Problems with Darvic Color-bands on Common Terns: Band Losses and Foot Injuries

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In 1988, I started to color-band Common Terns *(Sterna hirundo)* as part of ongoing studies of behavior. I chose to use Darvic(R) (high-density polyethylene) color-bands because they were reported to be more durable and color-fast than the celluloid bands that had been used previously on this species. I color-banded 289 adults in 1988 and 1989, and retrapped or resighted many of these individuals in 1989 and 1990. During the 1989 season, I found that several birds had lost color-bands and that a few others had foot injuries apparently caused by the color-bands. This paper describes my observations of these problems in 1989 and 1990 and my attempts to solve them. Parallel studies on Roseate Terns *(S. dougallii)* in this and other breeding colonies will be reported separately.

METHODS

I worked at Bird Island, Marion, MA (41°40'N, 70°43'W), where I have conducted a long-term study of Common Terns (Nisbet *et al.* 1984). I caught adult Common Terns on their nests using drop traps (Nisbet 1981). Unbanded birds were banded with incoloy bands (4.3 mm internal diameter; see Hatch and Nisbet 1983). Birds previously banded with aluminum bands were rebanded with incoloy bands; those already carrying incoloy bands were released with them. Adults included in my behavioral studies were given an incoloy band on one leg and a single uniquely numbered Darvic color-band on the other leg. Two birds were given two color-bands on the same leg. The colors used were dark green, light blue, black, and white.

I used Darvic(R) bands supplied by A.C. Hughes, Ltd., of Hampton Hill, Middlesex, U.K. The bands are butt-ended and are of internal diameter about 4.0 mm when fully closed. To apply a band, I opened it with a tapered opening tool supplied by Hughes, closed the band over the bird's leg, and squeezed the band with finger and thumb (usually overlapping it) to correct any stretching that had occurred during opening. All bands were fully closed when the birds were released.

In 1989, I experimented with methods for sealing the Darvic color-bands. I was unable to seal the bands using solvents or glues, but I succeeded in heat-sealing them using a battery-powered (cordless) soldering iron (ISOTIP(R), manufactured by Wahl Clipper Corporation, Sterling, IL, and available at electronics dealers for about $35.). The soldering iron is charged overnight and holds enough charge to seal about 60 color-bands before requiring recharging. I hold the bird in one hand and hold the closed band between finger and thumb of the same hand. I then use the soldering iron to soften the surface of the plastic on each side of the join and to spread the tacky plastic across the join. Some practice is needed to apply enough heat to melt the surface without applying enough to char the surface or melt through the band. Care is needed, also, to avoid burning the bird's leg or the bander's fingers. In 1989, I sealed 11 (about 10%) of the color-bands placed on Common Terns. All color-bands were sealed in 1990.

I trapped 171 adult Common Terns in 1988, 159 in 1989, and 131 in 1990. Some of my study-plots were the same in each year, so that I retrapped many of the same birds in successive years (Table 1). Within the study-plots, I trapped all the birds designated for study; I did not select for trapping birds with or without color-bands. I also saw many color-banded Common Terns while scanning groups of loafing birds on the beach or rocks around the island. Although I usually could not read the numbers on the color-bands to identify these Common Terns individually, I believe that I saw most of the individuals that had survived and returned to the island with their color-bands. This belief is based on the fact that I saw more than 80% of the individually marked Roseate Terns that had been marked in parallel studies of that species.

RESULTS

Band Losses

Table 1 shows the numbers of Common Terns banded and retrapped in each year. Among 289 birds color-banded, 64 were retrapped one year after color-banding and 18 after two years. Seven of the 82 birds retrapped (8%) had lost their Darvic bands. This total included six of 41 birds retrapped in 1989 (15%), but only one of 41 birds retrapped in 1990 (2%). However, the differences among the groups listed in Table 1 were not statistically significant (Fisher tests, $P>0.05$).

One bird which was banded and color-banded in 1988 had lost its incoloy band when retrapped in 1990. This was the only one of about 230 color-banded birds seen or retrapped in 1989 or 1990 that had lost its incoloy band.

Foot Injuries

Three Common Terns were trapped and three or four others were seen in which the Darvic band had lodged over the toes or the metatarsal joint. Four of these birds were encountered in 1989 and two or three in 1990. In two of these birds, the Darvic band had closed over one or two toes, puncturing the web between the toes; these birds limped, but their walking was only moderately impaired and they recovered within ten days after the band was removed. In another bird, the Darvic band had cut through the skin and flesh on the toes; the foot was swollen badly and the bird was unable to walk on this foot. This bird recovered within 20 days after the band was removed. One or two other birds were seen with similar impairments but could not be trapped. Another bird was seen with its Darvic band around the metatarsal joint late in 1989 and could not be relocated in 1990. One of the two birds that had been given two Darvic bands on the left foot in 1988 returned in 1989 with its left foot missing. This bird (a male which had been the subject of long-term study) was unable to walk and its foraging was impaired because it could not fish from perches as it habitually had done in earlier years. In spite of these impairments, it and its mate raised two chicks to fledging in 1989; it did not return in 1990.

Performance of Sealed Bands

In 1990, I retrapped two of the 11 Common Terns that I had released in 1989 with sealed Darvic bands. I found that these bands were still sealed and showed no signs of embrittlement or other failure that might have been caused by the sealing. I obtained similar results with sealed bands on Roseate Terns (unpublished data). This provides preliminary indication that sealing the bands may prevent losses and injuries, at least through the first year after banding.

Differences Among Colors

The Darvic bands used on Common Terns included 93 light blue, 89 dark green, 56 white, and 53 black bands; the first two colors were used mainly in 1988 and the last two only in 1989. The bands lost or seen over the feet included 5 light blue, 5 dark green, 1 white and 1 black. Considering the fact that the first two colors had been "at risk" for longer, these data provide no evidence for differences in rates of loss or injury among these four colors.

DISCUSSION

Although I did not observe any Darvic bands being pulled over the foot or otherwise lost, I suspect that some are pulled over the foot when the bird snags the band on woody vegetation or other objects. I saw one Common Tern snag its metal band on a projecting wire and pull at it for about 10 seconds before freeing itself. In two other Common Terns, the color-band became lodged over the foot during the season of banding. If snagging is the primary cause, most band losses and foot injuries would occur during the breeding season, as the birds generally frequent beaches or other open substrates during the remainder of the year. Unpublished data on Roseate Terns suggest that rates of loss of Darvic bands are higher at Bird Island than at other colonies studied, perhaps because Bird Island is more densely vegetated and littered with human artifacts.

Band losses and foot injuries are strongly associated with absence of the hallux (hind toe). I found this condition on two of the three Common Terns that I trapped with Darvic bands over the toes, on the Common Tern that I found with the incoloy band missing, on two other Common Terns that I trapped with slight foot injuries (a calloused metatarsal joint and a broken toe), and on at least two other Common Terns that I trapped with missing Darvic bands. Ordinarily, the hallux supports the band and provides a first line of defense against pulling it over the metatarsal joint. Apparently, loss of the hallux facilitates this process. However, I do not know whether loss of the hallux by these birds was itself an injury caused by the bands, or whether it was an unrelated condition that precipitated band loss and other injuries.

Based on the reported experience of others, I had expected that Darvic bands would be more durable than celluloid bands. In fact, my data for Common Terns show rates of loss of up to 15% by the end of the first year after banding (Table 1). Excluding data for sealed bands, the average rate of loss of unsealed Darvic bands is about 7% (7/98) per year. To calculate the injury rate, I treat the year of banding as well as the year of observation as years in which the bands were at risk, because injuries could have been observed throughout both years. The average rate of injury (including cases in which the bands were observed lodged over the foot without visible impairment) was then about 1% per year (6 or 7/620). Although some of these injuries appeared minor, at least three were major and there is circumstantial evidence that one caused the death of an experienced breeder.

Three options to prevent such injuries are: (1) to use coiled bands, (2) to seal the bands, or (3) to discontinue use of Darvic bands altogether. Coiled Darvic bands should be more difficult to pull over the foot than butt-ended bands, but O'Briain (1991) has reported high rates of loss (85% within three years) of coiled Darvic bands from Roseate Terns in Ireland. Coiled bands are heavier than butt-ended bands and one user has told me that they also can be snagged on vegetation and cause injury. My preliminary data reported in this paper indicate that heat-sealing of butt-ended Darvic bands is effective in preventing losses and injuries, at least through the first year after banding. However, heat-sealing is tricky and time consuming, and it remains to be seen whether this is a lasting solution. If not, it will be necessary to discontinue use of butt-ended Darvic bands on these and other ground-nesting species. It may also prove necessary to retrap birds already carrying these bands and to remove the bands.

LITERATURE CITED

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Table 1. Bandings, retrappings and losses of color-bands among Common Terns.

Year of Banding	Number Color-banded	Number Retrapped 1989	Number Retrapped 1990	Number With Missing Band 1989	Number With Missing Band 1990
1988	171	41	18 [a]	6	0
1989	118 [b]		23		1

[a] Includes 12 birds that had been retrapped in 1989 also.
[b] Includes 11 birds whose color-bands were sealed (see Methods).

Spring Owl Banding at the Whitefish Point Bird Observatory, Michigan, from 1981 to 1990. Part 2: Repeats and Returns

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INTRODUCTION

Grigg (1991) described the capture methods and results of the spring owl banding program at the Whitefish Point Bird Observatory from 1981 to 1990. This paper will present the owl repeats and returns resulting from the WPBO owl banding program during this period.

RESULTS

During the springs of 1981 to 1990, a total of 1494 owls of seven species were banded at WPBO (Table 1). Seventy-nine (6.1%) were recaptured subsequently in the same season at WPBO during the springs of 1982 to 1990. (Recaptures were not recorded in 1981.) This compares favorably with the 5.3% repeat rate for the nearly 6500 Sharp-shinned Hawks, *Accipiter striatus*, banded here during the springs of 1982 through 1987 (Grigg, unpublished data).

Fall studies of Northern Saw-whet Owls, *Aegolius acadicus*, in Wisconsin (Mueller and Berger 1967) showed a 20.2% same-season recapture rate, and at Prince Edward Point, Ontario, a 17.8% rate was calculated (Weir et al. 1980). This is far greater than the 2.9% spring repeat rate for Northern Saw-whet Owls at WPBO. Coincidentally, Catling (1971) reported a 2.9% recapture rate for Northern Saw-whet Owls in the spring at Toronto, Ontario. The Whitefish Point data may be partially biased by some of the volunteer banders not recording all of their recaptures. It is also more strongly influenced by the fact that spring birds may have a more hurried northbound migration due to their upcoming breeding season than birds going south in the fall. Obviously, the geography of the banding station as well as the seasonal timing of occurrence plus the area's weather could also affect the recapture rates and length of stopover.

Interestingly, more than half (55.6%) of all same-season recaptures were made after a two or more night stopover in the WPBO area. Recaptures after ten or more nights totalled 21 encounters, 26.6% of all repeats. After 20 nights, there were eight recaptures, or 10.1% of the total repeats. The longest period between banding and subsequent same-season recapture was of 29 nights for a Boreal Owl, *Aegolius funereus*, banded on 28 April 1983 and recaptured on 27 May (Table 2).

Unfortunately, only 21 of the repeats had both the initial (banding) weight and recapture weight recorded. The maximum weight loss per body weight between banding and recapture was for an adult Boreal Owl banded on 13 April 1988 and recaptured on 19 April. The bird's weight loss was 18 grams, or 10.9% of the original banding weight. The greatest weight gain was 12.4% of original banding weight. This was for a Northern Saw-whet Owl banded on 16 April 1987 and recaptured one night later. Obviously, a positive change in body weight between banding and recapture indicates that the owl had fed recently prior to recapture, so the timing of feeding is important to the recapture weight gain or loss between periods.