A STUDY OF WEIGHT LOSS FROM ALUMINIUM RINGS TAKEN FROM BIRDS OCCUPYING EITHER A DRY LAND OR FRESH WATER HABITATS

Dr D. Whitelaw
24 Twickenham Road
Mowbray
CAPE TOWN 7700

Introduction

Long term ringing projects are based on the assumption that the rings used will remain intact for the life of the bird. This assumption may not be valid; rings may be lost for a variety of reasons including removal of the ring by the bird (Poulding 1954, Ludwig 1967). Abrasion and corrosion are however the most common causes of ring loss (Ludwig 1967). This paper reports on the analysis of the rate of corrosion and weight loss of aluminium rings used by South African ringers. It is based on rings which had been recovered and returned to the South African Bird Ringing Unit (SAFRING). The main aim of the work was to determine the extent to which long term recoveries may be influenced by ring loss and the possible effect of this on population studies.

Materials and Methods

Rings used in the analysis were those used by South African ringers over the past twenty years which had been returned to SAFRING. The rings were made from an aluminium alloy supplied by the Gey Band and Tag Co., Nashville, Tennessee U.S.A.

Rings were divided into two categories:

a. Those recovered from birds occupying a dry land environment, predominantly doves (*Streptopelia sp*). These were all from a single ring series.

b. Those recovered from birds occupying a fresh water environment; in effect the rings analysed came from ducks (*Anas sp*., *Tadorna cana*) and coot (*Fulica cristata*). There were sufficient data from four separate ring series (586, 587,

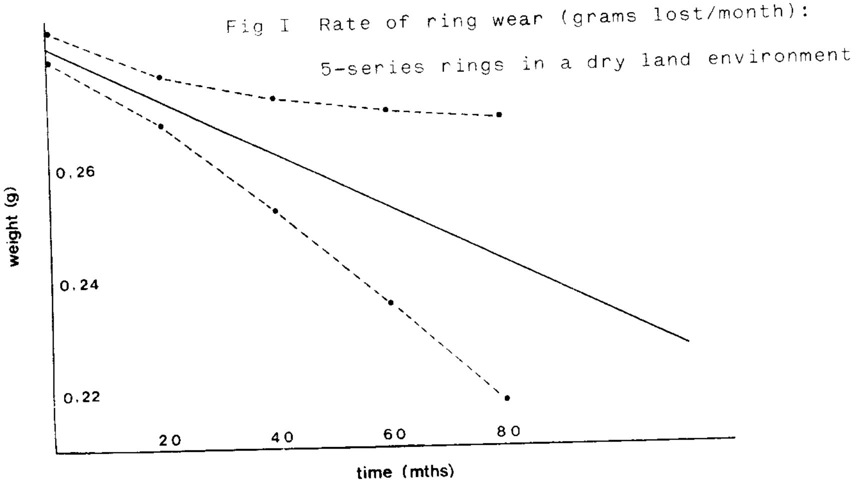

Fig I Rate of ring wear (grams lost/month): 5-series rings in a dry land environment

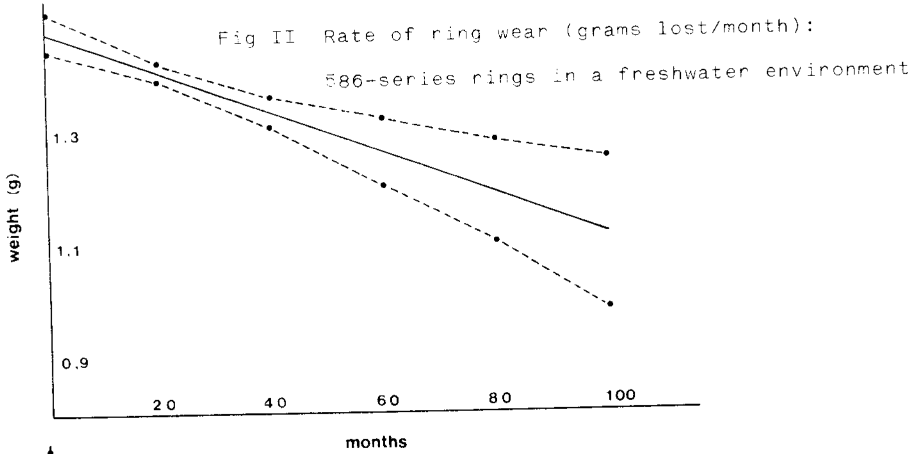

Fig II Rate of ring wear (grams lost/month): 586-series rings in a freshwater environment

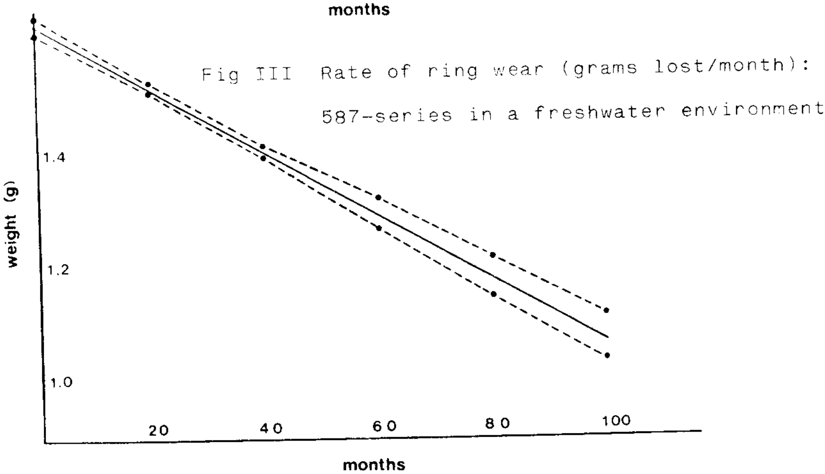

Fig III Rate of ring wear (grams lost/month): 587-series in a freshwater environment

597 and 646) to allow for a meaningful analysis. It is unfortunate that a large number of rings had to be excluded from the analysis due to missing ringing or recovery dates.

Each ring was cleaned and weighed to an accuracy of 0,01g. Ten unused rings from each series mentioned above were similarly treated to give a mean "new weight". Regression lines, based on the least mean squares method, of weight lost against time were plotted to permit weight loss per unit time to be calculated. The programme also enabled 95% confidence limits at twenty-month intervals to be computed.

Results and Discussion

Rings are lost once 65% of their weight has been corroded away (Ludwig 1967), and in the following discussion it will be assumed that this determines the effective life of the ring.

Rings used on birds in a dry land environment:

These rings (5-series) showed the least rate of wear being corroded at the rate of 0.48×10^{-3} g./month (Figure 1). Thus these rings have an effective life of approximately 11 years, although rings could be lost as early as 6½ years (Table 1). Local ringing records show that Streptopelia sp. have been recovered 77 months after having been ringed (Elliott & Jarvis 1973). It is possible therefore that even rings placed on birds of this size and occupying a dry habitat may be lost through corrosion or abrasion.

Rings used on birds in a fresh water environment:

The average effective life for the four series analysed varied from 97 months in series 597 to 128 months in series 646 (Table 1). Regression lines are shown in Figs. ii - v. Predictions as to the earliest ring loss, based on Ludwig's work, shows that rings from 597 series could be lost after 76 months, while those from 646 series would remain intact for an additional 39 months. The other two series could be predicted to show ring loss between

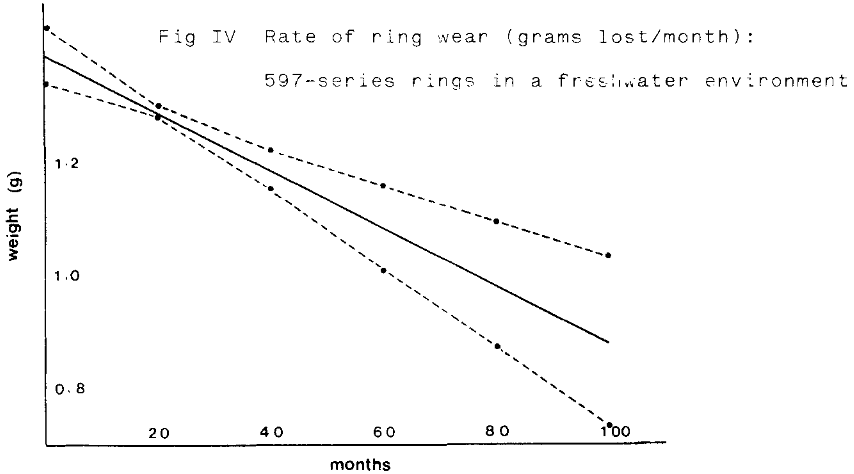

Fig IV Rate of ring wear (grams lost/month): 597-series rings in a freshwater environment

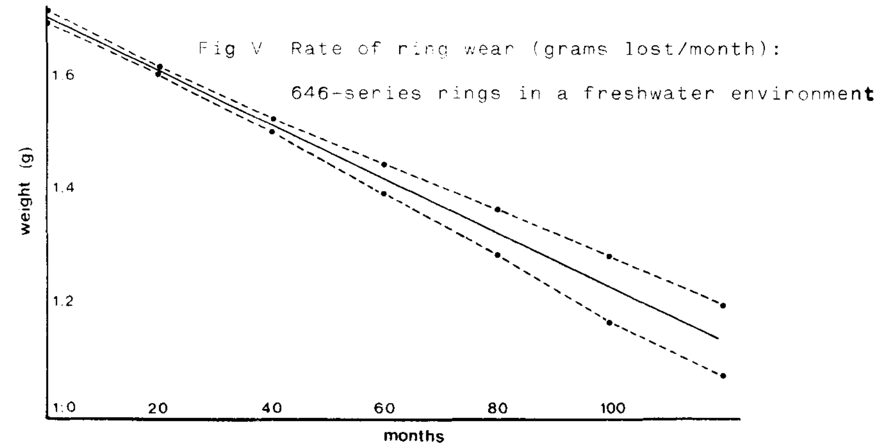

Fig V Rate of ring wear (grams lost/month): 646-series rings in a freshwater environment

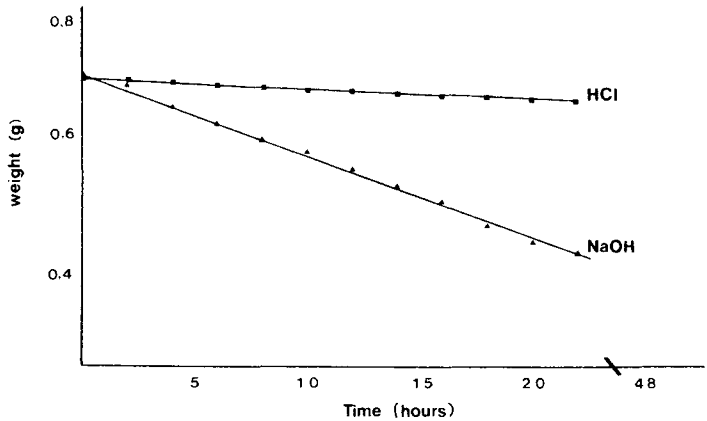

Fig VI Aluminium rings: comparison of the rates of weight loss in acid (HCL) and alkaline (NaOH) solutions these two values.

Longevity records (based on ringing recoveries) approach and in some cases overlap these figures. Thus Shelduck (Tadorna cana) have been recovered 89 and 125 months after ringing, and Yellow-billed Duck (Anas undulata) 83 months after ringing, while a coot (Fulica cristata) has been recovered 68 months after ringing.

Wide variations in the rate of wear were revealed by the analysis, thus wear in series 586 is 60% of that found in series 587. There are a number of factors which may explain this observation:

1. Differences in ring composition. Analysis of all the series involved was performed by Huletts Aluminium Cape Town. This showed that all the rings had been manufactured from the same alloy - M57 S (96% aluminium with trace amounts of eight other elements). Thus differences in ring composition is not responsible for the observed variations in wear.

2. Environmental factors. Laboratory experiments have shown that aluminium corrodes 10 times faster in an alkaline solution than in an acid solution (Appendix 1). Due to greater productivity in alkaline waters waterfowl tend to congregate on these waters rather than the less productive acid waters (Rowan, 1963). Barberspan, an area rich in waterfowl and an important ringing station for these birds, has a pH which varies from 8,2 to 10,4 (Milstein 1975). Trace elements of certain salts, particularly those of mercury and sulphates are also known to catalyse aluminium corrosion (Ball, pers.comm.).

3. Bird Behaviour. Ringing recoveries show that certain species disperse more readily than others. Thus 70% of A. undulata and 55% of T. cana are recovered more than 50km. from the ringing site, compared with 12% of F. cristata. However the stability of a stretch of water is of importance in determining dispersal. (Elliott & Jarvis 1973). It is probably safe to assume that movement is towards areas of greater

productivity and hence alkalinity.

The difference in the tendency of species to disperse may be reflected in the correlation coefficients in the different series. Thus rings analysed from series 586 and 587 were taken from all three species already mentioned (A. undulata, T. cana and F. cristata). The correlation coefficients from these two series are lower than those from 597 and 646 where the rings were obtained from single species (A. undulata and T. cana respectively). The rationale being that wear is influenced by the habitat sought by a particular species; thus the greater the variation to which the rings are exposed, the greater the variation in wear.

The Effects of Ring Wear on Long Term Recoveries. Analysis of the cumulative records of recoveries at SAFRING showed that only a small number of individuals of the species discussed above reach an age greater than 75 months (the period of time after which the earliest ring loss could be expected.) These figures are given in Table 2. Both aluminium and stainless steel /monel recoveries were included in the survey and distribution in these two ring classes appeared to be proportional to the number of rings recovered indicating that the small numbers of long term recoveries was not due to ring loss. The small numbers involved however do not make a statistical analysis of this possibility worthwhile.

Conclusion. A number of authors (Harris 1964, Coulson & White 1955, and Kadlec 1975) have emphasised the unreliability of aluminium rings when used on marine birds. The analysis described above suggests that longevity of some species of waterfowl may exceed the life of aluminium rings and even a Columbid may occasionally outlive the effective life of its rings. This only occurs in a small percentage of individuals and is unlikely to influence results based on long term ringing studies.

TABLE 1

The rate of wear, correlation co-efficients and predicted time of loss of rings for the five series analysed.

RING SERIES	NO.OF RINGS	CORRELATION CO-EFFICIENTS	REGRESSION SLOPE*	MONTHS TO 65% WEIGHT LOSS	MONTHS TO 95% CONFID. LIMIT
5	28	-0,53	0,0005	127	77
586	35	-0,61	0,0036	115	88
587	21	-0,40	0,0056	101	93
597	14	-0,84	0,0051	97	76
646	28	-0,86	0,0047	128	115

* Rate of wear expressed as g/mth.

TABLE 2

Percentage of rings from three species (*A. undulata*, *T. cana* and *F. cristata*) recovered more than 75 months after ringing.

SPECIES	TOTAL NO. OF RECOVERIES	NO. RECOVERED AFTER MORE THAN 75 MONTHS	PERCENTAGE OF TOTAL
A. undulata	807	16	2
T. cana	278	9	3
F. cristata	1053	14	1,4

Appendix 1. As indicated in the test the acidity (as measured by pH) varies considerably from one area to another in South Africa and also at a particular site it may vary from season to season. In order to gain some insight into the possible effect that pH may have on ring wear, a laboratory experiment was conducted.

Twenty rings from series 645 (which were made from the same alloy as the other rings in this study) were cleaned and weighed correct to 0.01g. They were then divided into two equal groups.

One group was placed into a Molar solution of hydrochloric acid and the other group into 1 Molar sodium hydroxide. The rings were removed at two hourly intervals, dried, weighed and then replaced in the solution. The solutions were changed every two hours to ensure that the hydrogen and hydroxyl ions remained in excess.

Fig. VI illustrates the comparative rates of weight loss in the two solutions. Mean rate of loss in acid solution was 0,0015g/hr compared to 0,0128g/hr in alkali. While these concentrations are not likely to be encountered in natural waters it does reflect the relative effect of two equivalent strengths of acid and alkali on aluminium rings.

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