

## **Quantifying and improving restoration success: ecological metrics of constructed vernal pools**

Final report to Edna Bailey Sussman Foundation  
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### **Background**

Vernal pools are a unique wetland type that undergo an annual cycle of flooding and drying. Increasing scientific and regulatory interest in these unusual wetlands has accompanied a growing awareness of their importance in supporting biological diversity, including many New York listed amphibian species. Wetland losses resulting from inadequate legal protection and the contemporary ecological crisis of global amphibian population declines have compounded this interest, and focused attention on the need to improve habitat conservation approaches. Construction of new pools has been proposed to offset historic losses and to augment critical habitat for vernal pool-dependent species.

My graduate research involves evaluating outcomes resulting in pools constructed according to various design criteria such as basin dimensions and placement in the landscape. In 2010, a network of 71 pools was constructed on a SUNY ESF research property by the Upper Susquehanna Coalition (USC), a regional leader in wetland conservation and construction efforts. This research represents an unparalleled opportunity to assess the state of the art of vernal pool construction, but the relevance of the results are limited in that they are confined to the earliest stages of ecosystem development. While this experimental design is intentionally standardized with regard to this temporal dimension, evidence suggests that newly created wetlands undergo a period of naturalization during which ecological conditions, including the value as habitat, can change drastically. For this reason, I sought the support of a Sussman Foundation internship to expand sampling to include additional pools constructed by USC on public and private lands during the past decade. This expansion provides crucial temporal context for the results obtained in newly constructed pools.

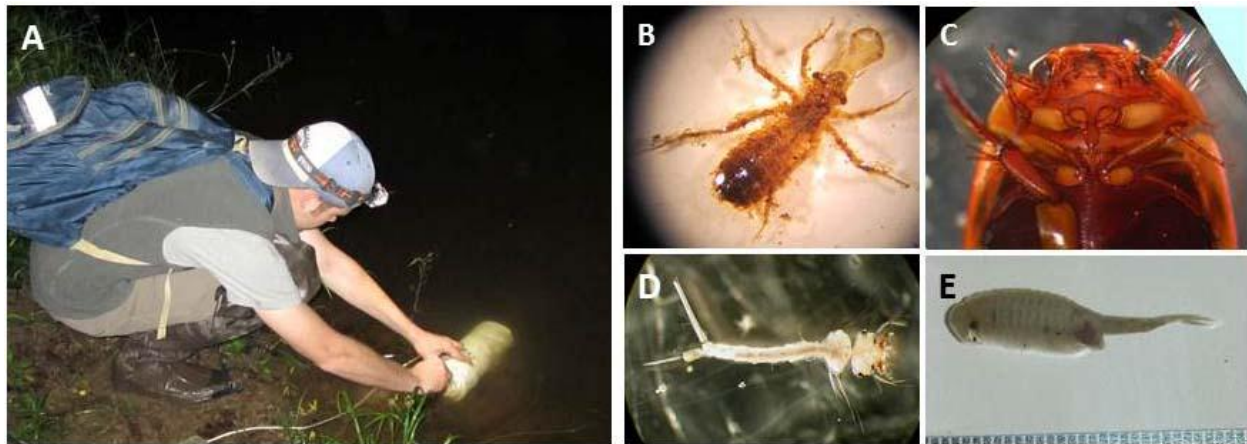
Specifically, I compare the ecological value of pools with two metrics that emphasize the importance of these wetlands in supporting biodiversity: 1) amphibian biomass production by species and 2) aquatic macroinvertebrate taxonomic richness. I will apply results toward making specific design recommendations for objective-driven pool construction, which will be of benefit to USC in improving their wetland restoration activities.

### **2011 Accomplishments**

Working with USC staff, I identified suitable study pools using USC records and field visits. Nine pools (Fig. 1) were sampled for aquatic macroinvertebrates (Fig. 2) and larval amphibians (Fig. 3) in May and June 2011. Given the constraints of sampling within the amphibian larval developmental period, the target number of thirty pools was not attainable; provision has been made to sample the balance in 2012. Sorting and identification of macroinvertebrates and data analysis are ongoing.



**Figure 1:** Locations of nine pools surveyed in 2011. Area is approximately 2 km northwest of Beaver Dams, NY. Image: New York GIS via GoogleEarth.



**Figure 3:** Deploying a nocturnal light trap in a constructed vernal pool to collect aquatic macroinvertebrates (A), such as (B) a larval dragonfly (*Corduliidae: Somatochlora* sp.), (C) adult predaceous diving beetle (*Dytiscidae: Agabetes acuductus*), (D) mosquito larva (*Culicidae: Culex territans*), and (E) fairy shrimp (*Chirocephalidae: Eubbranchipus vernalis*).



**Figure 2:** Demonstration of pipe sampling technique for surveying density of larval amphibians in a constructed vernal pool (A), a typical sample of larval wood frogs (*Lithobates sylvaticus*) and spotted salamanders (*Ambystoma maculatum*) (B), and processing (i.e., identifying and measuring length and mass) of larval amphibians (C).

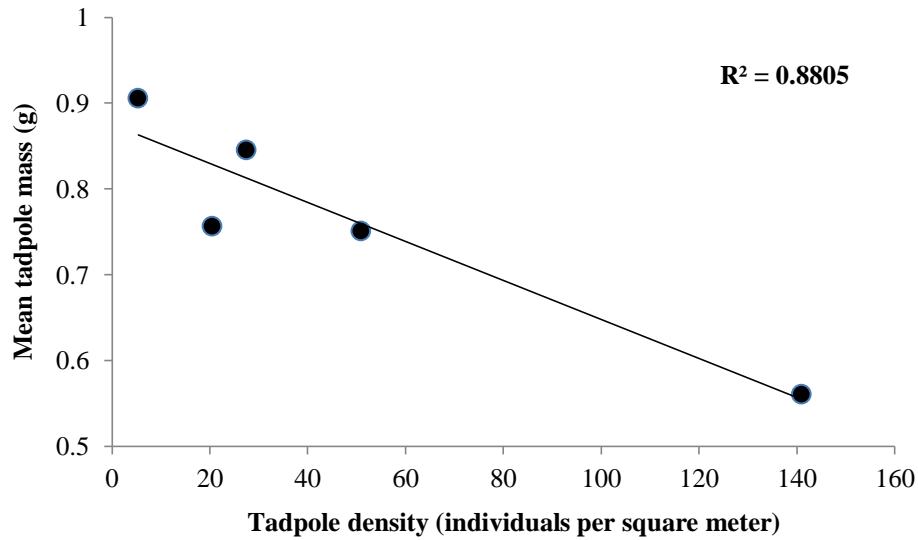
### Preliminary results

*Aquatic macroinvertebrate richness.* – Processing of aquatic macroinvertebrates, in particular the identification of individuals to species- or genus-level, will continue through the winter. At this point, family-level data are available (Fig. 4). Given that most families potentially contain several genera and species, an analysis of pool age and taxa richness is premature. In addition, results will be improved by comparison with the 71 pools constructed near SUNY-ESF in 2010.

Invertebrate families	Pool ID									
	141	145	146	173	174	178	180	501	502	
Aeshnidae										
Dytiscidae										
Haliplidae										
Ceratopogonidae										
Chaoboridae										
Chironomidae										
Baetidae										
Corixidae										
Glossiphoniidae										
Corydalidae										
Lestidae										
Total # families	3	5	5	5	6	6	5	4	8	

**Figure 4:** Presence (filled)-absence (blank) matrix and family richness totals for aquatic macroinvertebrates detected in vernal pools near Beaver Ponds, NY in 2011.

*Larval amphibian sampling.* – Wood frog (*Lithobates sylvaticus*) and spotted salamander (*Ambystoma maculatum*) larvae were detected in six and two pools, respectively. Estimates of density, mean individual mass, and developmental stage have been calculated, and will be evaluated within the context of the 71 pools constructed near SUNY-ESF in 2010. A cursory view of data indicates a clear relationship between tadpole density and mean individual mass (Fig. 5), suggesting definable limits to aquatic carrying capacity and biomass production (the ultimate variable of interest).



**Figure 5:** Scatter plot and simple linear regression trendline demonstrating the relation between wood frog tadpole density and mean body mass from five vernal pools near Beaver Dams, NY.

### **Acknowledgments**

I am grateful to the Edna Bailey Sussman Foundation for providing the opportunity to include additional study sites during the 2011 field season, greatly enhancing the spatial and temporal perspective of my dissertation research. My internship supervisor, James Curatolo and his staff at the Upper Susquehanna Coalition, especially Melissa Yearick, provided essential logistical support. James Curatolo provided access to pools on his property and camping accommodations. Tess Youker helped with sampling and staging amphibian larvae. Finally, my advisor, James P. Gibbs, consistently provided advice and encouragement.