

BAND LOSS FROM THE WESTERN GULL ON SOUTHEAST FARALLON ISLAND

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Loss of standard U.S. Fish and Wildlife Service (FWS) aluminum (Al) bands from long-lived species precludes the use of recovery data for certain biological studies (Kadlec, *Bird-Banding* 46:230-235, 1975). Kadlec and Drury (*Bird-Banding* 40:217-221, 1969) estimated that standard Al band loss from Milk Island Herring Gulls (*Larus argentatus*) was approximately 45% after 3 years of wear, about 56% at 4 years, and that the loss thereafter continued at an estimated cumulative 20% per year. Kadlec (1975), in a subsequent study, placed incoloy, titanium, and standard Al bands, in combination, on Herring Gulls and reported less than 1% Al loss after 5 and 6 years, and only 3% loss after 7 years.

As the Western Gull (*Larus occidentalis*) is similar in size and habits to the Herring Gull, band loss from these gulls may be due to similar factors. Since 1971, Point Reyes Bird Observatory biologists have banded approximately 2000 Western Gull young each year on Southeast Farallon Island, 42 km west of San Francisco, California. In all years except 1972, each chick received a size 6 FWS butt-end Al band. In 1972, 1800 gull chicks received size 6 FWS butt-end Al bands, while 300 others received size 6 FWS butt-end monel bands. The Al bands used in this study differed in malleability depending on the numerical series of the bands. Bands used in 1971 and 1972 of 776 series were made of slightly harder Al, while those used in 1973 through 1977 were of 806 series made of somewhat softer Al. In 1978, 876 series Al bands were used. In all years each chick received a 10 mm inside diameter (ID) polyvinyl-chloride (PVC) roll-on color band on its other leg; a different color or leg combination has been used each year.

It has now become apparent that these gulls are losing metal bands at a high rate, but that loss of PVC bands is considerably less. In this paper band loss is quantified and its implications are discussed.

METHODS

Metal band loss.—In January 1979, Farallon PVC-banded gulls of hatching-years (HYS) 1971 through 1975 were censused at the island while they occupied their territories. I noted the presence or absence of metal bands, and for 1972 HY gulls I recorded the band type: Al or monel.

In February and March 1979, Farallon PVC-banded gulls of 1976 through 1978 HYS were observed for presence or absence of Al bands at eight California locations: Table Bluff Refuse Disposal Site (RDS), Humboldt County; Fort Bragg-Casper RDS, Mendocino Co.; Monterey Co. RDS; Berkeley, Alameda and Oakland City RDS's, Alameda Co.; Richmond City RDS, Contra Costa Co.; and a bathing/loafing site on Southeast Farallon Island. One day of censusing was spent at each site. Al bands were read with a spotting scope in order to amass a count of

individuals of respective HYS. These PVC-banded subadults were missing very few Al bands; individuals which had lost them could be aged by plumage and soft part differences recorded at each of the 8 locations. It is possible that a few individuals which had lost Al bands were counted at more than one site. However, among subadults with both PVC and Al bands, 5% or fewer of each age class were recorded at a second site. In view of their low rate of Al band loss and low degree of inter-site movement, I did not consider the effect of recounting individuals as significant.

The loss of Al and monel bands is assumed to be independent of the presence of PVC bands (see below), and is calculated only from birds which retained PVC bands. For each HY, the percent loss of Al bands is equal to $(\# \text{ birds with PVC only})/(\# \text{ birds with PVC and Al} + \# \text{ birds with PVC only})$.

PVC band loss.—PVC band loss, as related to age, was quantified between June 1978 and May 1979. As part of an on-going study, Al bands on Farallon Western Gulls, as well as others, were read along the California and Oregon coasts, and especially at the San Francisco Bay Area and Southeast Farallon Island. For this investigation, the quantification of PVC band loss is based on 2534 Farallon bands read during that study. Equal effort was given to the reading of Al bands on Western Gulls, except those obviously not banded on the Farallon Island. It is possible that counts to assess loss of PVC bands are biased by the fact that Al bands are less easily seen than PVC bands. Thus Al bands on PVC-banded birds might be more frequently read than those on individuals which have lost their PVC bands. However, in view of the thorough manner in which the legs of Western Gulls were examined, I do not believe that this bias was serious: 10% of the loss value. A 10% degree of error would change values for loss of PVC bands by less than 0.5%. The percent loss of PVC bands, calculated from birds with Al bands intact, is equal to $(\# \text{ birds with Al only})/(\# \text{ birds with PVC and Al} + \# \text{ birds with Al only})$.

Band measurements.—Thirty PVC bands not used during 1978 were measured at their widest and narrowest ID's (Fig. 1). These bands were first "rolled on" and squeezed to simulate the banding of a gull. PVC band ID measurements were again taken immediately after rolling and squeezing ("applying"), and after 2 days of undisturbed standing. PVC bands, 30 not used during each of the years 1971, 1973, and 1975, were also measured before and just after "applying." The narrowest and widest post-application ID measurements from those PVC bands representing each of the 4 years were then grouped and averaged.

Thirty-two PVC bands which had been removed from adult Farallon gulls were also measured at their narrowest and widest ID's. These bands had been worn an average of 7.1 years (SD = 1.01).

Widest ID measurements were also taken from 25 Al bands that had been removed by cutting the legs of dead chicks which failed to fledge in 1978.

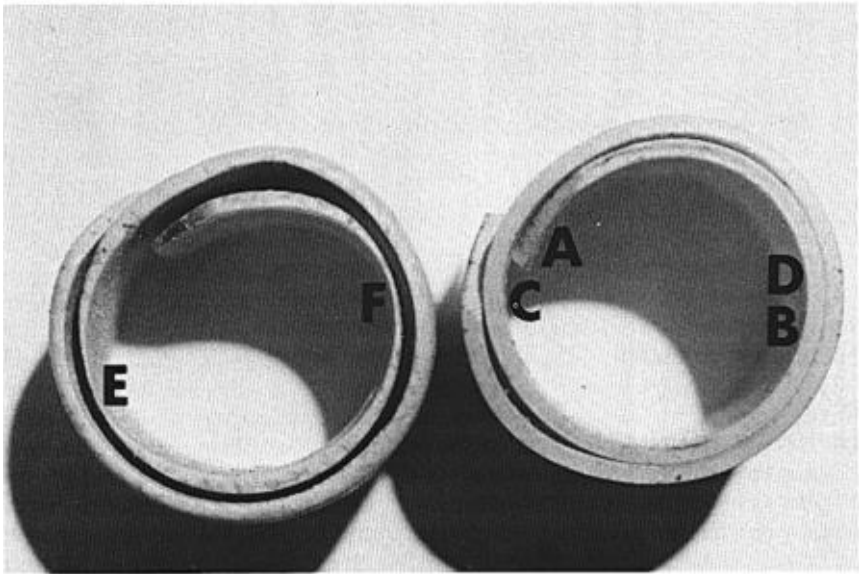


FIGURE 1. Unused 10 mm PVC band (right) and 10 mm PVC band which shows the typical pattern of wear (left) after being carried 8.1 years by a Farallon Western Gull. The lettering depicts: (1) A to B: narrowest ID; (2) C to D: widest ID; (3) E and F: areas where wear is greatest.

Al band weight and weight loss.—Twenty bands each of 776 and 806 series that had been removed from the legs of dead Farallon gull chicks were weighed and then averaged for each series. These bands had been worn briefly and were considered as new. Weights of eighteen 776 series and thirty-nine 806 series bands that had been lost by banded birds and found lying opened and uncorroded on the Southeast Farrallon Island between May 1978 and May 1980, were also averaged for each series.

The condition of bands attached to dead gulls found in various stages of decomposition on the Farallones suggests that on these islands an oxidation layer becomes evident on the outside of Al bands at 2 or 3 months after they are no longer being worn actively. Assuming that

TABLE 1.
Aluminum band loss from 7 age classes of Farallon Western Gulls.¹

Hatching year	1978	1977	1976	1975	1974	1973	1971
Years of wear	0.7	1.7	2.7	3.7	4.7	5.7	7.7
Gulls carrying PVC bands	110	142	58	66	151	72	74
Gulls carrying PVC but not Al	0	5	5	15	58	40	26
Percent w/o Al bands	0	4	9	23	38	56	35

¹ Data from the 1972 age class are analyzed separately: see Table 2.

TABLE 2.
Metal band loss from 88 Farallon Western Gulls of the 1972 age class.

	Number banded	Percent banded	Number expected	Number observed	Percent loss
Monel	300	14	12	2	83
Al	1800	86	76	47	38

opened unoxidized bands found on the Farallones had been lost an average of 2 months prior to recovery, the weight loss per year was calculated for each band, i.e. (weight when new - weight when found)/(years of use). Al bands removed from dead adults, or adults which were trapped and rebanded, were included in the weight loss rate analysis. In all, twenty-seven 776 series and fifty-three 806 series bands were examined. Band weight loss rates were averaged for each series.

Independence of Al and PVC wear.—It was assumed that Al and PVC band wear was not correlated, i.e. that factors which may cause excessive wear on Al bands being worn by certain gulls do not have the same effects on their PVC bands. The basis for this assumption is the apparent difference in the primary cause of wear and loss of the two band types. Evidence supporting this assumption is given in the discussion.

RESULTS

Band loss.—Al band loss was not serious in 1978, 1977, and 1976 HY gulls; however the rate of loss averaged about 16% per year in year classes between 1976 and 1973 (Table 1). A lower rate of Al band loss was observed for 1972 and 1971 HY gulls (Table 1 and 2). Monel band loss proved to be greatest (Table 2). The loss of PVC bands was least, but also tended to increase with age (Table 3).

Band measurements.—Significant differences ($P < 0.001$) were found between widest as well as narrowest ID measurements before and after simulated application of PVC bands representing each respective year that was examined (Table 4). The grouped samples, "applied" PVC bands from 4 years combined, averaged 10 mm at the narrowest ID, and over 11mm at the widest ID. There was no measureable difference

TABLE 3.
PVC band loss from 8 age classes of Farallon Western Gulls.

Hatching year	1978	1977	1976	1975	1974	1973	1972	1971
Years of wear	0.7	1.7	2.7	3.7	4.7	5.7	6.7	7.7
Gulls carrying Al bands	557	493	385	383	297	119	166	134
Gulls carrying Al but not PVC	3	3	3	8	19	5	7	15
Percent w/o PVC bands	<1	<1	1	2	6	4	4	11

TABLE 4.

ID measurements of size 6 FWS butt-end Al and 10 mm Warner PVC bands from several years of Western Gull banding on Southeast Farallon Island.

Band type	Narrowest ID (mm)	Widest ID (mm)
	Mean \pm SD	Mean \pm SD
#6 Al (new)	—	9.8 \pm 0.05
10 mm PVC:		
Unused in 1978:		
(a) before applying	9.1 \pm 0.08	10.3 \pm 0.09
(b) after applying	10.0 \pm 0.11	11.2 \pm 0.11
(c) 2 days after applying	—	11.2 \pm 0.10
Unused in 1975:		
(a) before applying	9.2 \pm 0.06	10.5 \pm 0.10
(b) after applying	10.0 \pm 0.11	11.3 \pm 0.08
Unused in 1973:		
(a) before applying	9.2 \pm 0.08	10.5 \pm 0.09
(b) after applying	10.0 \pm 0.13	11.4 \pm 0.11
Unused in 1971:		
(a) before applying	9.0 \pm 0.07	10.2 \pm 0.07
(b) after applying	9.9 \pm 0.08	11.1 \pm 0.09
Unused grouped: after applying	10.0 \pm 0.12	11.3 \pm 0.14
Used: after removal from adults	11.1 \pm 0.25	12.6 \pm 0.28

in ID's of PVC bands measured immediately after application and again after 2 days of standing. Although there were significant differences ($P < 0.05$) between mean ID's of PVC bands used during certain years, the significance was due to the ID uniformity of bands representing those used during each respective year. In terms of gull banding these ID differences were small.

The widest mean ID of PVC bands removed from Farallon adults was significantly greater ($t = 37.62$, $df = 150$, $P < 0.001$) than that of "applied" samples of unused 10 mm PVC bands saved from 4 banding years.

The widest mean ID of new size 6 FWS butt-end Al bands that were removed unopened from the legs of dead gull chicks was significantly less ($t = 50.74$, $df = 143$, $P < 0.001$) than that of samples of unused 10 mm PVC bands saved from 4 banding years (Table 4).

Band weights and weight loss.—New 776 series bands were significantly heavier ($t = 4.07$, $df = 38$, $P < 0.001$) than new 806 series bands, this difference being due primarily to the uniformity of weights of bands representing respective band series (Table 5). The average weight of 776 series bands found open on the Southeast Farallon Island was sig-

TABLE 5.

Weights of 776 and 806 series FWS butt-end Al bands when new and after being found opened (on Southeast Farallon Island) and including yearly weight loss.

		Band weights (g) Mean \pm SD
<i>When new:</i>		
	776 Series	0.85 \pm 0.005
	806 Series	0.84 \pm 0.003
<i>After being found opened:</i>		
	776 Series	0.59 \pm 0.027
	806 Series	0.69 \pm 0.037
		Yearly weight loss (g) Mean \pm SD
	776 Series	0.033 \pm 0.0021
	806 Series	0.036 \pm 0.0062

nificantly less ($t = 10.03$, $df = 55$, $P < 0.001$) than that of 806 series bands which had been found under like circumstances (Table 5).

The average yearly weight loss of 776 series bands was significantly less ($t = 2.39$, $df = 78$, $P < 0.05$) than that of the 806 band series.

The 806 series bands that were found opened had averaged 4.3 years ($SD = 0.69$) of wear, the 776 series bands 8.0 years ($SD = 0.78$). All opened bands of the 806 series were quite legible. Although most 776 series bands could be easily read, outside wear of these bands was more advanced than that of the 806 series bands (Fig. 2).

DISCUSSION

Cause of Al band wear and loss.—No comments can be offered concerning monel band loss in the 1972 age class; however evidence indicates that the loss of Al bands in this gull population occurs after bands wear and/or corrode to the point that they are easily opened. Size 6 butt-end bands, when new and properly applied, fit snugly on the tarsi of Western Gulls. At that time rotation and/or slippage of the bands on the gulls' tarsi is slight, if any. Thus it is probable that these bands experience little inside wear while they are tightly shut. The scratched outside of Al bands found lost or removed from Farallon Western Gulls suggests that much wear takes place on that surface. It is probable that this wear happens when the bands come in contact with abrasive rock or cement surfaces. Al band wear may be enhanced when the gulls drop into, or rise from, a resting position. They then fold or unfold their legs, and at these moments the outside of their bands is grated against the substrate beneath them.



FIGURE 2. New (1A, 2A) and used (1B, 2B) 776 and 806 series butt-end Al bands. The used 776 band had been worn by a Farallon Western Gull for 8.0 years (wt. = 0.59 g), the used 806 band 4.3 years (wt. = 0.69 g).

A large number of Farallon adults wear Al bands which at this time are partially opened, some to the extent that they appear very near to dropping off. The 57 worn, opened Al bands found on the Farallones during the 2 years of this investigation attest to the high rate of Al band loss due to opening. Ludwig (Bird-Banding 38:309–323, 1967) observed an adult Herring Gull pull a newly-placed size 6 Al band from its leg. Of 108 Western Gulls I have banded as adults, two made great attempts to remove their new size 6 butt-end Al bands, but neither was successful. While some adults may react violently to newly received bands, others do not appear to notice them, or pull briefly at them. It is my experience that gull chicks do not appear to be aware of the bands, and that adults which have been banded as chicks give little attention to their bands. I have never witnessed the loss of a band, but it is likely that most band loss occurs when bands are caught or entangled in foreign objects. On several occasions I have observed gulls catch their bands on debris at dumps, and this may have been an important source of band loss.

Band quality standardization.—Al band loss due to progressive wear and band weakening would explain the relatively linear, age-related trend in the percent loss from 1978 through 1973 age classes, but is difficult to apply to the pattern of band loss observed from 1972 and 1971 HY gulls (Table 1). The divergence seen here is likely due to a difference

choosing the correct band size. Thus while small chicks may accommodate a size 6 Al band, their legs are too small to hold a PVC band measuring over 11 mm at its widest ID. Pre-wrapping of these bands once before application so that upon application they resume the original wrap pattern does eliminate some band expansion. However they still average approximately 11mm at their largest ID. PVC bands were frequently found on the island after each banding season. Farallon biologists were much concerned when they observed gulls of earlier age classes returning to the colony with PVC bands that had slipped down over one foot. In later years much care was taken not to band chicks that were too small to hold the PVC bands (in 1980 the Point Reyes Bird Observatory plans to use 9 mm Warner PVC bands). These precautions may in part explain differences in trends of PVC band loss seen in the age classes 1971 through 1974, and 1975 through 1978 (Table 3).

Some PVC bands are being lost by adult Farallon gulls. Of 156 PVC-banded 5- to 8-year-olds whose breeding activities were followed in 1978 and 1979, three lost PVC bands within that time period, and 2 others now wear PVC bands which have slipped over one foot. This is apparently due to wear on the inside of those loosely-fitting bands which slide freely up and down the gulls' tarsi. Although broken PVC bands are not found on the Farallones, PVC bands which show moderate inside wear are not infrequently found there, and give further evidence that some of these bands are lost due to slippage after several years of wear.

Examination of worn PVC bands indicates that wear takes place mostly at two distinct areas of the inside wrap (Fig. 1). It appears that rotation of these bands around the gulls' tarsi is retarded as the protruding end of the inside wrap rubs against the anterior or posterior areas of the tarsi. As wear advances, besides enlarging, the inside of the band becomes oval: the shape of a gull's foot when closed.

While Warner PVC bands retain their color and appear to be highly durable, researchers using them would be well advised to use bands with widest ID's per the ID recommended by the FWS. This may necessitate the ordering and measuring of samples.

SUMMARY

The rates of band loss were assessed in Western Gulls banded at the Farallon Islands. Loss of Fish and Wildlife Service aluminum bands was due to wear and/or corrosion to the point that bands became weak. Most loss in these gulls was probably due to band entanglement with foreign objects. There was no evidence that Farallon gulls removed their bands. Loss of the Fish and Wildlife Service 806 series bands began in the second year, but did not become serious until about the third year. Loss of these bands increased from 9% at 2.7 years of wear to 23% at 3.7 years. Between 2.7 and 5.7 years of use, the rate of loss of this band series averaged approximately 16% per year. However the rate of loss

of 776 series bands was less than that of the 806 series, and was probably due to differences in quality of band materials.

There was little loss observed for PVC bands. That which has occurred was probably due to bands slipping from the legs of chicks just after banding, and from adults after band inside diameters became enlarged from wear against the gulls' legs.

ACKNOWLEDGMENTS

I thank the members of the San Francisco Chapter of the Oceanic Society, who provided reliable transportation to and from the Farallon Islands on many occasions. I am grateful to Bryant T. Bainbridge, Robert J. Boekelheide, Thomas Harvey, R. Phil Henderson, Harriet R. Huber, Stephen H. and Michael R. Morrell, Douglas A. Nelson, Mattias Radecki, and Craig S. Strong for their assistance, and to O'Brien Young for applying her secretarial skills to the final draft. David G. Ainley, Daniel W. Anderson, and Hans Blokpoel reviewed the ms. Their comments and criticisms were more than helpful.

Much of this investigation was conducted on the Farallones National Wildlife Refuge, and was supported in part by a grant from the Packard Foundation administered through the Moss Landing Marine Laboratories. This is contribution number 198 of the Point Reyes Bird Observatory.

4990 Shoreline highway, Stinson Beach, CA 94970. Received 14 Dec. 1979; accepted 15 Sept. 1980.