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GEORGE WRIGHT SOCIETY

P.O. Box 65
Hancock, Michigan 49930-0065 USA
1-906-487-9722 • fax 1-906-487-9405
www.georgewright.org

Realizing Efficiencies through Simultaneous Implementation of Vegetation Research

Paul Petersen, National Park Service, Prince William Forest Park, 18100 Park Headquarters Road, Triangle, Virginia 22172; Paul_E_Petersen@nps.gov

Introduction

Prince William Forest Park comprises 15,000 acres of Piedmont forest and protects a majority of the Quantico Creek watershed in Triangle, Virginia. The third-largest national park in Virginia, Prince William Forest Park lies along the border of two physiographic zones: the Piedmont and the Coastal Plain. The park also lies within the transition zone between northern and southern climates. This confluence of environmental factors creates a wide diversity of vegetative communities and habitats that support a unique combination of life. Vegetative species include mixed oak forest, mesic hardwood forest, butternut, bigtooth aspen, swamp white oak, cottonwood, box elder, sycamore, and American beech. Unique habitats include oligotrophic saturated forests (seepage swamps), vernal pools, and habitat for a federally listed threatened orchid.

Before the establishment of the park in 1936, considerable portions of the Quantico Creek watershed were used for logging, subsistence farming, and mineral mining. Land use, combined with the undulating terrain and sandy soils, led to severe erosion problems, including the eventual disappearance of the Quantico Bay due to heavy sediment loads. Once the park was established, the long process of restoration was begun on open farmlands and mined areas.

During the 70-year history of Prince William Forest Park, resource managers have learned a great deal about the types of flora and fauna that exist in the park. However, the last five years have seen the most intensive research on the vegetative composition of the park. Research has included intensive monitoring of exotic plant species, a comprehensive floristic survey, the implementation of a vegetation monitoring program, a vegetation mapping project, and surveys and documentation of a federally listed threatened plant species, *Isotria medeoloides*.

Exotic plant survey

In the fall of 2000, an exotic plant management team (EPMT) was established in the National Capital Region (NCR) of the National Park Service (NPS). The EPMT was one of five rapid-response teams placed throughout the country to give individual parks assistance in surveying and eradicating invasive plant species. In the spring of 2001, park resource managers met with EPMT staff to delineate and prioritize areas to be surveyed in the park. These areas included road corridors, stream corridors, fields, old home sites, utility lines, cemeteries, and backcountry areas. Using a Trimble global positioning system (GPS) unit and field data sheets, the EPMT collected information on the scope of exotic plants within the park's boundary. The team entered this information into the Alien Plant Control and Monitoring (APCAM) database, which has been shared with park resource managers, along with numerous spatial datasets of invasive plant locations.

To date, the EPMT has surveyed over 200 acres within the park, and discovered 45 species of exotic plants (APCAM). Chinese wisteria *(Wisteria sinensis),* princess tree *(Paulownia tomentosa),* Japanese stiltgrass *(Microstegium vimineum),* Japanese barberry *(Berberis thumbergii),* multiflora rose *(Rosa multiflora),* mile-a-minute (*Polygonum perfollatum*), Japanese knotweed *(Polygonum cuspidatum),* and oriental bittersweet *(Celastrus orbiculatus)* are some of the main threats to native vegetation included in this list. Since the completion of the initial survey, the EPMT has focused treatment on highly invasive infestations of Chinese wisteria and Japanese knotweed.

Floristic survey

In 2002, Ted Bradley, associate professor of biology at George Mason University (GMU), and a former graduate student, John Dodge, began a comprehensive survey of vascular plants in Prince William Forest Park. The goals of the project were to accurately estimate the number of vascular plants within the park, to 90%, and to verify that accuracy through an intense plant survey. Bradley's initial 90% estimate was developed by a heuristic method that combined the findings of two vascular plant surveys from similar habitats; one in western Virginia, and the other from the Delaware Water Gap. Prior to the actual field survey, the researchers 90% estimate was 652 species, which implied that the field survey would yield around 724 species. More importantly to resource managers, the survey provided a complete list of vascular plants within the park.

The survey was organized into three main phases. First, by using U.S. Geological Survey (USGS) topographic maps, digital ortho quarter quads (DOQQs), and other spatial data sets, Bradley and Dodge delineated different habitat types within the park boundary. The second phase involved frequent field surveys and plant collection trips. The third phase was a repetition of the field survey trips to similar areas, but during different periods. This was done in order to ensure the identification of plants that emerged, fruited, or flowered during different seasons. Field vouchers were collected for plant species that were unidentifiable in the field, and later identified in a laboratory.

The final report for the floristic survey will be finished by the end of April 2005, but preliminary analysis indicates that 749 species have been identified. This number is only twenty-five more than what was estimated by Bradley.

Isotria medeoloides. Commonly known as the small whorled pogonia, *Isotria medeoloides*, a federally listed threatened plant, was discovered in Virginia in 1983. The first formal study of the park's *Isotria* colonies was conducted in 1988 by Donna Ware, an associate professor of biology at the College of William and Mary (Ware 1989). Currently, seven colonies of the plant are known to be within Prince William Forest Park. These colonies are important because only 47 colonies of *Isotria* have been found in Virginia, and few are on protected lands.

The U.S. Fish and Wildlife Service recovery plan for *Isotria* aims to protect 61 colonies within the normal habitat range of the plant. Of these colonies, 75% must be self-sustaining populations. A self-sustaining population for this plant is defined as a colony of at least 20 emergent stems, of which, 25% must flower over a 10-year period (USFWS 1992). Two colonies that lie within the park may meet the recovery plan's criteria.

In the summer of 2003, Ware revisited the park to survey five research blocks for old and new colonies of *Isotria*. *Isotria* generally grows in upland mixed hardwood forests with trees of at least 40 years of age (Ware 1991), and is often found in an open shrub layer or near a canopy break (Ware 1987). The five research blocks surveyed contained similar characteristics as described above. These areas were meticulously searched by creating a search grid with two to five surveyors walking 2 m apart. Unfortunately, no new *Isotria* colonies were discovered in the 2003 survey.

Vegetation monitoring

Starting in 2003, Biological Science Technician Patrick Donovan re-established fifty 20x20-m vegetation monitoring plots in Prince William Forest Park. The plots had previously been established in 1991; however the program was terminated due to funding constraints. The plots are being used to establish baseline vegetation information, help detect changes, and assist in other research capacities. Along with the fifty vegetation plots, 12 vegetation enclosures were constructed adjacent to randomly selected vegetation plots in order to research the effects of deer browsing on park vegetation.

Protocols for the vegetation monitoring were developed over the winter of 2003–2004, and plot sampling began in the spring of 2004. Data collected at the plots include a conditional assessment of all trees in the plot over 5 cm dbh (diameter at breast height), a randomly placed 2x2-m subplot for the herbaceous layer and seedling classification, and a line transect, bisecting the plot, for shrub layer information. The initial plot sampling will be completed by October 2005 and the park will continue to collect data at five-year intervals (Donovan 2004).

Vegetation mapping program

In 2003, the NPS entered into a cooperative agreement with NatureServe to produce a vegetation classification dataset for the 13 park units in the NCR. The information from the classified vegetation map will assist the regional inventory and monitoring network to establish Vital Signs protocols, help identify threats to vegetation, give insight on the status of vegetation communities within the parks, and assist park managers during planning. In order to have uniformity for the region, the classification process will evaluate all parks within the region as if they were one park.

The classification process can be broken down into three steps: field classification, photo interpretation, and accuracy assessment. For the field classification phase, ecologists Gary Fleming and Kristin Taverna, from the Virginia Division of Natural Heritage, conducted plot sampling using a standardized vegetation sampling protocol at 35 locations throughout Prince William Forest Park. The field plot locations were selected so that all habitat types within the park would be represented. The photo interpretation phase combined the plot sampling data along with color infrared imagery of the park, obtained from flights in the spring of 2004, to delineate vegetation classes to the finest level according to the U.S. National Vegetation Classification, the plant association. An accuracy assessment will be performed after the final product is produced in 2006.

Synthesis

Simultaneously researching multiple aspects of vegetation management has helped resource managers at Prince William Forest Park achieve synthesis. Each of the five vegetation projects conducted at the park over the last four years has given managers valuable information on each individual vegetation assessment. The information has allowed managers to take a more holistic approach in protecting the resource. Also, information from each vegetation assessment improved the results of other assessments. This synthesis was achieved through three broad concepts: relationship-building, coordination, and data-sharing.

Part of the success of these projects and the realization of synthesis was due to the relationships of the researchers. Bradley, Ware, and Fleming had worked on numerous projects prior to their most recent projects in the park. Most notably, they were co-authors of the third edition of the *Atlas of the Virginia Flora* (Harville et. al. 1992). In addition, they worked together to classify Virginia natural communities. There were other important relationships connecting the different vegetation assessments. Donovan, the biological science technician in charge of the vegetation monitoring plots, is currently student of Bradley's at GMU.

Resource management at Prince William Forest Park encouraged coordination and data sharing between projects whenever possible. Some examples of the types of cooperation that occurred include:

- Bradley, Ware, and Fleming met at a private residence, at the beginning of their prospective projects, and reviewed maps of the park in order to delineate areas of interest for their projects.
- Donovan accumulated vegetation identification knowledge and field plot construction skills from assisting researchers in the floristic survey, Isotria survey, and vegetation mapping plot sampling surveys.
- Dodge assisted Donovan in the development of vegetation plot sampling protocols for the vegetation monitoring program.
- The EPMT confirmed the existence of exotic plants for the floristic survey, and identified habitats of interest for field ecologists in the vegetation mapping program.
- The initial species list for the floristic survey was supplied to Bradley by Fleming from the vegetation mapping program.
- Researchers for the floristic survey and vegetation mapping project identified exotic plant sites undiscovered by the exotic plant management team.

At times, researchers from differing projects were converging in the field, sharing information about the location of habitats or plants that may have been important to the other researcher. This would not have happened if there had not been an atmosphere of cooperation between the researchers.

Recommendations and conclusions

From the spring of 2001 until 2005, resource managers at Prince William Forest Park implemented five vegetation assessments, a floristic survey, rare plant survey, exotic plant survey, vegetation mapping project, and a vegetation monitoring program. By performing these

projects simultaneously, the resulting knowledge gained was greater than if the projects had been done at separate times. The information shared between assessments enhanced the findings of each individual project, thus supporting synthesis. Park resource managers believe that this synthesis occurred because related research efforts were coordinated, relationships between researchers were encouraged, and researchers and park staff were able to work on multiple vegetation projects.

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