One major advantage of the PC trap was that it could be left unattended for an indefinite amount of time without any mortality because the animals were able to escape. This allows much more flexibility in trapping schedule and much less constant upkeep when compared to techniques such as drift fences that must be checked daily (Gibbons and Semlitsch 1981). Although drift fences are an effective way of collecting species moving from one finite area to another such as a seasonal wetland, they may not be practical to use in long and thin habitats such as springs and streams that cannot be surrounded easily. Drift fences may also fail to capture salamanders that are able to climb out of pitfalls or over fences. Ryan et al. (2002) suggested that a combination of census techniques should be used when monitoring herpetofaunal communities to account for the maximum number of species. The PC trap, while efficient in sampling salamanders in its immediate area and habitat, is not designed to be an all-inclusive, mass sampling technique such as a drift fence. Instead, it is most useful when sampling fully or semi-aquatic salamanders in or in very close proximity to water on a sporadic sampling schedule.

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An Effective and Durable Funnel Trap for Sampling Terrestrial Herpetofauna

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The global population decline of amphibians has attracted much international attention (Alford and Richards 1999). Although less attention has been paid to reptile populations, they appear to be declining at a faster rate than amphibian populations (Gibbons et al. 2000). Part of the discrepancy in attention between the two groups is due to the difficulty in estimating the population trends of reptiles. Reptiles tend to be secretive, solitary, and dispersed, making them difficult to sample, and these traits hinder long-term mark-recapture studies that are necessary to generate population trends.

To study the population ecology of terrestrial herpetofauna, researchers have employed various techniques such as timed searches, cover boards, and drift fences with pit fall traps or funnel traps (Renken et al. 2004; Ryan et al. 2002). Although all of these methods are effective, drift fences with funnel traps catch the largest species diversity and the most individuals (Ryan et al. 2002), especially for reptiles. Here we present our design for an effective, light, and durable funnel trap.

Species that aggregate for hibernation allow for a unique opportunity to acquire reliable population size estimates (Blouin-Demers et al. 2000; Prior et al. 2001). Each spring since 1996, we have sampled a population of Black Ratsnakes (*Elaphe alleghaniensis*) at the Queen's University Biological Station (150 km S of Ottawa, Ontario, Canada) by enclosing 12–18 hibernacula with perimeter fences fitted with funnel traps. We surround the hibernaculum with a wooden frame to which we staple heavy-gauge polyethylene plastic sheeting. We fold the plastic on itself twice before stapling and we staple through a piece of cardboard (3 × 10 cm) to prevent the plastic from ripping under wind force. We fold the plastic towards the inside of the fence at the bottom and pile rocks, sticks, and leaves on the fold until it is completely covered. We install one funnel trap along the fence when the enclosure has a diameter < 5 m and we install two traps diametrically opposed if the diameter of the enclosure is between 5 and 10 m. The enclosure and funnel traps allow a large proportion of the ratsnake population to be sampled: we capture ca. 200 individuals each spring (Blouin-Demers et al. 2000). We capture all size classes, from neonates (SVL = 250 mm, mass = 7 g) to adults (SVL = 1750 mm, mass = 1250 g). In addition, our funnel traps regularly capture (approximately 50 individuals per year) the other eight species of snakes encountered at our study site that use ratsnake hibernacula: *Nerodia sipedon, Thamnophis sirtalis, T. sauritus, Storeria dekayi, S. occipitomaculata, Diadophis punctuatus, Liochlorophis vernalis,* and *Lampropeltis triangulum.*

We construct the cylindrical frame of the trap and the funnel with 1.27 mm (0.5 inch) hardware cloth (18–20 wire gauge) fastened with cage rings (these materials are commonly available at farm supply stores). We shape the funnel to be ca. 60 cm long, with a large opening of diameter > 30 cm and a small opening of diameter ca. 5 cm. We attach the funnel to a square piece (60 cm × 60 cm) of 1.91 mm (0.75 inch) plywood with a 30 cm circular hole cut 5 cm from the bottom (Fig. 1). The funnel is thus 5 cm above the ground after installation, but because we pile rocks, sticks, and leaves on top of the plastic sheeting we use as fencing, the opening of the funnel is actually level with the substrate (Fig. 2). We push the funnel from the outside through the opening in the plywood until it fits tightly and then cut, flatten, and secure (with 8 mm staples) the outer rim of the funnel to the plywood (Fig. 1). The diameter of the trap is also 30 cm, allowing us to use the plywood circle (cut out for the funnel) as the back of the trap.

To allow the capture of small snakes and to dissuade larger snakes from pushing their heads through the hardware cloth, we wrap the trap and funnel with aluminum window screening. We overlap the screening ca. 10 cm and sew it to the hardware cloth with aluminum wire (20–22 gauge), using 2-cm long stitches. The window screening and hardware cloth can both be purchased in 122 cm (4 feet) width, which is a convenient trap length.

After sewing the window screening to the trap, we install the

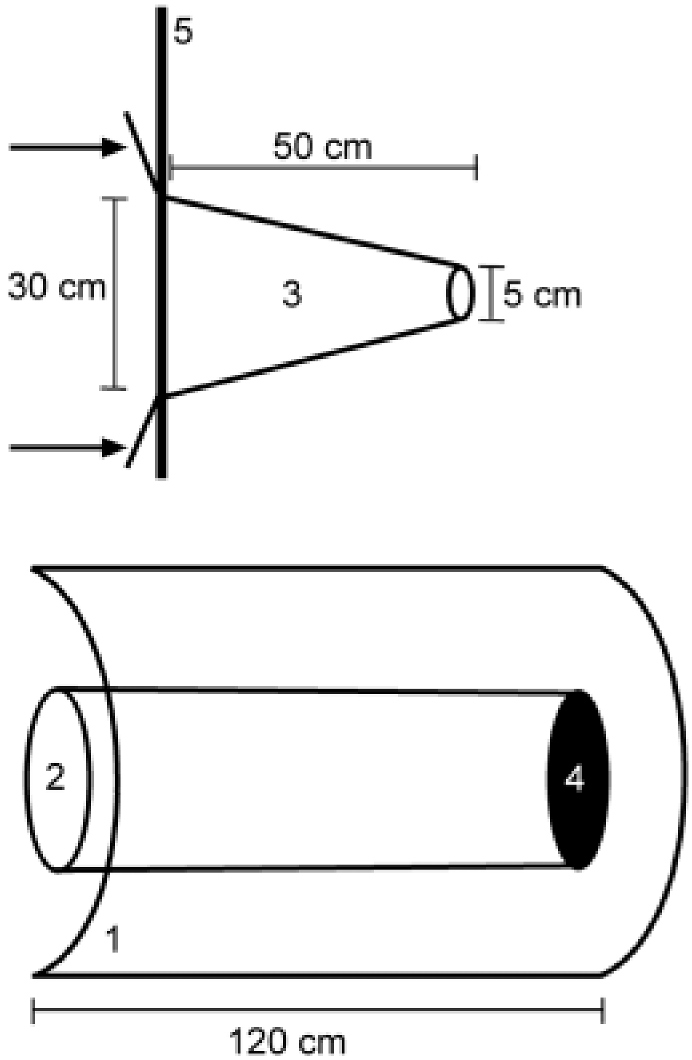

Fig. 1. Diagram of a simple and durable funnel trap. The trap (2) and the funnel (3) are made out of 1.27 mm (0.5 inch) hardware cloth and surrounded with aluminum window screening (1). The support for the funnel (5) and the back of the trap (4) are made with 1.91 mm (0.75 inch) plywood. The funnel is pushed through the hole in the support and then cut, flattened, and secured with staples around the edge of the funnel (arrows).

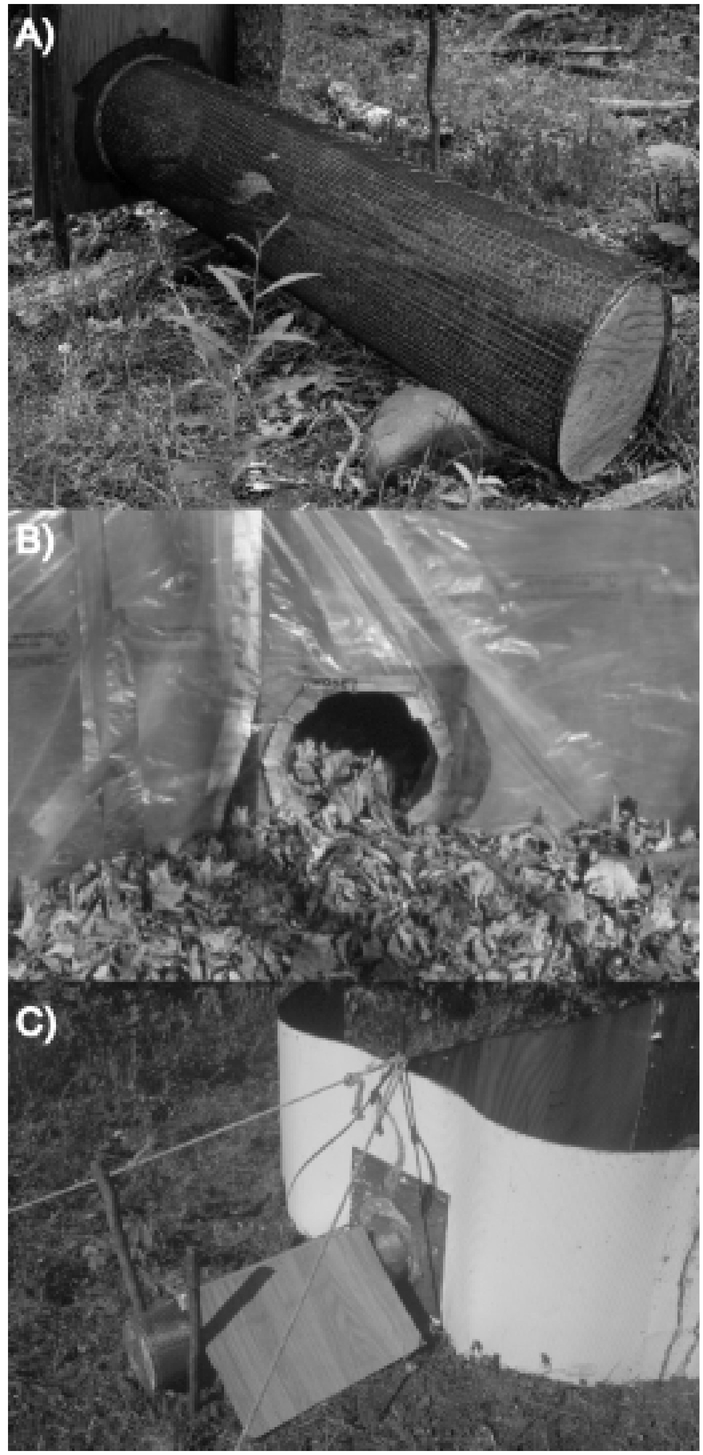

Fig. 2. Photographs of the simple and durable funnel trap (A), of the accumulation of debris on the plastic fencing that allows the funnel to be level with the substrate along a perimeter fence (B), and of the trap in use at the end of a metal drift fence with leads (C).

plywood circle at the back of the trap and secure it with 8 mm staples. It is important to attach the back of the trap last because it facilitates sewing the screening and the staples can secure both the hardware cloth and the mesh to the back of the trap.

Finally, we coat the small opening of the funnel with two-part epoxy (we found Plasti-Dip to be much less durable than epoxy). We dip the end of the funnel multiple times to build a thick coat. This serves two purposes: it makes the funnel more durable by hardening and securing the window screening and it covers sharp ends from the cut window screening which could injure snakes or deter them from entering the trap.

The trap is pushed tight against the funnel and secured by attaching a rope to the plywood on each side of the funnel (through two drilled holes) and passing that rope around the back of the trap. Because the trap is made of screening and hardware cloth, a visual inspection of the trap is sufficient to detect the presence of animals. When animals are captured, we detach the retaining rope, pull the trap back and quickly surround the opening of the trap with a snake bag (we use a pillow case). We gently raise the back of the trap until the animals slide in the bag. To prevent bites when dealing with venomous snakes, one could empty the trap in a hard plastic bucket or a garbage can instead of a bag.

To prevent overheating, we ensure that animals have shade by covering one end of the trap with a tarp or plywood scraps. Only one end is covered, as covering the whole trap could impede airflow and also lead to overheating.

Our funnel trap was inspired by earlier versions that were made solely of window screening held with office staples (e.g., Enge 1997), but we found those too flimsy for our purpose. The addition of hardware cloth, epoxy, and plywood does not add much weight and retains the effectiveness of earlier designs, but renders the traps more durable (some of our traps have been in service for 10 years) and better able to handle numerous large snakes (Fig. 2). Although we designed those traps to be placed on perimeter fences, they are versatile and can be placed at the end of a drift fence with leads (Fig. 2) or can be modified easily into a two-ended funnel trap (by the addition of a second funnel) to be placed at the center of a fence. Compared to box designs, we believe our mesh design is advantageous because it is light and see-through, but we think it is also more effective because it allows airflow. Airflow is likely a cue animals use to find an escape hole along a fence. If one makes many traps, the cost will be < US $20 per trap because the materials can be purchased in large quantities (e.g., full plywood sheets, 30.5 m (100 feet) rolls of hardware cloth and window screening). In conclusion, the traps can be used to catch a variety of terrestrial herpetofauna in numerous environments.

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Using Deep-Water Crawfish Nets to Capture Aquatic Turtles

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The most primitive method used to capture turtles is by hand, and a variety of hand capture methods appear in the literature (Cagle 1950; Carpenter 1955; Marchand 1945). Non-baited traps, particularly basking traps of various forms, have also been used in many turtle studies (Cagle 1950; Lagler 1943; Petokas and Alexander 1979; Robinson and Murphy 1975). The most popular baited-trap method is the hoop net, originally described by Legler (1960), and later refined by others to suit their specific needs. Since Plummer (1979) reviewed collection methods for turtles, many individuals have improved earlier trap designs and developed innovative capture techniques (e.g. Kuchling 2003; Sharath and Hegde 2003). Here we describe a novel technique that uses baited deep-water crawfish nets to capture carnivorous or omnivorous turtles. We include some preliminary data using this technique and discuss the potential advantages and disadvantages of these nets over traditional hoop nets.

Two dozen custom-made deep-water crawfish nets were purchased for US $75/dozen from a private dealer in Chalmette, Louisiana. Deep-water crawfish nets were constructed from a 50.8 cm diameter stainless steel ring (4.8 mm diameter) to which 16 mm black-dipped mesh was attached loosely to form a pocket (Fig. 1). Three 30.5 cm ropes were attached to the steel ring at equal distances from each other and were tied together at the other end to form a knot. A 5.1 cm diameter, 1.9 cm thick cork was attached above the knot followed by another knot to keep this cork in place. When placed in water, the cork suspended the three ropes above the mesh and minimized interference caused by turtles attempting to feed. A larger, second cork (5.7 cm in diameter and 3.8 cm