Band Wear In Elegant Terns

Charles T. Collins
Department of Biological Sciences
California State University
Long Beach, CA 90840
ccollins@csulb.edu

ABSTRACT

Butt-end size 3 aluminum bands used on Elegant Terns (*Thalasseus elegans*) lost an average of 4.95 % (range 0.34 – 11.5 %) of their initial weight per year. Most wear was on the inner surface of the band. Band loss may be significant when >50% of the band's original metal is lost. In Elegant Terns the minimum expected life span of a band is 4.5 years.

INTRODUCTION

Before a bird is banded, banders should ask themselves two questions. How long will this bird live? Will this band last for the expected life-span of the bird? The second question is probably asked far less often than it should be.

Recoveries of birds banded as part of the USGS Bird Banding Laboratory's (BBL) program provide direct information on the maximum life span of wild birds, as well as migration routes, over-wintering areas and possible age and sex differences in these characteristics. Other equally important demographic parameters are calculated on the basis of these recoveries and are dependent upon band longevity and bands not being lost during the life span of the bird. Estimating the annual survival rate of birds is important in modeling long-term population trends, particularly for endangered or threatened species. Loss of bands from older birds in the population severely compromises survival estimates (Nelson et al. 1980) and also management decisions based on them.

To date, band wear, often to the point where bands are lost, has been documented for diverse body sizes and taxa of birds ranging from waterfowl (Ludwig and Steblay 1972, DuWors et al. 1987) to albatrosses (Ludwig et al. 1995). It has been particularly well described for several species of gulls and terns (Ludwig 1967, 1981, Spear 1980, Hatch and Nisbet 1983a, 1983b, Nisbet and Hatch 1983, Bailey et al. 1987, Dolbeer and Belant 1994, Wooller and Wooller 1998). I present here similar data for the Elegant Tern (*Thalasseus elegans*).

Elegant Terns currently breed at three colony sites in southern California ranging from Los Angeles Harbor south to San Diego Bay (Collins 2006). However, 95% of this species' breeding population is located at Isla Rasa, in the Gulf of California, Mexico, where about 180,000 pairs nest (Burness et al. 1999, Velarde et al. 2005). Elegant Terns first bred in San Diego, CA, in 1959 and expanded north to the Bolsa Chica State Ecological Reserve (= Bolsa Chica) in coastal Orange County in 1987 (Collins et al. 1991) and to Los Angeles Harbor (=Pier 400) in 1998. Interannual movement among these three northern colonies is frequent (Collins 2006).

METHODS

Between 1988 and 2003, 15,956 pre-flying Elegant Tern chicks (HY-L) were banded at either the Bolsa Chica or Pier 400 colonies with a maximum of 3,000 at Pier 400 in 2002. All chicks were banded with standard pre-opened size 3 butt-end aluminum bands issued by the BBL. In subsequent years, some banded Elegant Terns were found dead in the breeding colonies, often entangled in monofilament fishing line. Recovered bands were reported to the BBL and 35 were available for this analysis. To assess band wear, recovered bands were weighed to the nearest 0.0001 g on a Mettler AC 100 electronic balance and the weights compared to a sample of 15 unused bands from the same

numerical series as those used in the field. Band thickness was measured to the nearest 0.001 mm with digital calipers. Since the pattern of wear was not uniform around the band's circumference, measurements were made of both the maximum and minimum thickness and compared to similar measurements of the unused bands.

RESULTS

The 35 bands recovered from Elegant Terns weighed between 99.04% and 49.91% of the mean weight of the unused bands after having been on the terns between two and 12 years. The bands lost between 0.34% and 11.52% of their initial weight per year with a mean of 4.95% (SD 3.13). The rate of weight loss was, on average, less in years 1-3 than in years 4-6, 7-9 and 10-12 (Table 1), but showed only slight variation in total weight loss after year 4 (Figure 1). An unusually low rate (3.72%/yr) was recorded for a band that had been on for 12 years and a high rate (11.52%/yr) recorded for a band that had been on for only four years (Table 1).

Thickness of the recovered bands ranged from 89.7 % (minimum) to100% for a band that had been on for only two years and from 39.7% (minimum) to 67.0% (maximum) for a band that had been on for nine years. The decrease in thickness was, on average, less in years 1-4 than in years 5-8 and 9-12 (Table 2) but showed substantial variation in both minimum and maximum thicknesses (Figure 2).

DISCUSSION

The rate of band wear for Elegant Terns is similar to that recorded in most studies of other terns where aluminum bands were used (Table 3). Strikingly lower annual rates of band wear were reported (Table 3) for Arctic (*Sterna paradisaea*) and Sooty Terns (*Onychoprion fuscata*), both of which are largely pelagic in the non-breeding season and do not regularly rest or roost on sandy substrates where physical abrasion could be high. The corrosive effect of salt water on aluminum bands would also contribute to the high rate of weight loss of bands on birds inhabiting highly saline lakes and marine environments (Jehl 1990) and would also be true for Elegant Terns.

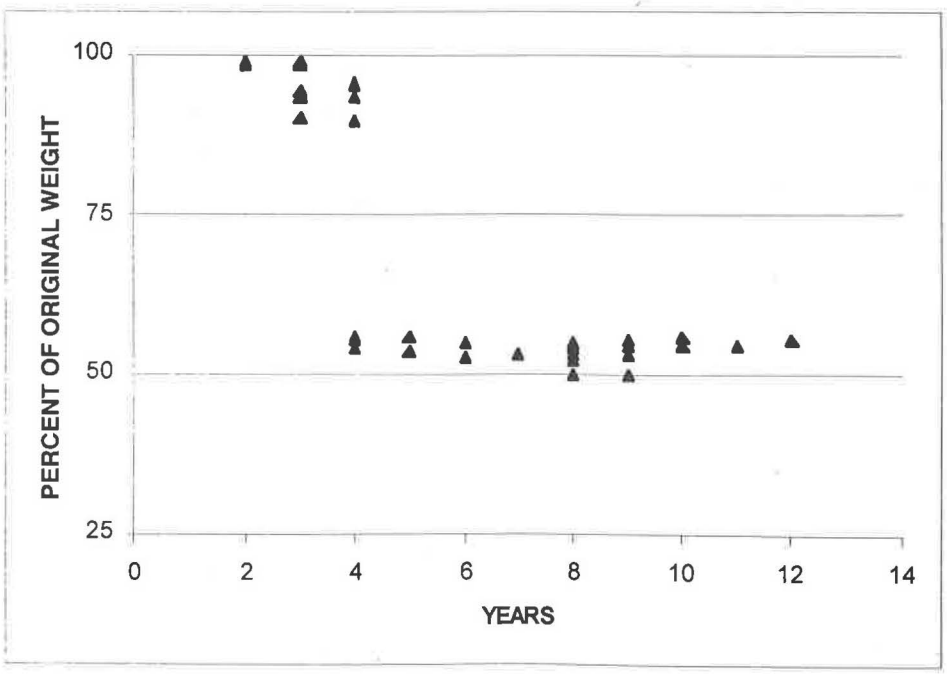


Figure 1. Weight loss in size 3 aluminum bands recovered from Elegant Terns.

Table 1. Average annual weight loss of bands on Elegant Terns as percent of original weight.

	n	Mean (%)	S. D.	Range
Years 1-3	8	1.22	1.09	0.34 - 3.32
Years 4-6	10	7.26	4.05	1.11 -11.52
Years 7-9	13	5.70	0.47	4.95 - 6.67
Years 10-12	4	4.22	0.37	3.72 - 4.56
All years	35	4.95	3.13	0.34 -11.52

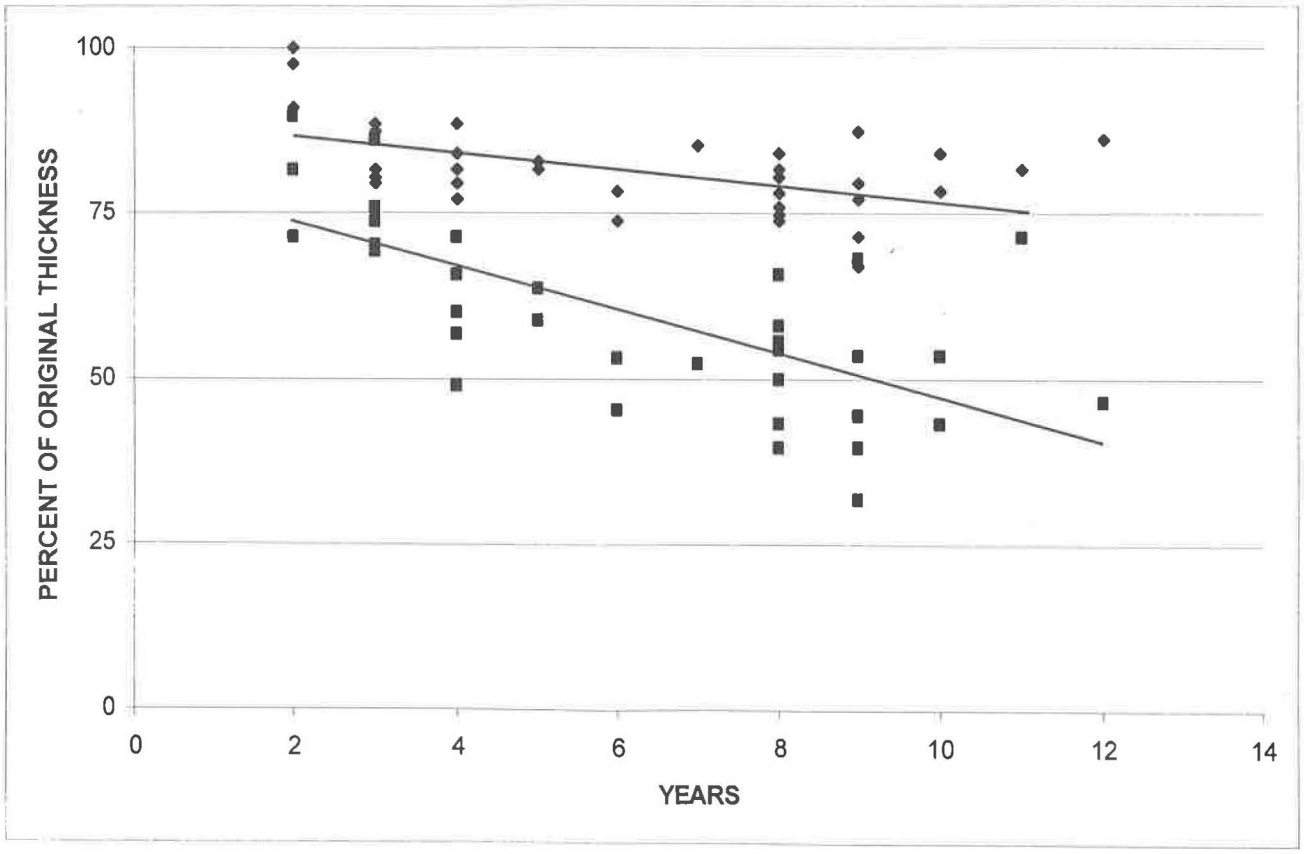


Figure 2. Decrease in thickness of size 3 aluminum bands recovered from Elegant Terns. Diamonds indicate maximum thickness of bands; squares indicate minimum thickness of bands.

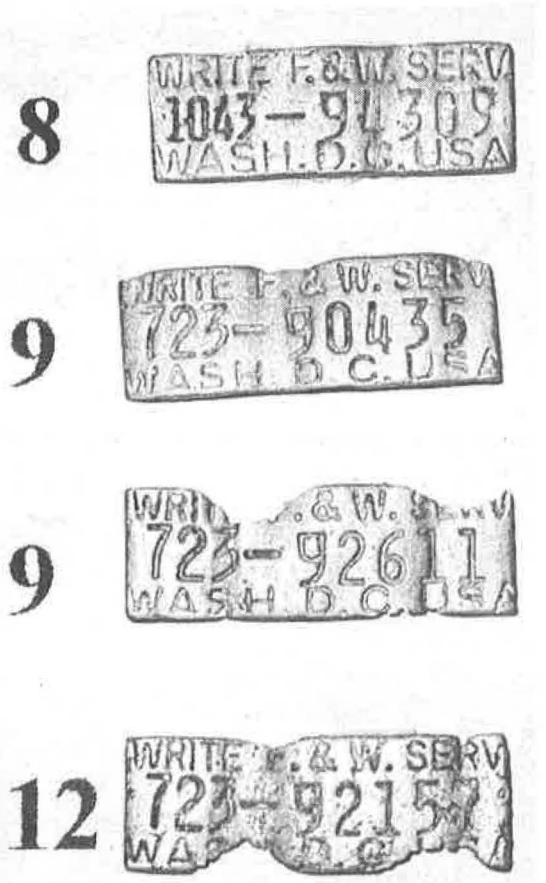
Table 2. Average maximum and minimum thickness of bands recovered from Elegant Terns as percent of original thickness.

		n	Mean (%)	S.D.	Range
Years 1-4	Maximum	14	85.5	7.0	77.2-100
	Minimum	14	70.9	11.0	60.2-89.7
Years 5-8	Maximum	12	79.3	4.0	73.8-85.2
	Minimum	12	53.3	7.9	43.1-65.9
Years 9-12	Maximum	9	79.2	6.7	71.5-87.5
	Minimum	9	50.2	1.3	31.8-71.5

Table 3. Average annual weight loss of aluminum bands on terns as percent of original weight.

Species	Band size	Weight loss	Source
Caspian Tern (*Hydroprogne caspia*)	5	3.04	Ludwig 1981
Elegant Tern (*Thalasseus elegans*)	3	4.78	this study
Sooty Tern (*Onychoprion fuscata*)	3	0.57	Bailey et al. 1987
Common Tern (*Sterna hirundo*)	3	5.42	Hatch and Nisbet 1983a
Common Tern	2	4.08	Hatch and Nisbet 1983a
Common Tern	3	5.11	Ludwig and Steblay 1972
Roseate Tern (*Sterna dougallii*)	2	5.67-6.27	Nisbet and Hatch 1983
Arctic Tern (*Sterna paradisaea*)	2	0.91	Hatch and Nisbet 1983b

Figure 3. Bands recovered from Elegant Terns after 8-12 years. There is little apparent wear to the external surface but much erosion of the margins on some of the oldest bands.



The apparent lower rate of band wear on Elegant Terns in the first few years (Table 1, Table 2) is likely to be the result of the bands fitting tighter on the tarsus and thus moving less at this time. After three years, the bands would have worn a bit and thus fit more loosely. By the fourth year, increased movement of the looser-fitting bands appeared to increase the abrasion rate on the inner surface of the band, particularly when sand got between the band and tarsus. This same pattern of movement-related band wear has been noted previously (Rowley 1966, Ludwig and Steblay 1972, Ludwig 1981, Hatch and Nisbet 1983a) and accounted for the difference in band wear between the sexes in Red-Billed Gulls (*Larus scopulinus*; Mills 1972) and Laughing Gulls (*Larus atricilla*) reported by Dolbeer and Belant (1994). In the latter study, the tarsus diameter of female gulls was smaller, and the size 4A bands used on both sexes moved more freely on females and thus accelerated band wear. This sexual difference in wear was not noted when the gulls were banded with size 5 bands, which moved equally on both sexes (Dolbeer and Belant 1994). Similarly, the annual wear rate of bands on Caspian Terns (*Hydroprogne caspia*) dropped from 3.04% on size 5 bands to 2.22% when smaller size 4A bands were used (Ludwig 1981). Band wear on all ages of Silver Gulls (*Larus novaehollandiae*) was a nearly uniform 4.1%/year (Wooller and Wooller 1998).

The Elegant Tern bands recovered here showed little wear on the external surface even after 8-12 years (Figure 3). Thus, the recorded loss of weight and decrease in thickness is attributable to abrasion of the inner surface only. Erosion of the band margins was seen in some of the oldest bands (Figure 3) and contributed to weight loss measurements.

Severe wear on the external surface of bands has been noted for Western Gulls (*Larus occidentalis*; Spear 1980) and for burrowing species such as Manx Shearwaters (*Puffinus puffinus*) and Atlantic Puffins (*Fratercula arctica*), which scrub the tarsus and bands on the burrow substrate (Harris 1964, 1980). This was also noted in cliff-nesting White-throated Swifts (*Aeronautes saxatalis*, Collins 1973).

Bands that have become thin through years of continuing wear can be lost by several means including getting caught on vegetation or foreign objects in the environment and being pulled off by the bird carrying them (Ludwig and Steblay 1972, Spear 1980). The time to reach the point where this loss is significant enough to impact survival estimates varies from species to species and with differences in the annual rate of band wear.

Uneven wear, shown here, which results in pronounced thin areas of the band would only

accelerate the overall weakening and eventual loss of the bands. Ludwig and Steblay (1972) suggested that band loss in many species occurs when more than 50% of the band's metal has been lost. In Elegant Terns, the complete absence of any recovered bands that had lost more than 50.5% of their initial weight (Figure 1) and only two whose thickness was less than 45% of the original thickness (Figure 2) suggests that these may, on average, be the points when band loss becomes appreciable in this species as well. This amount of weight loss and band thinning implies that the expected life span of a band is about 4.5 yr in Elegant Terns. Other estimates of the amount of band weight reduction at which band loss would become important range from as little as 32% in Common Terns (Hatch and Nisbet 1983a) or as much as 86% in Sooty Terns (Bailey et al. 1987).

The wear rates of non-aluminum bands on a variety of birds were substantially lower than for aluminum bands (Ludwig 1967, Anderson 1980, Hatch and Nisbet 1983a, Wooller and Wooller 1998). Incoloy or stainless steel bands, in particular, have shown much reduced levels of wear and clearly would be the better choice for long-term studies (including this one) where older birds are likely to be recovered and the use of these bands would permit unbiased survival rates to be calculated.

It is now well established that not all bands will last the lifetime of long-lived birds. Although most of the documentation for this has involved seabirds, it is also true for terrestrial species including passerines (Bergstrom 1964, Rowley 1966, Ludwig and Steblay 1972, Collins unpublished). Accordingly, banders working with long-lived species should consider closely the second question posed in the introduction and choose an appropriate band size and band composition and not just (as here) opt for the convenience of easier-to-apply pre-opened aluminum bands. There is a laudable increase in use of stainless steel and Incoloy bands and they are available from the BBL in sizes 1A and 1B up to size 9. The better quality data obtained through their use will more than repay the extra time it takes to place them on long-lived study subjects.

ACKNOWLEDGMENTS

I am indebted to the teams of field helpers and fellow banders who made the round-up and banding of Elegant Terns possible. A special thanks to Wally Ross, Brian Foster, Nathan Mudry and Robert Patton who saved bands from dead terns to be included in this analysis. Elegant Terns were banded under Master Banding Permit 08707 and Protocol No. 227 from the Institutional Animal Care and Use Committee, California State University, Long Beach. Access to the colonies at Bolsa Chica and Pier 400 was kindly granted by California Department of Fish and Game and the Port of Los Angeles. I appreciate the comments from W. B. Tyler, W. D. Loughman and an anonymous reviewer that improved the final manuscript. K. Loughman provided an additional useful reference.

LITERATURE CITED

Anderson, A. 1980. Band wear in the Fulmar. *J. Field Ornithol.* 51:101-109.

Bailey, E. E., G. E. Woolfenden, and W. B. Robertson. 1987. Abraision and loss of bands from Dry Tortugas Sooty Terns. *J. Field Ornithol.* 58:413-424.

Bergstrom, A. 1964. Band loss by Blue Jays. *Bird-Banding* 35:42-44.

Burness, G. D., K. Lefevre and C. T. Collins. 1999. Elegant Tern (*Sterna elegans*). *In* The birds of North America. No. 404. (A. Poole and F. Gill, eds.). The Birds of North America Inc., Philadelphia, PA.

Collins, C. T. 1973. Notes on survival and band wear in White-throated Swifts. *Western Bird Bander* 48:20-21.

Collins, C. T. 2006. Banding studies of Elegant Terns in southern California. *N. Amer. Bird Bander* 31:17-22.

Collins, C. T., W. A. Schew and E. Burkett. 1991. Elegant Terns breeding in Orange County, California. *Am. Birds* 45:393-395.

Dolbeer, R. A. and J. L. Belant, 1994. Differential band wear for male and female Laughing Gulls. *J. Field Ornithol.* 65:513-530.

DuWors, M. R., C. S. Houston, and P. Kelnoe. 1987. More rapid wear of bands on Common Goldeneye than on White-winged Scoter. *N. Amer. Bird Bander* 12:97-98

Harris, M. P. 1964. Ring loss and wear of rings on marked Manx Shearwaters. *Bird Study* 11:39-46.

Harris, M. P. 1980. Loss of weight and legibility of bird rings. *Ringing and Migration* 3:41-48.

Hatch, J. and I. C. T. Nisbet. 1983a. Band wear and loss in Common Terns. *J. Field Ornithol.* 54:1-16.

Hatch, J. and I. C. T. Nisbet. 1983b. Band wear in Arctic Terns. *J. Field Ornithol.* 54:91.

Jehl, J. R., Jr. 1990. Rapid band wear in Eared Grebes and other saline lake birds. *J. Field Ornithol.* 61:108-110.

Ludwig, J. P. 1967. Band loss – its effect on banding data and apparent survivorship in the Ring-billed Gull populations of the Great Lakes. *Bird-Banding* 38:309-323.

Ludwig, J. P. 1981. Band wear and band loss in the Great Lakes Caspian Tern population and a generalized model of band loss. *Colon. Waterbirds* 4:174-186.

Ludwig, J. P. and J. K. Steblay.1972. Study of the factors promoting band loss and their influence on population data in eight selected species of birds. Unpublished report to U. S. Department of the Interior, Bemidji State College, Bemidji, Interior, Bemidji State College, Bemidji, MN. [A copy has been deposited in the Van Tyne Memorial Library, University of Michigan, Ann Arbor.]

Ludwig, J. P., C. L. Summer, H. J. Auman, T. L. Colborn, F. E. Ludwig, and G. Diefenderfer. 1995. Band loss in North Pacific populations of Laysan Albatross (*Diomedea immutabilis*) and Black-footed Albatross (*D. nigripes*). *N. Amer. Bird Bander* 20:157-164.

Mills, J. A. 1972. A difference in band loss from male and female Red-billed Gulls *Larus novaehollandiae scopulinus*. *Ibis* 114:252-255.

Nelson, L. J., D. R. Anderson, and K. P. Burnham. 1980. The effect of band loss on estimates of annual survival. *J. Field Ornithol.* 51:30-58.

Nisbet, I. C. T. and J. J. Hatch. 1983. Band wear and band loss in Roseate Terns. *J. Field Ornithol.* 54:90.

Rowley, I. 1966. Rapid band wear on Australian Ravens. *Australian Bird Bander* 4:47-49.

Spear, L. 1980. Band loss from the Western Gull on Southeast Farallon Island. *J. Field Ornithol.* 51:319-328.

Velarde, E., J-L. E. Carton, H. Drummond, D. W. Anderson, E. Palacios, and C. Rodriguez. 2005. Nesting seabirds of the Gulf of California's offshore islands: diversity, ecology, and conservation. Pp. 452-270 *in* Biodiversity, ecosystems and conservation in northern Mexico. (J-L. Carton, G. Ceballos and R. S. Felger, eds.) Oxford Univ. Press, NY.

Wooller, R. D. and S. J. Wooller, 1998. Wear rates of aluminium and stainless steel leg bands on Silver Gulls. *Corella* 22:29-31.