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A COLORED LEG BANDING TECHNIQUE FOR *AMAZONA* PARROTS

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Abstract.—A technique for individual identification of *Amazona* was developed using plastic leg bands. Bands were made from 5- and 7-mm-wide strips of laminated PVC coiled 2.5 times with an inside diameter 4–5 mm > the maximum diameter of the parrot's leg. Seventeen parrots were captured in Puerto Rico, marked with individual plastic leg bands, and observed for 204–658 d with only one lost or damaged plastic band. Plastic leg bands did not cause injury to or calluses on parrots' legs. The plastic material used for making leg bands was available in 18 colors in 1994, which would allow unique marking of 306 individuals using one plastic leg band on each leg.

UNA TECNICA PARA EL ANILLAJE CON COLORES EN LAS PATAS DE COTORRAS *AMAZONA*

Sinopsis.—Se desarrolló una técnica para la identificación individual de cotorras del género *Amazona* fue usando anillas plásticas para las patas. Las anillas fueron hechas de tiras de PVC laminado de 5 y 7 mm de ancho enrolladas dos veces y media con un diámetro interior de 4–5 mm > que el diámetro máximo de la pata de la cotorra. Diecisiete cotorras fueron capturadas en Puerto Rico, marcadas individualmente con anillas plásticas y observadas por un período de 208 a 658 días con sólo una anilla perdida o dañada. Las anillas plásticas no causaron heridas ni callos en las patas de las cotorras. El material plástico usado para hacer las anillas, para el 1994, estaba disponible en 18 colores, lo que hubiera permitido la identificación individual de 306 individuos usando una sola anilla en cada pata.

Few investigators have used markers on psittacines to identify individuals from a distance (Beissinger and Bucher 1992; Menkhorst et al. 1990; Rowley and Saunders 1980; Saunders 1980, 1982, 1988). Marking is difficult, because many psittacines have strong bills and can easily bring their feet to their bill. These characteristics reduce the number of potentially satisfactory markers for use with parrots compared to other birds (Marion and Shamis 1977). General approaches for marking parrots include patagial tags and leg bands.

Rowley and Saunders (1980) recommended metal patagial markers for cockatoos. Further research by Saunders (1988) and others (Chapman and Chapman 1990, Howe 1980, Southern and Southern 1985), however, found unacceptable mortality associated with certain types of patagial markers, although patagial tagging did not always increase mortality compared to leg-banded birds (e.g., Hannon et al. 1990).

Colored anodized aluminum bands, stainless steel split rings and plastic split-ring leg bands have been used on Green-rumped Parrolets (*Forpus passerinus*), which have weaker bills than *Amazona*. Although the alumi-

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num and stainless steel bands were never lost, 35% of the adults removed the plastic bands annually (Beissinger, pers. comm.; Beissinger and Bucher 1992). Menkhorst (pers. comm.) successfully used split-ring plastic leg bands on *Neophema chrysogaster* for 5 yr, but this species also has a rather small, weak bill (Forshaw 1989, Menkhorst et al. 1990). In another study to identify individual cockatoos, Saunders (1988) applied closed stainless-steel leg bands that were grooved on the outside edge by a lathe for application of various colors of enamel paint. Closed bands, however, must be attached to nestlings, which limits their usefulness in studying parrots.

Strips of PVC plastic have been used to make wrap-around colored leg bands for waterbirds (Ogilvie 1972, Strong et al. 1987). Lynnply, a PVC plastic, has been used to make riveted (or bolted) and wrap-around plastic leg bands for cranes and eagles (S. R. Derrickson, pers. comm.; Drewien et al. 1981; Kuyt 1978; McCollough 1990). PVC plastics have been used to form color leg bands for Ospreys (*Pandion haliaetus*) and Bald Eagles (*Haliaeetus leucocephalus*) (D. A. Hammer, pers. comm.; Meyers and Miller 1992), Snail Kites (*Rostrhamus sociabilis*) (Snyder et al. 1989, 1989), grackles and Yellow-rumped Caciques (*Cacicus cela*) (S. K. Robinson, pers. comm.). Snyder et al. (1987) discovered potential problems with flat bands that were similar to wrap-around color leg bands and cautioned against their use on parrots, which have a relatively short, hourglass-shaped tarsus.

For this study, the desired marker would eventually be used on the critically endangered Puerto Rican Parrot (*Amazona vittata*), so I rejected the use of a patagial marker in favor of a less conspicuous and possibly safer colored leg band. My objective was to determine safe methods and materials for attaching colored leg bands on adult *Amazona*, which would allow individual identification at distances of 30–100 m with binoculars and 100–200 m with telescopes.

METHODS AND MATERIALS

Leg band construction.—I made plastic colored leg bands from 1.5 mm-thick PVC material, Wardle Storeys Cobex (laminated, three layers), manufactured by Storeys Industrial Products, Ltd., Brantham, Manningtree, Essex C011, 1NJ, England, telephone (0206) 392401 (use of brand names does not constitute government endorsement). Red, yellow and white plastic were selected for testing.

Cobex PVC was cut into 5- and 7-mm-wide strips that were long enough to coil 2.5 times around the parrot's leg. The inside diameter of the band was 4–5 mm more than the maximum diameter of the tarsus. The band should appear loose on the parrot's leg. Before the band was molded, its corners and edges were sanded to remove sharp edges.

Cobex PVC was easily molded when placed in hot water (>73 C) for a few seconds. Before molding, I attached the plastic strip to the end of a wooden dowel (4–5 mm larger than the diameter of the parrot's leg) with a small nail through a small hole at one end of the strip. I then placed

the dowel and plastic into hot water, and began coiling the plastic around the dowel, manipulating it with needle-nosed pliers while in the hot water or just after removing the band from the hot water. Care was taken to obtain a perfectly rounded coil of plastic with no gaps between the overlapping areas. After molding, I carefully removed the small nail with side cutters. The end of the plastic band with the nail hole was trimmed to remove the hole when the band was inverted for attachment. Bands with different inside diameters should be prepared since individual legs can vary in diameter within the same species.

Leg band attachment.—I recommend that this procedure be practiced on a wooden dowel until perfected. The plastic leg band was placed in 58–68 C water for 30 s. Immediately after removing the band from the water, I inverted it as shown in Figure 1. This inversion relaxed the coil slightly and allowed application of waterproof epoxy glue (5-min setting time). The glue was applied to the outside of the inverted band (Fig. 1). After the glue set for 3 min, I re-inverted the band with the parrots's leg under the leading end of the band (Fig. 1). A small spatula or thin wire was used to apply additional glue into overlapping areas of the coiled band.

After applying the band to the parrot's leg, I carefully clamped the band ends with small needle-nosed pliers, being sure that the overlapping coils were in contact on all surfaces and held the band for 10 min. After releasing the band, I checked to be sure that the total gap between the inside of the band and leg was at least 4–5 mm. I also checked to be certain there was no glue on the outside of the band. A small adjustable steel hose clamp was placed around the plastic band and tighten just enough to hold the clamp on the band. During the next hour, the banded parrot was placed in a darkened cage to allow the glue to harden completely before I removed the clamp.

Banding trials.—During 1992–1993, I captured 17 parrots (see methods in Meyers 1994a) and attached a single 7- or 5-mm-wide plastic band to each one. During banding the parrots wings' were held to the body with Vetrap® (3M, St. Paul, Minnesota 55144) and the head was held and covered with a light towel to prevent injury. Four White-fronted Parrots (*A. albifrons*), one Orange-winged Parrot (*A. amazonica*), and one Hispaniolan Parrot (*A. ventralis*) were banded with 7-mm wide plastic bands. Eight Red-crowned Parrots (*A. viridingenalis*), one Hispaniolan, and two Orange-winged Parrots were banded with 5-mm wide plastic bands. Each parrot also was marked with a metal band on the other leg. I sealed all plastic bands with waterproof epoxy glue except two, which were sealed with PVC cement. Plastic bands were inverted for attachment at room temperatures (26–30 C).

I also attached radio transmitter collars on 15 of the leg-banded parrots (Meyers 1995). Seven were tracked and observed for 2–7 mo in western Puerto Rico, and also were observed after radio failure at roosting areas for 8–22 mo during 1992–1994. Eight parrots were radio-tracked and observed for 12 mo during 1993–1994 in southern Puerto Rico. I observed

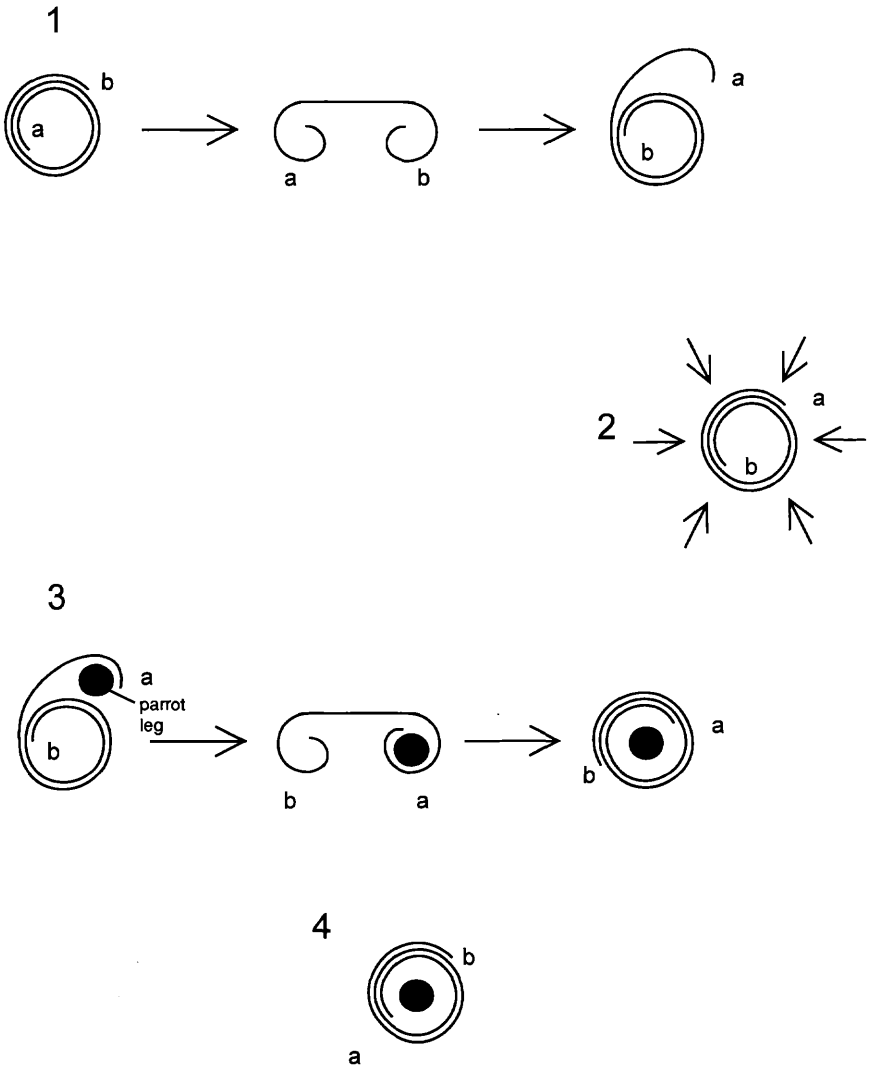

FIGURE 1. Procedures for attachment of plastic leg band to parrots: 1. invert the band (a and b identify ends of band); 2. apply epoxy glue on the outside of inverted band and between coils; 3. re-invert the band with the parrot's leg under the leading end of the band; 4. securely clamp the band in its final form, being sure that overlapping coils are in contact on all surfaces and epoxy glue fills the gaps.

parrots for 1–2 wk/mo during the first year after marking and every 3–4 mo thereafter. Bands were checked with 10× binoculars when parrots were <30 m and with 80–130× telescopes when parrots were 30–200 m from the observer. With a 130× telescope at ≤100 m away from a parrot,

I could examine fine details on the bands, including condition of the glue, presence of small (<1–2 mm) nicks and condition of the parrot's leg.

Temperature effects on band formation.—I conducted tests to determine the effects of warming the bands before inverting them for attachment. I hypothesized that small cracks may occur in the plastic during inversion for application of glue and when attaching the bands, which could eventually cause band loss. Warming the plastic band for 30 s before inverting may reduce cracking and subsequent band loss.

Cobex became limp at 73 C, so I selected three temperatures <73 C (58, 63 and 68 C) and a control (room temperature, 28 C) for testing the effect of temperature on cracking of the PVC. Three bands for each temperature were tested by immersing them for 30 s just before inverting them. Damage to the band was observed with a 25× stereoscopic microscope and classified as no damage and open cracks.

RESULTS

Only one of 17 plastic leg bands failed or was damaged by the parrot during 1.8 yr of the study. Of the first eight parrots banded with plastic leg bands in 1992, three were seen with bands still intact at 568–658 d, three others were seen with bands intact at 204–403 d and were not seen thereafter, and one was recovered from a dead parrot at 321 d with the plastic band and parrot's leg undamaged. Only one parrot removed its plastic band and this occurred by 35 d. The lost band was 7 mm wide and one of two attached with PVC cement. All nine parrots banded in late 1992–1993 were observed with plastic leg bands intact and undamaged for 259–318 d ($\bar{x}$ = 299 d, SD = 21), the life-time of the radio transmitters they carried. No injuries or calluses were observed on the legs that were banded with plastic leg bands.

Warming plastic bands to 68 C for 30 s just before inverting them for gluing and attaching to the parrot prevented cracking. Inverting plastic bands after warming caused only small indentations or wrinkles, which were less prevalent at 68 C than at 58 or 63 C. The wrinkles were found only on the innermost part of the coiled plastic band where parrots could not chew. One of three plastic bands inverted at 28 C cracked.

DISCUSSION

Plastic leg bands made of ≥1.5 mm thick Cobex PVC plastic or similar material may be useful for long-term marking of *Amazona* spp. This plastic is highly resistant to fading from UV light and was strong enough to prevent damage and removal by large *Amazona,* e.g., Orange-winged Parrots. Coiling the plastic from 5-mm wide strips that were long enough to wrap around the parrot's leg 2.5 times, created a color marker suitable for individual identification. Plastic coiled bands may stay on longer when attached with epoxy cement, which should fill all the gaps that may be present in the coiled band. The number of individuals that can be marked with Cobex PVC plastic bands on each leg is limited to 306 combinations

of 18 colors that were available in 1994. Some of these colors, however, may be difficult to distinguish in the field under various light conditions (e.g., blue and black may be hard to distinguish in forest shade). Only one 5-mm wide band could be placed safely on each *Amazona* parrot's leg. I doubt that smaller bands (2.5- to 3.0-mm-wide strips) would remain on a parrot's leg, but this should be tested, because four bands could be used to create many additional individual markers. There was no evidence of problems that may cause lower survivorship for parrots with plastic leg bands in this study as in Saunders's (1988) cockatoo study, which used patagial tags for individual markers. One leg-banded and radio-marked female parrot was found nesting in my study and it successfully raised and fledged two young.

Allowing at least 4–5 mm of total space between the inside of the band and the parrot's leg may prevent calluses and leg injuries. None were found during this study. Injuries on some parrots, however, were caused by USFWS aluminum lock-on bands that were 10-mm wide and of smaller inside diameter than the plastic leg bands (Meyers 1994b).

McCollough (1990) reported a high annual loss rate (34.9%) for Lynnply laminated plastic leg bands (1.0 mm thick) attached to Bald Eagles (*Haliaeetus leucocephalus*) and all bands were lost within 4 yr. I also noted two losses of three-layer laminated PVC plastic leg bands (1.5 mm thick) on 35 Bald Eagles marked and released in Alabama (unpubl. data). In both cases, alpha-numeric codes were etched into the plastic, which critically weakened the bands. Unlike the parrot bands, which were created by wrapping plastic 2.5 times around the leg, the eagle plastic leg bands were wrapped 1.33–1.75 times. This probably allowed easier unwrapping by the bird. Furthermore, PVC plastic that is <1.5 mm thick may not be suitable for leg bands on birds with strong bills. McCollough (1990) also observed eagles removing plastic leg bands by chipping at cracks in the plastic. Cracking may be decreased by warming Cobex plastic to 68 C for 30 s before inverting it for marking.

Although not as easy to see as patagial markers, colored plastic leg bands did not injure parrots. They were visible up to 100 m with 10× binoculars and up to 200–300 m with 80–130× telescopes. Cobex laminated PVC plastic lasted almost 2 yr without fading or cracking and may be retained by the parrots for much longer times. Long-term leg bands with more color coding capabilities may be needed and I am currently developing a parrot leg band made of composite material that may safely use two colored bands per leg and that may last for at least 20 yr.

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The North American Loon Fund announces the availability of 1996 grants in support of management, research, and educational projects directly related to the conservation of the Family Gaviidae. Proposals in the range of $500–3000 are most likely to be considered for funding. High priority topics include: (1) identifying and recommending non-toxic alternatives to lead for fishing tackle; (2) identifying and refining locations of important habitat areas for all loons on migration and during winter, and for juvenile loons during summer; (3) obtaining more information on the population dynamics of all species of loons, including the average age of initial breeding, annual survival rate, longevity, dispersal, and sources of mortality; (4) designing methods and establishing population trends in poorly known regions with significant loon populations. The deadline for submission of proposals is 15 Dec. 1995. Funding awards will be announced by 30 Mar. 1996. Please submit guideline requests to North American Loon Fund, 6 Lily Pond Road, Gilford, New Hampshire 03246, USA.