
TECHNIQUES

Herpetological Review, 2002, 33(3), 179–180.
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Rearing Larval Anurans in the Field: Maintenance of Equal Volumes and Ease of Multiple Sampling Using a Two-Component Enclosure

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Understanding larval biology is of interest because of continuing concerns about declining amphibian populations (Alford and Richards 1999). Various studies have documented the effects of anthropogenic stressors to larval anurans using field enclosures (e.g., Semlitsch et al. 2000), though most authors do not describe enclosure design (see Harris and Bogart 1997). To address the effects of chemicals associated with landfill leachate on development of gray treefrog (*Hyla versicolor*) tadpoles in the field, we constructed enclosures for rearing larvae to monitor survival and

body condition through metamorphosis (S. Richter, unpubl. data).

The enclosures allowed a large number of larvae to be reared at moderate and equal density (one larva per liter; up to 60 larvae per enclosure) by monitoring the number of larvae per enclosure and adjusting depth (thus volume) of the enclosure accordingly. They were designed to remain in the water column and stationary with respect to location in the pond and could be moved vertically as water levels changed between and within study ponds. The top was securely attached but could easily be removed to allow multiple sampling. Our design is an alternative to larger field pens (e.g., Wilbur 1976), which must be placed on the pond bottom and moved horizontally if water levels change. Both methods are valid; the appropriate enclosure should be chosen based on goals and logistics of the study.

Each enclosure was cylindrical and housed in an outer cage, which allowed the inner enclosure to be removed when necessary (Fig. 1). The cylinder of the inner enclosure was constructed of 1.6-mm aluminum screening (92 cm high and 30.5 cm diameter), and the top and bottom panels were made from 1.6-mm fiberglass screening and attached to the cylinder using 30.5-cm cross-stitch hoops, which are readily available at craft stores. To ensure proper size, we wrapped the aluminum screen around the inner hoop of the 30.5-cm wooden cross-stitch hoop (made of two hoops, the outer with a screw for tightening material between them), stitched the seam closed using 20-gauge galvanized wire, and then sealed the seam using nontoxic silicon. We attached the top and bottom panels with the cross-stitch hoops. The inner hoop was stitched to the inside of the cylinder with 20-gauge galvanized wire. A 35.5-cm² piece of fiberglass screening was placed over the hoop and cylinder; then the outer hoop was positioned over the screen and tightened with the screw. Thus, the cylinder and end screen were tightened between the inner and outer hoops. We strengthened the bottom by applying nontoxic silicon around the edges of the outer and inner hoop and cutting away excess fiberglass screening. No silicon was applied to the top of the enclosure so that it could be removed to sample larvae and metamorphs.

The outer cage was a cylinder with an open top made of 1.3-cm, 19-gauge hardware cloth and was slightly larger (2.5 cm) in diameter and 2/3 the height of the inner enclosure. We stitched the bottom panel (33 cm di-

ameter) to the cylinder (61 cm high) using 20-gauge galvanized wire. We attached the outer cage to a stake in the study pond using two wood screws and plastic cable ties, which allowed depth to be adjusted by cutting the cable ties, placing the cage at the new level on the wood screws, and replacing the cable ties. The outer cage protected the inner cage from floating debris and ensured that it maintained an upright position. It was adjusted as water levels changed within and between sites to maintain an equal water volume in the inner enclosure. When installed with the top 10 cm above the water surface, the volume of water in the inner enclosure was 60 L (total volume = 67 L).

Because of the small size of most early-stage anurans compared to the mesh of the inner enclosure, eggs and embryos might need to be housed in the laboratory in water from the study ponds until the larvae reach a large enough size to preclude escape. If the experiment needs to begin in ponds, our enclosure could be modified by replacing the fiberglass and aluminum screening with Nitex nylon (500- μ m mesh; Tetko, Inc., New York), as used by Harris and Bogart (1997).

Our method can be used in various studies of larval amphibians. The two-component design (outer cage and inner enclosure) is unique and allows multiple sampling through metamorphosis while maintaining equal water volume between sites with ease. The large size allows high initial density of larvae so that multiple sampling is possible with adequate sample sizes. The enclosure is particularly useful in studies designed to assess the effects of different pond environments on various stages of anuran development or in studies that manipulate density as a treatment.

Acknowledgments.—We thank Janalee P. Caldwell for comments on the manuscript.

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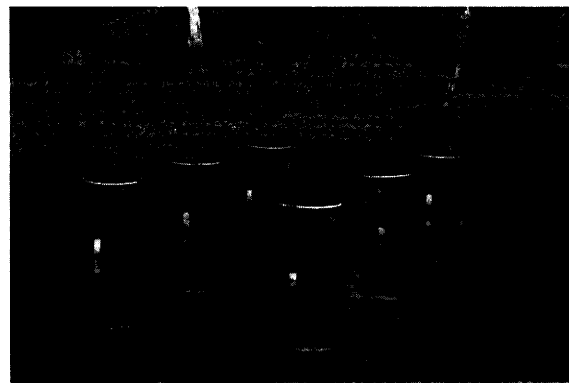


FIG. 1. Field enclosure showing (left) inner component and (right) inner components installed in outer components in the field.