Investigation of the Characteristics of Ponds and Vernal Pools used by Eastern Tiger Salamanders and their affects on Juvenile Recruitment

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ABSTRACT

The Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum)* is endangered in part due to rapid over-development on Long Island. In order to properly manage this species, protocols must be developed to identify suitable habitat and habitat preservation requirements. Egg mass surveys can be used to evaluate the optimum conditions of ponds and vernal pools used by tiger salamanders for reproduction. Linking egg mass presence and abiotic factors, such as hydroperiod, weather, pH, conductivity, etc., with juvenile recruitment can assist in creating models that predict how productive a pond or vernal pool has the potential to be. This research investigated the characteristics associated with ponds and vernal pools used by tiger salamanders for breeding to determine which ponds are the most productive, as well as which ponds result in the greatest amount of surviving larva. Egg mass surveys were conducted from 2000 through 2006 at thirty-seven pond and vernal pool locations throughout the Brookhaven National Laboratory property and juvenile recruitment data was collected at four of the ponds via drift fences and several ponds were sampled via seining. Data suggest that hydroperiod and weather may be the most crucial factors influencing the survival of larvae into metamorphosis. To look further into hydroperiods affect on metamorphs, t-tests were conducted to see if there was a significant difference in the mass and snout-vent-length (SVL) of metamorphs captured at two of the focal ponds, P7 and P13. The tests resulted in significant differences which indicate the potential affect of hydroperiod.

INTRODUCTION

The Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*) species was once widely distributed across Albany and Rockland Counties of New York, as well as in Nassau and Suffolk Counties on Long Island. However, it is currently found only in a few isolated populations on Long Island Suffolk County and in the recent past, Nassau County. Populations in Nassau County are now suspected to have been extirpated. Approximately 120 sites have been defined as tiger salamander breeding sites across Nassau and Suffolk Counties, although most sites have not been re-confirmed since the early 1980's and a 1994 census effort of 51 previously documented sites resulted in just 28 confirmations [1]. The decline in tiger salamanders is mostly attributed to over development on Long Island and to protect this species from local extinction a better understanding of the characteristics of ponds and vernal pools used by tiger salamanders is needed.

Egg-mass surveys, with attention to climactic conditions, can be used to develop predictive models for determining the suitability of ponds and vernal pools as tiger salamander breeding sites [2,3]. In addition, juvenile recruitment data can be collected and used to determine the optimum conditions for larval survival [4].

This research set out to: 1) Investigate the characteristics associated with ponds and vernal pools used by tiger salamanders for breeding, 2) Determine which ponds are the most productive, and 3) Determine which ponds result in the greatest amount of surviving larva. Protocols developed from this and other studies will be applied to a management plan to ensure the survival of this endangered amphibian with recommendations for identification of suitable habitat and minimum habitat preservation requirements for habitat in areas that are being developed.

Figure 1. Map of Brookhaven National Laboratory Wetlands

Tiger Salamander Captured in Drift Fence

One of the focal ponds at Brookhaven Lab

METHODS

The data were collected in the springs of 2000 through 2006 at thirty-seven pond and vernal pool locations throughout the Brookhaven National Laboratory property (Figure 1). Pond characteristics of both known and unconfirmed tiger salamander ponds were surveyed during this study in order to create comparisons to predict potential occurrence of tiger salamanders in unstudied habitats. Numbers of egg masses per pond were recorded on an annual basis, as well as several habitat variables. These variables include vegetation cover, water depth (both average and maximum) air temperature (ºC), water temperature (ºC), turbidity, pH, conductivity, and dissolved oxygen levels. Average daily and monthly temperatures and precipitation were also documented. Presence of adult and juvenile salamanders during surveys was also noted. Surveys conducted utilized primarily daylight investigations, with some additional night surveys for confirmation of activities. Egg mass surveys are often hindered by presence of ice on ponds that may extend well into March annually.

Juvenile recruitment data were collected via drift fences at four ponds. At, three of the ponds drift fence data was collected since 2003 on all amphibians and mammals captured. The yearly drift fence and egg mass data were compared at these three ponds to further our understanding of the factors affecting recruitment.

The fourth pond's drift fence was installed this year and could not be compared to previous years. However, seining data from previous years was used to estimate juvenile recruitment for those years and those estimates were used for comparison with this year's data.

RESULTS

Figure 2 shows the average egg mass counts per year, with error bars, for ten of the ponds in this study. The average number of egg masses ranged from 2.17 to 29.33, with standard deviation ranging from ±3.13 to ±27.41.

Due to the lack of seining data, further tests were conducted. We tested the mass and SVL of P13 X P7 for years 2005 and 2006, P13 (year 2005) X P13 (year 2006), and P7(year 2005) X P7(year 2006). Table 1 shows the P-value of the t-tests.

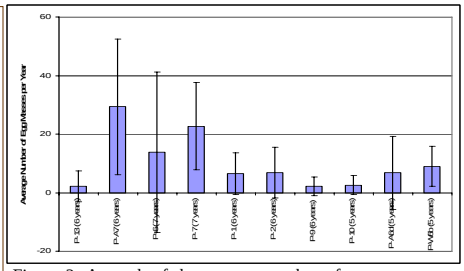

Figure 2. A graph of the average number of egg masses per year, counted at ten study ponds from 2000-2006. The error bars show the standard deviation in yearly counts and the legend notes, in parentheses, how many years each pond has been included in the study.

	P13XP7 2005	P13XP7 2006	P7(2005) X P7(2006)	P13(2005)XP13(2006)
Mass P-value	2.56365E-05	0.000258964	3.11379E-07	0.029442632
SVL P-Value	0.014130956	0.025805632	0.00430285	0.041855051

Table 1. T-test results showing significant differences in the mass and SVL of tiger salamander metamorphs captured at two focal ponds.

CONCLUSION AND DISCUSSION

Upon examination of the Figure 2, we noted that ponds with lower average counts also had lower deviation from the mean. Reasons for this possible trend are unknown at this time. However, it may be due to fluctuations in any or all pond variables discussed above. The most influential factor may be hydroperiod, which is known to play a major role in tiger salamander activity.

Because we suspected the problems with seining were also caused by changes in hydroperiod, we decided to look deeper into P13 and P7. In 2005, the water level of P13 was constant throughout the season and the water level of P7 declined rapidly in July and dried up completely before the established time of emergence. The metamorphs captured at P13 in 2005 were significantly greater than those captured at P7. In 2006, the opposite trend was observed. P13 began drying up so prematurely we had to have water added by the fire department to keep the egg masses from dying. P7 however, maintained a constant water level and metamorphs captured at P7 were significantly greater than those captured at P13. Also, the 2006 P7 metamorphs were significantly greater than the 2005 P7 metamorphs and the 2005 P13 metamorphs were significantly greater than the 2006 P13 metamorphs, which implies that the hydroperiod affects the development and potentially the survival of newly metamorphosed salamanders.

Without careful consideration of the needs of pond-breeding amphibians, such as pond hydrology or upland habitat requirements, many populations of amphibians can be affected. If development affects the hydrology of ponds and vernal pools it may ultimately affect the tiger salamanders population in a negative way. More long-term data are needed to truly understand the relationships between tiger salamanders and the ponds in which they breed.

REFERENCES

[1] S.C. Bishop, "The salamanders of New York," New York State Museum Bulletin, No. 324, pp 1-365, 1941.

[2] A.J.K. Calhoun, T.E. Walls, S.S. Stockwell, and M. McCollough, "Evaluation vernal pools as a basis for conservation strategies: a Maine case study," Wetlands, vol. 23, pp. 70-81, 2003

[3] R.S. Egan and P.W.C. Paton, "Within-pond parameters affecting oviposition by wood frogs and spotted salamanders," Wetlands, vol. 24, pp. 1-13, 2004.

[4] J.S. Richardson, W. Klenner, and J. Shatford, "The tiger salamander in British Columbia: An amphibian in an endangered desert environment," presented at a conference on the Biology and Management of Species and Habitats at Risk, Kamploops, B.C., Feb. 1999.

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