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Introduction to the Symposium on the Natural History of the Big Levels Area: Shenandoah Valley Sinkhole Ponds and St. Marys River

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Combined results of multidisciplinary studies of a single geographic area often reveal patterns and interactions that cannot be discovered by single focus studies. The Great Dismal Swamp, for example, has been the subject of symposia held in 1911, 1974, and 1997. Proceedings of the last two symposia were published in book form (Kirk, 1979; Rose, 1999). The various chapters in these books solidified management and scientific interest in the Swamp and demonstrated the uniqueness of the area. The Big Levels area of southeastern Augusta County, Virginia, contains several types of aquatic and terrestrial habitats that have received variable amounts of attention over the past 70 years. Until now, academic researchers and resource managers have focused largely on their own discipline, in some cases accumulating considerable information on their target species, species group, or physical system. No one has reviewed all the available published and unpublished information, and indeed some of that information has not been assembled into documents or other sources accessible to others interested in the area. In the mid-1990s, we became aware that a large body of information had been accumulated from studies conducted in various parts of the Big Levels area. Our interest in determining what work had been conducted in this area developed into the establishment of the first symposium on this region of Virginia. The results of this symposium contained in the papers published in this issue of *Banisteria* demonstrate collectively that the Big Levels area is one of the most unique natural areas in the state.

The symposium held on 16 October 1998 consisted of 16 papers on a wide variety of topics ranging from wildlife management to geology to flora and fauna. Of these, 13 were submitted as papers for this issue of *Banisteria*. One paper on the geology of the alluvial fans near Stuarts Draft was already in press (Whittecar & Duffy. in press; also see Whittecar et al., 1999 abstract) and was replaced with the paper on the hydrology and geomorphology of Green Pond (Whittecar & Lawrence, 1999). We invited Scott Klopfer to submit his analysis of the climate of the Big Levels area after discovering that he had an existing data set and could derive a paper from his Master's thesis to provide yet another dimension to our coverage of the area. The resulting set of papers provides a thorough review of the body of knowledge that now exists for this region of Virginia. In addition, the information in these papers all point to the fact that the Big Levels area has been more intensively studied than previously recognized by the scientific and resource management communities.

The papers for this symposium proceedings were designed to stand alone as separate published contributions in a peer-reviewed journal. That way, authors could provide information that supported their

perspective and not have to cite the symposium introduction or other papers extensively. All papers were reviewed by at least one, usually two, reviewers and the primary editor for this issue (JCM).

The Big Levels area is a approximately12,950 ha region of the Blue Ridge Physiographic Province contained within the George Washington National Forest's Pedlar Ranger District. The St. Marys Wilderness Area lies within Big Levels, as does a high elevation natural, freshwater pond (Green Pond), and a series of natural sinkhole ponds (Fig. 1). Big Levels is a series of flat-topped mountains (Cellar Mt., Kelly Mt., Kennedy Ridge) that reach an elevation of about 990 m. The name "Big Levels" comes from the flattened mountainous topography. Major drainages include the St. Marys River in the southwestern portion and numerous streams that drain the upper elevations of Big Levels largely to the north. Alluvial deposits from ancient weathering processes created fans of Antietam quartzite cobbles in a sand, silt, and clay matrix overlying carbonate limestone some 50-150 m below the surface. Collapse of limestone in some places on these terraces helped create natural surface depressions that fill with water and exist as vernal pools. The Coal Road is an all-season access road, unless washed out by winter rains and snow melt, that skirts the upper region of the area. Recreational opportunities were enhanced in this region with the construction of Sherando Lake during the Civilian Conservation Corps era in 1935-1936.

The long-term history of Big Levels is one of geological change. The St. Marys River apparently flowed northward into the present day Shenandoah River over 140,000 years ago before being captured by the South River that flows into the James River, as documented by Bank et al. (1999). Erosion of the mountains along Big Levels in the Pleistocene and Miocene periods created the alluvial fans that are now dotted with sinkhole ponds (Whittecar et al., 1999). The topography, orientation, and geographic position in Virginia contribute to the relatively cold climate characteristic of the Big Levels area (Klopfer, 1999).

The pre-history and modern history of Big Levels include Native American use of the area as a hunting ground (Tolley & Barber, 1999) and intensive development using game management techniques in the 1930s through the 1980s (Swartz & Kocka, 1999). Human occupation of the area dates back about 12,000 years. Modern use of the area includes the development of early game management and conservation programs. Currently, the area is used extensively by local citizens and recreationists, and is managed in a multiple use context by the U.S. Forest Service.

The Shenandoah Valley sinkhole pond system occurs in a series of three clusters of ponds largely on U.S. Forest Service land. This pond system was once much more extensive in the Shenandoah Valley but many ponds have been lost due to agricultural practices and urbanization. One large pond noted by Carr (1940) that contained rare plants at that time is now a public recreational swimming pool. Buhlmann et al. (1999) provide detailed descriptions and photographs of 36 of these sinkhole ponds and evaluate the conservation biology of this system. Downey et al. (1999) demonstrate that the acid precipitation in the region is also affecting the sinkhole ponds and may be a problem in the future.

The flora of the sinkhole ponds has been studied by botanists since the 1930s and Spring Pond is famous for its disjunct and rare flora. Fleming & Van Alstine (1999) provide detailed descriptions of the plants and analyze the floristic communities in the Big Levels area. Knox et al. (1999) evaluate the distribution and abundance of one rare, and now federally listed, plant, the endemic Virginia sneezeweed (*Helenicum virginicum*). The animal fauna has not been as well studied as the flora. Three contributions expand our knowledge of dragonflies and damselflies (Roble, 1999), amphibians and reptiles (Mitchell & Buhlmann, 1999), and small mammals (Reynolds et al., 1999). The rich odonate fauna contains several rare and disjunct taxa, and one species of amphibian, the state endangered tiger salamander (*Ambystoma tigrinum*) occurs in several of the ponds. The combined flora and fauna of the Shenandoah Valley sinkhole pond system is a unique mix of species found nowhere else in Virginia or the Appalachian region.

St. Marys River is now famous for its impoverished invertebrate and fish faunas. The watershed was degraded severely by mining in the 1800s and early 1900s, although the river still maintained an apparently pristine aquatic fauna. Acid precipitation has since become a severe problem for the aquatic life in the St. Marys River. Webb & Deviney (1999) describe the changes in water chemistry over an eight year period in this stream and demonstrate that the river has indeed acidified. Surber (1951) conducted the first scientific sampling in the river and documented the invertebrate fauna, trout distribution, and salamanders in the late 1930s. His data set serves as the baseline against which changes in the abundance of these animals have been assessed. The documented changes in the benthic invertebrate fauna (Kaufmann et al., 1999) and the fish fauna (Bugas et al., 1999) demonstrate how detrimental acid precipitation has been in the system. Kirk & Mitchell (1999), however, show that the streamside salamander fauna has not been as affected as the other two groups. They show that salamander distribution in the St. Marys may be more affected by the presence of brook trout (*Salvelinus fontinalis*).

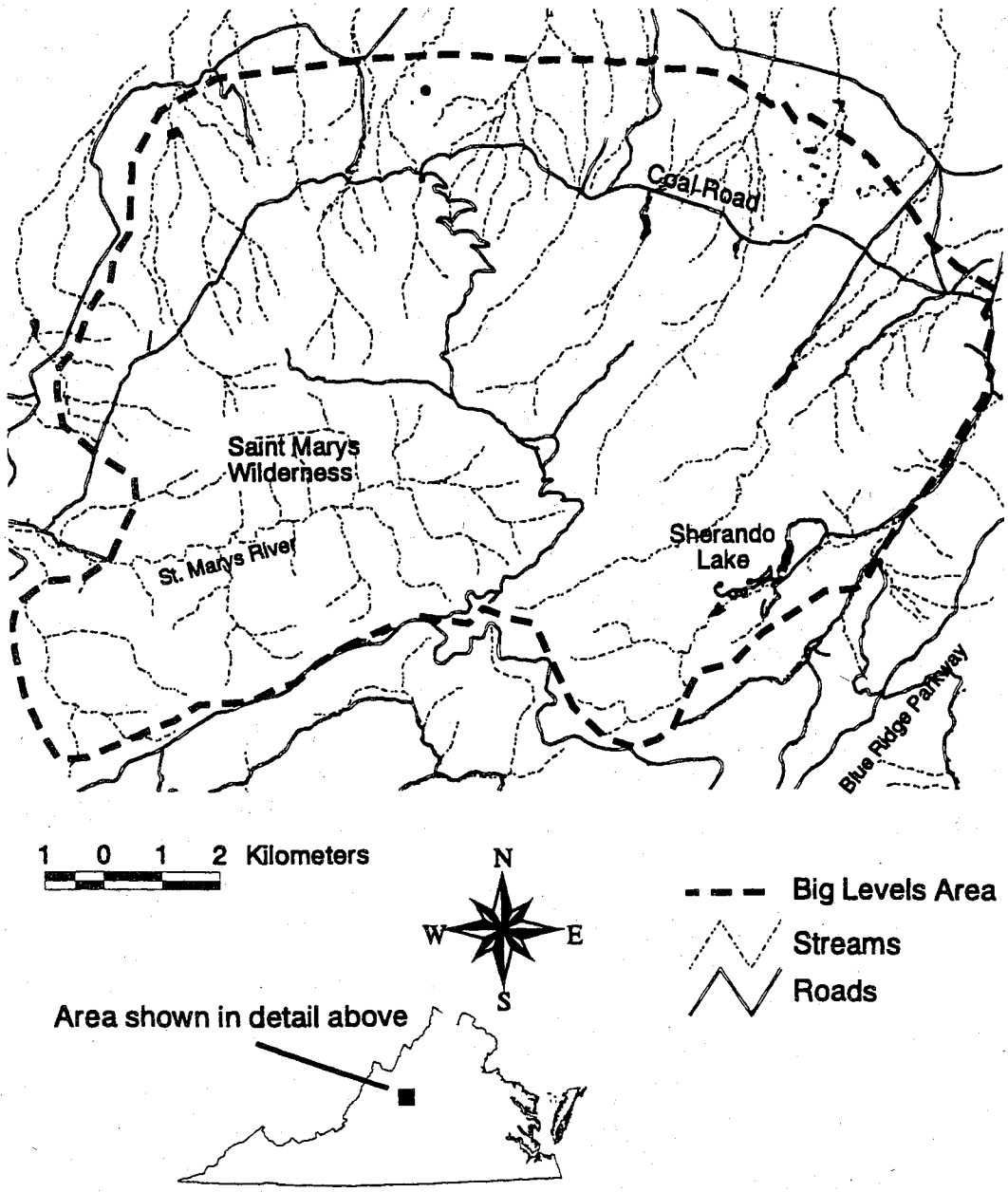

Fig. 1. Map of the Big Levels region in southeastern Augusta County, Virginia, showing the Shenandoah Valley sinkhole pond system, St. Marys River, and other prominent features.

Green Pond is an isolated, shallow pond located at an elevation of about 976 m on the top of Kennedy Ridge. Whittecar & Lawrence (1999) describe the hydrology and geomorphology of this spring-fed pond and demonstrate that water level fluctuations have been extensive over the past two decades, including several periods of complete pond drying.

Resource managers and others interested in the natural resources of this area should read all of these papers. Readers will realize quickly that every author shares a wealth of knowledge of the Big Levels area and that the uniqueness of the region should be maintained and preserved in as natural a state as possible. Readers will also realize that we must maintain long-term monitoring

of acid precipitation and its effects on sensitive animals and plants, as well as remain vigilant to the changes that are bound to occur to rare species and habitats with the encroachment of increasing number of people who are moving into and using the area. Conservation efforts on behalf of the Big Levels area should take a multi-disciplinary approach and be planned for the long-term. Issues such as acid precipitation effects, liming, illegal motorized vehicle use of the area, illegal logging for firewood, garbage dumping, poaching, timbering programs, and restoration efforts should be evaluated with respect to the conservation value of the region. We recommend that a team of forest service managers, appropriate state agency personnel, scientific researchers, and conservation biologists be organized to serve as an advisory group to the U.S. Forest Service that oversees activities in the Big Levels area.

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