Emergent Tiger Salamander (*Ambystoma tigrinum tigrinum*) Use of Coverboards at Brookhaven National Laboratory

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Introduction

The tiger salamander, *Ambystom tigrinum*, is presently recognized as a single distinctively polytypic species with a wide geographic range (Collins, et al., 1980). The species ranges from Long Island to Northern Florida, to Minnesota, to Missouri (Dunn, 1940). On Long Island, the New York State Department of Environmental Conservation (NYSDEC) has confirmed 91 active tiger salamander breeding sites, most of the distribution centering around the towns of Brookhaven and Southampton.

In New York State, the eastern tiger salamander (*Ambystoma tigrinum tigrinum*) is designated as an endangered species, first listed as such in 1983. Loss of habitat has been the primary factor contributing to the extirpation of this species from heavily developed western Long Island. The threat to their existence also results from pesticide and other contaminant use, development and other land use patterns, as well as pond disturbance, introduction of predatory fish, and expansion of bullfrog populations. Migrating adults are also jeopardized by off-road vehicles and increased road construction that fragments their habitat. The intention of this investigation is to determine whether tiger salamanders demonstrate a propensity for use of artificial cover, and whether they exhibit any preference regarding board choice. The results of this experiment will contribute a basis for all future studies to better divulge salamander behavior relating to migration patterns immediately following emergence.

The use of artificial cover objects is the method of choice for this experiment for several reasons. The results of previous experiments (Monti, et al. 2000) have suggested that salamander use of artificial cover objects (ACO) is not affected by nearby logs, and other natural cover objects. Experimental results also demonstrate that cover is not limiting. Low recapture rates as well as a lack of fidelity to an individual ACO may indicate that territorial behavior might not lead to problems of counting the same animal week after week, or reducing the odds of multiple salamanders sharing the same ACO (Monti, et al. 2000). The method seems to be preferable to other methods also used at the present time, such as quadrat searches and transect walks, for several reasons. Advantages include that counts can be made in daylight hours, installation is less labor-intensive than the installation of pitfall traps, and the use of boards does not degrade habitat as other methods might, such as in the turning or breaking of logs or disrupting forest litter (DeGraaf and Yamasaki, 1992). In addition, according to Taub (1961) artificial cover objects have twice the efficiency in yielding salamander captures of naturally-occurring logs and rocks.

Materials and Methods

In previous studies, all of the twenty-four ponds on the Brookhaven National Laboratory site had been surveyed for evidence of tiger salamanders (egg masses). Ultimately, two of the ponds on site were chosen to be participants in the investigation, based on ease of accessibility and high incidence of larval tiger salamanders. Each of the ponds on site has been assigned a label according to whether they are confirmed tiger salamander habitats (TS) or potential tiger salamander habitats (ts) as well as a number. The ponds being surveyed in this study are TS-7 and TS-10. TS-7 is a historic recharge basin in the central lab area and TS-10 is a recharge basin in the south central lab area.

Preliminary seining was done to confirm the presence of tiger salamander larvae in each of the ponds as well as to test water quality. Seining was carried out in approximately fifteen-minute sessions using a ten-foot minnow seine with quarter inch mesh. At the end of each drag, the net was brought up to the surface and any salamanders caught were transferred to a holding bucket (fig. 4). Measurements were taken on the salamanders collected. Snout-vent length (in centimeters), total length (in centimeters), and weight (in grams) were taken on each individual salamander. All tiger salamander larvae and adults were immediately released after they were measured to the area in which they were found. All research was conducted under New York State Fish and Wildlife permit # ESP01-0085 for endangered/threatened species.

From previous studies (Metts et al., unpublished) it was determined that coverboards would be placed five meters from the edge of the water, and at intervals of ten meters apart. Additionally, a second and third row of boards were added, at ten meters from the water, and fifteen meters from the water, respectively (figs. 1 and 2). Each board is a four-foot by four-foot sheet of three-eighths inch thick plywood, and was placed in the configuration previously mentioned around the two ponds (TS-10 and TS-7). A single row of boards was positioned around a third suspect area (ts-12) as well; however, neither larval nor adult salamanders have been collected from this area to date. A numbering system was devised, and the boards were numbered according to the pond location as well as the row position, and were consecutively numbered clockwise. The exact position of each coverboard was recorded using a Global Positioning System (GPS) and the points have been plotted on a map (figs. 1 and 2). The results of this GPS will be included in the Brookhaven National Laboratory Geographic Information System (GIS) in order to enhance its ecological information.

The coverboards were always checked in the morning in order to collect the salamanders that had most recently emerged from the previous night. At first the boards were checked only periodically (two to three times per week), but the boards were checked daily for the presence of adults after further seining determined that at least a few individuals of salamanders were nearly ready to emerge. The snout-vent length (SVL), total length, and weight were taken on any adult salamanders found, which were then released immediately following measurement to the area in which they were found. For both adult and larvae measurements, an Ohaus CS-2000 compact scale was used for weights and a standard fishboard was used for lengths. Any vertebrates other than tiger salamanders found underneath the boards were identified and recorded, but no measurements were taken on those animals.

Adult tiger salamander found at pond TS-10 on July 3.

Table 1:Salamanders Observed Under Cover-boards at Ts-7

Date	Pond	Board	Snout-vent length (cm)	Total Length (cm)	Weight (g)
07/12/2001	Ts-7	B5	6.3	11.9	9
07/12/2001	Ts-7	B5	6	11.4	9
07/12/2001	Ts-7	C14	6.7	12.7	12
07/12/2001	Ts-7	B17	6.2	11.7	9
07/12/2001	Ts-7	B17	6.5	12	9
07/12/2001	Ts-7	C12	6.5	12.2	11
07/12/2001	Ts-7	A7	6.4	12.2	11
07/13/2001	Ts-7	A7	6.5	12.5	11
07/13/2001	Ts-7	A9	6.3	12	9
07/13/2001	Ts-7	B16	6.5	12.2	9
07/16/2001	Ts-7	B3	6.5	12.3	10
07/16/2001	Ts-7	A5	5.9	11.9	10
07/17/2001	Ts-7	B9	6	10.9	8
07/17/2001	Ts-7	A13	6.3	11.6	8
07/17/2001	Ts-7	C7	6	11.1	8
07/17/2001	Ts-7	C7	6.1	11.6	9
07/17/2001	Ts-7	B17	6.2	11.6	9
07/17/2001	Ts-7	B17	6.4	11.4	9
07/17/2001	Ts-7	B17	6.2	12	9
07/17/2001	Ts-7	B17	6.5	12	9
07/17/2001	Ts-7	C12	6.4	12.5	11
07/19/2001	Ts-7	A15	5.9	10.9	8
07/23/2001	Ts-7	A15	6	10.8	7
07/26/2001	Ts-7	A5	6.2	11.6	8
07/26/2001	Ts-7	A9	6	11.5	9
07/26/2001	Ts-7	A10	6.2	11	8
07/26/2001	Ts-7	B14	5.9	11.1	10
07/26/2001	Ts-7	A15	6.2	11.3	9
07/27/2001	Ts-7	C5	6.2	11.4	10
07/27/2001	Ts-7	A7	6.1	11.9	10
07/30/2001	Ts-7	B7	6.5	12.5	12
07/30/2001	Ts-7	C5	6.3	12.3	10
07/31/2001	Ts-7	C5	6.5	12.2	10
07/31/2001	Ts-7	A7	6.1	12	9
08/01/2001	Ts-7	C5	6.1	11.9	9
08/01/2001	Ts-7	A7	6.3	12	9
08/02/2001	Ts-7	C5	6.1	11.9	9
08/02/2001	Ts-7	A7	6.3	12	9
		Averages:	6.244736842	11.78947368	9.3421053

Table 2: Salamanders Under Cover-boards at Ts-10

Date	Board	Snout-vent (cm)	Total Length (cm)	Weight (g)
7/12/01	A10	7	13.3	17
7/12/01	B11	6.5	12.4	14
7/13/01	A10	6.6	13.1	16
7/13/01	B11	6.5	12.4	14
7/16/01	B11	6.3	12.2	13
7/17/01	B11	6.5	12.6	11
7/24/01	A9	7.1	14.4	19
7/30/01	C9	7.4	14.3	18
	Averages:	6.7375	13.0875	15.25

Results

Several tiger salamanders as well as other species were observed under the coverboards (fig. 5). Species found included the Fowler's toad (*Bufo woodhousei fowleri*), white-footed mouse (*Peromyscus leucopus*), green frog (*Rana clamitans melanota*), and several species of snakes, including black racer (*Coluber constrictor constrictor*), northern ringneck (*Diadophis punctatus edwardsi*), ribbon snake (*Thamnophis sauritus sauritus*), and Eastern garter snake (*Thamnophis sirtalis sirtalis*). The coverboards under which salamanders were observed are listed in Tables 1 and 2. The presence of adult salamanders has been confirmed at ponds TS-10 (N=8) and TS-7 (N=38). The sizes of salamanders contrasted significantly between the two ponds (tables 1 and 2). At TS-7, the average snout-vent length was 6.24 centimeters (range = 5.9 to 6.7 cm), the average total length was 11.79 centimeters (range = 10.8 to 12.7 cm), and the average weight was 9.34 grams (range =7 to 12 g). At TS-10, the average snout-vent length of salamanders was 6.74 centimeters (range = 6.3 to 7.4 cm), the average total length was 13.09 centimeters (range = 12.2 to 14.4 cm), and the average weight was 15.25 grams (range = 11.0 to 19.0 g). There were also differences between the two groups with regard to board choice. The tiger salamanders at TS-10 were observed under boards that are concentrated in the same general area (table1, fig. 2). The salamanders at pond TS-7 were observed under boards that are scattered around the edge of the pond, although a few are clustered together (table 2, fig.1). There are noticeable peaks in salamander counts on certain days (fig. 3) when compared to other, a pattern that suggests emergence of reproductive cohorts seen earlier in larval sampling.

Table 3: Water quality data for each pond at the time of seining.

Date	Time	Location	Water Temp	Conductivity	Dissolved O2	pH	ORP	Turbidity
6/11/2001	14:45	Ts-7	25.33	42	7.45	7.32	294.4	2.4
6/11/2001	15:38	Ts-10	24.4	189	9.04	8.16	300.5	8.8
6/11/2001	16:40	Ts-6	21.1	26	8.48	5.67	299.1	3.3
6/29/2001	13:00	Ts-7	30.08	37	8.52	7.38	276.9	0.7
6/29/2001	14:00	Ts-10	30.02	--	12.46	9.07	260.7	--
6/29/2001	14:50	Ts-6	24.87	25	7.44	6.49	269.9	--
7/5/2001		ts-A6a	26.31	150	7.1	6.65	359.7	-8.2

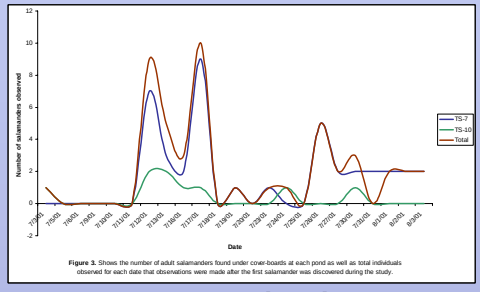


Figure 3. Shows the number of adult salamanders found under cover-boards at each pond as well as total individuals observed for each date that observations were made after the first salamander was discovered during the study.

Discussion and Conclusion

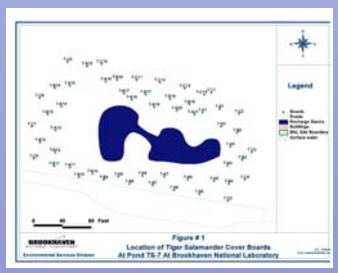
According to the data taken, the presence of tiger salamander larvae as well as emerging adults has been confirmed at two ponds on site at Brookhaven National Laboratory. At the time of the preliminary seining, different cohorts were apparent (see table 5), however, by the time of emergence, size was relatively consistent among the tiger salamanders. Observed salamander population peaks suggest periods of cohort emergence.

There was a significant difference in size between the salamanders found at TS-10 and the salamanders found at TS-7 (tables 1 and 2). A difference in temperature between the two ponds has the possibility to affect growth rates, as salamanders typically develop faster in warmer ponds, so as to emerge sooner (table 3). Another possibility is a difference in pH (table 3), which may also have had an effect on the size of the salamanders, as low pH has been shown to reduce hatchling size or time of hatching, and thus potentially larval growth rates and size at time of metamorphosis (Whiteman, et al. 1995). This is supported by the data, as TS-10 had a higher pH than TS-7 at times of seining, and continually had larger salamanders, both as larvae and adults.

It is possible that the tiger salamanders at TS-10 have a preference on coverboard selection, as all tiger salamanders at this location chose boards in the south/southeast corner of the pond area, and point in the direction of the forested area that surrounds this pond, as well as a medium-grade hill. However, at TS-7, salamander use of coverboards seems to be comparatively random, although there is a slightly higher incidence of salamanders that tend toward the road-side of the pond (south) than the sides which lead into the wooded area surrounding the pond on three sides. Any number of factors may influence the number of salamanders found under coverboards in these areas, including time of day, season, density of artificial or natural cover, and habitat type (Heyer, et al. 1994).

Systematic sampling of artificial coverboard arrays can yield large number of reptiles and amphibians, as well as quantitative estimates of relative abundance that include representation by rare species (Grant et al., 1992), however, there are many considerations regarding the degree to which this data is extrapolated. Salamanders were not marked in any way to distinguish among individuals. Data not associated with mark-recapture studies must be used cautiously in estimation of apparent biodiversity (Grant et al., 1992). For these reasons, it would be critical to employ a mark-recapture technique if the study is continued in the future. Furthermore, as salamanders show a preference for older, weathered ACOs (Monti et al., 2000), the data from the first few months following installation should be used with extreme caution.

There is much work to be done before effective monitoring programs can be designed, and then implemented, for monitoring amphibians in North America. Global amphibian decline has recently come to the forefront of attention, and has thus encouraged scientists to initiate long term monitoring programs, but few have effectively examined programs in order to verify the adequacy and accuracy of these programs (Smith and Petranka, 2000). The relevance of long-term surveys is emphasized by the need to determine the contributing factors to amphibian population declines. It is difficult to distinguish between anthropogenic effects and natural population fluctuations. One might easily mistake a human-caused population decline as a natural fluctuation just as easily as a natural cause may be misinterpreted as having a human cause. Additionally, natural fluctuations and anthropogenic effects acting together could result in population decline easier than either cause independently (Pechmann et al., 1991).



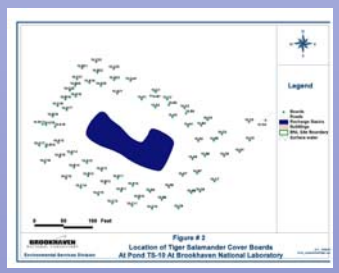


Figure 4: Tiger salamander larvae collected from pond TS-7 during preliminary seining.

Figure 5: Tiger salamander (in larval stage) being weighed after it was collected from TS-7 during seining.

Acknowledgements

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