

## BANDING IS INFREQUENTLY ASSOCIATED WITH FOOT LOSS IN SPOTTED SANDPIPERS

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**Abstract.**—Foot-loss rates as high as 50% associated with leg banding have been reported for some shorebirds. Foot loss in a banded population of Spotted Sandpipers (*Actitis macularia*) was studied over 19 yr. A total of 267 banded birds were seen in at least one subsequent year, representing 774 bird years. Seven of 267 banded birds (2.6%) lost one foot in years following banding. One additional banded bird lost a toe. Three unbanded birds missing feet and one missing a toe were also noted. Of the seven banded birds missing feet, six lost the foot on the side with the aluminum band. Assuming foot loss was independent of the aluminum band, the probability of observing at least six of seven losses on the aluminum-banded side is 0.013 (binomial test). A plastic colored leg band caused toe loss on one bird. It is concluded that banding Spotted Sandpipers probably caused little harm to this population. Individual harm usually was associated with the aluminum band.

### EL ASOCIAR CON POCA FRECUENCIA EL ANILLAMIENTO A LA PÉRDIDA DE PATAS POR PARTE DE INDIVIDUOS DE *ACTITIS MACULARIA*

**Sinopsis.**—La pérdida de patas en playeros, hasta un 50%, ha sido asociada al anillamiento con bandas de aluminio. Por un período de 19 años, se estudió la pérdida de patas en una población anillada de *Actitis macularia*. Un total de 267 individuos anillados fueron observados por lo menos el año subsiguiente al anillamiento, representando esto 774 aves-años. Siete de las aves anilladas (el 2.6%) perdieron una pata en años subsiguientes al anillamiento; un ave adicional perdió un dedo. Tres aves que no fueron anilladas también perdieron una pata y otra un dedo. De las siete aves que perdieron una pata, seis perdieron la extremidad con la anilla. Asumiendo que la pérdida de la pata fue independiente al anillaje, la probabilidad de observar 6/7 individuos con pérdidas de la pata anillada, es de 0.013 (prueba binomial). Una anilla plástica causó la pérdida de un dedo en un playero. Se concluye que el anillamiento de estos playeros con bandas de aluminio causa muy poco daño a la población de los mismos. El daño a individuos se asoció al uso de bandas de aluminio.

Many methods are used to mark birds, all of which are known to cause some injury under particular conditions (Marion and Shamis 1977). Aluminum, steel and plastic colored leg bands are the most frequently used markers, and occasionally are associated with foot injury or loss (Henckel 1976, Marion and Shamis 1977). Shorebirds are among those reported as harmed by bands. Banding was associated with bill injury and death of 50% of a captive population of Pied Avocets (*Recurvirostra avosetta*) (Salzert and Schelshorn 1979). J. Sidle and G. Lingle (pers. comm.) found foot-loss rates for Piping Plovers (*Charadrius melodus*) as high as 11% (5/45) in one population (1 or 2 feet), although nation-wide loss rates were 1-3%. It is difficult to determine if injury associated with banding shorebirds is ubiquitous because most species have not been the focus of long-term studies. Here we summarize foot loss in a banded population of Spotted Sandpipers (*Actitis macularia*) that was studied for 19 yr.

Birds were banded and observed during the breeding season from 1973 to 1991 on Little Pelican Island (LPI), Leech Lake, Minnesota (47°07'N, 94°21'W). The foraging substrate was primary sand. Birds were banded with one USFWS aluminum band and 1–3 unsealed plastic colored leg bands. The leg with the aluminum band also carried a plastic colored leg band; all adult birds were banded on both legs. LPI's small size and open habitat allowed us to observe sandpipers easily. We also monitored breeding birds on Pelican Island, 200 m north of LPI, starting in 1979, and breeders at two mainland sites 7 km south of LPI, starting in 1983. Every breeding season we banded all new breeding adults and chicks, and thousands of hours were spent observing the population (Maxson and Oring 1980, Oring and Lank 1986). In this paper, when we refer to foot loss we are referring specifically to loss of all digits, and varying portions of the tarsometatarsus; no part of the tibiotarsus was ever lost. Toe loss refers to digit loss. Bands were placed exclusively on the tarsometatarsus.

Five-hundred twenty-eight birds banded as adults or chicks were seen in subsequent years. Of these, 267 were seen in more than 1 yr, representing 774 bird years. The number of unbanded transient birds observed but not caught is unknown, but was always substantially fewer than the number of banded birds. We never observed band-induced injury to birds in the year banded. We observed seven birds that lost a single foot in years after banding, 2.6% (7/267) of banded birds, and one that lost a toe. We also observed three unbanded birds missing feet, and one missing a toe. It is unknown if these birds were once banded and subsequently lost a foot. In addition, we saw eight banded birds limping, or in some way crippled, and one with a swelling on one leg; one unbanded bird was seen limping. Limping was usually a result of conspecific fighting, however.

Of the seven birds that lost feet, six lost them on the side with the aluminum band, which also had a plastic colored leg band. The seventh had only plastic colored leg bands on the foot-loss side. If the chance of losing a foot was independent of the side containing the aluminum band, the probability of an observation at least as skewed as ours is 0.013 (binomial test). Of the six birds that lost feet on the aluminum side, in five the aluminum band was the distal band ( $P = 0.11$ , binomial test). Also, five of seven were females ( $P = 0.23$ , binomial test). Foot loss was observed 1–4 yr after banding (2 of 7 lost within 1 yr). The lost toe was a result of the color band slipping over the foot. Although none of the foot losses could be attributed directly to bands, the presence of an aluminum band was associated with greater foot loss than were plastic colored leg bands.

Foot loss is not due exclusively to banding. For example, it can be a result of lesions associated with pox (McClure 1989). We observed footless and toeless unbanded Spotted Sandpipers at our study site, as well as footless and injured unbanded shorebirds of other species, including Sand-erlings (*Calidris alba*), Semipalmated Sandpipers (*C. pusilla*), and Ruddy Turnstones (*Arenaria interpres*). C. Gratto-Trevor and H. L. Dickson

(pers. comm.) found a natural leg-injury rate in Black-necked Stilts (*Himantopus mexicanus*) of 0.5% (five birds with healed breaks, one with a missing leg, out of 1179 birds); rates were lower for other shorebird species.

Although the sex bias we observed in foot loss was not significant, there is a biological reason to expect females of this species to have a higher rate of foot loss if loss is caused by bands. Females are larger than males (Oring and Lank 1986), so the band is a tighter fit and has more of a tendency to wedge against a joint than in males (Oring, pers. obs.). Also, females are the more aggressive sex, and intrasexual fighting can be extremely intense (Maxson and Oring 1980). We sometimes saw females limping following fighting, and on one occasion a female lost a foot after her leg was broken in a fight. It is not unreasonable to think some injuries could be compounded by the presence of bands.

Foot loss affected individuals differently, but did not prevent breeding. For example, of two birds, each missing a foot in 1991, one had a difficult time walking, the other lacked noticeable impediment, but both reproduced. Another female that was missing a foot reproduced successfully even though she had to copulate lying down. Given our low foot-loss rate, and the complication of year effects, it is difficult to determine how much of a decrease foot loss had on individual lifetime reproductive success.

We can, however, make a qualitative estimate of the local population effect of foot loss on fledgling production. The primary ways local fledgling production would be affected by female injury is if (1) foot loss decreased critical maternal care, (2) females were able to defend a territory but not capable of breeding, or (3) if injured females died and were not replaced by outside females. Although females often help males incubate clutches, the extent of female incubation does not appear to affect reproductive success at our study site (Oring et al. 1991). We never observed a footless female able to hold a territory that was apparently infertile, but her mating success might have been reduced. As males are a limited resource to female reproduction in this sex-role reversed species, however, reduced mating success by one female should result in increased mating success by another. Therefore, the second scenario was not likely a problem. Each year an excess of females is seen on LPI as transients (Reed and Oring 1992), so the availability of replacement females does not appear to be a problem.

We conclude that the foot-loss rate to females reported here had little effect on our population. Male foot loss might have more of an effect on local population dynamics because male availability limits female egg production (Lank et al. 1985), but foot loss for males at our study site associated with bands was only 0.7% (2/267).

It is possible that deaths due to band effects at a high-quality breeding site could create a breeder sink, and reduce fledgling production across several adjacent populations. Of the five banded footless birds that we could have seen in subsequent years, none were observed (the other two banded footless birds were first seen in the final year of the study).

Banding birds has many benefits that increase our ability to understand and manage shorebird populations, e.g., knowing turnover rates, dispersal rates and patterns, and age structure. Banding should be done with extreme care because foot loss can occur if bands are applied improperly. Banding above the tibiotarsal/tarsometatarsal joint might prevent foot loss in shorebirds (Salzert and Schelshorn 1979). In some shorebird species, however, bands above the joint are not easily seen. It should not be assumed that a detrimental effect from banding in one shorebird species, or population, means all species, or populations, will suffer similar detrimental effects. How much death and loss of reproductive output associated with banding might be compensatory is not known. Banding is not totally benign, however, and each population should be monitored for band and banding effects.

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