Oikos

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Urban, M. C. 2008. Salamander evolution across a latitudinal cline in gape-limited predation risk. – Oikos117: 1037–1049.

Appendix 1. Potential gape-limited and unconstrained predators of *A. maculatum* larvae found in 40 temporary ponds in southern New England, USA.

Potential predators of *A. maculatum* determined based on a taxon's trophic level and published knowledge about their preference for amphibian prey (Merritt and Cummins 1996, Schneider 1997, Wilbur 1997, Brunkhurst 2004, Urban 2004). In addition, predators were separated into gape-limited and gape-unconstrained categories based on prior literature (Wilbur and Fauth 1990, Wissinger 1992, Wilbur 1997). Only gape-limited predators with gape size over 2 mm, the minimum body width of prey, were included. Although *Ptilostomis postica* and *Acilius* larvae sometimes prey upon *A. maculatum* hatchlings (Brunkhurst 2004), they were excluded based on personal observations suggesting that these predators rarely prey on *A. maculatum* and that *Acilius* larvae more frequently become the prey, rather than predator, of *A. maculatum*.

Gape-limited predators	Proportion of total predator abundance	Median gape size and (range) in mm
Fish		
Rhinichthys atratulus	0.1	2.52 (2.30 – 2.74)
Caudata		
Ambystoma opacum	7.4	8.07 (6.25 – 9.62)
Notophthalmus viridescens (A)	2.2	6.21 (4.93 – 7.47)
Anura		
Rana clamitans	2.7	2.61 (2.01 – 3.98)
Rana catesbiana	< 0.1	3.47 (3.45 – 3.48)
Odonata		
Sympetrum	41.1	2.67 (2.03 – 3.58)
Pachydiplax	3.8	3.09 (2.38 – 4.85)
Leucorrhinia	1.7	2.98 (2.17 – 4.99)
Libellula	0.5	3.89 (2.43 – 4.98)
Perithemis	< 0.1	4.08 (—)
Gape-unconstrained predators		
Odonata		
Aeshna	8.0	
Coleoptera larvae (L) and adults (A)		
Dytiscus L	20.3	
Hydaticus A	0.6	
Agabus L	0.3	
Tropisternus L	0.2	
Hydrochara L	0.2	
Dytiscus A	< 0.1	
Gyridinae L	< 0.1	
Agabetes A	< 0.1	
Agabus A	< 0.1	
Coptotomus L	< 0.1	
Cybister A	< 0.1	
Hemiptera		
Notanecta	3.0	
Lethocerus	1.7	
Hydrometra	0.3	
Hirudinea		
Mooreobdella	1.1	
Erpobdellida	0.4	
Nehelopsis	< 0.1	
Megaloptera		
Chauliodes	3.0	
Sialis	< 0.1	

Appendix 2. Predator diets and size refuge thresholds

Ambystoma opacum

I conducted diet analyses on a sample (n = 50) of *Ambystoma opacum* larvae collected from 13 ponds from March until June 2004 at both the southern and intermediate sites. The maximum size of prey items increased with *A. opacum* gape width (Fig. A2.1; slope: 0.533; $F_{1,48}$ = 23.28, p < 0.001). I also found evidence that the ratio of maximum prey size and gape width increased with time (slope: 0.003; $F_{1,48}$ = 26.61; p < 0.001). Therefore I estimated the mean ratio only over the time period in which *A. maculatum* hatchlings co-occurred with *A. opacum*. For this time span, the ratio remained approximately constant ($F_{1,30}$ = 0.17, p = 0.679) at 0.37 ± 0.13 (SD).

Notophthalmus viridescens

Diet analyses were also performed on *Notophthalmus viridescens* adults (n = 48) sampled from 15 ponds from May until August 2004 and March until May 2005 at all three sites. The maximum size of prey items found in dissected stomachs did not increase significantly with newt gape width (Fig. A2.1; $F_{1,44}$ = 0.49, p = 0.487). The ratio of maximum prey width to gape width did not change over time for newts ($F_{1,44}$ = 0.74, p = 0.393). The lack of change likely can be attributed to the minimal and non-significant growth of adult newts through the time period of *A. maculatum* development (0.004 mm day^{-1}, p = 0.201). I estimated the mean newt size threshold as the mean ratio of maximum prey size to gape width across all samples and times to be 0.37 ± 0.17 (SD).

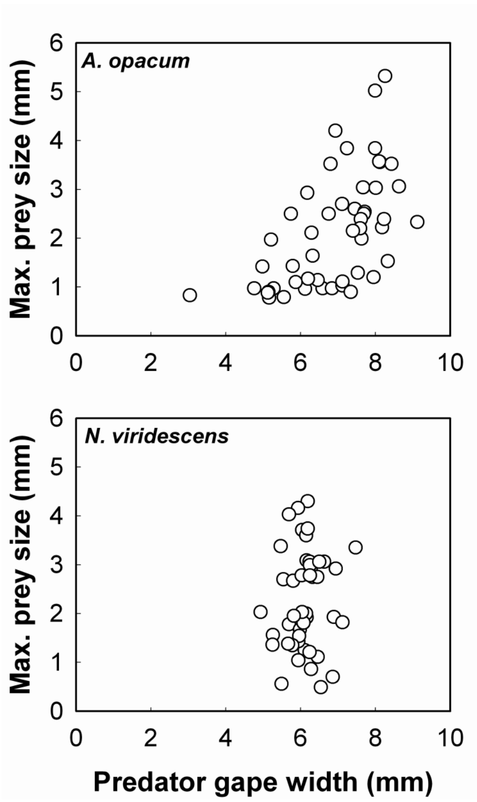

Fig. A2.1. Maximum prey size in diets of field-collected *A. opacum* larvae and *N. viridescens* adults in relation to gape width.

Appendix 3. Selection under free-ranging *A. opacum* by site and treatment.

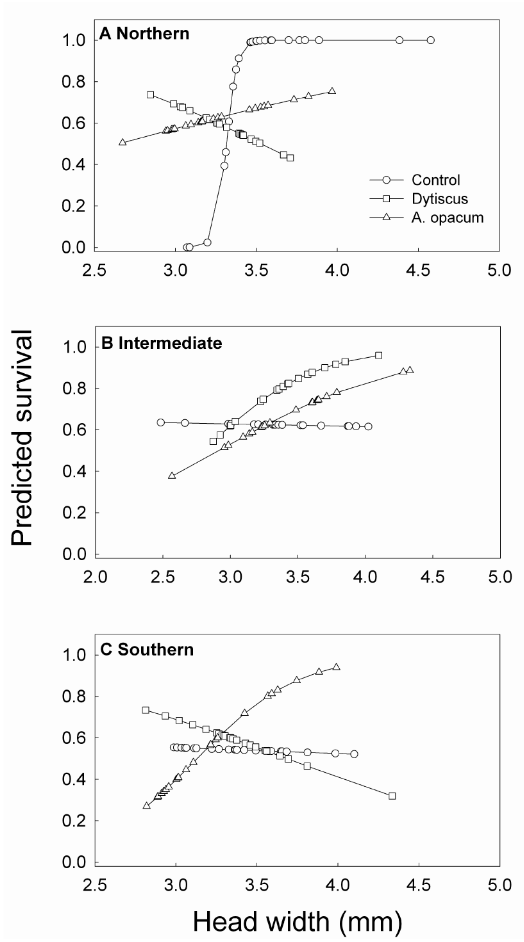

Fig. 3.1. The predicted survival probabilities of *A. maculatum* larvae under predation threat by *A. opacum* dependent on prey head width. Subpanels organized from top to bottom by site. In each panel, predicted logistic relationships are plotted based on whether larvae developed under control conditions (○), or exposed to *Dytiscus* (□) or *A. opacum* (Δ) kairomones.

Appendix 4. Variation in alternative selection regimes among sites

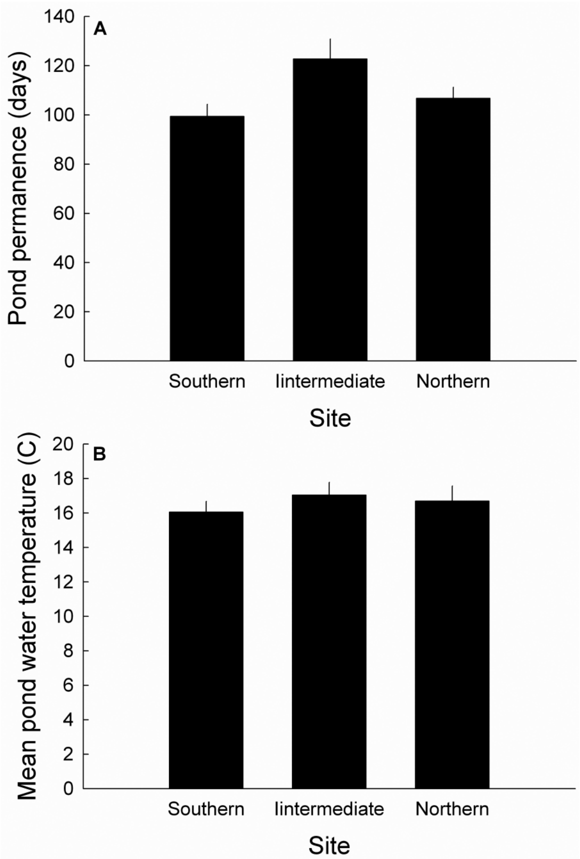

Fig. 4.1. Variation in among-site (A) pond permanence and (B) pond water temperatures that could provide alternative explanations for the observed clinal variation in larval *A. maculatum* masses.

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