

The Journal of Raptor Research



READABILITY OF ANODIZED ALUMINUM BANDS VERSUS PLASTIC DARVIC BANDS ON STRIATED
CARACARAS IN THE FALKLAND ISLANDS (MALVINAS)

MICKY REEVES

Falklands Conservation, Jubilee Villas, Stanley, Falkland Islands

MELISSA M. BOBOWSKI

*Acopian Center for Conservation Learning, Hawk Mountain Sanctuary, 410 Summer Valley Road, Orwigsburg,
PA 17961 U.S.A.*

MARC J. BECHARD

Department of Biology, Boise State University, Boise, ID 83725 U.S.A.

DAVID R. BARBER AND KEITH L. BILDSTEIN¹

*Acopian Center for Conservation Learning, Hawk Mountain Sanctuary, 410 Summer Valley Road, Orwigsburg,
PA 17961 U.S.A.*

J. Raptor Res. 50(2):223–226

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DAVID R. BARBER AND KEITH L. BILDSTEIN¹

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PA 17961 U.S.A.*

KEY WORDS: *Striated Caracaras*; *Phalacroboenus australis*; band wear; Falkland Islands; *Islas Malvinas*.

Bird banding has played a critical role in helping biologists understand the movement ecology and demographics of raptors for almost a hundred years (Thomson 1926, Bildstein 2006). Color-banding, too, has made significant contributions to the field (Varland et al. 2007). Longevity records for banded raptors demonstrate that traditional aluminum bands can remain readable, at least in-hand, for decades (Klimkiewicz and Futcher 1989). Little published information, however, exists on color-band wear and loss.

Many researchers (see Varland et al. 2007 for review) have used colored metal bands with alphanumeric codes successfully on raptors. In many cases, the bands have been engraved anodized aluminum bands manufactured by Acraft Sign and Nameplate Co., Ltd., of Edmonton, AB, Canada (Varland et al. 2007). In general, reports to the U.S. Bird Banding Lab by raptor researchers indicate that these bands have proved to be both durable and colorfast on most raptors. Exceptions include reports of considerable wear in anodized color bands fitted (1) on Galapagos Hawks (*Buteo galapagoensis*) on Santiago Island in the Galapagos, where abrasion by lava rocks rendered many bands unreadable within 4–5 yr (K. Levenstein pers. comm. in Varland et al. 2007), and (2) on Northern Crested Caracaras (*Caracara cheriway*) in central Florida (J. Morrison pers. comm.), where these bands were used in studies of breeding-site fidelity and species survival (Morrison 1999 and 2003). In addition, a report involving Common Ravens (*Corvus corax*) banded in and around Jackson Hole, WY (Bedrosian and Craighead 2007), indicated both rapid wear and color loss on anodized aluminum bands that compromised their readability in as few as 9 mo. In this instance, rapid band wear was attributed to the birds' spending a large part of their time walking on the ground across abrasive substrates including "glacial sand, talus rock, river beds and ice" (Bedrosian and Craighead 2007). Overall, reports suggest that band wear, including anodized aluminum bands, is more common among birds that feed in and around water, particularly if the water is brackish or marine, where the rapid corrosion of aluminum is more prevalent (c.f., Poulding 1954, Hatch and Nisbet 1983, Jehl 1990).

Here we report on our experiences using alphanumeric-coded anodized aluminum bands and plastic Darvic bands on Striated Caracaras (*Phalacroboenus australis*), the raptor with the most southerly distribution in the world (Ferguson-Lees and Christie 2001). Striated Caracaras are opportunistic scavenging and occasionally predatory raptors that spend most of the time on the ground in treeless coastal habitats in the Falkland Islands, and Tierra del Fuego (Strange 1996, Meiburg 2006, Catry et al. 2008, Rexer-Huber and Bildstein 2014). With an estimated global population in the low thousands, the Striated Caracara is

considered globally Near Threatened (BirdLife International 2015).

One goal of our long-term studies has been to band at least 75% of the overall population of Striated Caracaras on four small islands in the Falklands to better understand the species' feeding and movement ecology and social behavior. Given that one banded Striated Caracara lived for 16 yr in the wild in the Falklands and that captive birds have lived for 28 yr (Strange 1996), we wanted our bands to be readable for at least 15–20 yr.

Eight Striated Caracaras were fitted with anodized aluminum bands in August 2010, eight were banded in December 2010, and an additional 98 were banded in July–August 2011. All aluminum bands measured 13 mm in inside diameter and 18 mm in height, and were green ($n = 25$) or blue ($n = 89$) anodized aluminum, pop-riev bands with aluminum alphabetic ($n = 7$) or alphanumeric codes ($n = 107$) etched to a depth of <0.2 mm. The bands were manufactured by Acraft Sign & Nameplate Co., Ltd., in Edmonton, AB, Canada. Most banded birds were sighted at least once more than 1 mo after banding, and many were resighted dozens of times in subsequent years.

We removed 24 of the anodized aluminum bands between July 2012 and February 2014, 12–38 mo after we had fitted them, because of wear and damage that made 18 of the 24 bands recovered from retrapped birds difficult and, sometimes, impossible to read as close as <5 m (Fig. 1). Band readability was categorized as easily readable at 5 m (1, $n = 6$ [25%]), marginally readable at 5 m (2, $n = 6$ [25%]), or largely unreadable at 10 m (3, $n = 12$ [50%]). Readable bands had been on the birds 12–25 mo, marginally readable bands 19–25 mo, and largely or totally unreadable bands 19–38 mo. Band wear was especially pronounced on the sides of the bands adjacent to the rivet-flange (see Fig. 1). Most likely this occurred because rivet-flanges routinely aligned themselves in place when the birds dug in soil and sand while hunting invertebrates. Four of the 24 aluminum bands that we removed were bent along the top edge of the band; these four bands may have been damaged when the band became entangled in wire from livestock fencing when the birds walked through it, or when the birds themselves bent their bands while picking at them. Although entanglement may be unusual, local landowners have witnessed it at least three times. None of the four birds with bent bands appeared to have suffered injury as a result of the bent band. Furthermore, in no case did band wear sharpen the edges of the bands, as has been reported for Piping Plovers (*Charadrius melodus*) wearing similar bands (Amirault et al. 2006).

Given readability problems with anodized aluminum bands, we began using plastic Darvic bands with etched alphanumeric codes in February 2012. Since then we have placed more than 1000 of these bands on individuals on Saunders Island, and at three other island study sites in the Falklands. All plastic bands were 13 mm in inside diameter and 18 mm in height, and were yellow (Saunders Island), black (Steeple Jason), white (Carcass Island), or

¹Email address: bildstein@hawkmtnt.org



Figure 1. Eleven largely unreadable and seven marginally readable bands removed from caracaras 19–38 mo after being affixed, together with a dirty unreadable worn band on a caracara. (Bands in the figure were flattened by hand and, if necessary with a few taps of a rubber mallet so as to avoid further damage to their surfaces.)

green (New Island) wraparound plastic bands with an alphanumeric code ($n = 1055$) etched to a depth of 0.7 mm. The bands were manufactured by ECOTONE, Gdynia, Poland.

Unlike the aluminum bands we used, the plastic bands did not wear to the point of being unreadable, at least not within the first 3 yr after banding caracaras. We believe that this is because the etching on the plastic bands is more than four times as deep as on the anodized aluminum bands, and because the plastic bands are wrap-around and not flanged, and thus do not routinely align themselves in place when the birds dig in soil and sand for invertebrates. That said, the readability of both bands can be impeded, temporarily, when soil, sand, and vegetation episodically accumulate on them. In addition, several of the Darvic bands have broken or developed cracks, and at least one plastic band that was placed on a bird that also had been fitted with a backpack-mounted satellite tracking device either was removed by the bird itself or broke and fell off the bird.

In all other cases of reported rapid wear of anodized aluminum bands, on Common Ravens, Galapagos Hawks, and Northern Crested Caracaras, as noted above, the researchers mentioned the ground-foraging nature of the birds in abrasive, rocky, and sandy substrates as factors influencing band wear, and one study (K. Levenstein pers. comm. in Varland et al. 2007) mentioned the corrosive nature of the birds' coastal habitats. It seems likely that a ground-foraging lifestyle, particularly in sandy, coastal brackish, and oceanic marine environments enhances rapid wear in anodized aluminum bands. For Striated Caracaras, the situation appears to have been exacerbated by digging behavior. We recommend that researchers consider other marking techniques for Striated Caracaras and other raptors that regularly walk through similar potentially abrasive substrates.

Finally, our experiences with laminated Darvic wrap-around bands suggest that although band wear affecting readability is far less of a problem with this type of band, band loss may be a problem. Because of this we are now looking into the possibility of using stainless steel or titanium stamped bands in addition to more easily readable Darvic plastic bands.

We thank several referees, including Joan L. Morrison, for helping us improve our presentation. We thank the Pole-Evans family for their outstanding hospitality on Saunders Island, and the Falkland Islands Government for issuing the permits necessary for our studies. Kalinka Rexer-Huber, Sam Cockwell, and James Dwyer helped band Striated Caracaras on Saunders Island in 2010 or 2011 and we are grateful to them for their assistance. Funding for our work comes from the Darwin Initiative (DEFRA, U.K.), Wallace Research Foundation, Jean and Jim MacAfee, the Acopian Family, and several other donors. We thank them all. This is Hawk Mountain Contribution to Conservation Science No. 259. Research and banding conducted under Falkland Islands Government Research License No. R03/2010-2014.

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Received 21 September 2015; accepted 1 January 2016