BAND LOSS - ITS EFFECT ON BANDING DATA AND APPARENT SURVIVORSHIP IN THE RING-BILLED GULL POPULATION OF THE GREAT LAKES

By JAMES PINSON LUDWIG

The inadequacy of life tables produced from bird-banding data for Herring Gulls (*Larus argentatus*) is well documented (Hickey, 1952; Paynter, 1966; Veermer, 1963). The several attempts to produce workable life tables have each failed to provide enough survivorship to breeding age even to maintain stable populations, let alone explain the general phenomena of increasing gull populations in the northern hemisphere. Paynter (1966) reviewed these attempts, citing evidence that band loss, from removal by the gulls themselves and possibly wear, had surely biased all existing data for the species. He concluded that banding data are useful only to demonstrate the maximum life span, distribution and migration patterns for this species.

Faced with a similar inadequacy in banding data for the Ring-billed Gull (*Larus delawarensis*) population of the Great Lakes, I collected bands from birds found dead or captured in cannon-netting operations. From 1964 through 1966 I gathered a sample of 406 bands from Ring-billed Gulls, 8 bands worn by Herring Gulls, and 10 from Caspian Terns (*Hydroprogne caspia*). This paper reports on wear of bands carried by Ring-billed Gulls and presents a method of correcting banding data for loss of bands that have worn enough to fall off the birds.

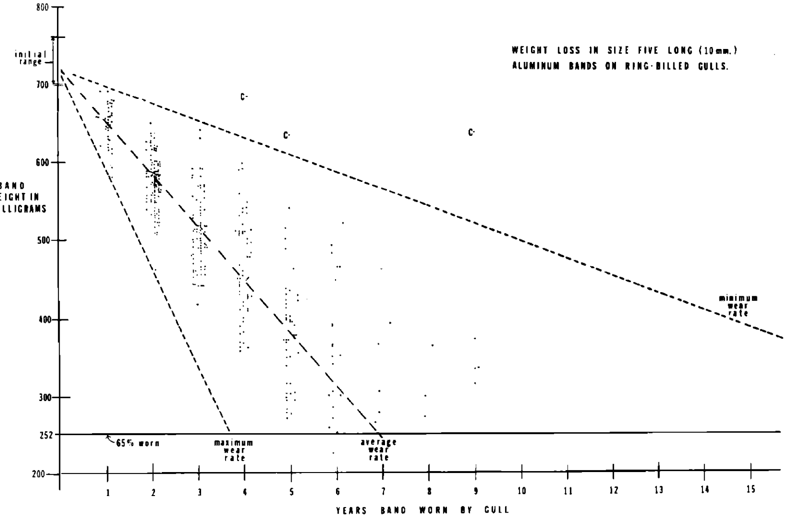


FIGURE 1. Weight Loss in size Five Long Aluminum Bands worn by Ring-Billed Gulls. Note the normal distributions of wear rates in each age-class 1-5 and the increasing variance in wear rates with each older age-class of bands. Note also that the 3 long aluminum bands worn by Caspian Terns (plotted as C.) each wear at a much slower rate than any of the 362 gull bands.

TABLE 1. WEAR CHARACTERISTICS OF THE VARIOUS STYLES AND METALS USED IN AMERICAN BANDS WORN BY RING-BILLED GULLS, HERRING GULLS, AND CASPIAN TERNS.

Band Size	Number in Sample	Style and Metal	Range of time in years bands worn by birds	Average annual rate of weight loss as % of original weight	Expected end point per cent worn	Range of life expectancy for bands	Average life expectancy
ON RING-BILLED GULLS							
4	7	Long Aluminum	1.13-1.23 years	7.86 percent	65. per cent	5.6-14.9 years	8.26 years
5	362	Long Aluminum	0.83-13.0	9.55	65.	3.6-21.7	6.81
6	4	Long Aluminum	2.92-4.00	10.57	65.	5.0-7.4	6.15
5	17	Short Aluminum	3.92-6.92	7.59	60.	5.3-11.1	7.90
5	16	Long Monel	1.92-4.00	4.30	65.	9.8-100.0	19.64
ON HERRING GULLS							
6	7	Long Aluminum	3.20-8.08	7.50	65.	6.3-14.8	8.66
6	1	Long Monel	3.00	1.62	65.	44.1	44.10
ON CASPIAN TERNS							
5	3	Long Aluminum	3.92-9.00	1.63	65.	27.8-52.8	43.43
5	4	Short Aluminum	7.08-14.08	3.13	60.	15.0-21.8	19.32
5	3	Long Monel	3.92	9.61	65.	5.1-11.4	6.77

TABLE 2. CHARACTERISTICS OF WEAR IN 362 LONG ALUMINUM BANDS CARRIED BY RING-BILLED GULLS

Band Age	Number	Average Weight in milligrams	Range of Weights	Average % of weight lost per pear	Average expected life in years
0	30	721	702-762	——	——
1	40	653	581-692	9.48	6.86
2	109	578	507-651	9.90	6.57
3	81	515	418-652	9.54	6.81
4	54	463	358-599	8.93	7.28
5	42	380	279-541	9.53	6.82
6	22	353	225-526	8.53	7.62
7	6	327	265-464	7.81	8.32
8	3	311	273-365	7.14	9.10
9	4	357	317-374	5.85	11.11
13	1	333	-	4.11	15.9

Of the 406 bands accumulated from Ring-billed Gulls, 362 were made of the same metal and style, being 10 millimeters long, size 5, aluminum bands averaging 721 milligrams prebanding weight. Other band styles represented in the sample include 7 size 4 long aluminum bands, 4 size 6 aluminum bands, 17 size 5 short aluminum bands, and 16 size 5 monel stainless steel bands (table 1). The major portion of this paper concerns the description and quantification of wear in the large sample of 362 size 5 long aluminum bands from Ring-billed Gulls and uses the other smaller samples of bands largely for reference. One of the bands in the sample of 362 was recovered when it fell off a bird at 4.92 years of wear and 279 milligrams weight.

As I suspected that newer aluminum bands might wear differently than older bands, I first divided these 362 bands into two samples that segregated the newer "tempered" from the older "soft" alloy bands. However, the rates of weight loss for each group were virtually identical. Finding no reason to keep the groups separate, I lumped all long aluminum bands into one sample. Table 1 summarizes data on all samples of bands collected from the species noted above.

In order to present the data on wear graphically, each band was weighed to the nearest milligram on a Mettler H-15 automatic balance and its weight plotted against the length of time it was worn by a gull (figure 1). Because this graph suggested the rate of wear to be constant, at least through the fifth year, the average rate of weight loss was computed for each age-class of bands. On the average, for each of the first five years, the rate of weight loss was constant. Hence, the total amount of weight lost by the bands was directly proportional to the length of time worn by the gulls. This confirmed the idea that the rate of weight loss did not change

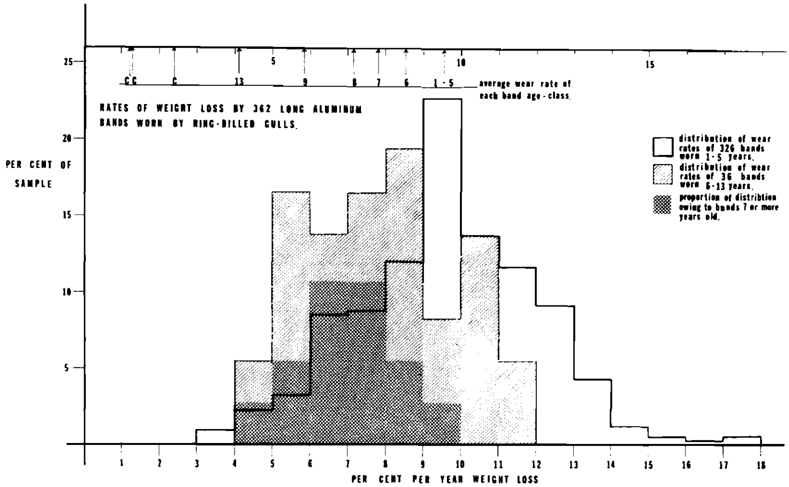


FIGURE 2. Distribution of wear rates of 362 long aluminum bands worn by Ring-billed Gulls. Note the normality of wear rates in the age-classes 1-5, the departure from normal after the fifth year, and the progressive shifting mean wear rate with age of bands surviving more than five years of wear.

as the gulls and their bands aged. The first five year-classes declined in weight at nearly identical rates (table 2), and the 326 bands worn 0.83 - 5.16 years averaged 9.55 per cent per year weight loss, when expressed as a percent of the original weight. Thus wear is probably a function of the exposed surface area of the band, since this area changed very little as the bands on gulls aged.

After the fifth year the average rates of wear declined progressively with each age-class. It was obvious on reexamining figure 1 that the bands of age-classes 1 through 5 formed a normal distribution of remaining weights about a mean value (dashed line) but that after the fifth year the lower end of the normal distribution suddenly disappeared. If these bands had been lost by the gulls, then they were not recovered to be included in this sample (of bands still on the birds' legs).

The end point, or weight below which no band survives, was found by considering that no band survived below a weight of 225 milligrams (69 per cent worn), but that 25 bands weighed less than 300 milligrams (58.1 per cent worn). One band was recovered when it fell off a bird: it weighed 279 milligrams after 4.92 years of wear (61.4 per cent worn). The real range of weights where bands are lost probably lies between 60 and 70 per cent worn (289-217 milligrams of metal remaining) and therefore 65 percent worn (252 milligrams) was chosen as the end point for all bands.

If it is assumed that all bands are retained until the end point and then instantaneously fall off, one may calculate a life expectancy for each band since the rate of wear is constant. Of course, this assumption is empirically false; but, providing that 65 per cent

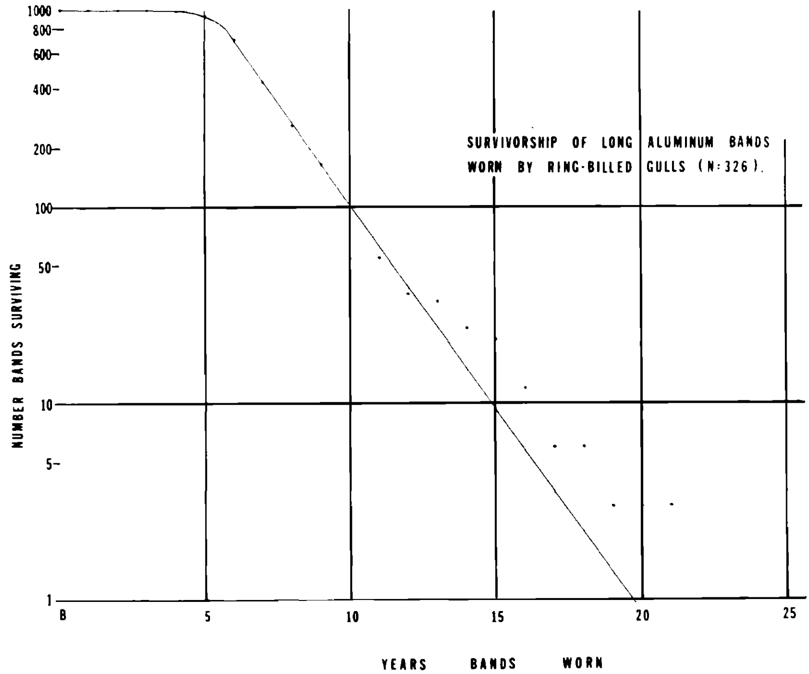


FIGURE 3. Survivorship of long aluminum bands worn by Ring-Billed Gulls. Note that the straight line indicates a constant rate of band loss after the sixth year at approximately 38 per cent per year.

worn is the average end point for these bands and that wear rates are normally distributed, then a sufficiently large sample of bands (as 326 is) will eliminate random error. Figures 1 and 3 illustrate clearly that wear rates are indeed distributed normally through the fifth year and that after the fifth year the average wear rate continually assumes a new, always lower, value—the fastest-wearing bands no longer contribute to the distributions because they have been lost. Table 2 gives the mean expected survivorship for bands of each age-class. The average life span predicted for the 326 bands of age classes 1-5 is 6.81 years. Barely 10 per cent of these are expected to survive 10 years of wear (table 3).

These data predict that band loss begins to bias banding data severely after 4.5 years of wear, and accelerates through the fifth year to a constant rate of 38 per cent per year of the surviving bands from 6 years onward. One long aluminum band per thousand may be expected to survive 19.6 years of wear by Ring-billed Gulls. It is little wonder that the oldest recovery for a Ring-billed Bull is 21 years (see table 3 and figure 3).

Using the expected survivorship of these 326 bands, correction factors were computed for banding data in order to produce a more

TABLE 3. PREDICTED SURVIVORSHIP OF 326 BANDS WORN BY RING-BILLED GULLS 0.83-5.16 YEARS

Years Bands Worn	Number Surviving	Ratio Surviving Per Thousand	Survivorship Correction Factor 1 + (# Lost/ # Surviving)
3.5	326	1,000	1 + 0.00 = 1.00
4.0	323	991	1 + 9/991 = 1.009
4.5	321	985	1 + 15/985 = 1.015
5.0	303	930	1 + 70/930 = 1.075
5.5	262	804	1 + 196/804 = 1.244
6.0	229	703	1 + 297/703 = 1.422
6.5	186	571	1 + 429/571 = 1.751
7.0	141	432	1 + 568/432 = 2.315
7.5	103	316	1 + 684/316 = 3.165
8.0	85	260	1 + 740/260 = 3.846
8.5	66	202	1 + 798/202 = 4.950
9.0	54	165	1 + 835/165 = 6.061
9.5	45	138	1 + 862/138 = 7.242
10.0	33	101	1 + 899/101 = 9.900
11.0	18	55	
12.0	12	36	
13.0	11	33	
14.0	8	24	
15.0	7	21	
16.0	4	12	
17.0	2	6	
18.0	2	6	
19.0	1	3	
20.0	1	3	
21.0	1	3	
22.0	0	0	

accurate life table for Ring-billed Gulls (table 3). In order to test the utility of these corrections, a survivorship curve for Ring-billed Gulls banded with size five long aluminum bands was prepared from data on bandings made from 1953 through 1966. Useable data in complete form were available through December, 1965; incomplete data through August, 1966 have been projected to provide an estimate of survivorship through the thirteenth year (tables 4 and 5). Included in this mortality series were all birds unquestionably killed or found dead. Birds trapped and released, those rebanded, and recoveries falling into categories such as "band found" or "band removed" were excluded. Gulls shot or collected for scientific specimens were not excluded: Paynter (1966) excluded these birds on the grounds that man did not act as a constant source of mortality. However, it is doubtful that any factor killing gulls operates in a constant manner and therefore these recoveries must be included. Man, whatever be his motive in killing gulls, is simply another factor adding to the total load of mortality that this population must deal with.

Survivorship rates were determined by comparing numbers of recoveries in adjacent age classes (table 4). These data were plotted on a semilogarithmic basis and a survivorship curve drawn by eye (figure 4). These uncorrected data produce a curve for breeding-age

TABLE 4.

Recoveries of Ring-billed Gulls banded with Long Aluminum Bands

Data complete from June, 1953 through December, 1965.

Year of Banding	Number of Recoveries made during Years after Banding														
	0-6 months	1	2	3	4	5	6	7	8	9	10	11	12	13	Ratio
1953	10	10	2	2	0	1	0	0	0	1	1	0	0	1	
1954	34	19	4	6	7	3	8	4	1	3	0	0	0		1:0
1955	83	38	15	11	12	7	14	3	5	4	0	0			8:1
1956	120	63	18	25	20	19	11	5	6	2	1				12:10
1957	273	68	36	32	28	19	18	6	3	0					18:15
1958	204	62	31	15	26	16	10	7	0						63:25
1959	250	66	29	27	26	15	17	1							80:78
1960	249	87	52	40	26	22	1								145:102
1961	319	122	61	51	35	8									209:180
1962	345	113	66	71	16										314:280
1963	380	158	129	33											807:443
1964	691	284	97												2958:1090
1965	562	105													
1966	6														

Incomplete data for years 10 and 13 projected.

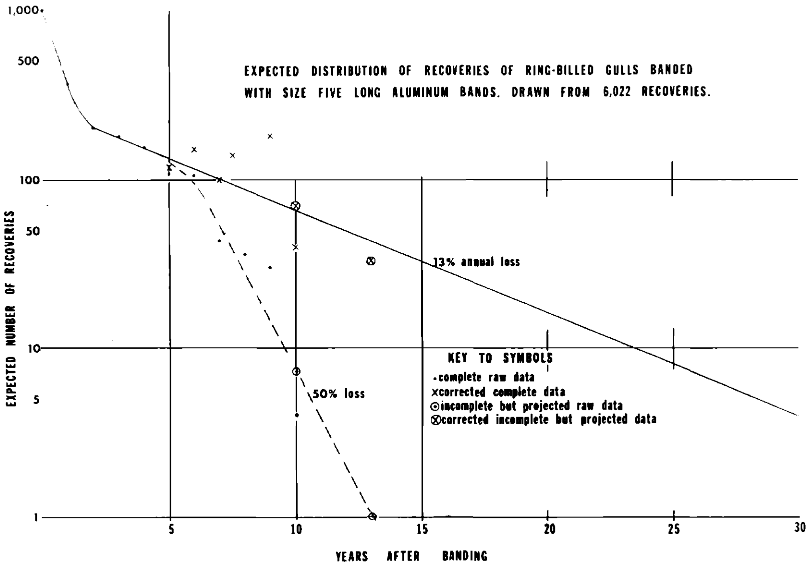
Data below this line is incomplete. Note that although the data is complete through December, 1965 (all that processed by the banding lab as of August 31, 1966), only data on birds banded through 1964 is admissible.

Sample Survivorship Ratio 314:280 = $\frac{280}{314}$ = 0.892 survivorship between age classes 2 and 3.

gulls with three parts: an initial rate from the second to the fourth year averaging 12.2 per cent per year loss; an increasing rate from the fourth through the sixth years; from the seventh through thirteenth years the indicated death rate is about 50 per cent of the survivors annually. A rate of 30 percent annual loss of adults approximates the average rate of loss for all breeding-age birds. If band loss does occur in the manner predicted from the study of worn bands, then the survivorship curve based on the uncorrected "raw" data should be warped in the same manner as is the band loss curve (figure 3). These curves are remarkably similar in shape.

These raw banding data were also corrected by multiplying the number of recoveries found in the age classes affected by band loss by the correction factors computed in table three, which mathematically projects a life span for each band found (table 5). A line was fitted by eye to the points from 2-13 years and the resulting slope was found to indicate slightly less than 13 per cent annual adult mortality. (Figure 4). The corrected data for age-classes 8 and 9 fall considerably above the line, largely because more people have been active in the field during the past five years than when these age-classes were younger. This introduces a slight bias that favors the recovery of old birds in, and hence enlargement of, these advanced age-classes.

Two arguments support the contention that the real adult mortality rate is near 13 percent annually. First, between the second and fourth year when no band loss is expected, the annual mortality rate is 12.2 per cent. Second, an annual loss of 13 per cent of the adults is consistent with published studies on repor-



ductive rates and population dynamics of this species. The mean age of first breeding approximates 2.5 years in this population (Ludwig, 1966). Knowing this, it is possible to calculate the proportion of fledgings that survive to breeding age given the raw data, and the corrected data with 13 percent average annual loss of adults. This is done by summing the number of expected recoveries as immatures and adults under both conditions (table 6).

The raw data predict that 33.8 per cent of the fledglings attain breeding age, and with an average annual adult loss of 30 per cent (600 adults per thousand breeding pairs each year), a minimum of 1.78 fledgings per nesting pair is required each year just to maintain a stable population. This is an unacceptable estimate in view of the recent population growth (Ludwig, 1966), as it approaches the clutch size for this species.

Using the corrected data, 49.7 per cent of the fledglings are predicted to attain the average age of first breeding and coupling this with a 13 per cent average annual loss of adults, only 0.523 fledgings per pair per year are required for population stability. Even if we assume that no Ring-billed Gulls breed until they are three years old (which is clearly false), and that gulls older than 25 are reproductively sterile (for which there is not a shred of evidence), then only 0.63 fledglings per pair per year will maintain this population stable. Emlen (1956) studied a colony in the Straits of Mackinac in 1952 and 1953 when this population was stable, finding an average production of 0.67 chicks per breeding pair per year. From 1963 to 1965 when this part of the population was

TABLE 5. COMPUTATION OF EXPECTED RECOVERY RATES FROM RAW DATA, CORRECTED DATE, AND 13% ANNUAL LOSS OF ADULTS.

	Age 0-6 months	1	2	3	4	5	6	7	8	9	10	11	12	13
Survivorship ratios for raw data		0.368	0.549	0.892	0.861	0.703	0.975	0.410	0.833	0.833	0.125	0	0	0
Expected Number of Recoveries with Raw Data	1,000	368	202	180	155	109	106	43	36	30	7*	—	—	1*
Expected Number of Recoveries x Correction Factors	1,000	368	202	180	156	117	150	99	138	181	69	—	—	34
Expected Number of Recoveries with 13% loss after third year	1,000	368	202	180	155	135	117	102	89	77	67	58	50	44

*Includes projected incomplete banding data.

TABLE 6. RAW AND CORRECTED BANDING DATA REQUIREMENTS FOR POPULATION STABILITY

A. Expected Distribution of Recoveries:

	With Raw Data		With Corrected Data	
Age	Number of Recoveries	Per Cent	Number of Recoveries	Per cent
Immatures	1,469	66.2	1,469	50.3
Adults	768	33.8	1,458	49.7

B. Average annual loss of breeding birds:

With Raw Data	With Corrected Data
30 per cent	13 per cent

C. Computation of Fledging Rate Required for Stability:

With Raw Data	With Corrected Data
0.338 x 1.78 = .600	0.497 x 0.523 = .260

Formula used: (Proportion of Fledglings Surviving to Breed) x (Fledging Rate) = Necessary Recruitment Rate.

growing at the incredible rate of 30 percent breeding birds per year, Ludwig (1966) found fledging rates that averaged 1.74 in 26 colonies of Lakes Huron and Michigan.

The fact that these corrected data provide a reasonable explanation for the reality of field studies is a measure of proof that band loss does happen as predicted by studying the worn bands. It is interesting to note that the uncorrected banding data curve (50 per cent per year loss) should be produced by two rate constant curves—the real gull mortality (13 per cent) curve, plus the band-loss curve (38 per cent)—which add to produce the warped raw data.

Presumably the methods described above can be applied to banding data for other species, providing that the species studied permit their bands to wear out and fall off, and do not remove their own bands before natural processes of wear would cause the bands to fall off. From this study, I regard all band-data-derived survivorship curves for long-billed birds as suspect, particularly those with a warping of the survivorship curve downward at some time in adult life. Before accepting any banding data on long-lived birds, a sample of bands worn by the species being studied ought to be examined. On the positive side, it appears that it is possible to correct banding data by studying worn bands; and that a defensible alternative to the continual quest for new, harder, more durable bands is to study those we have (which can be economically produced) and to determine the rates of wear and loss so as to correct the huge accumulations of band-loss biased data now available.

However, studies on Herring Gulls (which initiated the current interest in band loss) also suggest that individuals of this species do remove their bands. If so, then an independent estimate of this activity will have to be made, as well as studies of band wear to provide accurate correction of the Herring Gull survivorship curve. Poulding (1954) found evidence that Herring Gulls do actively remove butt-end style bands, and Paynter (1966) believes that the removal of bands as well as wear operate to distort all attempts to produce a workable life table and survivorship curve. An incident from my own field work illustrates an individual Herring Gull's antipathy to a new band:

May 18, 1962, Scarecrow Island. "10:33 . . . about 5 minutes ago I banded 1 adult Herring Gull that was caught in a mist net. A large bird, perhaps 1,500 grams, male? He is now standing on a stump about 100′ away from me on the SW point. He doesn't much like the band, working at it. 11:15 H. Gull still pecking at—tears at band. He's so incensed he's fallen down several times—once off the stump—while working at it. May have it partly open. 11:40 The H. Gull is exhausted but still at the band. Pays no attention to other gulls. 12:10 While (*I was*) having lunch the bird finally flew off. Found the band twisted, with blood and (*leg*) scales on it. Put it on a chick."

This band was a size 6 "soft" aluminum butt-end band.

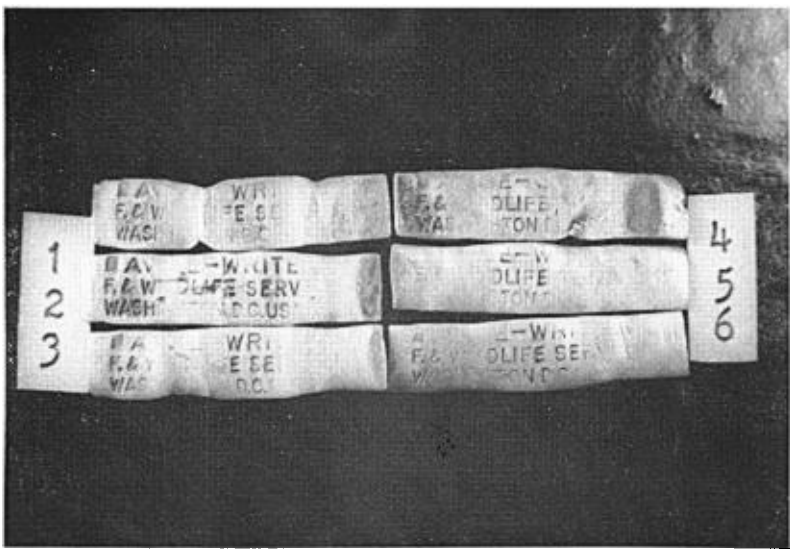
Tinbergen (1960: 42) describes a ritualized behavior pattern "inspecting the feet" performed by Herring Gulls where birds peer at their feet, remove scaled skin and groom the legs. Probably this is when bands are removed. I have seen Herring Gulls mouth their bands briefly during general grooming. Such a ritualized behavior pattern is, I believe, either missing or not well developed in the Ring-billed Gull. These data on band wear may be normally distributed because the Ring-billed Gull tolerates its bands and rarely, if ever, removes them.

Other styles and sizes of bands have different wear characteristics. Among the long aluminum bands worn by Ring-billed Gulls in sizes 4 and 6, the data indicate that the smaller diameter bands wear the most slowly. Perhaps this is because these bands fit tighter. A small sample of short aluminum bands from Ring-billed Gulls was also recovered, but as band loss probably had begun before I was able to recover any of these bands, there is no way to judge whether this is a good sample. The Ludwig banding team used 12,000 long size 5 monel stainless steel bands on Gulls and terns from the Great Lakes from 1962 to 1964. On gulls the rate of metal loss from the monel bands is about one-third the rate of metal loss from aluminum bands of the same size and style; some monel bands are expected to last beyond the maximum life expectancy for this species. It seems reasonable to recommend that long monel metal bands be used on gulls, in the smallest sizes that the various species can tolerate.

Aluminum bands worn by Caspian Terns declined in weight very slowly compared to bands of the same sizes and styles worn by gulls; aluminum bands seem adequate to provide accurate survivorship data for the species (note the three Caspian Tern long aluminum bands on Figure 1.). Short aluminum bands on these terns may wear rapidly enough to be lost after the fifteenth year. In analyzing banding data for the Great Lakes Caspian Tern population, most of which was produced from bandings made with short aluminum bands, I found an 11 per cent average annual mortality until the fifteenth year and then a rising death rate thereafter, all recoveries ending after 26 years. Originally this decreased survivorship after the fifteenth year was attributed to senescence (Ludwig, 1965). It now appears more likely from these new data on band wear that the rise in mortality of aged birds was not real, but an artifact in the data, produced by band loss.

However, three monel stainless steel bands worn by Caspian Terns for 3.92 years have been recovered, virtually illegible owing to severe pitting of their surface. E. B. Baysinger, Director of the Bird-Banding Laboratory, (pers. comm.) reports that bird feces blacken monel bands, apparently by oxidizing one of the metals in this "stainless steel" alloy. Fecal matter is often found adhering to bands carried by Caspian Terns and probably is the source of this severe corrosion. Thus monel bands are contraindicated for use on Caspian Terns and all species that habitually defecate (Ibis, Wood Stork, etc.) on their legs.

All bands (that are not corroded) worn by these species show identical patterns of wear. Many bands are severely creased along their length when recovered, following either natural faults in the metal or creases made at banding by pliers in opening and closing the bands (Photograph 1). Preopened bands distributed on plastic tubes may help reduce this problem. Most bands are scalloped along the edge that rested against the knobby base of the tarso-



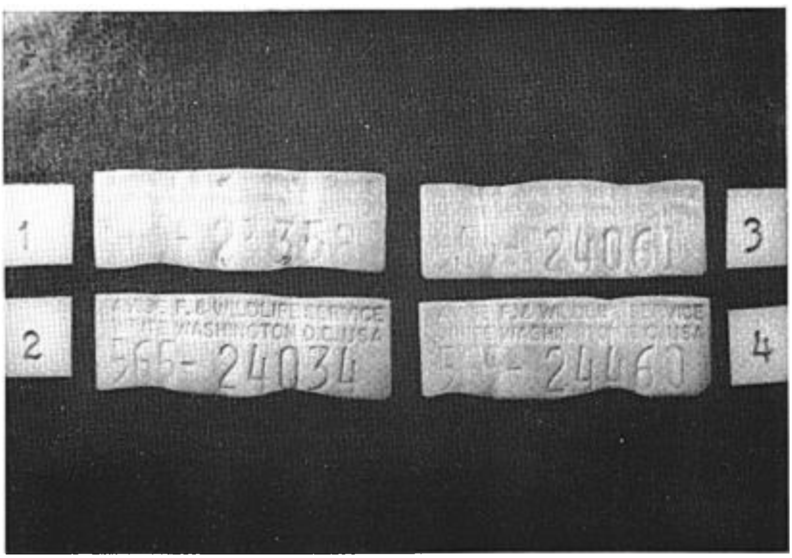
PHOTOGRAPH 1. Crease wear in Aluminum Bands worn by Ring-Billed Gulls. These are six size 5 Short Aluminum Bands which had the address printed on the inside of the band. All bands were worn 4.92 years.

metatarsus (photograph 2). Every aluminum band recovered in this study was legible. However, many older bands were paper thin, implying that most of the wear in bands worn by these species is on the inside. Wear on the inside probably mostly occurs by abrading the metal from the band against the bird's leg or substances adhering to the legs. Particularly Ring-billed Gulls, which often "follow the plow" (feeding in freshly turned fields by walking along the ground) expose their bands to much abrasion. In general gulls will walk away from a noxious stimulus or along beaches in search of food. Caspian Terns, on the other hand, seem to walk very little; they fly from noxious stimuli, and search for their food on the wing.

These data do not support the theory that salt water corrodes aluminum bands rapidly, for Caspian Terns from this population reside in marine habitats for a much greater portion of their lives than do Ring-billed Gulls from the Great Lakes (Ludwig, 1965).

SUMMARY

1.) Many investigators have illustrated the inadequacy of banding data for production of accurate survivorship data for



PHOTOGRAPH 2. Scalloping of the edges is well illustrated by all Bands here. All bands except number 3 were worn with the numbers right-side up. Bands 1 and 3 show the most severe outside surface wear of all 362 Long Aluminum bands studied.

Band #	Years Worn	Weight	Rate of Wt. Loss % per year
565-23358	5.92	352	8.6
565-24034	4.92	401	9.0
565-24061	4.92	317	11.4
565-24460	5.92	390	7.8

Herring Gulls. Analysis of raw banding data for the Great Lakes Ring-billed Gull population similarly produced unacceptable results.

2.) A sample of 362 long aluminum bands recovered from Ring-billed Gulls was examined for wear. Analysis of the data computed from these bands indicated that:

A. Wear rates were normally distributed about a mean value of 9.55 per cent per year weight loss as per cent of the original weight.

B. The rate of metal loss from bands was constant.

C. The average band declined to an expected end-point weight of 252 milligrams of metal remaining (65 per cent worn) 6.81 years after banding. One band per thousand is predicted to withstand 19.6 years of wear by Ring-billed Gulls.

D. Survivorship of bands is predictable, given a large enough sample of bands worn by a particular species.

E. In this Ring-billed Gull population band loss begins to depress recovery rates between the fourth and fifth year, and after the sixth year assumes a constant rate of 38 per cent per year of the surviving bands.

3.) Correction factors computed from the study of band loss were applied to raw banding data. This produced a corrected estimate of survivorship in this Ring-billed Gull population, where 49.7 per cent of the fledglings survive to age of first breeding, 13 per cent of the adults die annually, and a fledgling rate of 0.523 chicks per pair of adults maintains a stable population size. Uncorrected banding data required 1.78 fledglings per pair per year to maintain stable population size. With the corrected data, even if no gulls breed until their third year, and none contribute young after their 25th year, only 0.63 fledglings per pair per year will keep this population stable.

4.) This method of correcting survivorship curves based on banding data can probably be applied to other species, provided that these do not remove their bands before the tags wear out and fall off unaided by the birds. Herring Gulls do apparently remove some bands used on them.

5.) Monel bands offer a reasonable alternative to provide accurate raw banding data for gulls, but not for species which defecate on their legs. Monel bands recovered from Caspian Terns were corroded.

6.) Bands of the smallest size which does not injure birds should be used, rather than loose-fitting large bands in order to minimize wear on the inside of bands.

7.) Accurate survivorship curves for the Caspian Tern population of the Great Lakes based on banding data were obtained because aluminum bands wear very slowly on this species.

8.) The theory that salt water corrodes aluminum bands rapidly is not supported.

ACKNOWLEDGEMENTS

Most of the raw banding data used to produce the survivorship curves came from bandings by W. P. Nickell, Mr. I. R. Sturgis, and the Ludwig banding team, to whom I tender specific thanks for permission to analyze their data. Fewer reports came from 23 other banders. A. J. Duvall and E. B. Baysinger granted permission for and saw to duplication of the data. O. S. Pettingill, Jr., R. W. Storer, N. G. Hairston, and F. E. Smith each saw parts of these data or analyses and made many helpful suggestions. The Frank M. Chapman Fund of the American Museum of Natural History supported part of the field work when bands were collected. This is a contribution from the University of Michigan Biological Station.

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Department of Zoology, University of Michigan, Ann Arbor, Michigan 48104.

Present address: Dept. of Biology, St. Cloud State College, St. Cloud, Minn. 56301

Received January, 1967; revised April, 1967.