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# Survival of Aluminum and Monel Bands on Black Brant

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## Introduction

Three recoveries of Black Brant (*Branta bernicla nigricans*) were recently reported in the "Significant Encounters" section of North American Bird Bander (Anon. 1986). At the time of recovery these Brant were 21.5, 22 and at least 22.5 years old. The significance of these recoveries caught my attention as all were of birds banded on the Yukon Delta, Alaska in 1963 by the Alaska Department of Fish and Game. In that year bands made of monel metal, a corrosion-resistant alloy consisting mainly of nickel and copper, were used for the first time in anticipation that they would survive significantly longer than standard aluminum bands in the estuarine and marine habitats used by Brant. Follow-up studies of the experimental banding were conducted by the Yukon Delta National Wildlife Refuge of which I was manager from 1964-1975.

The longevity records cited above and their relationship to the use of monel bands focused my attention on the problem of rapid wear and apparent loss of aluminum bands that had motivated the initial use of monel bands on Brant. Although Hickey (1952, p. 24) warned that because of loss and illegibility of bands, caution should be used in interpreting banding data for waterfowl beyond the fifth year, there has been little effort to determine the importance of this problem. I found only one published report (DuWors et al. 1987) on the extent of band wear and loss for this group of species, although waterfowl are the major focus of banding by many federal and state agencies. This lack of information seems surprising, as a basic assumption of analyses for estimating survival of banded birds is that there has been no loss of bands (Brownie et al. 1985, p. 6, Pollock and Raveling 1982). Nelson et al. (1980) evaluated the effect of band loss on estimates of survival and found that those calculated from life tables were often biased to such an extent that it was difficult to interpret much existing literature. However estimates of survival based on models of Brownie et al. (1985) were only slightly biased and band loss presented a significant problem only when it was severe for species with low mortality rates.

The lack of information on loss of bands among waterfowl indicates that my unpublished data on survival of

bands on Black Brant would be of interest, as the long life of this species presents the situation in which loss of bands may be of most concern. This paper compares recovery patterns and survival of aluminum and monel bands placed on Black Brant; examines prior estimates of survival and considers the potential for obtaining further "significant encounters" or longevity records from Brant banded with monel bands.

## Methods

Two approaches were used for evaluating the relative survival of aluminum and monel bands: (1) comparison of band retention and wear in an experimental sample of Brant banded in 1963 with monel and aluminum bands, and (2) comparison of recoveries from Brant banded from 1950-1952 and in 1962 with aluminum bands to those of Brant banded in 1963 with monel bands. The experimental sample consisted of 324 SY (yearling) and 500 ASY (two years or more old) Brant banded with monel and aluminum bands on opposite legs. All ASY Brant captured in the subsequent 11 years were examined for the presence or absence of each type of band. Loss of bands and all digits still legible on existing bands were recorded.

The temporal distribution of recoveries for SY and ASY banded birds are compared for 3,321 Brant banded with aluminum bands in 1950-1952 and 2,459 in 1962 and for 3,596 banded with monel bands in 1963. Double banded birds (824) from the experimental sample were included in the banded sample from 1963 as were Brant banded with both aluminum and plastic bands (297) in the sample from 1962. Recoveries included those processed by the U.S. Fish and Wildlife Service Bird Banding Laboratory to October 1985. Only recoveries from Brant that were reported as "shot" or "found dead" were considered in this comparison, because recoveries in other categories, particularly of Brant recaptured in banding operations, are biased by annual variation in banding effort and location of banding stations.

Survival rates for the 2,312 Brant banded with aluminum bands from 1950-1952 and for 6,012 SY and

ASY Brant banded with monel bands from 1967-1975 were calculated using models described by Brownie et al. (1985).

## Results and Discussion

A total of 144 (17.15%) of the double-banded Brant were recaptured 178 times in the 11 years after banding. Of these, one Brant was caught four times, seven three times, 19 twice, and 117 only once. Total recaptures and repeated captures of the same individual were both reduced by a change in the location of banding in 1967 and later years to an area about 25 km distant from the point where experimental birds had been banded.

No monel bands were known to have been lost and all digits remained legible during the 11 years subsequent to banding. When examined in the field, most monel bands appeared to be in virtually new condition although abrasion on the lower inside of some bands was evident. Loss of monel bands could not be determined if both bands were missing, but the lack of wear and obvious good condition of monel bands indicated that loss, if any, may be negligible.

Attrition of aluminum bands commenced almost immediately. Evidence of abrasion on margins was much more obvious than on monel bands, eventually producing sharp, scalloped edges and overall reduction in width, although most bands were probably lost before this degree of wear was reached. The rapid obliteration of digits and thinning of bands indicated that surface erosion was substantial. By the second year some digits on nearly a third of the bands had become illegible and few bands were legible after the fourth year (Table 1). Three of 51 (5.9%) aluminum bands were lost during the second or third years. Although none were missing on 20 Brant recovered the fourth and fifth years after banding, only 2 of 10 Brant recaptured during the sixth and seventh years after banding, retained aluminum bands. The proportions of Brant recovered through the fifth year from banding in 1950-1952 (10.6%) and 1962 (9.7%) with aluminum bands, and in 1963 (9.8%) with monel bands were not significantly different ( $P = 0.51$ ) indicating that few aluminum bands had been lost to that time (see Table 2). Subsequently, recoveries of Brant with aluminum bands dropped sharply, only 11.7% of those from Brant banded from 1950-1952 and 13.1% banded in 1962 being reported after the fifth year in contrast to 37.7% of recoveries from Brant banded with monel bands in 1963. Recoveries after the fifth year from the two cohorts with aluminum bands were not significantly different ( $P = 0.35$ ) but both differed significantly ( $P < 0.01$ ) from that with monel bands. Of the 556 recoveries of Brant with aluminum bands only 4 (0.7%) were recovered after the tenth

year. Even these four recoveries, however, may not indicate extended survival of some aluminum bands, as worn bands, except for the experimental banding, were normally replaced with monel bands. These replacement bands numbered several hundred during the study, but could not be identified on banding records that were available.

Table 1. Legibility of digits and survival of aluminum bands on recaptured Black Brant banded with both monel and aluminum bands (N = 824).

Years after banding	Number in sample	Bands lost		Bands with illegible digits		% lost or w/ illegible digits
		#	%	#	%	
1	80	0	0	0	0	0
2	37	1	2.7	11	29.7	32.4
3	14	2	14.3	5	35.7	50.0
4	13	0	0	9	69.2	69.2
5	7	0	0	6	85.7	85.7
6	3	2	66.7	1	33.3	100.0
7	7	6	85.7	1	14.3	100.0
8	0	--	--	--	--	--
9	2	1	50.0	1	50.0	100.0
10	4	4*	100.0	--	--	100.0
11	5	4*	80.0	1	20.0	100.0

\*These samples each contained 2 Brant for which bands had been recorded as lost or with illegible digits in a prior year.

In contrast to the rapid decline of recoveries from Brant banded with aluminum bands, Brant banded with monel bands continue to be reported through the twenty-first year after banding, the last year available for this analysis. There was no point at which a change in recovery patterns indicated significant loss of monel bands.

Hansen and Nelson (1957) calculated survival of AHY (yearling or older) Brant banded from 1949-1954 by means of life tables described by Bellrose and Chase (1950). This technique may produce estimates that may be seriously biased by loss of bands (Nelson et al. 1980), and their estimate of survival (67.8%) is substantially below an estimate ( $80.02 + 6.43$  SE) obtained by use of all subsequent recoveries and calculated by use of models described by Brownie et al. (1985). The latter estimate is not significantly different ( $P > 0.1$ ) from the estimate of average survival ( $83.53% + 4.11$  SE) obtained for Brant banded with monel bands from 1967-1975.

A total of 10,851 Brant were banded with monel bands between 1965 and 1980. The continued recovery of

Table 2. Number and percent of recoveries from Brant banded with aluminum bands in 1950-1952 and 1962 and with monel bands in 1963.

Years after banding	Aluminum Bands				Monel Bands Banded 1963	
	Banded #	1950-52 %	Banded #	1962 %	#	%
1	72	25.9	53	19.3	146	26.3
2	58	20.9	76	27.6	63	11.4
3	35	12.6	44	16.0	53	9.5
4	45	16.2	33	12.0	48	8.6
5	35	12.6	33	12.0	36	6.5
6	22	7.9	14	5.1	45	8.1
7	4	1.4	10	3.6	47	8.5
8	3	1.1	9	3.3	16	2.9
9	0	0	2	0.7	16	2.9
10	0	0	1	0.4	19	3.4
11	1	0.4	0	0	6	1.1
12	2	0.7	0	0	13	2.3
13	0	0	0	0	13	2.3
14	0	0	0	0	7	1.3
15	0	0	0	0	11	2.0
16	0	0	0	0	5	0.9
17	1	0.4	0	0	3	0.5
18	0	0	0	0	2	0.4
19	0	0	0	0	0	0
20	0	0	0	0	4	0.7
21	0	0	0	0	2	0.4
TOTALS	278	100.0	275	100.0	555	100.0
# banded	2,312		2,459		3,596	
% recovered	12.0		11.2		15.4	

Only Brant classified as SY or ASY at the time of banding and reported as shot or found dead when recovered are included in the analysis.

Brant banded with monel bands in 1963 during the 21 years available for the present analysis, and the large reservoir population from banding in subsequent years indicates that many additional longevity records for Black Brant will be established over the next few years. More importantly, however, the rapid loss of aluminum bands in contrast to the long retention of monel bands indicated by the results of this study, underscore the importance of using the most durable materials available for banding of long-lived species such as Black Brant. Although the most appropriate material and type of band may differ among species, both the reliability and kinds of information obtained by using the most durable bands are enhanced, while cost per recovery is substantially reduced.

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#### Addendum

Since acceptance of this manuscript I have obtained reports of three additional recoveries of Brant banded in 1963 with monel bands. These include Brant that had survived 21, 23 and 24 years after banding or to minimum ages of 22.5, 24.5 and 25.5 years respectively. The oldest, examined and reported by Austin Reed, Canadian Wildlife Service (pers. comm.), had been banded as a yearling and was part of the experimental sample banded with both monel and aluminum bands. At the time of recovery all digits on the monel band were legible, but the aluminum band was missing.