2013

Proposing New Barrens National Natural Landmarks

Todd R. Lookingbill
University of Richmond, tlooking@richmond.edu

Mary C. Brickle

Katharina A.M. Engelhardt

Recommended Citation

Lookingbill, Todd, Mary C. Brickle, and Katharina A.M. Engelhardt. "Proposing New Barrens National Natural Landmarks." *George Wright Forum* 30, no. 3 (2013): 253-60.

Proposing New Barrens National Natural Landmarks

Mary C. Brickle, Todd R. Lookingbill, and Katharina A.M. Engelhardt

The National Natural Landmarks (NNL) Program, administered and maintained through the National Park Service, was established in 1962 with the goal of highlighting sites that best demonstrate the outstanding geologic and biologic features of the United States. In a unique partnership between public and private landowners, the National Park Service accepts sites into the program that best illustrate the diversity of our country's natural heritage regardless of ownership. The NNL program seeks solely to recognize these sites for their geologic and biologic significance and to strengthen the public's appreciation for and conservation of America's natural heritage. Potential NNLs are evaluated based on the following criteria: (1) outstanding condition, (2) illustrative value, (3) rarity, (4) diversity, and (5) value to science and education. Sites are designated by the secretary of the interior and, as of today, 586 landmarks have received the NNL designation.

We conducted an analysis of the existing NNL portfolio of sites within three physiographic regions of the Northeast Region: Piedmont, Valley and Ridge, and Appalachian Plateau (Figure 1). The goal of the assessment was to identify underrepresented biologic and geologic themes and to recommend potential new sites within the region whose character provides excellent illustrations of those theme gaps. To identify specific sites for recommendation to the program, we examined studies of hundreds of sites previously considered for nomination as potential NNLs in the relevant physiographic provinces. Two sites came to the forefront in this review: Albany Pine Bush Preserve and Nottingham Serpentine Barrens. Both are representative of a new barrens theme which is missing from the current list of landmarks. These biologically diverse ecosystems combine outstanding examples of important geologic themes (e.g., "Eolian Landforms"; "Works of Glaciers") and ecological processes (e.g., "Fire"). They also provide good habitat for rare species in relatively urban settings that have a high potential for public education. The gap analysis demonstrates how the NNL program provides a highly structured but flexible system for the continued expansion of this catalogue of the country's diverse natural landscape.

The George Wright Forum, vol. 30, no. 3, pp. 253–260 (2013).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

Figure 1. Map of three physiographic provinces assessed and two barrens study sites.

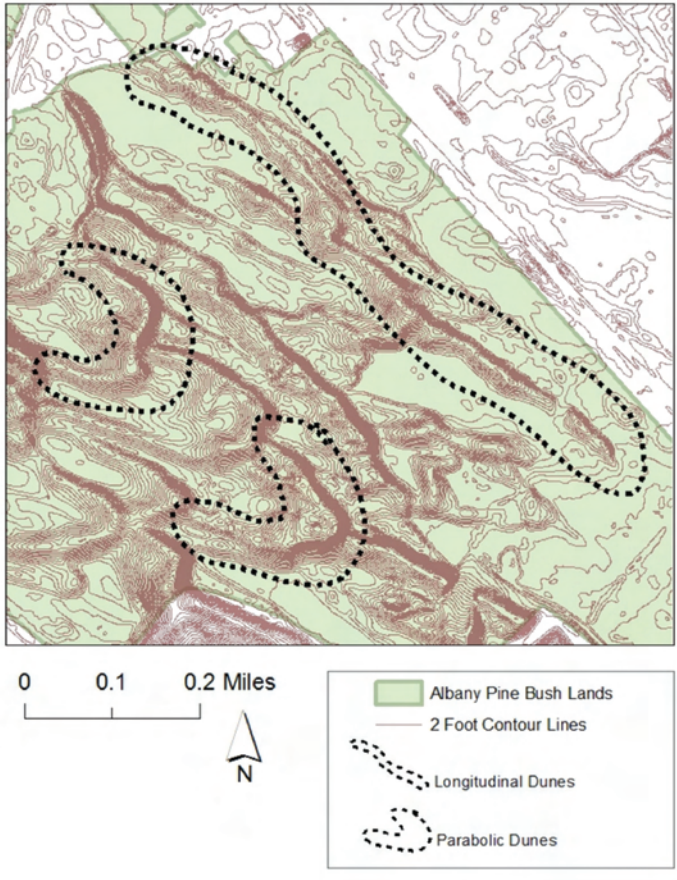
Albany Pine Bush

Albany Pine Bush Preserve supports significant examples of periglacial sand dunes and pitch pine–scrub oak barrens. The preserve is located between the cities of Albany and Schenectady in the Capital District of upstate New York (Figure 1). It is owned by multiple private and public organizations and managed by the Albany Pine Bush Preserve Commission. The site is one of only two pine barrens to support a dynamic sand dune landscape in the Appalachian Plateau region and one of two sand dune ecosystems within the Appalachian Valley and Ridge region. This extraordinary ecosystem gives rise to a variety of habitats. The sandy, well-drained soils are home to 45 of the 538 wildlife species of greatest conservation need (SGCN) found in New York State, including one state and federally listed endangered species, the Karner blue butterfly (*Lycaeides melissa samuelis*).

Primary geological features. Periglacial sand dunes are fossil landscape features that are common throughout colder climates of the world. These types of inland sand dunes are the result of wind action reworking sediments from glacial lakes or outwash dating back to prior periods of glaciation. The sand dunes at Albany Pine Bush are indicators of past aridity associated with the cold, dry, and windy climates encountered during the Late Pleistocene. Following the retreat of the Laurentide ice sheet and subsequent evaporation of the resulting glacial lake, thick sediment deposits were exposed to continual wind erosion. This led to the formation of scree and finer sand particles, which were shaped into dunes and depressions.

The preserve is a bit unusual in that it contains representative examples of both parabolic and longitudinal dunes (Figure 2). Prevailing northwesterly winds shaped most of the sand dunes, forming primarily parabolic dunes that ranged from 100 to 2,000 feet in length. Typically oriented with their longest axis running from northwest to southeast, the crescent shape of these dunes suggests they were colonized early by vegetation which helped stabilize the dune surface and prevent significant reworking (Barnes 2003). Eolian processes also contrib-

Figure 2. Examples of both longitudinal and parabolic dunes found in the Albany Pine Bush Preserve.



uted to the formation of short, broad, ridge-shaped longitudinal dunes, usually between 30 to 60 feet high and typically several hundred feet long (Bradley et al. 2010). Today, the dunes are characterized by a transitioning topography from flat to gently rolling surfaces, with both sand swells and low domes dotted with pitch pine (*Pinus rigida*) and carpeted with diverse understory plants. Swamps, wetlands, and shallow ponds have come to fill in holes that were long ago eroded into the sandy soil (Bried and Edinger 2009). In colder months, the low-lying depressions between the dunes can act as "frost pockets." As the cooler air settles into these areas, plant growth is delayed in comparison to the areas of higher elevation. This leads to less dense patches of scrub oak (*Quercus ilicifolia)* in these areas, and they instead become dominated by prairie grasses and sedges.

Primary biological features. The dynamic mosaic landscape of the Albany Pine Bush gives rise to a globally rare assemblage of plants and animals. Owing to nutrient-limiting sandy soils and the heterogeneous topography of the dunes, sand dune ecosystems support a diverse biota dominated by pine barrens in higher-lying drier habitats and wetlands in low-lying wet areas at the base of the dunes. The Albany Pine Bush provides one of the best and largest examples of an inland pine barrens ecosystem in the world, covering approximately 40 square miles prior to European colonization (USFWS 1997; Barnes 2003). Pitch pine–scrub oak communities dominate the Albany Pine Bush landscape, making up 42% of the mapped communities in the preserve. Fire disturbance within a pine barrens ecosystem serves to rejuvenate the natural community, drive out exotic plant species, and increase the food and habitat supply for native insects and other animals (e.g., Beachy and Robinson 2008). It is an important component in maintaining the unique ecological qualities of the community (Milne 1985). Good natural conditions for wildfires have existed within the Albany Pine Bush Preserve for thousands of years, especially during the frequent periods of high winds, because the sandy, nutrient-poor soil tends to be droughty and a fuel supply of plant litter accumulates rapidly due to retarded microbial decomposition (Barnes 2003). The dry, acidic soils of the Pine Bush do not promote the decomposition of litter, and the lack of earthworms or other organisms in the dry upper layers of the sandy soil mean that organic matter decomposed by fungi is not incorporated back into the soil.

The Albany Pine Bush is nationally recognized for its extensive populations of rare butterflies and moths, and management plans have focused on the protection of these rare insects (APBPC 2010). There are hundreds of Lepidoptera species found in the Pine Bush, including over 40 noctuid moths considered to be pine barrens specialists. A variety of regionally rare butterflies are also associated with the pitch pine–scrub oak barrens, grasslands, and other fire-maintained communities found in dry, sandy areas of the preserve. The federally listed endangered Karner blue butterfly typically occurs in the grassy openings in the pitch pine–scrub oak barrens; both its food plant and the host plant for its larvae is the wild blue lupine (Lupinus perennis), distributed throughout the Albany Pine Bush (Forrester et al. 2005). There is increasing evidence of a distinct and rich avian community in the pine barrens ecosystems of the Albany Pine Bush (Beachy and Robinson 2008; Gifford et al. 2010), and the site has been designated as a New York State Bird Conservation Area.

Nottingham Serpentine Barrens

The Nottingham Park Serpentine Barrens are composed of shallow serpentine rock outcrops and unique vegetation communities, especially serpentine grassland and open savanna communities. The park is located on the outskirts of Philadelphia in Chester County, Pennsylvania (Figure 1). The pine savanna and prairie ecosystems are especially species rich, supporting diverse warm-season grasses. The site contains some of the greatest numbers of endemic, rare, characteristic, and disjunct species found on serpentine soils within the Piedmont physiographic province. Recent surveys have confirmed the presence of at least 21 globally or state-rare plant species, including one of the largest populations in the world of serpentine aster (Aster depauperatus), which is one of the only two recognized serpentine endemics of eastern North America.

Primary geological features. Serpentine soils have been extensively studied in the United States, and historic mine sites at Nottingham provide glimpses of its underlying geology. Serpentinite is one of the most rare and unusual bedrock materials in the United States (Brooks 1987). The term "serpentine" is derived from the greenish color and pattern of the rock, which resembles that of a snake's skin. High concentrations of siderophile elements in the soils, such as chromium, nickel, and cobalt, are toxic to plants, resulting in low concentrations of calcium, nitrogen, phosphorus, and potassium and therefore creating conditions of extremely low soil fertility. The inability of crops or other common vegetation to thrive on these soils has permitted a rare, endemic flora to flourish.

The southernmost extent of the Wisconsin ice sheet was just north of the site, which provide an additional connection between the geology and biology of the site (Brooks 1987). New species established themselves in the tundra-like climatic conditions of the region during the period of glaciation. When the ice sheet retreated, these species remained in the serpentine barrens where they likely had far fewer competitors.

Primary biological features. Serpentine barren vegetation is found on only a small fraction of serpentine outcrops; this distinctive vegetation is characterized by a diverse native grassland with scattered pines and oaks, sclerophyllous shrubs, and a diverse herbaceous layer. In aerial view, these serpentine barrens appear as islands surrounded by forest and farmland of the heavily populated Piedmont. When compared with non-serpentine vegetation, serpentine plants generally display a greater tolerance of high magnesium and low calcium levels, have higher magnesium requirements for growth, have lower magnesium adsorption and greater calcium absorption, and show magnesium exclusion from leaves (Tyndall and Farr 1989).

Similar to the pitch pine–scrub oak barrens in the Albany Pine Bush, the rare communities that inhabit the serpentine barrens of Nottingham are fire dependent and maintained by an active prescribed burning management policy (Figure 3). Increased fire suppression beginning in the early 1900s has allowed fire-intolerant species such as Virginia pine (*Pinus virginiana*) and eastern red cedar (*Juniperus virginiana*) to increase in abundance on serpentine grasslands throughout the eastern United States (Tyndall and Farr 1989). The persistence of pitch pines in the Nottingham Barrens is unusual and indicates that fire con-

Figure 3. Prescribed fire management in the Albany Pine Bush Preserve. Photo courtesy of Neil Gifford.

tinued to burn parts of the Nottingham landscape throughout this historical period of fire suppression. Ongoing prescribed burning at the site provides an excellent opportunity to educate the public on the role of fire in natural ecosystem processes. Like Albany Pine Bush, the site is also host to a wide variety of birds, mammals, moths, butterflies, amphibians and reptiles including at least 33 that are rare globally or within the state. The site is included within an Audubon Society of Pennsylvania Important Bird Area.

Comparative assessment

After careful evaluation of the barrens ecosystems at Albany Pine Bush Preserve and Nottingham Park and throughout the Piedmont and Appalachians, we recommended both of these sites for designation as NNLs. Barrens are an important natural historical feature of the eastern United States that are largely underappreciated. Once thought to be biologically depauparate, these landscapes are increasingly recognized for their rich flora and fauna, including distinctive endemic and rare species. The designations of these sites would fill a significant gap within the NNL program. They also provide an opportunity to showcase the ecological value of fire to maintaining landscape diversity, and illustrate the important connections between geologic and ecologic processes.

Barrens landscapes are also highly threatened. The interplay of the underlying geologic substrates (inland sand dunes and serpentine outcrops) with the need for frequent distur-

bance provide an uncommon set of circumstances for the development of these ecosystems. As a result, they are easily degraded by activities such as fire suppression and associated biological invasions of coniferous trees and exotic species (Hochman 2001; Malcolm et al. 2008). Unfortunately, many barrens also have been lost to development in the last centuries. Those barrens sites that remain are frequently embedded in a sea of increasing human settlements. This landscape context provides a challenge to the preservation of high-quality, natural conditions at the sites. However, it also provides an opportunity as the National Park Service continues to recognize the educational and ecological importance of urban parks (Lookingbill et al. 2007; Gifford et al. 2010). Ongoing partnerships fostered by the unique land ownership aspects of the NNL program would encourage threatened sites such as these that are paramount to the nation's natural history to share information and solve problems cooperatively.

Acknowledgments

We gratefully acknowledge the National Park Service National Natural Landmarks Program and the University of Richmond Arts and Sciences Summer Research Fellowship for funding this project. We also are grateful to Neil Gifford and Bill DeCarme for their assistance with site visits and data compilation. Roger Latham and Mark Demitroff, among many others, provided useful review of the assessments.

References

APBPC [Albany Pine Bush Preserve Commission]. 2010. *Management Plan and Final Environmental Impact Statement for The Albany Pine Bush Preserve*. Albany: APBPC.

Barnes, J.K. 2003. *Natural History of the Albany Pine Bush*. Albany: New York State Museum.

Beachy, B.L., and G.R. Robinson. 2008. Divergence in avian communities following woody plant invasions in a pine barrens ecosystem. *Natural Areas Journal* 28: 395–403.

Bradley, J.W., M. Younge, and A. Kozlowski. 2010. The Sundler sites: Reconstructing the Late Pleistocene landscape and its people in the Captial Region of New York. In *Soldiers, Cities, and Landscapes: Papers in Honor of Charles L. Fisher.* New York State Museum Bulletin no. 513. P.B. Drooker and J.P. Hart, eds. Albany: University of the State of New York, The State Education Department, 213–223.

Bried, J.T., and G.J. Edinger. 2009. Baseline floristic assessment and classification of pine barrens vernal ponds. *Journal of the Torrey Botanical Society* 136: 128–136.

Brooks, R.R. 1987. *Serpentine and its Vegetation: A Multi-disciplinary Approach.* Portland, OR: Dioscorides Press.

Forrester, J.A., D.J. Leopold, and S.D. Hafner. 2005. Maintaining critical habitat in a heavily managed landscape: Effects of power line corridor management on Karner blue butterfly (*Lycaeides melissa samuelis*) habitat. *Restoration Ecology* 13: 488–498.

Gifford, N.A., J.M. Deppens, and J.T. Bried. 2010. Importance of an urban pine barrens for the conservation of early-successional shrubland birds. *Landscape and Urban Planning* 94: 54–62.

Hochman, D.J. 2001. *Pinus virginiana* invasion and soil–plant relationships of Soldier's De-

light Natural Environment Area, a serpentine site in Maryland. M.S. thesis, University of Maryland.

Lookingbill, T.R., R.H. Gardner, P.A. Townsend, and S.L. Carter. 2007. Conceptual models as hypotheses in monitoring urban landscapes. *Environmental Management* 40: 171–182.

Malcolm, G.M., D.S. Bush, and S.K. Rice. 2008. Soil nitrogen conditions approach preinvasion levels following restoration of nitrogen-fixing black locust (*Robinia pseudoacacia*) stands in a pine-oak ecosystem. *Restoration Ecology* 16: 70–78.

Milne, B.T. 1985. Upland vegetational gradients and post-fire succession in the Albany Pine Bush, New York. *Bulletin of the Torrey Botanical Club* 112: 21–34.

Tyndall, R.W., and P.M. Farr. 1989. Vegetation structure and flora of a serpentine pine–cedar savanna in Maryland. *Castanea* 54: 191-199.

USFWS [United States Fish and Wildlife Service]. 1997. *Significant Habitats and Habitat Complexes of the New York Bight Watershed—Complex #30 Albany Pine Bush.* Washington, DC: USFWS.

Mary C. Brickle, University of Richmond, Richmond, Department of Geography and the Environment, 28 Westhampton Way, Richmond, VA 23173; mary.brickle@gmail.com

Todd R. Lookingbill, University of Richmond, Richmond, Department of Geography and the Environment, 28 Westhampton Way, Richmond, VA 23173; tlooking@richmond.edu

Katharina A.M. Engelhardt, University of Maryland Center for Environmental Sciences, Appalachian Lab, 301 Braddock Road, Frostburg, MD 21532; engelhardt@umces.edu