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Within-pond Oviposition Site Selection in the Wood Frog (*Rana sylvatica*)

Abstract.

We examined the distribution of egg masses of Wood Frogs (*Rana sylvatica*) within a single pond on the Denison University Biological Reserve, Licking County, Ohio, USA. Water depth was the only factor that significantly differed between sites with Wood Frog egg masses and random sites without Wood Frog egg masses. There was a trend towards sites with Wood Frog egg masses having more vegetation (both submerged and emergent) than random sites.

For oviparous organisms, the selection of an oviposition site can have several consequences for the offspring (Resetarits, 1996). Several studies have shown that female amphibians can actively select the type of aquatic environment in which they deposit their eggs, thus helping to determine the larval environment of her offspring. In many cases, the presence of predators or competitors is the apparent proximate cue for oviposition site choice (e.g., Marsh and Borrell, 2001; Binckley and Resetarits, 2002; Murphy, 2003), although other factors, such as incident solar radiation and parasite risk, can also contribute (e.g., Kiesecker and Skelly, 2000; Halverson et al., 2003; Murphy, 2003).

Between-pond oviposition site selection has received more attention than within-pond oviposition site selection. However, selection of a specific oviposition site within a pond or body of water can also have important effects on offspring success or performance (e.g., Smith and Rettig, 1998; Kam et al., 1998; Rieger et al., 2004; Stevens et al., 2006).

We examined the distribution of egg masses of Wood Frogs (*Rana sylvatica*) within a single pond (Spring Peeper Pond) on the Denison University Biological Reserve (DUBR), Licking County, Ohio, USA to examine how pond characteristics might influence where egg masses are laid. In a previous study of two ponds in the DUBR (including Spring Peeper), Dougherty et al. (2005) found that Wood Frog eggs were laid nearer to shore, in shallower water, in warmer water, and at lower dissolved oxygen levels than would be expected if eggs were laid at random sites within the ponds. Here, we report on the influence of emergent and submerged vegetation cover, water depth, pH, and distance to shore on oviposition site selection by Wood Frogs, thus expanding our understanding of the characteristics affecting oviposition site selection within ponds by Wood Frogs. Such information could be used to assess the suitability of natural or artificial ponds for breeding by wood frogs, as well as suggest potential pond management strategies to facilitate wood frog breeding in ponds.

Materials and Methods.

During March and April of 2008, we surveyed Spring Peeper Pond for wood frog egg masses (see Schultz & Mick 1998, Smith et al. 2003a,b, Hargis et al. 2008 for details of the biology and ecology of this pond). The pond was divided into 6 m X 6 m sections. This grid was used to determine random sites for sampling. At each sampling site 7 variables were measured: distance from shore, water depth, water pH, emergent vegetation cover, submerged vegetation cover, and egg mass presence or absence. pH was measured with an Oakton Double Junction Waterproof pH Testr3+. Emergent and submerged vegetation cover was quantified at each sampling location by placing a 0.5 m X 0.5 m quadrat on the surface of the water, and recording the percent coverage of emergent and submerged vegetation. We used analyses of variance (ANOVAs) to compare characteristics of locations containing egg masses and locations containing no egg masses.

Results.

Wood Frog egg masses were found in deeper water than was found at sites without egg masses (Table 1; $F_{1,55} = 62.6$, $P < 0.0001$). Egg masses also tended to be slightly farther from shore than the no egg sites, but this difference only approached statistical significance (Table 1; $F_{1,55} = 3.41$, $P = 0.07$). Emergent vegetation coverage did not differ significantly between sites with eggs and sites without eggs, although there was a slight trend for more vegetative cover at sites with eggs (Table 1; $F_{1,55} = 2.23$, $P = 0.15$). Sites with eggs and sites with no eggs had similar amounts of submerged vegetation, but as with emergent vegetation, there was a trend for sites with egg to have more vegetation (Table 1; $F_{1,55} = 2.08$, $P = 0.15$). Sites with and without egg masses did not differ in pH (Table 1; $F_{1,55} = 0.017$, $P = 0.90$).

Table 1.—Characteristics of sites within Spring Peeper Pond that had wood frog (*Rana sylvatica*) egg masses and random sites that did not have egg masses. Means are given ± 1 SE.

	No egg masses (N = 21)	Egg masses (N = 36)
Water depth (cm)	12.7 \pm 2.1	33.7 \pm 1.6
Distance to shore (m)	4.2 \pm 0.5	5.3 \pm 0.4
% Emergent vegetation cover	8.5 \pm 2.2	12.6 \pm 1.7
% Submerged vegetation cover	18.9 \pm 2.5	23.4 \pm 1.9
pH	7.89 \pm 0.04	7.88 \pm 0.03

Discussion.

Of the factors we measured, water depth was the only factor that significantly differed between sites with Wood Frog egg masses and random sites without Wood Frog egg masses. Our current result contrasts with Dougherty et al.'s (2005) finding that Wood Frog egg masses were found in shallower sites in 2004 than would be expected by chance. Indeed, the main aggregation of Wood Frog egg masses in 2004 was laid in the same general corner of the pond as in 2008, but was much closer to the shore (< 2-3 m) whereas in 2008 the main egg mass aggregation was much further from the shore (7 – 10 m) (G.R. Smith, pers. observ.). It thus appears the choice of oviposition site within ponds can vary from year-to-year (see also Seale, 1982). Other studies have found water depth to be important for within pond oviposition site selection in Wood Frogs, however, the actual preferred depth seems to differ among studies (e.g., intermediate depths used, Seale 1982; shallower water than the maximum available used, Egan and Paton, 2004).

There was also a trend towards sites with Wood Frog egg masses having more vegetation (both submerged and emergent) than random sites. Previous studies have noted the importance of vegetation in oviposition site choice in Wood Frogs. Skidde et al. (2007) found that Wood Frogs laid more egg masses in ponds with more non-woody plant cover, as did Egan and Paton (2004). Haynes and Aird (1981) and Seale (1982) found that wood frog egg masses were frequently associated with vegetation.

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