SHIFTS IN THE AMPHIBIAN COMMUNITY OVER 30 YEARS AT AN ISOLATED WETLAND: HAS CLIMATE CHANGE ALTERED WETLAND HYDROLOGY?

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REFERENCE: *Proceedings of the 2011 Georgia Water Resources Conference*, held April 11–13, 2011, at the University of Georgia.

Abstract. Geographically isolated wetlands (GIW) constitute critically important habitat for many plant and animal species, including threatened, endangered and at-risk species. Most GIW on the southeastern Upper Coastal Plain are seasonal; i.e., not continually filled with water. Numerous pond-breeding amphibians rely on GIW for larval development and recruitment of juveniles to the population. Seasonal wetlands are particularly important to amphibians due to their complex life cycle and general need for fish-free aquatic habitat coupled with adjacent forests. Approximately 25% of the 127 salamander species in the U.S. are obligate or facultative GIW species, as are 70% of the 100+ anuran species. More than half of the anuran species in the U.S. use only GIW for breeding habitat. The secondary productivity of amphibians in GIW can be extremely high (e.g., >360,000 juveniles, >1400 kg wet biomass produced during a single breeding season).

Recruitment success for these frog, toad, and salamander species is determined largely by wetland hydroperiod (the amount of time a GIW holds water). Variation in hydroperiod results from differences in wetland size and geomorphology, timing and amount of rainfall, extent of connection to groundwater, vegetation, soils, and temperature. Wetland hydroperiod is the primary determinant of which amphibian species inhabit a particular wetland, both directly (via the amount of time water is available for larval development) and indirectly (via effects on predatory and competitive interactions). Most pond-breeding amphibian species have adaptations to subsets of conditions along the hydroperiod continuum; i.e., there are 'short-,' 'intermediate-,' and 'long-hydroperiod' species.

Climate change has the potential to exacerbate the increasingly serious problem of amphibian decline by inducing shifts in average hydroperiod, as well as "normal" pond filling and drying dates. For example, general circulation models for future climate in the Southeast predict rainfall amounts may shift from -10% to +20% from current levels, with changes in rainfall intensity and extremes also likely. Changes in precipitation and temperature regimes will likely lead to altered wetland hydroperiods at the landscape level.

GIW on the Department of Energy's (DOE) Savannah River Site (SRS) in South Carolina have been the subject of research for decades, particularly with regard to their amphibian and reptile communities, plant communities, and hydrologic variation. Forty-three species of amphibians occur on the SRS, a rich diversity in the most biodiverse region of the U.S. for amphibians; 27 of these species utilize GIW habitats. Although GIW make up only about 5% of the area of wetland and aquatic habitats on the SRS (and ~23% statewide), they are essential for the maintenance of local biodiversity. Rainbow Bay, a 1-ha seasonal wetland, has been sampled daily for herpetofauna for 32 years and is recognized by Guinness World Records™ as the longest running continuous study of an amphibian community in the world. Collectively, the long-term SRS studies provide some of the best data in existence relating variation in environmental variables (e.g., wetland hydroperiod) to population trends in amphibian communities.

We examined the dynamics of an amphibian community over 30 years in relation to changes in environmental variables and average wetland hydroperiod. Since 1978 the average hydroperiod has decreased ($F_{1,28}$ = 6.69, P = 0.01) and the average date of pond filling is later ($F_{1,28}$ = 8.34, P = 0.007). During that time we observed a shift in community dominance from several longer hydroperiod species (e.g., *Ambystoma talpoideum*, *A. tigrinum*, *Notophthalmus viridescens*) to a few shorter hydroperiod species (e.g., *A. opacum*). Species changes appeared to be primarily related to drought cycles and accompanying shortened hydroperiods, which differentially affected species' juvenile recruitment. Because water levels in GIW depend mainly on precipitation and evapotranspiration, changes in climate will produce changes in hydrologic regimes. Changes in hydroperiod dynamics of GIW across the landscape are likely to influence local (individual wetland) population persistence, as well as metapopulation dynamics by altering exchange rates of amphibians among wetlands.