

board (Fig. 2). These dowels allow the animal to first be placed onto the board and then the restrainer board can be pressed against one side of the salamander. Large binder clips are placed behind the restrainer board on the dowels to hold it in place while in use. To use the bender board, the hellbender is placed onto the board with its head under the forward dowel, ventral or dorsal side up depending on the procedure and its legs are adhered laterally with tail and body straight by sliding the restrainer board closed and securing the binder clips. This allows for safe handling and measuring of total length and snout-vent length (SVL), drawing of blood, and marking individuals. This design is also ideal and efficient for use in the field when working alone. The approximate time to restrain hellbenders from the point of placement onto the board to securing the restraining board was under 10 seconds. Throughout the study 183 individuals ranging in size (SVL) from 26.2 cm to 38.3 cm were restrained using the board.

This design should increase the accuracy of measurements by eliminating the salamander's ability to struggle. The possibility of injury and stress are also reduced because researchers will not need to manually restrain individuals for longer than is necessary. The polyfoam padding creates a soft, non-abrasive cushion to securely restrain hellbenders without injury and it holds moisture which helps prevent desiccation and reduces the need to continually apply water during processing procedures. Although only tested on hellbenders, this design could easily be modified for use on other salamander species, particularly other large paedomorphic salamanders such as sirens (*Siren* spp.), amphiumas (*Amphiuma* spp.), and mudpuppies (*Necturus* spp.). Due to the polyfoam's ability to hold moisture, we recommend that researchers employ multiple boards as this would allow for adequate disinfection between sampling occasions and reduce the potential for disease transfer. This lightweight, relatively small "bender board" is portable, easy to use in the field, and can be modified to include carrying handles. Variations on the design could include replacing wooden materials with plastic to further decrease weight, improve durability, and increase the ease of cleaning. Although not illustrated, we recommend placing an additional nonabrasive restraint in the form of a small piece of plexiglass or similar material over the space between the anterior dowel to prevent individuals from sliding forward and under the dowel which could allow them to escape. The responsible use of this design could increase researcher sampling efficiency and measurement accuracy, while decreasing handling stress and the potential for injury. The use of the "bender board" also would reduce the need to anesthetize individuals using tricaine methane sulphionate (commercially available as MS-222) which has shown to produce adverse physiological effects and an alteration of behavior (Byram and Nickerson 2008; Fedewa and Lindell 2005).

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## Suggested Modifications to Terrestrial Box Traps for Snakes

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There are a number of trapping methods available for capturing terrestrial snakes and numerous variations on these methods have been described (e.g., Fitch 1987; Rodda et al. 1999). Since the wooden box trap in association with drift fences was first described within the primary literature and refined with specific construction instructions (Burgdorf et al. 2005), the method has been widely applied (although often with some modifications) particularly within the southeastern United States (e.g., Hyslop 2009; Lee 2009; Linehan et al. 2010; Perry et al. 2009). It represents a useful method of capturing large terrestrial snakes (Burgdorf et al. 2005), a group that can be difficult to systematically sample. In the course of using these traps in Georgia, Florida, Tennessee, and Alabama, we have generated recommendations to make traps easier to maintain and which may decrease mortality of non-

target organisms. However, the effects of these modifications on trap efficacy for target snake species are not known.

In addition to snakes, numerous species, particularly mammals, are captured in box traps (i.e., non-targets). Rodents routinely captured in these box traps in the southeastern U.S. have included Cotton Rats, *Sigmodon hispidus*, and Old-field Mice, *Peromyscus polionotus*. Additional mammal captures have included, but are not limited to, Striped Skunk, *Mephitis mephitis*, Spotted Skunk, *Spilogale putorius*, Virginia Opossum, *Didelphis virginiana*, Pine Vole, *Microtus pinetorum*, Southeastern Pocket Gopher, *Geomys pinetus*, rabbits, *Sylvilagus* spp., Wood Rat, *Neotoma floridana*, and Long-tailed Weasel, *Mustela frenata* (Guyer et al. 2007; L. L. Smith, unpubl. data). At best, removal of non-target mammals from box traps is inconvenient and time consuming but can also be unpleasant and/or dangerous (e.g., skunks and weasels).

We suggest installing a side door in addition to the hinged door on top of the trap specified by Burgdorf et al. (2005). Figure 1d of Burgdorf et al. (2005) displayed 5.1 x 5.1 cm pieces of lumber within the corners of the box trap and another piece 15 cm from the corner. Within the original schematic these two pieces of lumber were separated with hardware cloth. We recommend replacing the hardware cloth within this gap with a hinged plywood door (Fig. 1). We recommend this door, which can be held shut with turn buttons, be placed at the opposite side of the trap as the door on the top of the box trap to facilitate easy flushing of mammals out the side. Venomous snakes can also be safely flushed out this door, or allowed to exit on their own. On occasions when regular tending of the trap may not be possible and exposure is a concern, the side door (as well as the top access door) can be left open to permit animals to escape the trap.

Burgdorf et al. (2005) suggested including a chick watering source inside the box trap. We suggest adding a shallow galvanized pan as a water source so that animals can submerge themselves; this may aid in thermoregulation. A small branch leaned against the side of the pan can be used as an access ramp by small vertebrates. A 30–60 cm piece of synthetic rope within the pan and anchored to the center or top of the trap also allows small mammals to escape the water (Borg et al. 2004). Ropes



FIG. 1. A hinged side door greatly enhances a researcher's ability to quickly and safely remove non-target captures from box traps.

made of synthetic material are less likely to drain the watering pan due to capillary action.

We also reduced the size of box traps to facilitate ease of transportation to study sites. Although of limited concern when extended travel is not a component of installation, we found that reducing the length of the box from 48 to 42 inches (121.9 to 106.7 cm) and the height from 18 to 16 inches (45.7 to 40.64 cm) allowed for more traps to safely fit in the bed of a standard pickup truck.

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