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Glow Sticks as Effective Bait for Capturing Aquatic Amphibians in Funnel Traps

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Funnel traps of various designs have been used to capture adults and larvae of aquatic amphibians (e.g., Buech and Egeland 2002; Richter 1995). Most studies use unbaited funnel traps to capture amphibians while others have used shrimp or salmon eggs (Adams et al. 1997). Light traps and light sticks are commonly used in studies of fish, particularly larvae (Doherty 1987; Marchetti et al. 2004), but have not been widely used to capture amphibians. Glow sticks have been mentioned briefly in the literature as a means to increase capture rates of aquatic amphibians (Smith and Rettig 1996), but no studies have estimated their effectiveness. In this study we compared the capture success of unbaited funnel traps and funnel traps baited with glow sticks.

We used commercially available plastic minnow traps (similar to Challenge Plastic Products #50176) to capture eastern red-spotted newts (*Notophthalmus viridescens*) in Station Pond at Mountain Lake Biological Station (MLBS) in Giles County, Virginia. Station Pond is a 0.65 ha stream-fed permanent pond constructed in 1965. One hundred and four minnow traps were used to capture aquatic adult *N. viridescens* as part of a larger project to estimate the population size of newts in the pond. We used Pollock's robust design for our sampling regime (Pollock 1982), with eight sampling occasions divided into four primary periods with two secondary sampling occasions per primary period (Table 1), so the data could be used in a capture-recapture study reported elsewhere. Trap locations were randomly assigned to receive a glow stick or remain empty on the first sampling occasion and were switched to the other treatment for the subsequent primary period. Therefore, fifty-two randomly selected traps contained glow sticks for sampling occasions 1, 2, 5, and 6 (primary periods 1 and 3) and the other fifty-two contained glow sticks for sampling occasions 3, 4, 7, and 8 (primary periods 2 and 4). This design was chosen to maintain consistent conditions within a primary period, a requirement for Pollock's robust design, and to account for spatial and temporal effects in capture efficiency.

Sixty-four minnow traps were placed around the perimeter of Station Pond with 4–4.5 m between each trap. Traps were attached to a length of rope, tied to a PVC stake on the bank, and alternated between being placed 1 meter and 2 m from the bank. Forty traps were placed in a grid in the middle section of the pond using a row boat. A foam float tied to a rock using string noted the location for each trap. A second string for the trap was attached to each foam float with a fishing stringer tied to the end of the string for ease of placement and removal of traps. Therefore, every trap was in approximately the same location for each sampling occasion.

For each sampling occasion traps were placed in the pond from 1900–2000 h. A small rock was placed in each trap so it rested on the substrate of the pond. Traps were removed from 0800–1000 h the following morning and *N. viridescens* were counted and sexed. The number of tadpoles captured was also recorded.

The glow stick treatment traps were baited with non-toxic yellow bracelet-sized glow sticks (Glow Universe, US $9.49 per 100; 20.32 cm length, 0.5 cm diameter, 6–8 h glow time). We chose thinner bracelet-sized glow sticks to avoid catching more individuals than could be handled in one day due to the large number of traps. Glow products, which are widely available and normally used as novelty jewelry, come in several sizes and our preliminary trapping indicated thicker glow sticks (10.16 cm length, 10 mm diameter), which emit more light, catch more individuals (38.2 *N. viridescens* captured per trap using thick glow sticks vs. 10.8 captured per trap using bracelet-size glow sticks). We suggest that glow sticks are activated in a darkened setting before placing them in traps as we found that 5–10 glow sticks per 100 were defective and did not produce light.

We first tested if glow sticks increased the number of captures per trap. Based on the distribution of the number of individuals captured per trap, we used a generalized linear model (PROC GENMOD in SAS; SAS Institute, Inc., Cary, North Carolina) to analyze the effect of glow sticks on the total number of newts and tadpoles captured per trap assuming the Poisson distribution. Of the 832 trappings (104 trap locations for eight sampling occasions), nineteen trappings were excluded from this analysis because of trap failure due to the trap not being closed correctly or variable water levels, which left a few traps without the funnel in the water. Next, we determined if male and female newts responded differently to the glow stick bait by testing for differences in trap sex ratio due to glow stick treatment using a one-way ANOVA. We calculated the proportion of males captured in each trap and performed an arcsine square-root transformation to achieve normality. A further 121 trappings were excluded from this analysis where no newts were captured (87 of the trapping occasions with zero captures were unbaited traps while 34 were baited with glow sticks). We weighted the ANOVA by number of individuals captured because traps which contained more individuals most accurately reflected the trapped sex ratio. Lastly, to account for spatial differences in capture success, we conducted paired t-tests to compare the mean number of newts and tadpoles captured at each trapping location with and without glow sticks ($N = 4$ trapping occasions per location with glow sticks and 4 trapping occasions per location without glow sticks). We square-root transformed the data to achieve normality. Of the 104 trap locations, only locations with all eight sampling occasions being successful were used in the analysis ($N = 89$ with 15 trap locations excluded due to one or more sampling occasions being failures).

Results.—*Notophthalmus viridescens* is the main salamander species present in Station Pond. Very small numbers of *Eurycea cirrigera* and *Desmognathus* spp. are washed in from a stream and a single adult *E. cirrigera* was captured, the only non-newt salamander captured during all sampling occasions. *Ambystoma jeffersonianum* is the only species of mole salamander known to be present at MLBS and is rarely seen in Station Pond (elevation 1160 m). A variety of frogs have bred in Station Pond (*Pseudacris*

TABLE 1. Total captures of *N. viridescens* for each sampling occasion. Secondary sampling occasions within a primary period were separated by one day. The vast majority of captured tadpoles were native *R. catesbeiana*.

Date	Sampling Occasion	Primary Period	Male Captures	Female Captures	Total Newt Capture	Tadpole Captures
5 June 2006	1	1	466	83	549	75
7 June 2006	2	1	351	67	418	73
3 July 2006	3	2	367	125	492	149
5 July 2006	4	2	313	114	427	113
11 July 2006	5	3	137	60	197	97
13 July 2006	6	3	299	118	417	95
24 July 2006	7	4	352	124	476	104
26 July 2006	8	4	460	175	635	90

crucifer, Hyla versicolor, Rana clamitans, Rana sylvatica, Rana palustris), but Bullfrogs (*Rana catesbeiana*) dominate the tadpole community and comprised the majority of tadpoles captured.

Over the eight sampling occasions 3611 adult *N. viridescens* and 796 tadpoles were captured (Table 1). We found that glow sticks significantly increased the number of *N. viridescens* captured (Fig. 1; $\chi^2_1 = 163.75$, $P < 0.0001$). Glow sticks increased the number of individuals captured for both males (mean ± SE per trap = 4.77 ± 0.22 for glow stick trappings vs. 1.99 ± 0.11 for unbaited trappings) and females (mean ± SE per trap = 1.45 ± 0.09 for glow stick trappings vs. 0.63 ± 0.04 for unbaited trappings). Overall, more male newts were captured than female newts (Table 1; mean ± SE per trap = 3.36 ± 0.13 males and 1.03 ± 0.05 females). The male-biased sex ratio per trap was not significantly affected by glow stick use ($F_{1, 691} = 1.64$, $P = 0.20$).

Similar results were found for tadpole captures (Fig. 2). More tadpoles were captured in traps with glow sticks than in unbaited traps (mean ± SE per trap = 1.21 ± 0.09 for glow stick trappings vs. 0.78 ± 0.07 for unbaited trappings; $\chi^2_1 = 17.91$, $P < 0.0001$).

We also found that spatial variation in trap success was high. Trapping locations varied from capturing a mean of 0.25–16.5 *N. viridescens* individuals per trap when glow sticks were used and 0–7 mean individuals per trap when unbaited. When examining captures at each trap location we found that traps captured significantly more newts when baited with glow sticks compared to when unbaited (mean increase ± SE = 3.80 ± 0.35 individuals; Student's t = 12.44, d.f. = 88, P < 0.0001). Trap locations also captured significantly more tadpoles when baited with glow sticks (mean increase = 0.30 ± 0.12 individuals; Student's t = 3.59, d.f. = 88, P = 0.0005). Overall, glow sticks increased newt captures at trapping locations by an average of 273% and increased tadpole captures at trapping locations by an average of 93%

We observed no negative effects of funnel trapping or glow stick use on captured amphibians. Of the 3611 *N. viridescens* captured, only two individuals were found dead. Both were gaunt and found in traps with other healthy individuals. No tadpole mortality was observed.

Discussion.—We found glow sticks to be extremely effective at increasing capture efficiency of aquatic amphibians in funnel traps. Overall, when using glow sticks as bait, we captured greater numbers of adult *N. viridescens* and *R. catesbeiana* tadpoles than when no bait was used. When the spatial variation in capture success was removed we found that a given trapping location was more successful when glow sticks were used compared to when the trap was set unbaited.

We captured significantly more male newts than female newts. A male-biased sex ratio in pond populations has been reported in numerous studies of *N. viridescens* (e.g., Attum et al. 2002; Chadwick 1944; Massey 1990), but has not been found in juveniles entering ponds and lakes to breed (Gill 1978; Healy 1974; Hurlbert 1969). A biased sex ratio in individuals captured in ponds could be due to an actual biased sex ratio (possibly caused by differential survival between the sexes) or differences in

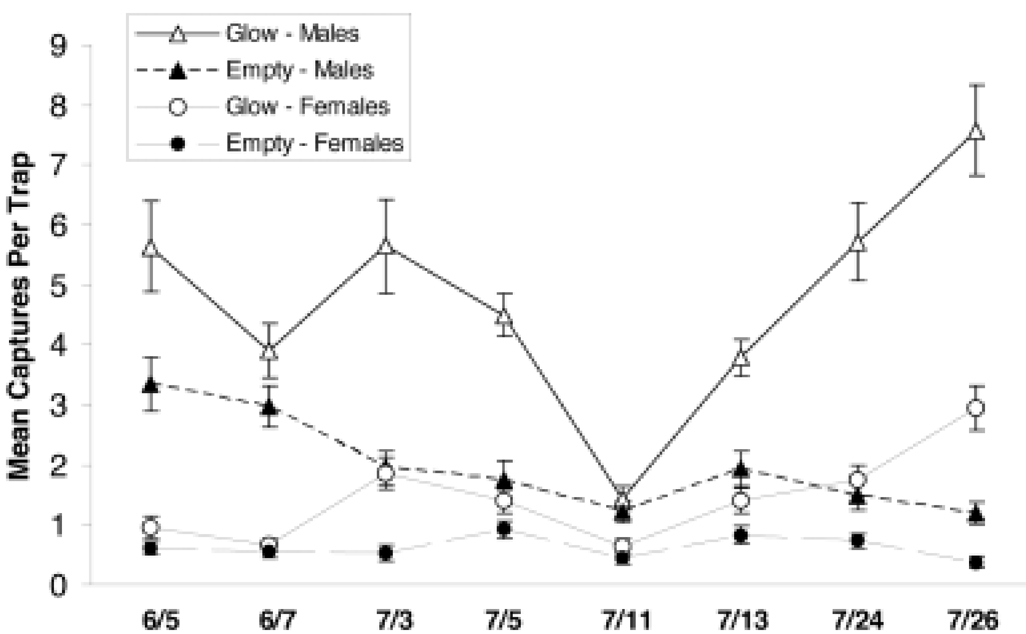

FIG. 1. Mean number of captures per funnel trap of *Notophthalmus viridescens* males and females over eight sampling occasions.

catchability between the sexes. For example, *N. viridescens* could have differences in movement patterns or microhabitat use between the sexes, which may result in female newts being more difficult to detect. Our data do indicate that male and female newts do not respond differently to glow sticks. Thus, while glow sticks increase captures for both sexes, one sex is not preferentially attracted to the glow stick bait compared to the other sex.

Capture efficiency varied over time likely due to differences in environmental conditions between sampling occasions. In particular, during the fifth trapping occasion (11 July 2006) less than half the typical numbers of individuals were captured. We noticed that a full moon and cloudless conditions resulted in particularly bright light conditions that evening. Moonlight can significantly impact the activity of aquatic salamanders (Anderson and Graham 1967; Green 2006) and we believe lunar illumination can lessen the effectiveness of the glow sticks compared to darker nights.

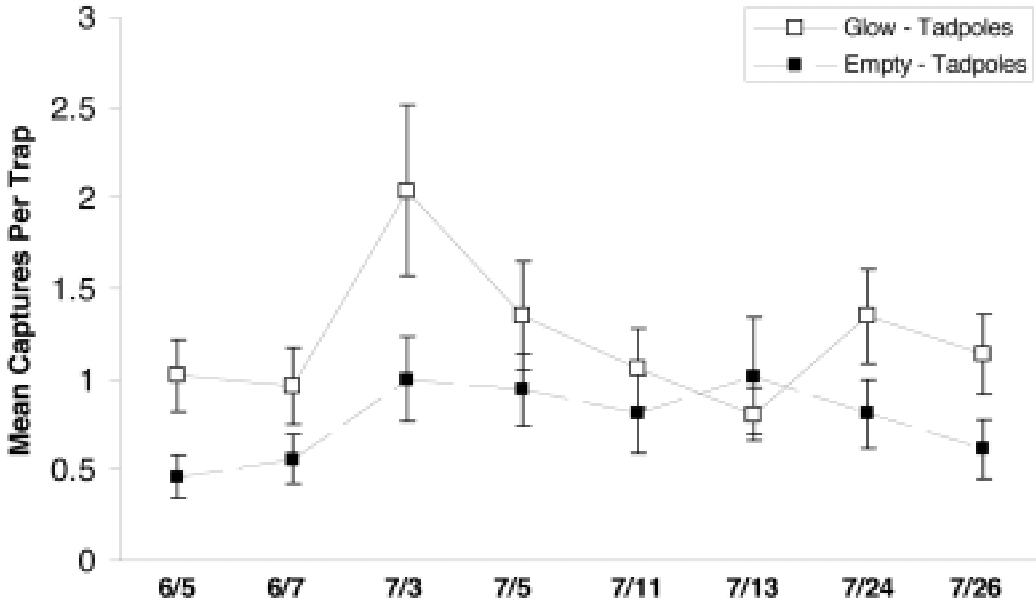

FIG. 2. Mean number of tadpole captures per funnel trap over eight sampling occasions. The vast majority of individuals captured were *Rana catesbeiana* due to their large size and numerical dominance in Station Pond.

The greatest number of individuals captured in a single trap was 37 *N. viridescens* and 14 *R. catesbeiana* for a glow stick trap and 14 *N. viridescens* and 12 *R. catesbeiana* for an unbaited trap. The pond trapped in this study is dominated by these two species but we suspect glow sticks would be effective for other species as well. Unless capturing too many individuals in a given night is a concern, we suggest the thickest glow sticks that produce the most light will result in the greatest number of captures per trap. However, further examination is necessary for studies of multiple species communities. As different species may vary in their catchability, response to glow sticks may also vary by species. We believe that glow sticks are a useful and inexpensive method for increasing capture efficiency in studies using funnel traps.

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LITERATURE CITED

ADAMS, M. J., K. O. RICHTER, AND W. P. LEONARD. 1997. Surveying and monitoring amphibians using aquatic funnel traps. *In* D. H. Olson, W. P. Leonard, and R. B. Bury (eds.), Sampling Amphibians in Lentic Habitats (Northwest Fauna 4), pp. 47–54. Society for Northwestern Vertebrate Biology, Olympia, Washington.

ANDERSON, J. D., AND R. E. GRAHAM. 1967. Vertical migration and stratification of larval *Ambystoma*. Copeia 1967:371–374.

ATTUM, O., P. EASON, AND G. COBBS. 2002. Effects of collection on weight, length, and sex ratio of red-spotted newts, *Notophthalmus viridescens*. J. Herpetol. 36:703–707.

BUECH, R. R. AND L. M. EGELAND. 2002. Efficacy of three funnel traps for capturing amphibian larvae in seasonal forest ponds. Herpetol. Rev. 33:182–185.

CHADWICK, C. S. 1944. Observations on the life cycle of the common newt in Western North Carolina. Am. Midl. Nat. 32:491–494.

DOHERTY, P. J. 1987. Light-traps: selective but useful devices for quantifying the distributions and abundances of larval fishes. Bull. Mar. Sci. 41:423–431.

GILL, D. E. 1978. The metapopulation ecology of the red-spotted newt, *Notophthalmus viridescens* (Rafinesque). Ecol. Monogr. 48:145–166.

GREEN, L. A. 2006. The ecology of plethodontid salamanders in acidic headwater streams in Virginia. Dissertation. University of Virginia, Charlottesville, Virginia.

HEALY, W. R. 1974. Sex ratio variation in samples of adult *Notophthalmus viridescens*. Am. Midl. Nat. 92:492–495.

HURLBERT, S. H. 1969. The breeding migrations and interhabitat wandering of the vermilion-spotted newt *Notophthalmus viridescens* (Rafinesque). Ecol. Monogr. 39:465–488.

MARCHETTI, M. P., E. ESTEBAN, M. LIMM, AND R. KURTH. 2004. Evaluating aspects of larval light trap bias and specificity in the northern Sacramento River system: do size and color matter? Am. Fish. Soc. Symp. 39:269–279.

MASSEY, A. 1990. Notes on the reproductive ecology of red-spotted newts (*Notophthalmus viridescens*). J. Herpetol. 24:106–107.

POLLOCK, K. H. 1982. A capture-recapture design robust to unequal probabilities of capture. J. Wildlife Manage. 46:752–757.

RICHTER, K. O. 1995. A simple aquatic funnel trap and its application to wetland amphibian monitoring. Herpetol. Rev. 26:90–91.

SMITH, G. R., AND J. E. RETTIG. 1996. Effectiveness of aquatic funnel traps for sampling amphibian larvae. Herpetol. Rev. 27:190–191.