



United States Department of the Interior

NATIONAL PARK SERVICE
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Memorandum

To: Kristen Gounaris Allen, Chief of Natural and Cultural Resources, Richmond National Battlefield Park

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Subject: Fish Inventory and Baseline Population Estimates Totopotomoy and Powhite Creeks, Virginia

Report Summary

Richmond National Battlefield Park (RICH) recently acquired two new parcels of land. These parcels contain aquatic resources that had not been previously assessed by NPS. Baseline stream fish community surveys were conducted in Powhite and Totopotomoy Creek, the largest stream in each property. Surveys revealed healthy fish assemblages indicative of expected communities of the Atlantic slope of eastern Virginia. Overall, we observed 14 species in Powhite and 13 species in Totopotomoy Creek. Yellow Bullhead was the most abundant species in removal reaches at both Powhite and Totopotomoy Creek with population estimates of 39 and 18, respectively.

More sampling would likely increase the species list for at least the Totopotomoy Creek site (see below for details). Additional sampling at either location will provide stronger baseline data for these fish communities, however the information obtained is sufficient for the park to make better informed, decisions regarding the management of aquatic resources in Totopotomoy and Powhite Creeks.

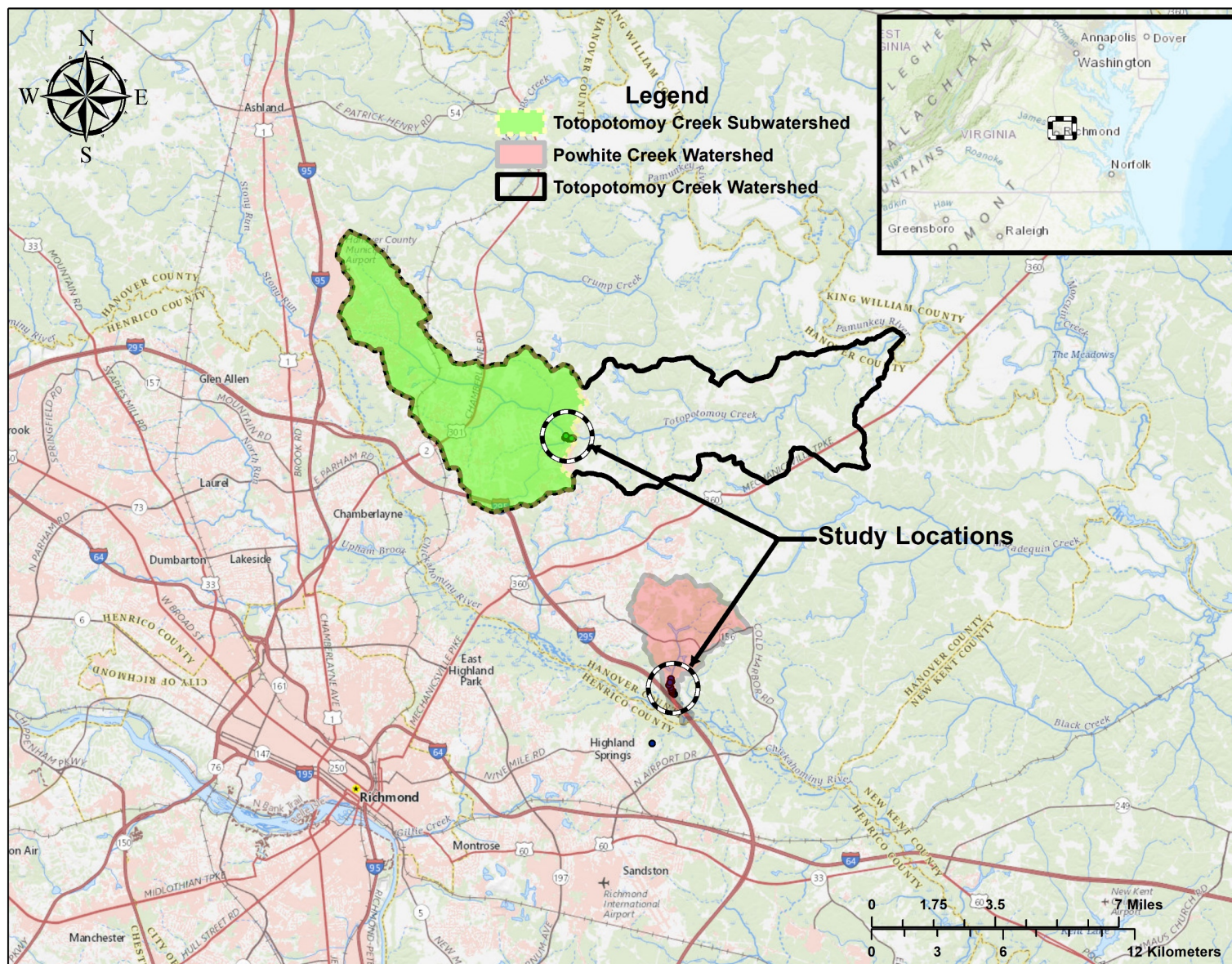


Figure 1. Study area location map showing the Totopotomoy (green) and Powwhite Creek (red) watersheds along with the locations of the sampling reaches.

Project Overview

Project Need

Richmond National Battlefield Park staff sought baseline information regarding the stream fish communities at both of these locations. The baseline information provided in this report serves three primary management purposes:

1. In order to develop effective park management strategies for riparian and water resources the park has to first know what aquatic species they have within their waterways as an important first step
2. The inventory and species population estimate data is also useful for tracking changes over time or for having a baseline by which to measure success of future stream restoration, stream bank fencing, or other riparian/watershed management action
3. If a Surface Unit Resource Protection Act (SURPA) action is undertaken by the park in response to a contamination event in either waterway, then the species data and population estimates may be used to help quantify damages and assess remediation costs.

In order to achieve the project objectives a collaborative team made up of individuals representing RICH, UPDE, SHEN, WRD, NERO, Eastern Rivers and Mountains and Mid-Atlantic Inventory and Monitoring Networks staff was assembled.

Principal Investigators

PI – Andrew S. Weber (UPDE/ERMN)

Co-PIs – Carl “Nic” Medley (WRD) and Dr. Peter J. Sharpe (WRD/NERO)

Chief Fish Taxonomist and project consultant – Earl “Dave” Demerest (SHEN)

Objectives

The primary objectives for the survey effort were twofold: 1) provide the park with a comprehensive inventory of fish species that occur at each site; and 2) provide the park with some baseline abundance/population data.

Survey Locations and Sampling Dates

Survey locations were chosen through conversations between RICH staff and WRD/NERO and were dictated largely by access and RICH boundaries. See Table 1 and Figures 2 and 3 for sampling dates, locations, and specific coordinates of upstream and downstream reach ends for each removal reach. Dates were chosen in advance in an attempt to maximize the expertise and number of researchers, as well as, work within manageable weather/flow conditions on-site.

Table 1. Sampling dates and coordinates of reach ends for each removal reach.

Survey reach	Survey date	Upstream end		Downstream end	
		Latitude	Longitude	Latitude	Longitude
Powhite Creek	9/26/2018	37.57440833	77.30444444	37.57389167	77.30444444
Totopotomoy Creek	9/25/2018	37.65236389	77.34638889	37.65246389	77.34555556

Methods

Upon arrival at each site, a 100m reach was selected for removal sampling. Upstream and downstream ends were blocked with a 6.35mm block net to prevent/minimize the chance of fish migrating into or out of the reach. Backpack electrofishing (Smith Root LR-20B) was used in an upstream direction to sample fish using a removal method. After each pass, fish were removed and temporarily retained, separated by removal pass. After the final pass, all fish were identified to species, counted, measured, and weighed. Total length, standard length (where applicable), and weight were recorded for each fish captured. All fish were then returned to the reach where they were captured. Two removal passes were performed at Totopotomoy Creek (see below for discussion of conditions) while four passes were performed at Powhite Creek.

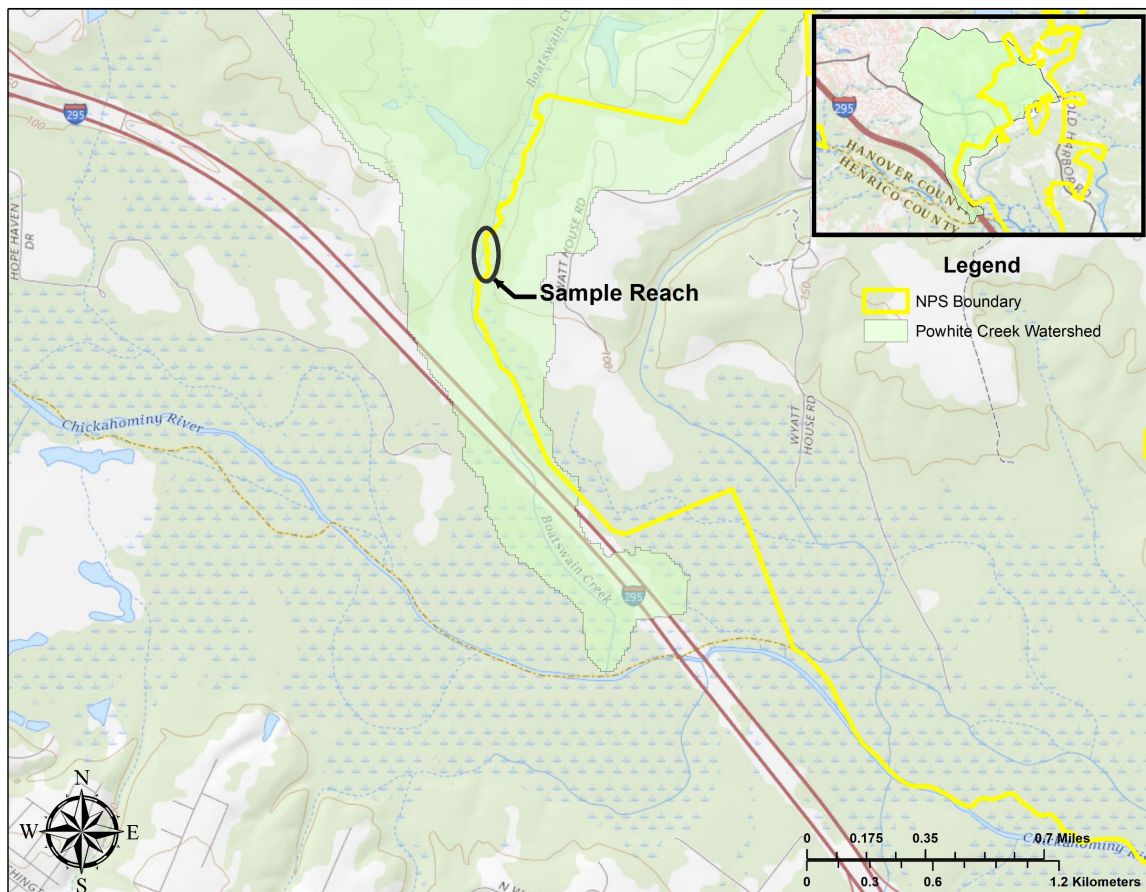


Figure 2. Study area location map showing the Powhite Creek watershed and the location of the sampling reach.

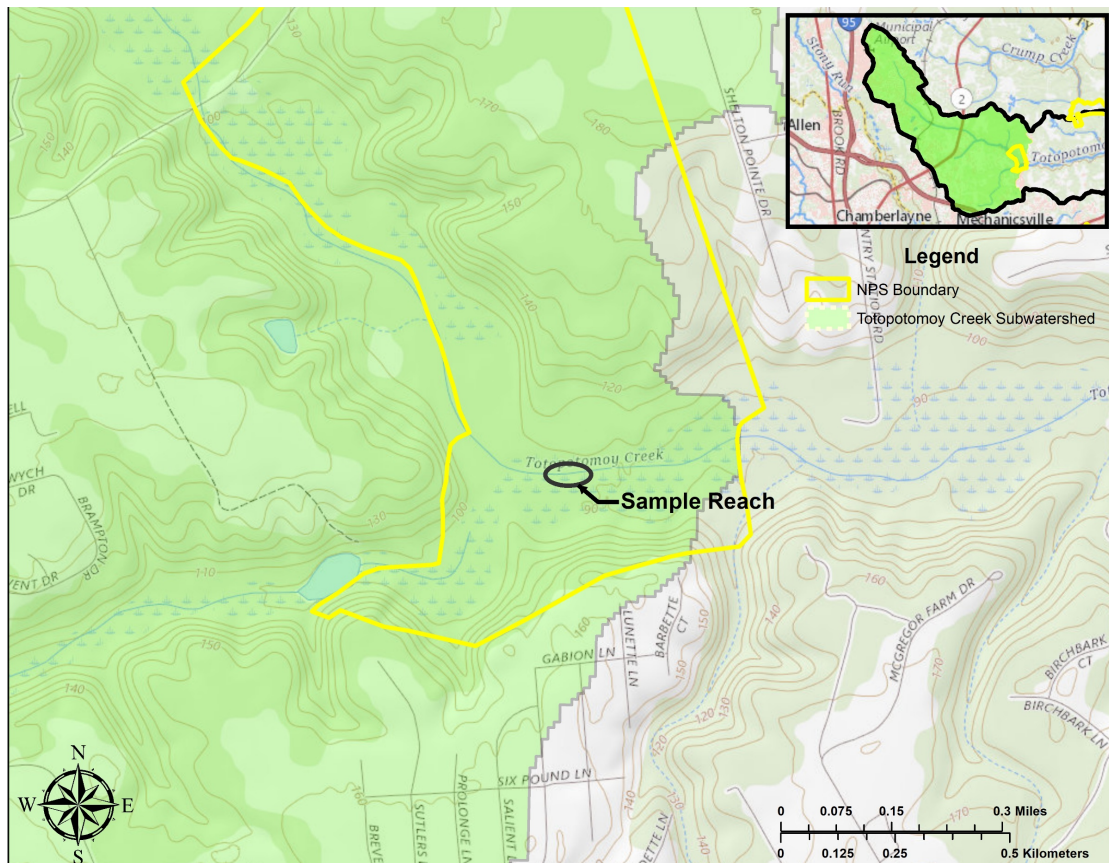


Figure 3. Study area location map showing the Powhite Creek watershed and the location of the sampling reach.

Species specific population estimates were calculated for each removal reach using the USGS Patuxent Wildlife Research Center’s online software module “CAPTURE” (<http://www.mbr-pwrc.usgs.gov/software/capture.html>). The online program computes estimates of capture probability and population size from removal data, for ‘closed’ population capture-recapture data using the variable probability removal estimator of Pollock and Otto (see Biometrics 1983 for details). [Note: While this module provides an easy to use tool to derive a population estimate for one species at one site, it is recommended that as more data becomes available, or in the event of an impact, Program Mark (White and Burnham, 1999; <http://warnercnr.colostate.edu/~gwhite/mark/mark.htm>) be used to compute population estimates. Program Mark uses Information-Theoretical (see Anderson 2008) statistical methods for model selection and multi-model averaging procedures for more accurate experiment-wide population estimation].

Based on the removals and population estimates, biomass of each species was calculated for each removal reach. It is important to note that at both removal reaches estimates for population and biomass of some species were based off of only one individual.

Once removal sampling was finished, seining and electrofishing were also employed in an attempt to maximize the species list (ensure that no rare species were missed) by sampling different habitat types. These were not performed at fixed survey reaches and were typically within ~300m from the upstream and downstream survey bounds. Fish collected during these efforts were identified to species, counted, and released.

It is also important to note that conditions at Totopotomoy Creek on 9/25/2018 were not ideal for electrofishing or performing a removal survey. Water was much higher than median (based on 40 years of data; see Figure 1) and turbid. On the survey date, discharge was ~45cfs while the median was ~7cfs (Figure 1). In fact, discharge was ~600cfs one week before the survey was conducted (Figure 1). It is likely that some fish were never seen; and therefore could not be captured during electrofishing efforts. It is also likely that there were more species present than were observed.

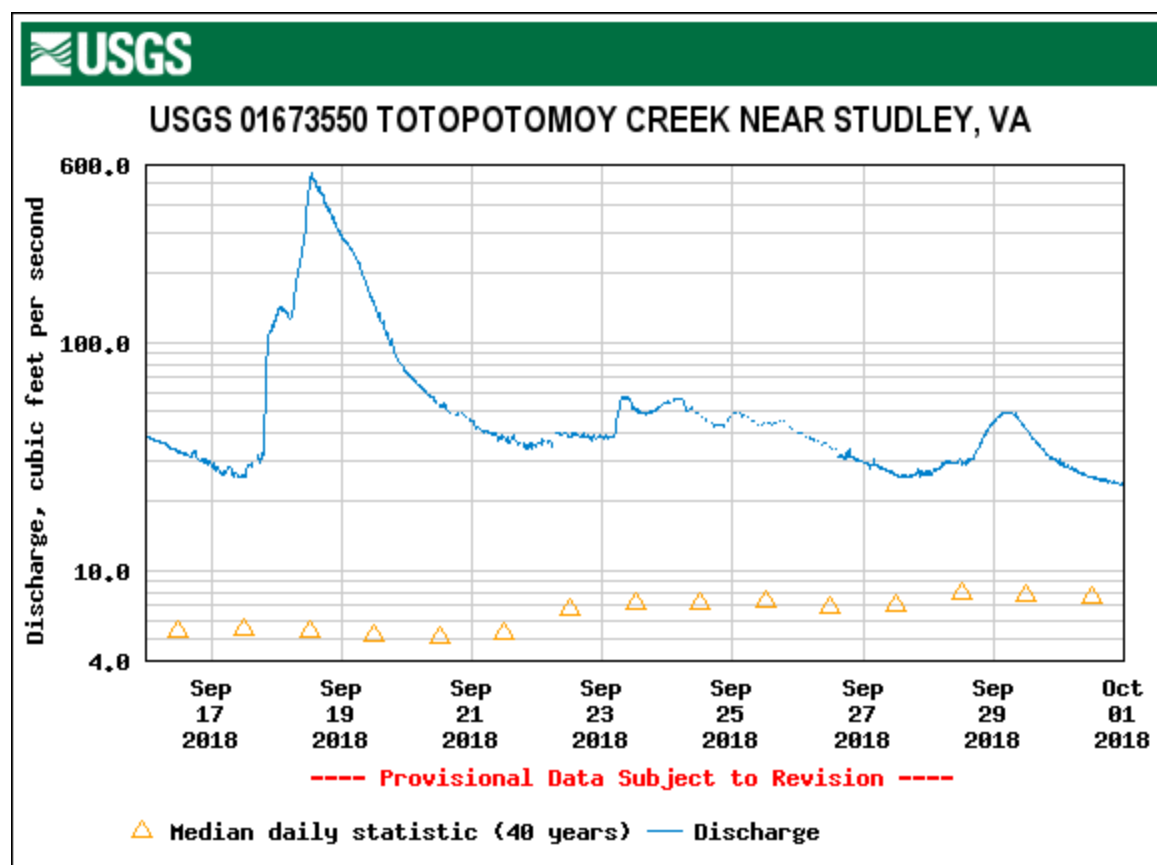


Figure 1. USGS stream discharge for closest gage to removal reach on Totopotomoy Creek. Figure represents the two week period from September 16 through September 30. Sampling occurred on 9/25/2018. *USGS data was provisional during the time this report was written

Results and Discussion

Overall, 15 fish species representing 10 families were observed (Table 2). The majority of species were observed in both streams. Creek Chubsucker (*Erimyzon oblongus*) and Creek Chub (*Semotilus atromaculatus*) were observed only in Powhite Creek while Chain Pickerel (*Esox niger*) was observed only in Totopotomoy Creek. All other observed species were found at both streams.

At both removal reaches, Yellow Bullhead (*Ameiurus natalis*) was the most frequently observed species with the highest estimated population and biomass (Tables 3-6 and Figure 4). Estimated biomass for Yellow Bullhead was higher than for all other species combined at both reaches.



Figure 4. Photograph showing an example of a Yellow Bullhead (*Ameiurus natalis*) sampled from Powhite Creek (26 September 2018).

Most of the observed species were found in the removal reaches. At Totopotomoy Creek, Eastern Mosquitofish (*Gambusia holbrooki*), Flier (*Centrarchus macropterus*), and Spotted Bass (*Micropterus punctulatus*) were the only additional species found outside of the removal reach. Eastern Mosquitofish and Flier were both found in isolated floodplain pools near the main channel while Spotted Bass was found in the main channel downstream of the removal reach during electrofishing efforts focused on maximizing the species list. At Powhite Creek, Eastern

Mosquitofish was the only additional species found out of the removal reach. It was found in the main channel downstream of the removal reach during electrofishing efforts focused on maximizing the species list.

The observed fish communities at each location were comprised largely of native species typical of the region. Bluegill (*Lepomis macrochirus*) and Spotted Bass were the only non-native species that were observed. These species have both been heavily stocked outside of their native ranges so it was not very surprising to find them at RICH.

Atkinson (2008) reported 30 species from RICH during surveys performed in 2002 and 2003. This was a much more intensive effort so it is not surprising that more species were encountered. The information contained herein could be viewed as a supplement to Atkinson (2008) that provides data for streams on the two newly acquired parcels. Due to the aforementioned higher than median flow conditions at Totopotomoy Creek on the survey date, it is recommended that, should funding arise, a second survey take place at the same removal reach.

Table 2. Family, species, and common name of fish species observed in Powhite and Totopotomoy Creek at Richmond National Battlefield Park within removal reaches and during additional searching (Misc.) to maximize species lists.

Family Species	Common Name	Stream			
		Powhite Creek Removal	Misc.	Totopotomoy Creek Removal	Misc.
Anguillidae					
<i>Anguilla rostrata</i>	American Eel	4	17	6	4
Aphredoderidae					
<i>Aphredoderus sayanus</i>	Pirate Perch	4	7	1	4
Catostomidae					
<i>Erimyzon oblongus</i>	Creek Chubsucker	1	6	0	0
Centrarchidae					
<i>Centrarchus macropterus</i>	Flier	1	0	0	2
<i>Lepomis auritus</i>	Redbreast Sunfish	1	9	7	2
<i>Lepomis macrochirus</i>	Bluegill	1	1	5	12
<i>Micropterus punctulatus</i>	Spotted Bass	1	0	0	1
Cyprinidae					
<i>Semotilus atromaculatus</i>	Creek Chub	2	0	0	0
<i>Semotilus corporalis</i>	Fallfish	1	0	1	0
Esocidae					
<i>Esox niger</i>	Chain Pickerel	0	0	3	0
Ictaluridae					
<i>Ameiurus natalis</i>	Yellow Bullhead	27	89	17	11
<i>Noturus insignis</i>	Margined Madtom	5	25	5	3
Percidae					
<i>Etheostoma olmstedii</i>	Tessellated Darter	2	5	2	3
Petromyzontidae					
<i>Lampetra aepyptera</i>	Least Brook Lamprey	2	2	2	0
Poeciliidae					
<i>Gambusia holbrooki</i>	Eastern Mosquitofish	0	1	0	5
Species by method		13	10	10	10
Total Species		14		13	

Table 3. Species, number captured during each removal pass, population estimate (N-hat), standard error, and lower and upper 95% confidence interval based on population estimate and fish removals for Totopotomoy Creek at Richmond National Battlefield Park on 9/25/2018.

Common name	Pass 1	Pass 2	Total	N-hat	SE	L 95	U 95
Yellow Bullhead	16	1	17	18	1.41	18	24
Redbreast Sunfish	5	2	7	9	2.00	8	17
American Eel	5	1	6	7	1.41	7	13
Bluegill	3	2	5	7	2.00	6	15
Margined Madtom	3	2	5	7	2.00	6	15
Chain Pickerel	3	0	3	3	0.00	3	3
Least Brook Lamprey	0	2	2	4	2.00	3	12
Tesselated Darter	1	1	2	3	1.41	3	9
Fallfish	1	0	1	1	0.00	1	1
Pirate Perch	1	0	1	1	0.00	1	1

Table 4. Species, number captured during each removal pass, population estimate (N-hat), standard error, and lower and upper 95% confidence interval based on population estimate and removals for Powhite Creek at Richmond National Battlefield Park on 9/26/2018.

Common name	Pass 1	Pass 2	Pass 3	Pass 4	Total	N-hat	SE	L 95	U 95
Yellow Bullhead	18	0	5	4	27	39	6.93	32	61
Margined Madtom	3	2	0	0	5	5	0.00	5	5
American Eel	0	1	2	1	4	7	3.46	5	22
Pirate Perch	1	0	2	1	4	7	3.46	5	22
Tesselated Darter	1	0	1	1	3	6	3.46	4	21
Creek Chub	1	0	1	0	2	2	0.00	2	2
Least Brook Lamprey	0	0	0	2	2	8	4.90	4	26
Bluegill	0	1	0	0	1	1	0.00	1	1
Flier	0	1	0	0	1	1	0.00	1	1
Redbreast Sunfish	0	0	0	1	1	4	3.46	2	19
Spotted Bass	1	0	0	0	1	1	0.00	1	1
Creek Chubsucker	1	0	0	0	1	1	0.00	1	1
Fallfish	1	0	0	0	1	1	0.00	1	1

Table 5. Estimated population (N-hat), average weight, and estimated biomass of each fish species captured in a 100m reach of Totopotomoy Creek at Richmond National Battlefield Park on 9/25/2018.

Common name	N-hat	Avg Wt (g)	Biomass (g)
Yellow Bullhead	18	43.35	780.35
Redbreast Sunfish	9	6.43	57.86
American Eel	7	26.83	187.83
Bluegill	7	9.2	64.4
Margined Madtom	7	9.6	67.2
Chain Pickerel	3	14.67	264
Least Brook Lamprey	4	2	8
Tesselated Darter	3	1.5	4.5
Fallfish	1	123	123
Pirate Perch	1	2	2

Table 6. Estimated population (N-hat), average weight, and estimated biomass of each fish species captured in a 100m reach of Powhite Creek at Richmond National Battlefield Park on 9/26/2018.

Common name	N-hat	Avg Wt (g)	Biomass (g)
Yellow Bullhead	39	40.63	1584.56
Margined Madtom	5	21.4	107
American Eel	7	12.75	89.25
Pirate Perch	7	4.25	29.75
Tesselated Darter	6	3	18
Creek Chub	2	17.5	35
Least Brook Lamprey	8	2.5	20
Bluegill	1	12	12
Flier	1	12	12
Redbreast Sunfish	4	66	264
Spotted Bass	1	8	8
Creek Chubsucker	1	34	34
Fallfish	1	67	67

Literature Cited

Anderson, D. 2008. Model Based Inference in the Life Sciences: A Primer on Evidence. Published by Springer. ISBN 978-0-387-74075-1

Atkinson, James B. March 2008. Fish Inventories of Mid-Atlantic and Northeast Coastal and Barrier Network Parks with Virginia, Maryland and Pennsylvania. Technical Report NPS/NER/NRTR—2008/113. National Park Service. Philadelphia, PA.

Pollock K. H., and M. C. Otto. 1983. Robust estimation of population size in closed animal populations from capture-recapture experiments. *Biometrics* 39:1035–1049.

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. *Bird Study* Vol. 46 , Iss. Sup1.