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Efficacy of Marking Snakes with Disposable Medical Cautery Units

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In many situations, marking snakes for recapture purposes is fraught with difficulty. Toe clipping has obvious drawbacks for snakes, and externally attached tags are easily lost via shedding or abrasion against surface objects. Passive integrated transponders (PIT tags) have near 100% reliability and are typically permanent if correctly implanted (Gibbons and Andrews 2004). However, PIT tags are expensive (a minimum of US $3.50 per tag if purchased in large numbers) and in many field studies the recapture rates of snakes are too low to justify their use. Even if funding is unlimited, the limited girth of some neonates and small species precludes the use of PIT tags (Gibbons and Andrews 2004).

Alternatively, snakes can be marked externally by a number of methods. The most commonly-employed technique is clipping of ventral scales anterior or posterior to the vent, in a pattern that varies with the researcher (Brown and Parker 1976; Ferner 1979; Woodbury 1956). These marks are of variable permanence (Shine et al. 1988), and difficulties with readability of marks or mortality of animals often arise if the marks are applied with too little or too much enthusiasm. Clipping scales leaves an open wound subject to possible infection, and marking small snakes is especially difficult (Weary 1969). Freeze-branding has been used by some researchers (Lewke and Stroud 1974; Measey et al. 2001), but this method requires availability of liquid nitrogen, Freon, or similar fluids that may be difficult to transport in field situations.

Heat branding has been used to mark reptiles and amphibians by a number of researchers (Clark 1971; Ehmann 2000; Ferner 1979). Methods of branding have been extremely varied, and equipment has included pyrographic needles (Weary 1969), resistance wire heated by Bunsen burners (Clark 1971) or by electricity (Ehmann 2000), and soldering irons (Ehmann 2000). The majority of this equipment has been improvised from a variety of materials, a task that may be beyond the abilities of the typical herpetologist. These units may also require electrical current from a wall socket, or require use of bulky and/or potentially explosive equipment to heat wires.

Herein, we report on the use of disposable medical cautery units ("Aaron Medical Change-A-Tip cautery units;" Aaron Medical, St. Petersburg, Florida 33710, USA; www.aaronmed.com) as an efficient means of marking snakes. These units are small, inexpensive, field-portable, and capable of quickly and precisely marking even very small snakes. Marks on most species are easily seen for at least two years.

Medical cautery units are designed for a variety of surgical applications and are available in two temperature classes. We have successfully used both high-temperature units (1204°C; ~US $25, available with two different handle styles [one operates on 2 C alkaline batteries, the other on 2 AA alkaline batteries]) and low-

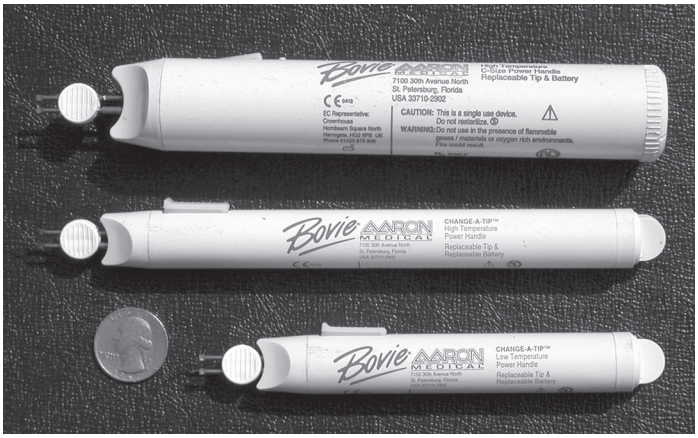

FIG. 1. Medical cautery units used to heat-brand snakes. From top to bottom: high-temperature, 2 CC battery handle; high-temperature, 2 AA battery handle; low-temperature, 1 AA battery handle.

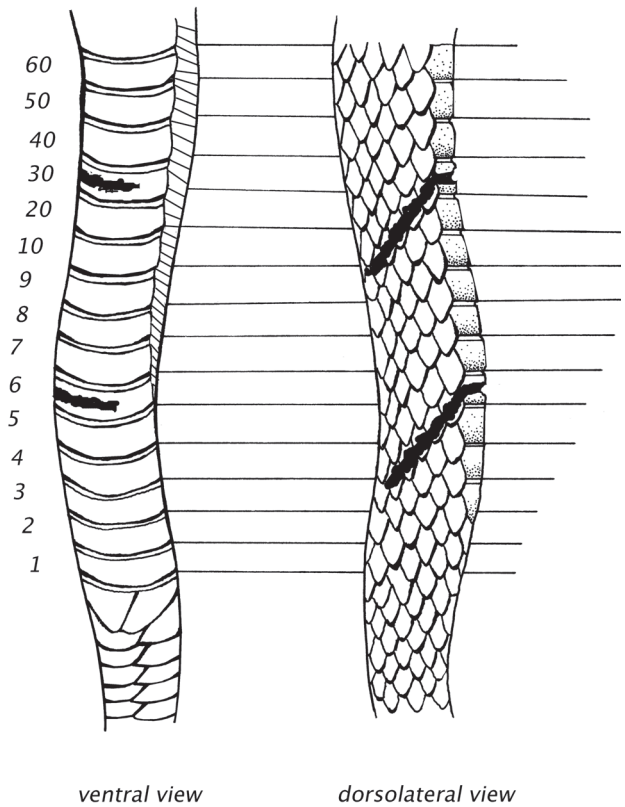

FIG. 2. Illustration of a snake heat-branded with ID # 36. For each mark, we branded the anterior portion of the ventral scale and extended the mark diagonally onto adjoining lateral scales. Illustration drawn by Rebecca Taylor.

temperature units (704°C; operates on 1 AA alkaline battery; ~US $20) designed for ophthalmological applications (Fig. 1). Both units are small and field-portable (Fig. 1). We have used individual units for over a year, marking hundreds of snakes. We replace broken/worn out tips (US $3.50 each) as necessary. Batteries last longer when marking small snakes, but in general batteries must be replaced fairly frequently. Due to the high temperature of the cautery units, marks should be applied with caution whenever fresh batteries are used.

From June 2002 to May 2005, we used medical cautery units to individually mark snakes as part of a long-term mark-recapture study of semi-aquatic snakes on the Department of Energy's Savannah River Site in the upper coastal plain of South Carolina. We also marked a smaller number of individuals of other species, which were not part of any extensive mark-recapture study, to demonstrate the utility of this technique for small and terrestrial species. On each snake, we branded 1–3 ventral scales anterior to the anal plate, forming a unique numerical code (Fig. 2). For each mark, we branded the anterior portion of the ventral scale and extended the mark diagonally onto adjoining lateral scales. We used high-temperature cautery units to mark medium and large snake species, such as Black Swamp Snakes (*Seminatrix pygaea*), Cottonmouths (*Agkistrodon piscivorus*), Racers (*Coluber constrictor*), watersnakes (*Nerodia* spp.), and Timber Rattlesnakes (*Crotalus horridus*), and low temperature units to mark juveniles and small species (e.g., *Cemophora coccinea*, *Lampropeltis triangulum*, *Tantilla coronata*). We found heat branding to be faster than traditional scale clipping for small-bodied snakes.

TABLE 1. Summary of recapture (RC) data for snakes branded with disposable medical cautery units on the Savannah River Site, South Carolina.

Species	N	RC Interval Range (days)	Mean RC Interval (days)
Seminatrix pygaea	105	5–784	320
Agkistrodon piscivorus	37	9–778	259
Coluber constrictor	22	9–785	135
Nerodia fasciata	32	5–1058	183
Farancia abacura	8	4–744	187
Lampropeltis triangulum	3	32–420	164
Elaphe obsoleta	3	41–201	127
Tantilla coronata	2	18–576	—
Crotalus horridus	2	14–59	—
Thamnophis sauritus	1	221	—
Nerodia taxispilota	1	41	—
Cemophora coccinea	1	27	—
Lampropeltis getula	1	26	—
Heterodon platirhinos	1	19	—
Regina rigida	1	17	—

An important assumption of capture-mark-recapture studies is that marks are permanent. In the field it is virtually impossible to determine if brands may be lost in some individuals or species, unless a second marking technique (e.g., PIT tags) is used or researchers can maintain a 100% recapture rate in the field. Alternatively, a laboratory colony of snakes can be maintained to determine mark retention rates over time. We chose this second method to asses the reliability of the brands. In spring 2002, we marked 36 neonate *Antaresia childreni* and *A. maculosa* from four different litters, and have kept them in the laboratory since that time (minus four individuals that were sacrificed for various reasons).

We have recaptured 220 heat-branded snakes of 15 species (Table 1) on the Savannah River Site, suggesting that this technique works well for a variety of taxa. The longest recapture interval was 1058 days, and we recaptured individuals of nine species after an interval > 200 days (Table 1). Additionally, long-term recaptures in small species (e.g., *Tantilla coronata*, 576 days; *Lampropeltis triangulum*, 420 days) attest to the effectiveness of marking delicate snakes with low-temperature cautery units. In general the brands were readily observable, even after greater than two years between captures and bouts of substantial growth (e.g., *Agkistrodon piscivorus*, grew 30.1 cm snout–vent length [SVL]; *Seminatrix pygaea*, grew 16.4 cm SVL). Similarly, the brands on *Antaresia childreni* and *A. maculosa* have remained obvious and readable in the laboratory for over three years, even as the snakes have tripled in length and increased many-fold in mass: no snake displayed marks that were appreciably faded. In combination, these results demonstrate that heat-branding with medical cautery units is an effective, dependable, and inexpensive technique for multi-year mark-recapture studies of snakes.

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