

SAFE AND EFFECTIVE METHODS FOR TRAPPING AND COLOR BANDING TRICOLORED BLACKBIRDS IN THE CENTRAL VALLEY OF CALIFORNIA

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We evaluated the safety and effectiveness of two trap designs, two hands-off methods for transferring trapped birds from traps to transport cages, and five methods for sealing plastic color bands placed on tricolored blackbirds, *Agelaius tricolor*, at six breeding colonies in the Central Valley. Nearly 7,000 tricolored blackbirds were banded in 68 days of banding, an efficient hands-free method for transferring birds from traps to transport cages was developed, and a small electric soldering iron attached to an automobile battery through a power inverter was found to be the most efficient method to seal colored plastic bands. Our materials and techniques may be useful to capture and band a wide variety of granivorous and omnivorous birds, especially where portability and low cost are important.

Key words: *Agelaius tricolor*, bird banding, blackbird, technique, trapping

INTRODUCTION

The tricolored blackbird (*Agelaius tricolor*), hereafter “tricolor”, is a highly colonial North American songbird that is nearly endemic to California (Beedy and Hamilton 1999). Due to large-scale losses of its breeding and foraging habitats, deliberate poisoning and shooting, market hunting, and several other factors, the numbers of tricolors dropped dramatically during the 20th Century (Neff 1937; DeHaven et al. 1975a; Unitt 2004; Cook and Toft 2005). Concern for the future of the tricolor led to a petition by the Center for Biological Diversity (2004) to list the tricolor under the State of California and U.S. Endangered Species Acts. Although this petition was declined by the U.S. Fish & Wildlife Service (2006), the tricolor is considered a federal Species of Conservation Concern (U.S. Fish and Wildlife Service 2002) and a state Species of Special Concern (California Department of Fish and Game 1992; Shuford and Gardali 2008).

Intensive investigations over several decades have revealed much about the natural history, especially the breeding biology, of the tricolor (DeHaven et al. 1975a; Beedy and

Hamilton 1999), but considerably less is known about spatial and temporal movements of the birds. Individualized marking (banding and color-banding) large numbers of birds can provide a population that is relatively easily seen in the field and that may help document movements of individuals before, during, and after the breeding season. Records of recaptured birds, "recaptures", and repeat observations of color-banded birds, "resightings", provide insights into spatial and temporal movements of birds. These efforts will help answer questions related to habitat use, site fidelity (for both breeding and winter roosting locations), and behavioral biology (Calvo and Furness 1992). Previous researchers have banded large numbers of tricolors (Neff 1942; DeHaven and Neff 1973); however, these efforts were limited to placing only federal aluminum bands on birds, and over 72% of the tricolors banded were nestlings (DeHaven et al. 1975b). Some limitations of using aluminum bands on nestlings the potential for high mortality rate of nestlings and the requirement to capture and handle birds to obtain useful information. In most cases, the examination of a carcass of a dead bird is required (e.g., Neff 1942; DeHaven et al. 1975b) but in some cases birds are recaptured. This severely reduces the size of the sample from which data can be obtained and the amount of information acquired on spatial and temporal movements (Lakhani and Newton 1983).

Our objectives were to: 1) increase the potential number of observations of banded birds, 2) band only adult and fledged birds, 3) band individuals with both aluminum USGS bands and two plastic color bands, and 4) widely disseminate requests for assistance. Information on movements may then be provided by passive field observation of color-banded birds and field-workers (agency and non-governmental organization staff, consultants), birders, and others who routinely observe birds in the field may report their observations and contribute to our efforts to document bird movements.

MATERIALS AND METHODS

Study Sites

We trapped birds immediately adjacent to, and within 10 m of, active tricolored blackbird breeding colonies. All colonies were located on private property and permission to access had been obtained from landowners. In 2007 we banded tricolors at three locations: 1) the Conaway Ranch in Yolo County (38°38'38"N, 121°42'32"W), 2) the Pioneer Duck Club in Colusa County (39°13'07"N, 122°06'47"W), and 3) a private ranch in Yuba County (39°01'43"N, 121°32'12"W). The Conaway Ranch colony was located in a weedy field dominated by milk thistle (*Silybum marianum*), mustard (*Brassica nigra*), and mallow (*Malva* spp.) at an elevation of 10 m. The surrounding area was a matrix of rice (*Oryza sativa*) cultivation, protected grasslands, and agricultural fields. The other two colonies were located in freshwater marshes dominated by cattails (*Typha latifolia*), and bulrush (*Schoenoplectus* spp.) at an elevation of 17 m. Both were surrounded by rice cultivation.

In 2008 we banded at three locations: 1) the Crane Ranch in Merced County (37°25'16"N, 120°32'04"W), 2) private property adjacent to Willow Slough in Yolo County (38°38'34"N, 121°42'40"W), and 3) the same private ranch in Yuba County. The Crane Ranch colony was located in an extensive stand of Himalayan blackberry (*Rubus armeniacus*) adjacent to a perennial stream and surrounded by open pasture at an elevation of 67 m. The Willow Slough colony was established in a weedy field dominated by mustard (*Brassica nigra*)

and milk thistle (*Silybum marianum*) at an elevation of 10 m. The surrounding area was a matrix of rice cultivation, protected grasslands, and agricultural fields.

Traps

We designed, constructed, and deployed two types of traps (modified Australian crow traps and dove traps), and transport cages. The transport cages were used to move the birds from the traps to the banding station.

We built two modified Australian crow traps similar to those illustrated in Hall (1994). Such traps are often called “decoy traps”, although the term decoy trap may refer to traps of any design which utilize captured birds as decoys to lure additional birds into the trap (Bub 1991). Our traps were constructed with frames of 5 x 5 cm wood into which 2.5 x 5 cm welded steel wire had been set into 1.25 cm deep grooves. The traps were approximately 2 x 2 x 2 m, with sloped roofs leading to an adjustable opening. Each trap consisted of six panels: two end panels, two side panels, two roof panels, and two ca. 7.5 cm x 2 m slats that could be adjusted to create a gap that allowed birds to enter the trap while preventing their escape. One end panel contained a door approximately 0.67 x 1.3 m through which investigators could enter and exit the trap (Figure 1). The traps were transported to the trap site as individual panels then assembled on-site and held together with eight 7.5 x 0.6 cm galvanized lag screws. The two roof panels (each approximately 0.7 x 2 m) were placed on the sloping sides of the end panels and the door was closed at the beginning of a trapping session. At the end of a trapping session, the door was held open, the roof panels were removed and stored next to the trap and the trap was re-baited to allow unrestricted access to the bait until the next trapping session, generally the next morning.

Dove traps were constructed of 2.5 x 5 cm welded steel wire. Each trap was “L-shaped” approximately 137.5 cm on a side and 20 cm high, with a 25 x 11.25 x 25 cm tapered funnel at the inside angle through which birds could enter but not exit (Figure 2). The top and sides were cut as separate panels, and panels were held together with “J-clips” (Bass Equipment Co., Healdsburg, CA 95448). One end of the trap had a 55 x 20 cm hinged “gathering panel”, used to confine the birds, and made of 2.5 x 5 cm welded steel wire. The gathering panel was attached to the trap floor ca. 20 cm from the door and was raised by pulling on a 2-3 m length of monofilament line. The end of the trap adjacent to the gathering panel had a 30 x 15 cm opening and a 50 x 20 cm door, hinged on one side, made of 2.5 x 5 cm welded steel wire. We used the modified Australian crow trap exclusively in year one (2007), and both kinds of traps in year two (2008).

Transport Cages

We constructed four 60 x 45 x 25 cm transport cages out of 2.5 x 2.5 cm welded steel wire. The transport cages were cut into panels that were held together by J-clips. Two types of transport cages were constructed: one utilizing an inside flap door plus an outside safety door, and the other utilizing only an outside door. Both transport cage designs had a 30 x 15 cm opening at one end. In the first design, the inside of the opening was covered by a 40 x 22.5 cm flap door made of heavy rubberized fabric and the outside was covered by a 45 x 25 cm safety door made of 2.5 x 2.5 cm welded steel wire (Figure 3). The bottom of the inside flap door was attached to a 2-3 m length of 40 kg test monofilament line. The monofilament line was used to open and close the flap door. The outside safety door was opened when



Figure 1. A modified Australian crow trap that was used to trap tricolored blackbirds in this study. The roof panels have been removed and door is open; the trap has been baited with cracked corn.

we placed the transport cage against the dove trap, and held shut with a steel clip when we carried the transport cage from the trap to the banding station.

In the second transport cage design, there was a single inside 35 x 20 cm door made of 2.5 x 2.5 cm welded steel wire with a ca. 5 x 20 cm lead weight strapped to the bottom. As with the first cage design, a 2-3 m length of 40 kg test monofilament was attached to the bottom of the door to enable us to operate the door remotely. The door was held closed by a steel clip when transporting captured birds.

The top of each transport cage has an opening for removing birds for banding. This opening consists of either 1) an elk hide-lined cuff ("cuff design") or 2) a 15 x 15 cm hole with a 20 x 20 cm lid of 2.5 x 2.5 welded steel wire ("lid design"). In the cuff design transport cage, a 13.75-cm diameter circular hole was cut through the welded wire top and reinforced by two discs of 1.25 cm exterior plywood. Four machine screws anchor the plywood discs and a piece of 0.625 cm thick elk hide to the top of the transport cage. The elk hide was cut in a star pattern (Figure 3) to enable a bander to reach into the transport cage while preventing the birds' escape. The cuff design eliminates the need for a separate lid and saves time by enabling bird banders to remove birds from the transport cage without alternately opening and closing a lid. In the lid design transport cage, a 15 x 15 cm hole was cut through the top and lined with 2.5 cm plastic edge protectors (Bass Equipment Co., Healdsburg, CA 95448). The hole was covered with a 20 x 20 cm lid made of 2.5 x 2.5 cm welded steel wire. The lid was then alternately opened and closed to remove birds for banding.



Figure 2. A dove trap of the type used to trap tricolored blackbirds in this study.

Transport of Birds

Captured birds were removed from the modified Australian crow trap by entering the trap, seizing the birds individually or in groups of up to four individuals and placed into a transport cage. In an attempt to reduce stress to the trapped birds by eliminating handling prior to banding, at the end of the 2008 field season one crow trap was modified. A hole of the same dimensions of the door in the transport cage was cut through the upper wall of the trap. Approximately 10 cm above this hole we placed two steel screw hooks into the wooden frame of the trap. A transport cage was hung on the exterior of the crow trap by the steel screw hooks. Monofilament line was attached to the door of the transport cage and held via a small clip to the opposite side of the crow trap to hold the door to the transport cage open. This modified design enabled birds to first enter the crow trap and then the transport cage without being handled. When a sufficient number of birds (effectively, more than 30) had been captured, we approached the crow trap from a direction opposite the transport cage and released the monofilament line, confining the birds to the transport cage. We then replaced the transport cage with an empty one and anchored the monofilament line to the opposite side of the trap, holding the door to the transport cage open and allowing captured birds to enter the transport cage.

Birds caught in the dove traps were transferred to the transport cage by opening the door to the trap, placing the opening of the transport cage against the matching opening on the dove trap, moving to a position opposite the transport cage, and pulling on the monofilament lines to raise the gathering panel and open the door of the transport cage.

When we moved to a position opposite the transport cage, the birds moved to a position furthest from us, thereby moving out of the trap and into the transport cage without being handled. When all birds had entered the transport cage, the monofilament lines were released, closing the transport cage door, lowering the gathering door, and confining the birds to the transport cage.



Figure 3. Transport cage of design 1 used in this study, showing the elk hide cuff used to provide access to trapped birds, the heavy rubber flap (in upright position), and the safety door.

Bait

Traps were baited with commercially-available cracked corn purchased in 22.8 kg (50 lb.) sacks from local pet shops or feed stores. Whole grain wheat was used for 2 days at one site, but birds did not consume the wheat and its use was discontinued. Sites were pre-baited with cracked corn for 3 days prior to trapping by placing small quantities (ca. 1-2 kg) of cracked corn once or twice each day in locations where traps were to be deployed. Where necessary, all vegetation was manually removed from trap locations to increase visibility and access to the cracked corn. The pre-baiting interval was followed, in the case of the modified Australian crow trap, with an additional 2-3 days of placing bait inside the trap while the door was open and the top panels had been removed, thus allowing free access to the bait and habituating the birds to the trap.

Bands

Captured birds were moved in the transport cages to a banding station approximately 30 m away. Each bird received three bands: one size 2 USGS aluminum butt-end band attached to the left tarsus and two 4 mm inside diameter plastic bands of different colors ("Darvic" size XBD bands; Avinet, Inc., P.O. Box 1103, Dryden, NY 13053-1103). One color band was used to indicate year and the other was used to indicate location of banding. Both color bands were placed on the right tarsus if the banded bird was a hatch-year (HY) bird, indicating that the year and location of birth are known. After-hatch year (AHY) birds received the year color band on the left tarsus above the USGS band and the location color band on the right tarsus, indicating that the year and location of birth are unknown (Figure 4). The plastic bands were sealed in place to prevent their subsequent removal as tricolored

blackbirds are known to be able to remove plastic leg bands (R. J. Meese and S. B. Simmons, personal observations).

Five methods for sealing the plastic bands were evaluated: 1) "Superglue", cyanoacrylate liquid, 2) PVC cement, 3) butane-powered portable soldering irons (Weller WEP1, Weller WPA2 Pyropen, Weller P2C Portasol Professional), 4) battery-powered portable soldering iron (Weller BP645MP), and 5) small electric "hobbyist" soldering iron (Weller SP23LK). The adhesives and several butane-powered and one battery-powered soldering iron were evaluated in 2007 and the 25 watt electric soldering iron was evaluated in 2008. The electric soldering iron was plugged in to a 400 watt power inverter (Black & Decker PI400AB) attached to an automobile battery. The automobile battery was recharged following a banding session by attaching it to a battery charger (Deltran Battery Tender Plus; Deltran Corporation, 801 US Highway 92E, Deland, FL 32724) overnight.

The complete banding sequence, from the removal of the bird from the transport cage to its release following the sealing of the second color band took, on average, about 75 seconds per bird, with the electric soldering iron, and variable amounts of time up to several minutes per bird with the other methods. Banding data were entered onto custom field forms and then entered into the program Bandit and submitted to the Bird Banding Laboratory in Laurel, MD.

Trapping and banding efforts began within days of the detection of breeding by tricolored blackbirds and continued until the young produced had fledged and most birds had departed the colony site. The door of the Australian crow trap was held open, both roof panels were removed, and additional cracked corn was provided between banding bouts to permit access to the cracked corn and thus continue to habituate the birds to the trap. Dove traps were removed from the trap sites or closed and moved away from areas where cracked corn was provisioned to prevent accidental trapping while we were not present.

We trapped birds from approximately 0700 until 1700 if daytime temperatures remained below 85°F (30°C) but ceased trapping when temperatures rose above 30°C in an attempt to minimize stress to the birds. Trapping and banding occurred from 0700 until late afternoon from April to mid-May (Crane Ranch in Merced County in 2008) and from 0700 until 1030-1130 from mid-May until late July (Yolo, Colusa, and Yuba County sites). Traps were continuously monitored during banding sessions and birds were removed from both types of traps at frequent intervals, typically every 15-30 minutes, rarely up to an hour if few birds were captured. In the case of the Crane Ranch, banding occurred continuously while an assistant transferred birds from the traps into the transport cages and brought the cages to the banding station, while at all other sites banding would cease while birds were transferred from the traps into the transport cages and brought to the banding station.

RESULTS

Both types of traps baited with cracked corn were safe and effective at capturing tricolored blackbirds. A total of 1,772 birds was banded in 30 days of banding from 3 sites in 2007 and a total of 5,174 birds was banded in 38 days of banding from 3 sites in 2008 (Table 1). In 2007, a total of 5 adults (0.28%) died and in 2008 a total of 18 adults (0.35%) died, apparently as a result of the stress caused by banding. Birds captured and banded were disproportionately females in 2007 ($\chi^2 = 22.66$, $df = 1$, $P < 0.05$) and 2008 ($\chi^2 = 503.77$, $df = 1$, $P < 0.05$). Here we assume a 2:1 female to male sex ratio as most males are mated to two females (Beedy and Hamilton, 1999).



Figure 4. A banded tricolored blackbird. One color band was used to indicate year and the other was used to indicate location of banding. Both color bands were placed on the right tarsus if the banded bird was a hatch-year (HY) bird, indicating that the year and location of birth are known. After-hatch year birds received the year color band on the left tarsus above the USGS band and the location color band on the right tarsus, indicating that the year and location of birth are unknown.

Both adhesives, the “Superglue” and PVC cement, were ineffective at sealing the plastic color bands. Neither adhesive formed a reliable seal and both created delays in releasing birds due to the time required to apply and then to wait for the adhesives to dry. Both adhesives were used on a minimum of 50 bands, and in most instances the quality of the seal was uncertain.

The portable battery-powered soldering iron was ineffective due to delays in heating the tip to the minimum temperature required to melt the plastic and to the frequent need to change batteries. The butane-powered portable soldering irons were initially effective at sealing plastic bands, but after a few hours’ use, they became unreliable, were difficult to start and refill, did not maintain a consistent temperature, and became impediments to efficient banding due to the time required for their maintenance. We tried three different models (Weller WEP1, Weller WPA2 Pyropen, Weller P2C Portasol Professional), and although each worked well for several hours, all were ultimately abandoned due to the time required to maintain them in workable order.

We tried only one electric hobbyist soldering iron, a Weller SP23LK, and found that it worked quickly and reliably for weeks of intensive banding. The soldering iron heated up in less than 3 minutes and, once hot, maintained a constant temperature that was ideal for melting and sealing the plastic color bands. Sealing the bands consisted of melting 2 or 3 small grooves across the butt ends of the bands and required a few seconds per band.

Also, the tip of the soldering iron was small enough that even on the 4 mm inside diameter plastic bands used in this study, there was minimal risk to burning either the bird or the bander. The only maintenance required of the electric soldering iron was the removal of melted plastic that inevitably accumulated on the tip, but cleaning the tip with a stiff wire brush took at most a few seconds for every few minutes of banding. The soldering iron was attached to a 12-volt automobile battery through a 400-watt power inverter. The original power inverter failed after less than 1 month's use, but was replaced with an identical model that worked well through the end of the field season. The battery could power a single electric soldering iron for 10 hours, but on one occasion, when we used two identical soldering irons attached to the power inverter simultaneously, the automobile battery was incapable of heating the soldering irons after 6 ½ hours of constant use. The automobile battery was recharged overnight by a battery charger, and the soldering iron-power inverter-automobile battery combination proved a very reliable and efficient means of sealing the plastic color bands.

Table 1. Summary of banding efforts. A total of 1,772 birds were banded in 30 days of banding from 3 sites in 2007 and a total of 5,174 birds were banded in 38 days of banding from 3 sites in 2008.

Year	No. Banding Days	No. Birds Banded (AHY/HY)	No. Females Banded (% of total)	No. Males Banded (% of total)	No. unrecorded sex banded
2007	30	1772 (1766/6)	1274 (71.9%)	494 (27.9%)	4
2008	38	5174 (5159/15)	4199 (81%)	960 (18%)	15

DISCUSSION

Both types of traps proved safe and effective at capturing relatively large numbers of tricolored blackbirds. Both males and females would approach and perch upon both types of traps, but males were more reluctant to enter the traps than were females. The remotely-controlled (monofilament line-operated) doors on the dove traps and transport cages allowed us to transfer, without handling, up to about 40 birds from the dove trap to the transfer cage in less than 2 minutes. This design minimized the time required to transfer captured birds from the trap to the transport cage, minimized our handling of captured birds, and maximized the time available to trap and to band birds.

Birds were more quickly, easily, and reliably removed from transport cages using the elk hide-lined cuffs than those with the hole and lid because the cuff eliminated the need to lift, and then lower, the lid each time a bird was removed for banding. Further, no birds escaped from the transport cage fitted with the leather cuff, while a small number of birds (< 10) escaped from the transport cage when the lid was opened to retrieve a captured bird for banding. Thus, the leather cuff was found to be more effective than the opening and lid combination because it eliminated escapes while reducing the amount of time required to remove an individual bird from the transport cage.

The traps and transport cages are: effective; constructed of inexpensive, readily-available materials using common power and hand tools; easy to build; portable; and durable. Although we trapped and banded tricolored blackbirds exclusively, similar traps and banding methods are likely to be effective with many species of granivorous or ground-feeding omnivorous birds. Weatherhead and Greenwood (1981), who worked with the related red-winged blackbird, *Agelaius phoeniceus*, reported that placing lure or “decoy” birds in their traps made them more conspicuous and effective; however, we emptied our traps of all captured birds, as we sought to minimize stress to the birds, and did not observe a conspicuous benefit from leaving lure birds in the traps.

We found both our trap/transport cage pairs to be safe and effective at capturing and transporting tricolors, and recommend that should others construct similar traps and cages, they share same-size openings with doors that can both be remotely-operated by pulling on a monofilament or similar line. Our experience demonstrated that the trap/cage combinations minimized both the time required to capture birds and to transfer captured birds from the trap to the transport cage while eliminating the need to handle birds during the transfer. When using the dove traps and attaching the transport cage to the side of the crow trap, we handled birds only once - when they were removed from the transport cage for banding. We believe that minimizing handling reduces stress to the birds and reduces banding-related mortality. We believe that our mortality rates are relatively low but, because banders rarely report banding-related mortality, a comparison with other studies is difficult.

The transport cage with the elk hide-lined cuff helped to improve handling efficiency by eliminating the need to repeatedly open and close the lid when removing birds prior to banding, and prevented birds from escaping through the opening in the roof of the transport cage. If large numbers of birds are to be processed, the increased efficiency with this design may reduce processing time, reduce stress to the birds, and maximize the number of birds banded in a banding session.

In most cases, the materials used for our traps and transport cages are inexpensive and readily available; the one exception may be the elk hide used in two of our transport cages. Elk hide is especially well suited for use in cages from which birds are to be removed for banding because it is both pliable and durable. An opening lined with such a leather cuff provides safe, rapid, and reliable access to captured birds while preventing their escape. We used 0.625 cm thick elk hide because one of us (SBS) had a large piece that seemed ideal for this purpose. Our experiences, covering several months and several thousand birds, confirmed its utility. Elk hide can be purchased from many craft stores and is readily available from many on-line vendors, but an acceptable substitute may be 0.625 cm thick steer hide leather, which is less expensive and may be more readily available. Heavy steer hide leather to be used in transport cages should approximate the thickness of the elk hide leather we evaluated, and we expect that it would provide similar benefits to those who band relatively large numbers of small to medium-sized birds.

In two seasons of trapping, adult female tricolored blackbirds have been disproportionately more likely to be captured than males and the biases in favor of adult females were observed in both trap types evaluated in this study. Biased sex and age ratios of trapped birds have commonly been reported in studies utilizing similar types of traps on tricolored blackbirds and related species of birds (DeHaven et al. 1975b; Weatherhead and Greenwood 1981), although the reasons for these biases remain unclear. In our work, conducted entirely during the breeding season, large numbers of both males and females landed and perched on both types of traps, but males were more likely to then fly off and

continue to forage elsewhere while females more frequently entered the traps to feed on the grain inside. The sex and age biases reported here are opposite those reported by DeHaven et al. (1975b), who used traps similar to, but much larger than, our Australian crow traps and who captured a majority of adult male tricolors during the breeding season and a majority of hatch-year birds following the breeding season. We cannot account for the discrepancy between our results and the breeding season results of DeHaven et al. (1975b); however, the traps deployed by DeHaven et al. (1975b) were located more distant from breeding colonies than were our traps, which were deployed immediately adjacent to colonies (often within 5 m of breeding birds). We removed birds from our traps at frequent intervals, typically every 15-30 minutes, while the frequency with which birds were removed from their traps was not reported (DeHaven et al. 1975b). It is possible that more males would have been captured if we had allowed the birds to remain in the traps for longer intervals, but we did not observe a tendency for more males to be captured after females had been captured.

Some investigators (e.g., Weatherhead and Greenwood 1981) have suggested that a condition bias may exist whereby individuals that enter traps are, on average, weaker than those that do not, and some studies have confirmed such a pattern (Weatherhead and Greenwood 1981, Dufour and Weatherhead 1991). Similar condition-biases have been observed in hunter-shot samples of many waterfowl species (e.g., Greenwood et al. 1986). Whether breeding adult female tricolored blackbirds are in poorer condition than either adult males or hatch-year birds is unknown, but an evaluation of potential age-sex-condition biases for tricolored blackbirds would require a random sample of birds from the local population, a sample that we did not obtain in this study. Additional efforts, perhaps including the capture of roosting birds with mist nets or other devices, are required to more thoroughly evaluate the reasons for the age and sex biases we observed.

Based upon our results, we recommend either of the trap types we evaluated, baited with an appropriate grain, to workers who desire to capture large numbers of birds. Both the crow and dove traps may be especially appropriate in cases where birds are to be trapped at multiple locations, and the portability of traps is an important logistical consideration. Smaller or larger birds could be captured with the Australian crow trap by changing the mesh size of welded steel wire and modifying the gap in the roof, at the base of the "V", appropriately.

Battery-powered soldering irons may be useful in cases where small numbers of birds are color-banded or as a temporary "back-up" to other, more efficient methods of sealing plastic bands but our experience, based upon a daily need to seal up to 2,000 color bands, showed that they are ineffective for sealing large number of plastic bands. We recommend the use of an electric soldering iron attached through a power inverter to an automobile battery as superior to butane or battery-powered soldering irons for sealing plastic color bands. Electric soldering irons require less maintenance, do not need to be turned off for refueling, last an entire 10-hour day on a single charge, and maintain a more consistent temperature that proved to be ideal for sealing the plastic color bands. The size and weight of the automobile battery may prohibit the use of this plastic band sealing combination in remote locations. A similar but more portable design would consist of an electric soldering iron plugged in to a power inverter connected to a 12 volt ATV or similar battery; however, this smaller battery type would likely not provide power for an entire banding day and would still need to be recharged at frequent intervals. If logistical constraints allow, and large numbers of plastic bands must be sealed, the automobile battery/power inverter/

hobbyist electric soldering iron combination is an efficient and effective method for sealing plastic bands and is the most effective method that we evaluated.

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