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RESEARCH ARTICLE

SURVEY OF ANISOPTERA (ODONATA) AT FIVE NATIONAL PARK BATTLEFIELDS IN HANOVER COUNTY, VIRGINIA

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ABSTRACT

Surveys of dragonfly species at five National Park Service Battlefields in Hanover County, Virginia were conducted from the spring of 2016 to 2022. The park sites are: Totopotomoy Creek, Beaver Dam Creek, Gaines' Mill, Cold Harbor and North Anna, all units of Richmond National Battlefield Park System. In total 31 different species of Anisoptera were catalogued.

Keywords: Dragonflies, Hanover County, National Park Service, Odonata, Virginia.

INTRODUCTION

The Virginia Division of Natural Heritage (VDNH) maintains lists of Odonata in the Virginia Counties. The Division's 2006 official species list for Hanover County includes 30 species, with no details as to specific collecting locations (VDNH, 2006). In addition, there are no journal published comprehensive or partial lists of Anisoptera in Hanover County, Virginia. The National Park Service was in need of location-specific lists of resident dragonfly species on their properties. Annual reports to the Park Service have been presented, but these reports are not available in journal publications.

This study and report provide documentation of the research to collect and identify resident dragonflies specifically found at Totopotomoy Creek, Beaver Dam Creek, Gaines' Mill, Cold Harbor, and North Anna; all were active battlefields either in 1862 or later in 1864. These locations are now under preservation protection by the United States National Park Service (NPS) and are a

part of Richmond National Battlefield Park. This study will add to a species list of Anisoptera for Hanover County, Virginia.

MATERIALS AND METHODS

With the assistance of a Scientific Research and Collecting Permit issued from the U.S. National Park Service for 2016 to 2022 the principal investigator (the author of this article) and numerous volunteers surveyed the five Battlefield sites on numerous occasions during the prime season for adult dragonflies, April to August from 2016 to 2022.

Surveys at these sites occurred from the spring and summer with a dozen cumulative visits made to the park sites including some fall seasons. Most surveys were conducted from 1000 hours to 1600 hours on the noted survey dates. Most collecting was done near water features in the parks. As the list of species grew per site, the number of individuals of a particular species re-caught were not recorded. Due to a requirement of the permit, no vouchers were retained, and only photograph records are available.

Collecting involved live capture with hand nets, careful retrieval of the specimen from the nets, depositing the live specimen into a cooler for 30 minutes to lessen specimen's movement, then extraction for photographing for logging records. All species were released soon after photographs were taken. Identification was assisted using Dunkle (2000), Merritt et al. (2008), Needham et al. (2000), and with conversations with Dr. Steve Roble of the Virginia Division of Natural Heritage.

Study Locations and Characteristics

These National Battlefield Park Sites in the County, have the following GPS locations:

	Totopotomoy Creek	Beaver Dam Creek	Cold Harbor	Gaines Mill	North Anna
Latitude:	37.375	37.599	37.587	37.574	37.912
Longitude:	-77.528	-77.362	-77.286	-77.293	-77.531

Totopotomoy Creek is 50.2 hectares, has deciduous forests and farmed field slopping to the lotic habitat associated with Totopotomoy Creek. This site has no ponds separate from the stream although some small beaver ponds do exist, and other ponds are within 1-3 kilometers of the Park. The site has some freshwater wetlands. The stream is a Class 1 stream, averages 5 meters across, with mostly sandy bottoms, and the bank full depth is 1.5 meters at the deepest points. The stream travels along the entire southern and eastern length of the Park.

Beaver Dam Creek is 107.7 hectares, has mostly riparian deciduous forest habitat and about 85 hectares of wetlands. This site has no standing ponds or impoundments separate from the stream although one is within 1.6 kilometers of the Park. Some small beaver ponds do exist. The stream is a Class 2 stream, averages 4 meters across, with mostly sandy bottoms, and the bank full depth is 2 meters at the deepest points. The stream travels along the entire length of the Park

Cold Harbor is 147.7 hectares has mostly deciduous forest habitat and several very small Class 1 streams, usually with some water flow. Six hectares of wetlands are within the Park. A small pond (about 1.5 hectares when full) is on the western side of the Park is man-made and does become shallow and smaller during very dry periods. Its bottom is sandy with much detritus.

Gaines' Mill is 150.6 hectares, has several streams, wetland habitats, several meadows and a large cultivated field. On the western and southern boundary of the park is Powhite Creek and in the center of the park is Boatswain Creek. Both creeks have riparian wetlands surrounded by deciduous forest. This site has no standing ponds or impoundments, although two two-hectare ponds are within one kilometer of the Park. All streams are Class 1 streams, have sandy bottoms and are about two meters wide and less than a meter deep.

North Anna is 260.2 hectares, has 3.6 kilometers of frontage on the North Anna River, a two-hectare freshwater pond, and one constant flowing stream Lowry Creek along its southern border. The Pond (unnamed) is located in the center of the site. The North Anna River is Class 3 stream with sand and bolder bottoms.

RESULTS

During this research a unique feeding behavior by *Epiaeschna heros* (Fabricius) and *Epitheca cynosura* (Say) were observed (Groover, 2017). These two species were “strafing” in a feeding action, the blooms on a tulip tree, occupied by small dipterans.

A total of 31 different species out of 359 individual dragonfly specimens were collected and released at these five National Battlefield Parks in Hanover County, Virginia, during the survey period (Table 1). *Libellula* spp. were the most common taxa. *Sympetrum vicinum* (Hagen), *Arigomphus villosipes* (Selys), and *Gomphaeschna furcillata* (Say) were caught less often in this survey.

Table 1. Odonata Captured then released (✓) and/or Observed (obs) at Totopotomoy Creek, Gaines' Mill, Cold Harbor Beaver Dam Creek, and North Anna National Battlefield Parks during 2016-2022 surveys.

Species	Date of capture	Location of capture	Photo available
<i>Tachopteryx thoreyi</i>	11 June 2016	Totopotomoy Creek	✓
<i>Gomphus exilis</i>	11 June 2016	Totopotomoy Creek	✓
<i>Progomphus obscurus</i>	11 June 2016	Totopotomoy Creek	✓
<i>Epitheca princeps</i>	12 June 2016	Totopotomoy Creek	✓
<i>Erythemis simplicicollis</i>	12 June 2016	Totopotomoy Creek	✓
<i>Libellula incesta</i>	12 June 2016	Totopotomoy Creek	✓
<i>Libellula luctuosa</i>	17 July 2016	Totopotomoy Creek	✓
<i>Libellula lydia</i>	17 July 2016	Totopotomoy Creek	✓
<i>Tramea lacerata</i>	17 July 2016	Totopotomoy Creek	✓
<i>Pachydiplax longipennis</i>	17 July 2016	Totopotomoy Creek	✓
<i>Phanogomphus lividus</i>	1 April 2017	Gaines' Mill	✓
<i>Epitheca cynosura</i>	2 April 2017	Gaines' Mill	✓
<i>Gomphaeschna furcillata</i>	9 April 2017	Gaines' Mill	✓
<i>Cordulegaster bilineata</i>	28 April 2017	Gaines' Mill	✓
<i>Epiaeschna heros</i>	29 April 2017	Gaines' Mill	✓
<i>Libellula vibrans</i>	30 April 2017	Gaines' Mill	✓
<i>Pachydiplax longipennis</i>	11 June 2017	Gaines' Mill	✓

Table 1 cont.

<i>Libellula incesta</i>	11 June 2017	Gaines' Mill	√
<i>Libellula pulchella</i>	11 June 2017	Gaines' Mill	obs
<i>Libellula vibrans</i>	2 June 2018	Gaines' Mill	√
<i>Libellula lydia</i>	2 June 2018	Gaines' Mill	√
<i>Libellula auripennis</i>	7 June 2018	Gaines' Mill	√
<i>Libellula cyanea</i>	7 June 2018	Gaines' Mill	√
<i>Erythemis simplicicollis</i>	7 June 2018	Gaines' Mill	√
<i>Tramea carolina</i>	7 June 2018	Gaines' Mill	√
<i>Tramea lacerata</i>	2 June 2018	Gaines' Mill	√
<i>Celithemis eponina</i>	7 June 2018	Gaines' Mill	√
<i>Celithemis tenera</i>	7 June 2018	Gaines' Mill	√
<i>Progomphus obscurus</i>	7 June 2018	Gaines' Mill	√
<i>Gomphus lividus</i>	21 April 2018	Gaines' Mill	√
<i>Libellula lydia</i>	15 July 2017	Cold Harbor	√
<i>Erythemis simplicicollis</i>	15 July 2017	Cold Harbor	√
<i>Libellula incesta</i>	15 July 2017	Cold Harbor	√
<i>Libellula luctuosa</i>	15 July 2017	Cold Harbor	√
<i>Pachydiplax longipennis</i>	15 July 2017	Cold Harbor	√
<i>Anax junius</i>	15 July 2017	Cold Harbor	√
<i>Tramea carolina</i>	15 July 2017	Cold Harbor	√
<i>Anax longipes</i>	4 July 2018	Cold Harbor	√
<i>Sympetrum vicinum</i>	7 Oct 2018	Cold Harbor	√
<i>Celithemis eponina</i>	29 May 2017	Beaver Dam	√
<i>Libellula cyanea</i>	29 May 2017	Beaver Dam	√
<i>Libellula lydia</i>	29 May 2017	Beaver Dam	√
<i>Pachydiplax longipennis</i>	29 May 2017	Beaver Dam	√
<i>Libellula incesta</i>	29 May 2017	Beaver Dam	√
<i>Erythemis simplicicollis</i>	29 May 2017	Beaver Dam	√
<i>Hagenius brevistylus</i>	4 July 2017	Beaver Dam	obs
<i>Anax Junius</i>	23 June 2021	North Anna	√
<i>Arigomphus villosipes</i>	23 June 2021	North Anna	√
<i>Hagenius brevistylus</i>	23 June 2021	North Anna	√
<i>Erythemis simplicicollis</i>	23 June 2021	North Anna	√
<i>Libellula cyanea</i>	23 June 2021	North Anna	√
<i>Libellula incesta</i>	23 June 2021	North Anna	√
<i>Libellula luctuosa</i>	23 June 2021	North Anna	√
<i>Libellula lydia</i>	23 June 2021	North Anna	√
<i>Libellula vibrans</i>	23 June 2021	North Anna	√
<i>Pachydiplax longipennis</i>	23 June 2021	North Anna	√

Table 1 cont.

<i>Perithemis tenera</i>	23 June 2021	North Anna	√
<i>Tramea carolina</i>	23 June 2021	North Anna	√
<i>Tramea lacerata</i>	23 June 2021	North Anna	√
<i>Tachopteryx thoreyi</i>	23 June 2021	North Anna	√
<i>Progophus obscurus</i>	14 July 2021	North Anna	√
<i>Epitheca princeps</i>	10 April 2022	North Anna	√
<i>Cordulegaster maculata</i>	13 April 2022	North Anna	√

Since the National Park Service permit restricts vouchers taken, once one of a species was captured, no other subsequent examples of that species were recorded. A comparison considering species richness can be made; Gaines' Mill had the most species (20). Calculating a Menhinick Index of species richness for the five sites is provided in Table 2.

Table 2. Menhinick's Index of species richness comparing Gaines' Mill, Totopotomoy Creek, Cold Harbor, Beaver Dam Creek, and North Anna National Battlefield Parks.

Battlefield site	Index value
Gaines' Mill	2.5
Totopotomoy Creek	1.3
Cold Harbor	1.1
Beaver Dam	0.9
North Anna	2.1

Similarly with voucher restrictions, a species diversity comparison can be made comparing the five sites with a Simpson Index, see Table 3. Gaines' Mill with a lower Simpson value demonstrates more diversity.

Table 3. Simpson Index of species diversity comparing Gaines' Mill, Totopotomoy Creek, Cold Harbor, Beaver Dam Creek, and North Anna National Battlefield Parks.

Battlefield site	Index value
Gaines' Mill	0.82
Totopotomoy Creek	0.95
Cold Harbor	0.96
Beaver Dam	0.97
North Anna	0.88

DISCUSSION

As noted in Table 1, Gaines' Mill has more resident Anisoptera species (20) compared to the other four sites. That may be due to more extensive and varied aquatic habitats at this park and the very close proximity of two large ponds near the park. In addition, this site was surveyed more often (9 times) than the other park locations.

A number of suspected dragonfly species were not cataloged but may be present at these parks. *Erythrodiplax minuscula* (Rambur) was possibly observed, but not caught, in the wetlands on the south end of Gaines Mill National Battlefield Park. The pond at Cold Harbor is often affected by seasonal drought and may have reduced the full list of species.

Dr. Steve Roble suspects that *Helocordulia selysii* (Hagen) may be present at one of these sites. More surveys of these sites may yield other species such as *Boyeria vinosa* (Say) and *Didymops transversa* (Say).

North Anna National Battlefield Park may provide more dragonfly species with further investigation, especially with the length of the River at this location. More extensive sampling along the North Anna River is recommended.

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