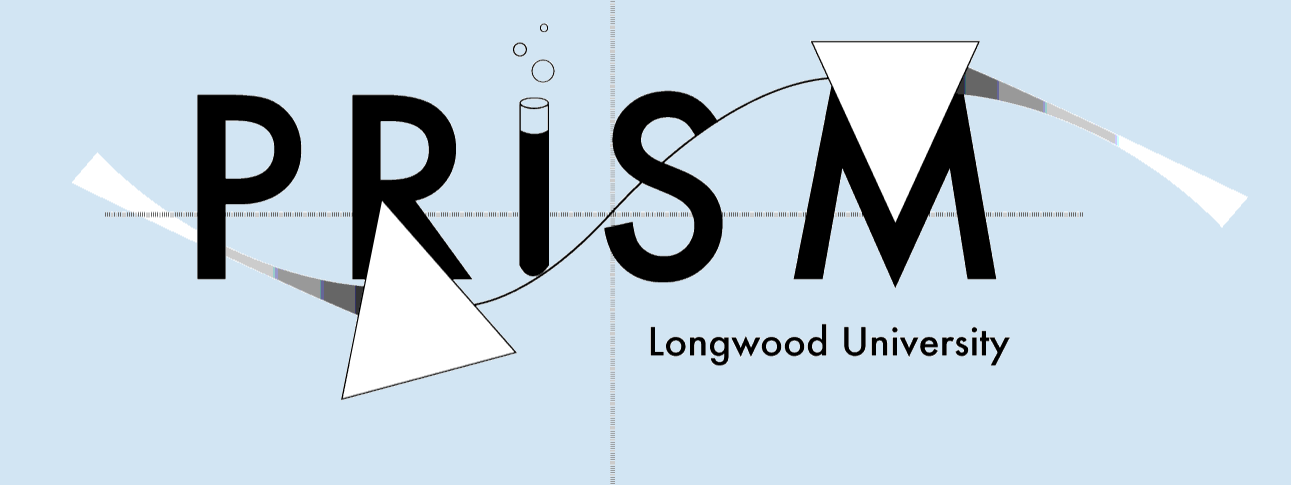




The Effects of Physico-chemical Parameters on the Vernal Pool Communities at High Bridge Trail State Park, Virginia



William Kish & Sujan Henkanaththegedara, Ph.D.

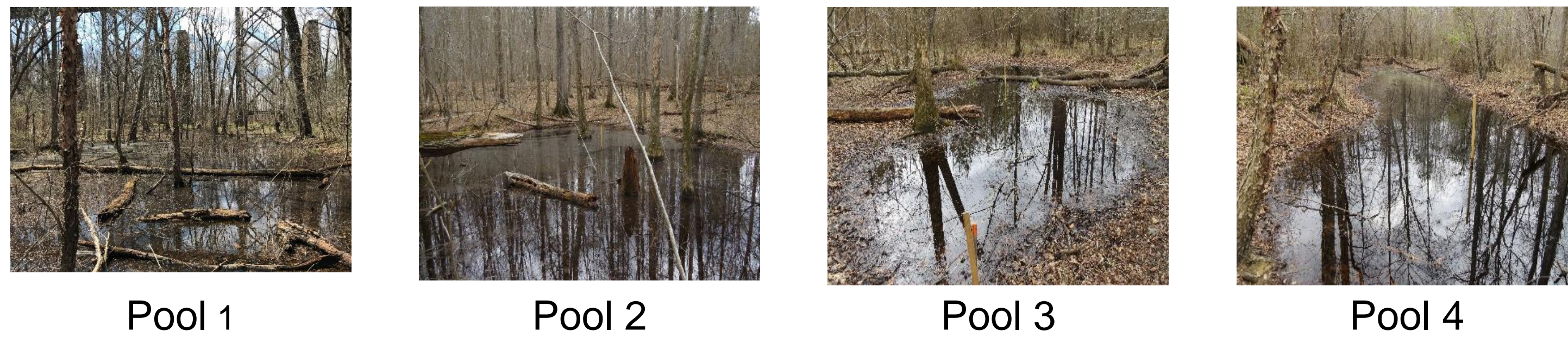
Department of Biological & Environmental Sciences, Longwood University, Farmville, Virginia

ABSTRACT

Vernal pools are temporary wetlands that fill with rain and snowmelt annually. Since they do not hold water yearly, they do not usually have fish population, allowing them to house unique amphibian and invertebrate communities. Due to their small size, temporary inundation, and lack of fish, it makes vernal pools less likely to receive conservation attention. Vernal pools in Piedmont of Virginia are poorly studied, thus the reason for current study. We surveyed four vernal pools at High Bridge Trail State Park from mid-February to mid-June, 2018 to generate baseline information on the effects of physico-chemical parameters on biotic communities. Throughout the sampling period, water temperature, total dissolved solids and pool depth have increased while the dissolved oxygen content has decreased. When correlating the taxa richness, taxa abundance, overall diversity, and dominance to the physico-chemical parameters, only pH, pool depth, and pool width were found to have significant effects. Overall, the physical parameters (i.e. pool depth and width) had more impacts on the biotic communities than the chemical parameters (i.e. pH). In the light of new information, more sound conservation measures can be implemented to protect these "endangered" ecosystems.

INTRODUCTION

- Vernal pools are seasonal wetlands that annually fill with rain and snowmelt in the winter and often completely dry up by the end of summer (Calhoun et al. 2003).
- Since vernal pools dry annually, they do not support fish populations; hence support unique invertebrate and amphibian communities (Burne and Griffin, 2005).
- Physico-chemical properties of vernal pools may vary depending on the season and individual pools, and may affect biotic communities in these pools (Hamilton et al. 2015).
- Vernal pools in the piedmont region of Virginia are poorly studied (e.g. Ganguly and Smock, 2010).
- We surveyed vernal pools in **High Bridge Trail State Park (HBTSP)** to assess the impact of the physico-chemical parameters on biological communities.



METHODS

Field Sampling

- We sampled biotic and physico-chemical properties of four pools at HBTSP from Feb 19 to June 11th, 2018.
- Dip nets were used along a line transect across the pool to collect specimens, which were sorted, counted, identified and released back into the pool.
- Specimens were identified using a field guide provided by Kenny and Burnes (2001).
- Weather and physico-chemical parameters (water temperature, dissolved oxygen, total dissolved solids, pH, pool depth, and pool width) were also measured during each sampling session.

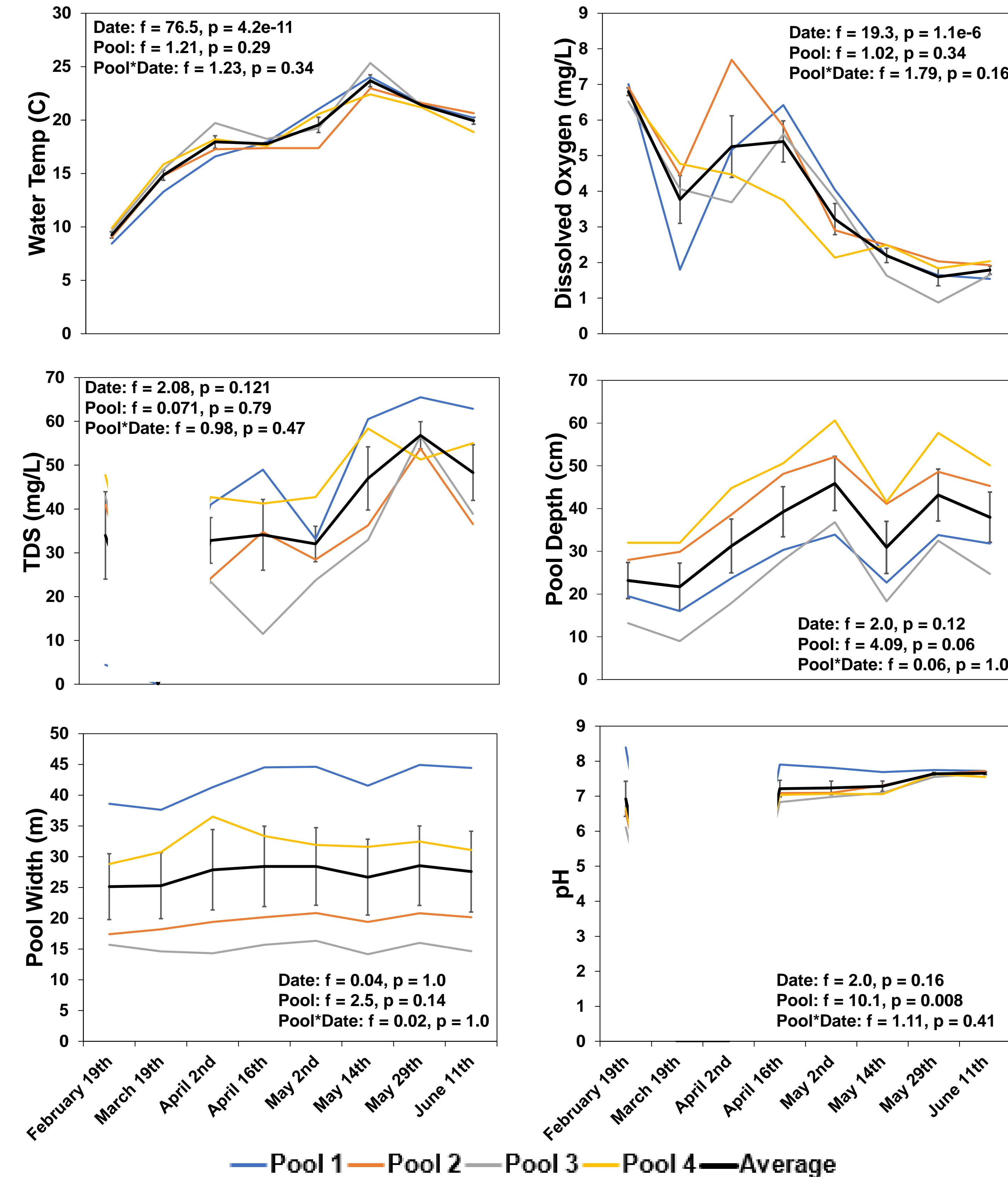


Data Analysis

- Mean differences of physico-chemical parameters within and among pools were analyzed using Two-way ANOVAs considering the physico-chemical parameter as the response variable and the sampling date and the pool as the predictor variable.
- Correlations between species diversity and physico-chemical parameters were analyzed using simple linear regressions. Taxa richness, taxa abundance, Shannon-Wiener diversity, and Simpson's dominance were considered as response variables and the physico-chemical parameters as predictor variables.

RESULTS

Variations of Physico-chemical Parameters

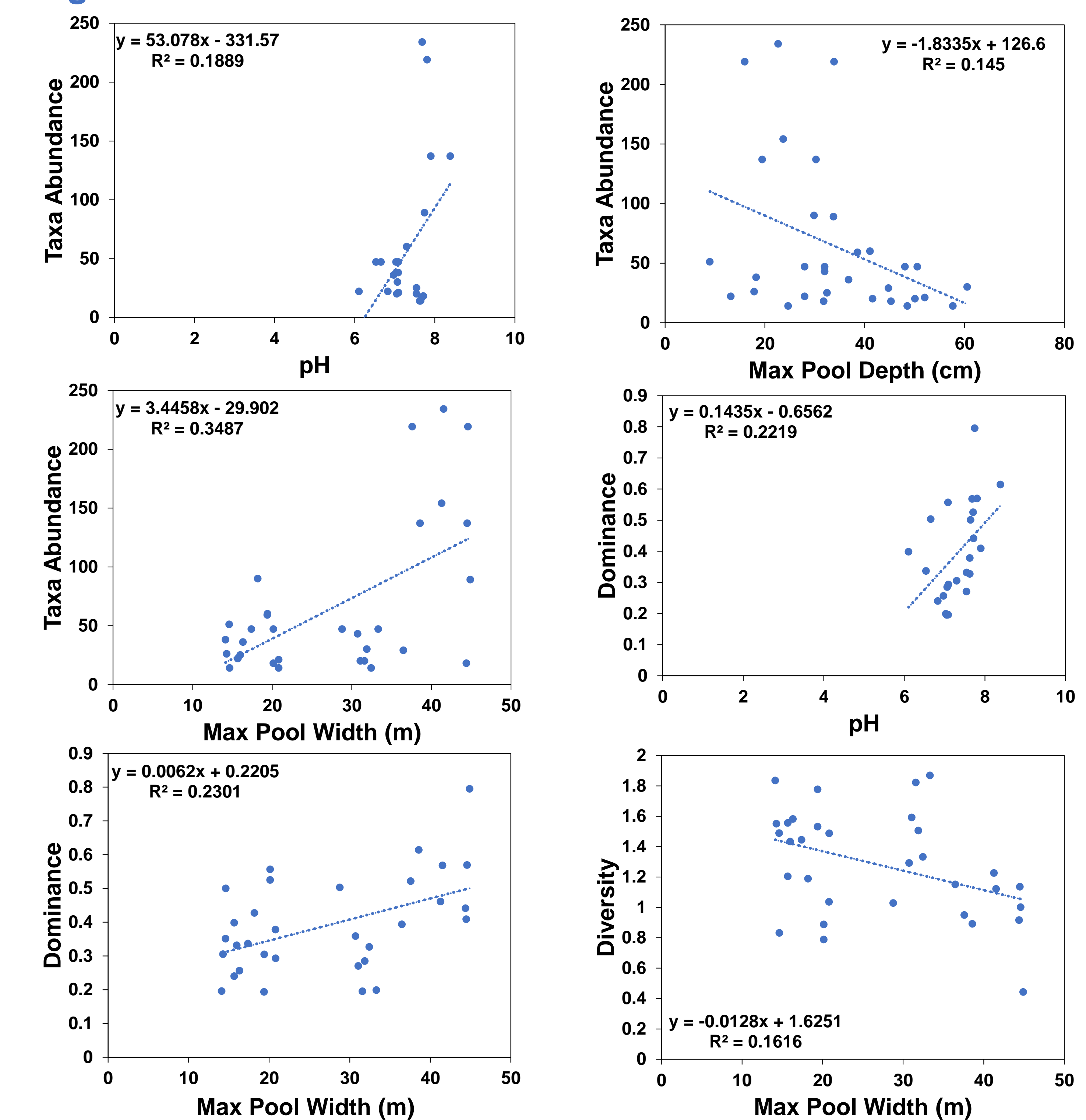


Summary Statistics for Correlations between Diversity Parameters and Physico-chemical Variables

	P value	F value	Adjusted R ²
Number of Taxa			
Water Temp	0.790	0.072	-0.0309
DO	0.331	0.977	-0.0007
pH	0.551	0.367	-0.0283
TDS	0.748	0.106	-0.0343
Depth	0.079	3.340	0.0700
Width	0.240	1.440	0.0139
Abundance			
Water Temp	0.633	0.232	-0.0254
DO	0.523	0.417	-0.0192
*pH	0.034	5.120	0.1520
TDS	0.964	0.002	-0.0384
*Depth	0.032	5.090	0.1170
Width	0.0004	16.100	0.3270
Dominance			
Water Temp	0.343	0.929	-0.0023
DO	0.976	0.001	-0.0333
*pH	0.020	6.280	0.1870
TDS	0.327	1.000	-0.0000
Depth	0.180	1.880	0.0277
*Width	0.005	8.960	0.2040
Diversity (H')			
Water Temp	0.396	0.743	-0.0084
DO	0.749	0.104	-0.0298
*pH	0.022	6.080	0.1810
TDS	0.248	1.400	0.0145
Depth	0.454	0.576	-0.0139
*Width	0.023	5.780	0.1360

RESULTS

Significant Biotic and Abiotic Correlations



CONCLUSIONS & DISCUSSION

- Overall, the physico-chemical parameters varied within and among pools.
- Water temperature, total dissolved solids, and pool depth all increased as the season progressed while dissolved oxygen content decreased with the season.
- The pH and pool width had significant positive correlations with taxa richness, while pool depth had a significant negative correlation with taxa abundance.
- The pH and pool width had a significant positive correlation with the Simpson's dominance, and pool width had a significant negative correlation with diversity.
- Overall, the physical parameters (i.e. pool width and depth) had more of an impact on the taxa abundance, dominance, and diversity than the chemical parameters.
- Our study provides the first set of extensive information about the impacts of physico-chemical parameters on vernal pool communities at HBTSP.
- This information may be critical in implementing future conservation management activities for this fragile ecosystem.

Acknowledgments

We would like to thank Ben Campbell, Al Lookofsky, Betsy Lookofsky, Steve Barber, Warren Rofe, and Eric Lewis for their assistance in the field; Craig Guthrie and Daniel Jordan at HBTSP for permission and logistical support, and Longwood PRISM program for research funding. This study was conducted under VDGIF Scientific Collecting Permit # 059601.

References Cited

- Burne, M.R. and C.R. Griffin. 2005. Protecting vernal pools: a model from Massachusetts, USA., *Wetlands Ecology and Management* 13: 367-375.
- Calhoun, A.J., T.E. Walls, S.S. Stockwell and M. McCollough. 2003. Evaluating vernal pools as a basis for conservation strategies: a Maine case study. *Wetlands*, 23: 70-81.
- Ganguly, S.S. and L.A. Smock. 2010. Spatial and temporal variability of invertebrate communities in vernal pools on the coastal plain of Virginia. *Journal of Freshwater Ecology*, 25: 413-420.
- Hamilton IV, R., P.S. Kountev, C. Post, J. Dillard, K.J. Knepper and R. Cowart. 2012. Physicochemical characteristics and benthic macroinvertebrate communities in temporary surface waters of Northern Stark County, Ohio. *The Open Entomology Journal*, 6: 1-12.
- Kenney, L.P. and Burne, M.R., 2009. *A field guide to the animals of vernal pools*. Massachusetts Division of Fisheries & Wildlife, Natural Heritage & Endangered Species Program & Vernal Pool Association. 77 pp.