

LOSS OF BANDS FROM ADULT HERRING GULLS

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INTRODUCTION

A number of authors have commented on the possible effects of band loss on measurements of survival in seabirds (Coulson and White 1955, Hickey 1952, Ludwig 1967, Paynter 1949, Poulding 1954). In another paper (Kadlec and Drury 1968) we emphasized the importance of band loss on recovery data (as did Ludwig, 1967, and Paynter, 1966) and measured the impact of this loss on the life tables for Herring Gulls (*Larus argentatus*) derived from those data.

In 1961, 349 adult Herring Gulls were banded and their plumage dyed on Milk Island off Cape Ann, Massachusetts, as part of a study of gull movements. In 1962, an additional 666 gulls were similarly marked. These banded adults have been resampled on Milk Island twice: (1) in 1965 by reading band numbers with telescopes and observing the ratio of banded to unbanded, and (2) in 1967 by trapping and banding. These samples enable us to draw certain inferences about the fate of the gulls and bands, and to identify certain biases in the sampling procedures.

METHODS

Original banding: The adult gulls were captured for banding by a variety of means: snap-trapping, using muskrat traps with padded jaws; drugging with tribromethanol; and clap-net trapping at nests. Captured gulls were sponged with a green dye, put in holding cages until the plumage dried, and then released. Observations showed these colored gulls did not become "social outcasts," but there was an indication that the treatment did cause some withdrawal and mortality (about 10 per cent).

Band reading: In 1965, a number of observers went on Milk Island on June 17, 18, and 25, and on July 30, to read the band numbers on as many gulls as possible, using telescopes. The data for June 17 and 18 were combined for comparison with those for June 25 and July 30. The island was visited on June 22 to determine the ratio of banded to unbanded gulls; all gulls seen well enough to determine whether or not they had bands were tallied by category.

Retrapping: In 1967, we used a gull nest-trap, designed by John Coulson in England, to capture 2,091 breeding adult Herring Gulls on Milk Island. This sample included a number of gulls bearing bands from 1961 and 1962.

Calculations: The data obtained permit six different calculations of the numbers of gulls banded in 1961 and 1962 which were still present in 1965. These are not all independent in the mathematical

TABLE 1. SUMMARY OF THE DATA OBTAINED ON BANDED ADULT GULLS ON THE MILK ISLAND, MASSACHUSETTS, COLONY

	1961	1962	Other
Number originally banded	349	666	—
Number read by telescope in 1965			
<i>June 17 & 18</i>	7	17	7
<i>June 25</i>			
Total band numbers read	25	65	30
Repeats from June 17 & 18	3	8	4
<i>July 30</i>			
Total band numbers read	16	29	15
Repeats from June 25	10	15	7
<i>Total different band numbers read on all dates</i>	35	87	41
Banded-unbanded ratio in 1965			
Unbanded (1,703)			
Banded (140)*	30*	75*	35*
Number obtained by trapping in 1967			
Total retrapped	28	73	32
Repeats from 1965	10	19	0

*These 140 banded birds seen were apportioned according to ratio of numbers read from 1961, 1962, and others.

TABLE 2. CALCULATIONS OF 1965 SURVIVORS OF ADULT GULLS BANDED IN 1961 AND 1962 COMPARED WITH AN ESTIMATE BASED ON EXPECTED AVERAGE MORTALITY.

	1961	1962
Number originally banded	349	66
Source of estimate		
Expected* survivors in 1965	250	519
Calculated** survivors in 1965		
A. Capture-recapture estimates		
1) 6/17-18/65 and 6/25/65 data	58	138
2) 6/25/65 and 7/30/65 data	40	126
3) 1965 and 1967 data	98	335
B. Banded-unbanded ratio	98	243
C. Based on estimated survival rates		
1) Jackson's negative method	110	281
2) Change in proportion banded	136	328

*Based on population structure analysis (Kadlec and Drury, 1968).

**See discussion of calculations under METHODS.

sense, for each set of data is used in more than one calculation. The data sets and calculations made are as follows:

- A. Capture-recapture.
 - (1) Band numbers read on 6/17-18/65 compared with those read on 6/25/65.
 - (2) Band numbers read on 6/25/65 compared with those read on 7/30/65.
 - (3) Total band numbers read in 1965 compared with the band numbers obtained by trapping in 1967.
- B. Banded-unbanded ratio expanded to total population—the 1965 observed ratio applied to the estimated total population (a variation of capture-recapture).
- C. Calculations based on estimated mean mortality from banding to re-trapping in 1967. In both cases, the mean annual mortality rate derived was applied to calculate the survivors present in 1965.
 - (1) Jackson's negative method (Coulson and White 1957) based on the original numbers banded and the 1967 re-trapping data.
 - (2) Changes in the proportion of banded gulls in the total population: the ratio of the number banded to the estimate of the total population in 1961-62; the observed ratio of banded to unbanded gulls in 1967.

RESULTS AND DISCUSSION

The data for the calculations are presented in Table 1 and the results of the calculations are given in Table 2. Also included in Table 2 are the expected numbers, the most realistic values available based on an analysis of the structure of the entire New England Herring Gull population (Kadlec and Drury, 1968). Admittedly, the fate of a small sample of the breeding population on one colony may deviate from the population as a whole but, because of band loss, this is still the best estimate available.

Two facts stand out in Table 2: (1) very large disagreement exists in the estimates, and (2) all the estimates are much below the expected number of survivors. This latter is undoubtedly the result of band loss—in fact, it will give a basis for estimating band loss if we can resolve the conflicts in various calculations of what is probably best termed “the number of survivors still having bands.”

Sources of bias: At least five sources of bias can be identified as possible contributors to the discrepancies among the calculated values for the size of the banded population in 1965. These are:

- (1) Non-randomness in the reading of band numbers by telescope. The lowest estimates were derived by capture-recapture analysis of records of band numbers read by telescope. The most logical explanation is that certain of the banded gulls occupied territories or perches where it was easier to read their bands than

those on other banded gulls. This in effect yields too many "recaptures" and results in an underestimation of the population.

(2) Estimation of the total breeding population in the colony. A value of 6,000 adults was arbitrarily used: (a) to expand the banded-unbanded ratio observed in 1965 to the whole population, and (b) to calculate the fraction of the population originally marked in 1961 and 1962. From a nearly complete nest count in 1965, the breeding population in that year was known to be slightly more than 6,000 gulls. From studies on other colonies, the population is expected to vary from year to year, but not greatly. During the period of interest on Milk Island, it is highly unlikely that the breeding population was more than 7,000 or less than 5,000 individuals. This variation would not alter the relative value of either of the calculations contingent on the estimates. It might, however, account for the differences in estimates based on survival rates (C1, C2, Table 2) calculated from the data.

(3) In the 1965 visual determination of the banded-unbanded ratio (B, Table 2), the two categories (banded and unbanded) may not have been equally visible or the observers may have concentrated on one or the other category. The fact that the calculation based on this estimate (B) is lower than those based on re-trapping data from 1967 (C1, C2) suggests underestimation, which implies a bias favoring the counting of unbanded gulls or not seeing the bands of some gulls. Conversely, it might imply the banded segment of the population (having initially been caught at the nest, not on perches) occupied less visible territories or perches than the unbanded segment.

(4) Reading band numbers by telescope may sample a sub-unit of the population characterized by "conspicuousness" while trapping samples a sub-unit characterized by "nest attentiveness." Since the original sample was trapped in 1961 and 1962, a bias of this sort would mean that band reading by telescope sampled the population differently and hence gave biased results. The bias should take the form of too few "recaptures" (i.e., incomplete overlap of the sub-populations sampled and hence overestimating the numbers of banded birds present). This might account for total absence in the "other" category (Table 1) of recaptures in the 1967-trapped sample of band numbers read in 1965. The odds against this absence of recaptures by chance are much greater than 100 to 1, so some real phenomenon is almost surely involved. Whatever it is, if it extends to the gulls banded as adults in 1961 and 1962, it must result in an overestimate in calculation A3, Table 2.

(5) In all of the calculations, one of the basic assumptions is that no emigration or immigration occurs. In an essentially stable population such as this, the effect of movements is to decrease the proportion banded. This, in essence, constitutes an increase in "mortality." Very detailed analysis of mortality based on banding data (Kadlec and Drury, 1968) indicates a regional long-term average of about 25 per cent mortality per year for adults. In

comparison, the mortality rates calculated for C in Table 2 were 25 per cent by Jackson's method and 21 per cent based on the change in the proportion banded. Obviously, there cannot be any serious bias due to movement in the data under consideration. This is also consistent with the often reported tenacity of adults for their breeding sites.

(6) Our recent work suggests that there are additional problems which we cannot yet specify.

Interpretation of calculations: Considering the biases discussed, the results of the various calculations are assessed as follows:

A. Capture-recapture.

- (1), (2) These estimates are low because band reading by telescope is non-random.
- (3) Since this calculation is based, in part, simply on all band numbers read, the problem of easily re-read numbers, (1) and (2) above, is eliminated. But since it also is based on gulls trapped (in 1967), the resulting estimate may be high because of the difference in sampling techniques.

B. Differences in "conspicuousness" between the banded and unbanded segments of the population or inaccuracy of the total population estimate can bias this calculation in either direction.

C. Estimates from survival rates based on retrapping data at least have the advantage that both the original capture and the recapture were by the same general method.

- (1) Jackson's method requires only that there be no emigration-immigration, which is probably fairly accurate in this circumstance.
- (2) Estimation of survivorship from the change in the ratio of banded to unbanded is apt to be biased upward by a greater "trapability" of the previously banded population, and either upward or downward by errors in estimating the total population size.

In summary, the results of this analysis suggest: (1) reading band numbers by telescope is apt to yield a biased sample of the banded population because of differences between individual gulls in the ease with which their band numbers can be read, (2) trapping also yields a biased sample of the population because of individual differences in "trapability," and (3) these biases can make calculations based on these data unreliable. In this study, Jackson's negative method is probably the most reliable because of the similarity in capture and recapture techniques, and because it does not require extrapolation.

Band loss: Kadlec and Drury (1968) inferred that band loss became serious three or four years after banding, but they were

unable to make any statement about band loss prior to that. The current studies indicate serious band loss by three years (1965 for 1962 banded birds)—probably about 45 per cent. This assumes that the estimate of 281 banded birds still present in 1965 by Jackson's method is about right and that the expected total of 519 is accurate.

By four years after banding (1965 for 1961 banded birds), the loss has increased to 56 per cent based on the same assumptions. The loss from year three to year four is about 23 percent of those still on at year three, which corresponds fairly well with our previous estimate of 20 per cent per year loss.

SUMMARY

The sizes of two cohorts of banded adult Herring Gulls were estimated by six different calculations, three and four years after banding. The estimates varied widely, indicating several sources of bias; but all underestimated the probable size of the cohorts. The underestimation is attributed to band loss, probably amounting to 45 per cent by the third year after banding.

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