance to be covered is the same as the average length of the jump then Class A is the most favorable, with Class B generally next most favorable to a return.

If the distance is some small multiple of the average jump length, then Class B will be most favorable.

If the distance is a large multiple of the average jump length, then Class D is the most favorable.

There will be no cases in which Class C will be most favorable.

It is unfortunate that, at the moment, we can advance only a theoretical solution. Such a solution, although unsatisfactory in some respects, tells us what we need to know in order to convert the theory into an actual solution for a given species. Even if the theory ultimately needs alteration and refinement it is the best guide we have to formulate methods for solution of the problem. For any species we need to know the length of the migratory jump, its variation, the unit of distance, and the points of origin of the birds arriving at a given station.

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AN EXAMPLE OF SEXUAL BIAS IN TRAPPING

BY CHARLES H. BLAKE

Farner (1949: 68-69) has pointed out the question of bias in trapping birds. Years ago, this was specifically noted for the towhee by Whittle (1928) and Wharton (1928). It was early apparent to me that the Red-eyed Towhee *(Pipilo e. erythrophthalmus)* shows a strong sexual bias with adult males trapping much more readily than adult females. It was not so clear that independent young of the year showed this same bias. The species is a good one for such an inquiry since the sexes are distinguishable even in the juvenal plumage (after attaining independence) and young birds are distinguishable by eye and gape color from adults, at least until they leave here (Lincoln, Mass.) in early October. The pertinent figures are in the table below. Returns act like, and are counted as, new birds.

	Adult ♂	Adult ♀	Young ♂	Young ♀
No. of birds	10	3	36	32
Total trappings	75	9	124	60

By inspection, adults are banded in the ratio of three males to one female and individual males trap 2.5 times as often per bird as do females. The young show essential equality of the sexes but males trap 1.8 times as often per bird as do females. It seems reasonable to conclude that the sexes are equal in numbers and field observations in my vicinity disclose no evidence of unmated males. It further appears that adult females are not prone to trap and, if trapped, females of all ages are more trap-shy than males.

Even if there were actual equality of the sexes we would not expect, bias aside, to realize equality in every sample. It is possible to compute the expectation of a random sample showing any given inequality with any actual sex ratio. Stern (1949: 390) gives the requisite formula. If we examine the present case we find, for adults, that a 6:7 ratio which is as near as we can come to 1:1 for 13 birds has an expectation (referred to unity) of 0.209 while a 10:3 ratio has an expectation of 0.0349. That is, the actual trapped adults show only 17 per cent of the expectation proper to a 6:7 ratio. If there were no trapping bias we would expect only 17 samples of 13 birds in 100 samples to depart so far from a 6:7 ratio.

In the case of the 68 young, a 1:1 ratio has an expectation of 0.096 while a 36:32 ratio has one of 0.086. Hence the young show 89 per cent of the expectation proper to sexual equality. Only 11 per cent of all 68-bird samples would be as near equality as 36:32. There are, of course, some random errors in these samples which can be assessed when enough data is at hand to warrant a subsampling procedure. The differences between young and adults are so great that I am convinced that the bias is real even if its magnitude is not entirely certain. On the basis of the figures adult trapping of Red-eyed Towhees is about five times as biassed in favor of males as is trapping of birds of the year.

A similar set of computations may be made for total captures. The figures are rather astronomical but it is clear that males repeat more often than females and again the bias is greatly less in young than in adults.

Keniston quoted in Whittle (1928) trapped an excess of males during May on Marthas Vineyard, as did Wharton (1928) in the winter at Summerville, S. C. However, Whittle's view that Keniston's takings were biassed by the later migration of females will not explain my results since each year I have trapped at least to the third week of

June and observation indicates that I take few or no migrant, adult towhees.

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A METHOD OF ESTIMATING ASSOCIATION OF INDIVIDUALS

BY CHARLES H. BLAKE

While it is easily observed that some birds (e.g. chickadees) travel in parties which maintain their identity, partially or wholly, for a considerable time, it is not so clear whether individuals of other species, trapped together occasionally, are, in fact, associated. Direct observation of a flock will sometimes be possible and evidence from such observation is usually conclusive. This is particularly true if the flock from which a sample is trapped is seen to fly into the trapping area as a unit.

Direct observations are not always possible and it is desirable to have some method by which the probability of association of individuals found together in the traps more than once can be estimated. It is always arguable that, if two birds are found together during a round of the traps, they did actually trap separately. The likelihood of such an event increases in proportion to the time between rounds. This must be taken into account by the observer.

Let us call the whole number of banded birds of a species present during a period of time, T; the number occurring in a flock, F; and any number of birds taken together (two or more) N. It is clear that $T \geqslant F \geqslant N$. The symbol $\geqslant$ is read "equal to or greater than." It is further evident that there are a definite number of different sets of N birds which may be drawn from F birds. This number of sets is given by the expression $_FC_N$, which is read: "combination of F things taken N at a time." Its numerical value is $F!/N!(F-N)!$. The symbol F! is read "factorial of F" and is obtained by multiplying together the successive whole numbers from 1 to F inclusive. We obtain N! and $(F-N)!$ by congruent operations. Comrie (1944, p. 2, 3) gives the factorials from 1 to 100, beyond which one would rarely have to go. It is more convenient to use common logarithms as given by Larsen (1948, p. 131). The procedure in this case is to subtract from log the sum of logN! and log(F—N)!. The arithmetic value of the answer will be found in any table of common logarithms. It is always possible to compute combinations by actually writing out the factorials and cancelling between numerator and denominator. If the factors remain-