

# Inventory of Fishes in Cowpens National Battlefield



*Submitted by*

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## ***Introduction***

South Carolina Department of Natural Resources Freshwater Fisheries staff inventoried freshwater fishes for the National Park Service in four Cumberland Piedmont Network parks in South Carolina and North Carolina. This document reports the findings from inventory activities at Cowpens National Battlefield (COWP). The inventory comprised a series of tasks that were addressed, as applicable:

- (A) Identifying species richness (to a 90% level),
- (B) Describing the distribution of each species within a park,
- (C) Determining abundance (particularly of sensitive species),
- (D) Collecting voucher specimens for those species where none exist or where species is not readily identifiable by photograph (no collecting of sensitive species),
- (E) Recording habitat variables and mapping observation coordinates
- (F) Collecting and organizing data to be compatible with existing databases,
- (G) Conducting representative sampling of common habitats and comprehensive coverage of specialized habitats,
- (H) Identifying fish species that are non-native to a park,
- (I) Reviewing Existing NPS Database Records for accuracy.

The park is located in Cowpens, South Carolina, within the Southern Outer Piedmont ecoregion. The park encompasses 842 acres and contains a battlefield that was the site of a decisive victory for Revolutionary War patriots. There are several small headwater tributary streams on the property that are part of the Broad River drainage (Santee River system).

## *Methods*

I obtained topographic maps and aerial photos from National Park Service staff to identify terrain features and hydrologic systems. Sites were initially selected using the maps and photos; actual sampling sites were then visited to determine accessibility and appropriate sampling methods. Freshwater habitats present were classified as stream systems. No lakes, ponds, wetlands or substantial springs capable of supporting fishes were identified. Although two ponds appeared on 1993 USGS topographic maps (largest one named “Scruggs Lake”), my ground truthing revealed no water at those locations. Recommendations of National Park Service personnel were also considered in selecting sampling locations. Since it is known that fish diversity increases with stream size, and given that a primary goal of the inventory is to collect a large percentage of species present on the park unit, I weighted effort toward larger streams and downstream reaches in determining sampling sites. A Geographic Positioning System unit (Garmin model 76CS, error typically reported +/- 4 to 12 m depending on topography and canopy cover) was used to assign coordinates (decimal degrees using datum NAD83) to selected sampling sites.

Fishes in COWP were sampled in July of 2005. Fish sampling was conducted using backpack electrofishing gear because all habitats were wadeable. Sampled stream lengths varied among sites. The lengths were equivalent to 30 times the average stream width because this effort has been shown to approach an asymptote of species richness for stream fishes (Angermeier & Smogor 1995). Each stream was sampled with one pass in a downstream to upstream direction, with thorough effort to collect all encountered fishes

in all habitats. All fish collected were identified to species, counted and released.

Voucher specimens of some species were retained and stored in a 70% ethanol solution with remaining vouchers comprising digital photos. No species listed as threatened or endangered by state or federal agencies were collected.

Number of individuals of each species collected was recorded for each sample location. Species relative abundance was calculated, determined by dividing the total number of fish of each species by the total number of fish collected at the site. Sites were pooled to give abundance and relative abundance by species for the entire park. I also report state conservation status of species as well as whether species were native or introduced to the system.

To give some likelihood that my effort captured 90% of fish species present on the park, I calculated the Chao1 estimator of total species richness from the sample data. This nonparametric estimator is based on the concept that rare species carry the most information about the number of missing ones, and uses single- and double-occurring species to estimate the number of species missing (Chao 2004). The Chao1 estimates of expected richness with 95% confidence intervals were computed from my samples using the EstimateS software (Colwell 2005) and estimates were compared to the richness I observed during the inventory.

I collected habitat variables at each site at the time of sampling according to SCDNR standard protocols. Geomorphic variables included average depth (m) and average

wetted width (m, taken from water edge to water edge) of the reach, obtained by taking widths and depths at five cross-section transects along the length of the sample reach. Water quality measured at the time of fish collection included water temperature (°C), dissolved oxygen (mg/L), pH, conductivity (uS/cm), and turbidity (NTU).

## ***Results***

I sampled four unnamed headwater streams in Cowpens National Battlefield on July 6, 2005 (Figure 1). For the purposes of this study, the streams were labeled as followed: COWP1 - Suck Creek # 2; COWP2 - Suck Creek # 1; COWP3 – Long Branch of Island Creek; COWP4 - Zekial Creek. Site coordinates, habitat and water quality measures taken at each site are presented in Table 1. The only water quality parameter falling outside of normal levels was dissolved oxygen at COWP4, likely due to lack of flow at the site during this period (standing water in pools). Even though these were all very small streams, several of which may be ephemeral, fishes were present at most sites.

I collected a total of 7 species from 2 families (Table 2), two species of which are listed in South Carolina's Comprehensive Wildlife Conservation Strategy as priority conservation species (SCDNR 2005). Fishes were patchily distributed among sites, and distribution patterns appeared to be associated with size and water quality of the streams (Table 3, Table 1). The two larger streams (COWP1 and COWP3; > 1 m wetted width) each contained six species, whereas the smallest stream (COWP2; less than 0.4 m width and 0.05 m depth) was devoid of fish. Site COWP4 harbored only creek chubs, a

generalist headwater species tolerant of the dissolved oxygen levels measured at only 2.46 mg/L (Table 3, Table 1). To obtain information on distribution, ecology, and conservation status of any of the species mentioned in this report (as of the date of this publication), NatureServe's website <http://www.natureserve.org/explorer/> could be searched by typing species names (common or scientific) into the search field.

Abundance of individual species also followed stream size rankings, as over 99% of the total 507 individuals collected in the park were found in the two larger streams (Table 4). Numbers of fish were directly related to channel width. The greatest number of fish, nearly 88%, were collected at COWP3, and most of the remainder were found at COWP1. Only two individual creek chubs were encountered in COWP4.

Relative abundance (defined as abundance by species divided by total catch) gives some picture of fish assemblage structure. Overall in the park, the most common species collected, in order of abundance, were: rosyside dace, blue head chub, creek chub, and highback chub (Table 5). At COWP1, creek chub dominated the assemblage (62%), followed by rosyside dace (18%) and highback chub (10%). COWP 3 contained a more even assemblage; the most abundant species were rosyside dace (41%), bluehead chub (21%), and highback chub (16%). These results for the most part are unsurprising, as rosyside dace is widely distributed in high-quality headwater streams of the uplands in South Carolina and both creek chub and bluehead chub are extremely widespread and common in the ecoregions above the fall line.

However, the occurrence of highback chub as a major part of the park's fish assemblage (15%; Table 5) is noteworthy as it is listed as a species of state conservation concern of moderate priority (SCDNR 2005). Moreover, the presence of Carolina fantail darter is of interest as it is a high conservation priority species. Both species are endemic to the southern Atlantic Slope, with distributions limited to the Santee and Pee Dee River drainages of South Carolina, North Carolina, and Virginia (Rohde et al. 1996). Both face similar threats across their range: impacts from land development, deforestation, loss of riparian cover, siltation, and hydrologic alterations (channelization and impoundment construction).

I assessed my inventory effort by comparing the inventoried species number, targeted at 90% of total species richness within the park, to Chao1 estimates generated from my sampling data. The computed expected value and confidence limits all converged on my observed value of seven species (Table 6). Therefore I conclude that my effort was more than adequate to inventory these small headwater streams.

Many other fish species that were not collected within the park occur in the piedmont region of the Broad River drainage. A partial list is presented in Table 7. Note that this list is generated from recent collections from often much larger streams, so many of these species would not be expected to occur in the small headwaters of COWP.

A list of digital photos taken at the COWP sites and their descriptions are included in Table 8. The images will be supplied separately from this report as digital files in JPG format.

### *Summary*

The Cowpens National Battlefield was found to contain several small headwater streams, four which were sampled and found to harbor a surprising number of fishes, seven species. The number of fishes was tied to the size of the stream, in keeping with standard theory and practice. Common headwater species were encountered along with two species of conservation concern to the South Carolina Department of Natural Resources.

The fact that the fish assemblage inhabiting the park includes two of South Carolina's priority conservation species, making up of about 15% of the park's fish fauna, is a good indicator. Land management is critical to aquatic systems, particularly headwater streams, since ecosystem processes such as hydrologic regime, carbon flow, and nutrient dynamics are highly influenced by the terrestrial drainage. Management to conserve aquatic ecosystem integrity includes restrictions on land development, maintenance of forested riparian zones to the maximum extent practical in keeping with cultural values of the park, and maintenance of natural hydrology and water quality. The role of the National Park System as good steward of these headwater streams is valuable and plays a part in the future persistence of our native fishes.

## **Acknowledgements**

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## **References**

Angermeier, P.L., and R.A. Smogor. 1995. Estimating number of species and relative abundances in stream-fish communities: effects of sampling effort and discontinuous spatial distributions. *Can. J. Fish. Aquat. Sci.* 52:936-949.

Chao, A. 2004. Species richness estimation. *In* N. Balakrishnan, C. B. Read, and B. Vidakovic, editors. *Encyclopedia of Statistical Sciences*. Wiley, New York.

Colwell, R. K. 2005. EstimateS: Statistical estimation of species richness and shared species from samples. Version 7.5. User's Guide and application published at: <http://purl.oclc.org/estimates>.

Rohde, F.C., R.G. Arndt, D.G. Lindquist, and J.F. Parnell. 1996. *Freshwater Fishes of the Carolinas, Virginia, Maryland, and Delaware*. University of North Carolina Press, Chapel Hill. 228 pp.

SCDNR. 2005. *Comprehensive Wildlife Conservation Strategy*.

<http://www.dnr.sc.gov/cwcs/index.html>

Table 1. Date of sampling, site coordinates in decimal degrees (datum NAD83), channel dimensions (meters), and water quality measures associated with each fish collection. Column abbreviations and measurement units are as follows: DO – dissolved oxygen (mg/L), CONDUCT – conductivity ( $\mu\text{S}/\text{cm}$ ), TURB – turbidity (nephelometric turbidity units), TEMP – temperature ( $^{\circ}\text{C}$ ).

SITE ID	FISH DATE	LATTITUDE	LONGITUDE	LENGTH	AVG WIDTH	AVG			CONDUCTIVITY ( $\mu\text{S}/\text{cm}$ )	TURBIDITY (NTU)	TEMP ( $^{\circ}\text{C}$ )
						DEPTH	DO (mg/L)	pH			
COWP1	7/6/2005	35.13970	81.81074	55	1.2	0.11	7.2	5.83	33	14.51	19.61
COWP2	7/6/2005	35.14118	81.81403	20	0.35	0.04	*	*	*	*	*
COWP3	7/6/2005	35.11950	81.80454	100	1.4	0.16	8.23	5.71	29	6.72	20.2
COWP4	7/6/2005	35.13317	81.81995	28	0.8	0.12	2.46	6.52	88	19.2	19.81

\* Site too shallow to submerge water quality instrument probe.

Table 2. Fish species collected from Cowpens National Battlefield, including their conservation and range status. Native refers to a species being indigenous to the Broad River drainage.

Common Name	Scientific Name	Family	State Conservation Status	Native/Introduced	Voucher status
redbreast sunfish	<i>Lepomis auritus</i>	Centrarchidae		Native	Photo DSCN1091.jpg
bluehead chub	<i>Nocomis leptcephalus</i>	Cyprinidae		Native	One specimen preserved
creek chub	<i>Semotilus atromaculatus</i>	Cyprinidae		Native	One specimen preserved
highback chub	<i>Hybopsis hypsinotus</i>	Cyprinidae	Moderate Priority	Native	Five specimens preserved
rosyside dace	<i>Clinostomus funduloides</i>	Cyprinidae		Native	Two specimens preserved
yellowfin shiner	<i>Notropis lutipinnis</i>	Cyprinidae		Native	Photo DSCN1092.jpg
Carolina fantail darter	<i>Etheostoma flabellare</i> complex	Percidae	Moderate Priority	Native	One specimen preserved

Table 3. Species distributions among sites. Any of the species mentioned in this report could be searched via NatureServe’s website <http://www.natureserve.org/explorer/> as of the date of this publication. Species names (common or scientific) can be typed into the search field to obtain information on distribution, ecology, and conservation status.

Common Name	COWP1	COWP2	COWP3	COWP4
creek chub	X		X	X
bluehead chub	X		X	
fantail darter	X			
rosyside dace	X		X	
highback chub	X		X	
redbreast sunfish	X		X	
yellowfin shiner			X	
Number of Species	6	0	6	1

Table 4. Abundance of each fish species by site and totals within the park.

Common Name	Number of Individuals				Park total
	COWP1	COWP2	COWP3	COWP4	
creek chub	38	0	54	2	94
bluehead chub	4	0	95	0	99
fantail darter	1	0	0	0	1
rosyside dace	11	0	184	0	195
highback chub	6	0	70	0	76
redbreast sunfish	1	0	2	0	3
yellowfin shiner	0	0	39	0	39
Number Individuals	61	0	444	2	507

Table 5. Relative abundance of each fish species by site and overall within the park.

Common Name	Relative Abundance (% of total catch)				Park Overall
	COWP1	COWP2	COWP3	COWP4	
creek chub	62%	0%	12%	100%	18.5%
bluehead chub	7%	0%	21%	0%	19.5%
fantail darter	2%	0%	0	0%	0.2%
rosyside dace	18%	0%	41%	0%	38.5%
highback chub	10%	0%	16%	0%	15.0%
redbreast sunfish	2%	0%	0%	0%	0.6%
yellowfin shiner	0%	0%	9%	0%	7.7%

Table 6. Observed fish species richness within COWP, computed Chao1 estimates of species richness, and percentage of observed richness versus the estimates. Goal of the inventory effort was to document 90% of species expected within the park.

Observed Species Richness	7	% Observed vs.Estimated Richness
Chao1 Expected Richness	7	100%
Chao1 lower 95% CL	7	100%
Chao1 upper 95% CL	7	100%

Table 7. A partial list of other fish species that were not collected within the park during this inventory, but which are native and commonly observed in streams of the outer piedmont ecoregion of the Broad River basin.

Common Name	Scientific Name	Family
striped jumprock	<i>Scartomyzon rupiscartes</i>	Catostomidae
bluegill	<i>Lepomis macrochirus</i>	Centrarchidae
warmouth	<i>Lepomis gulosus</i>	Centrarchidae
greenfin shiner	<i>Cyprinella chloristia</i>	Cyprinidae
sandbar shiner	<i>Notropis szepticus</i>	Cyprinidae
spottail shiner	<i>Notropis hudsonius</i>	Cyprinidae
eastern silvery minnow	<i>Hybognathus regius</i>	Cyprinidae
margined madtom	<i>Noturus insignis</i>	Ictaluridae
flat bullhead	<i>Ameiurus playcephalus</i>	Ictaluridae
yellow bullhead	<i>Ameiurus natalis</i>	Ictaluridae
seagreen darter	<i>Etheostoma thalassinum</i>	Percidae
tessellated darter	<i>Etheostoma olmstedi</i>	Percidae
eastern mosquitofish	<i>Gambusia affinis</i>	Poeciliidae

Table 8. List of digital photographs taken at COWP with their descriptions. Site codes are referenced in Table 1, and species information is found in Tables 2 through 5. The images will be supplied as digital files (JPG format) separate from this report.

Digital image file name	Description of image
DSCN1086	Site COWP1 looking upstream, showing tape measuring length of segment
DSCN1087	Site COWP2 during electrofishing, looking upstream
DSCN1088	Site COWP2, side angle
DSCN1089	Site COWP3 from bridge at park boundary
DSCN1091	Photo voucher of redbreast sunfish
DSCN1092	Three of the fish species present at COWP3, from top: rosyside dace, yellowfin shiner, highback chub
DSCN1093	Site COWP4, looking upstream

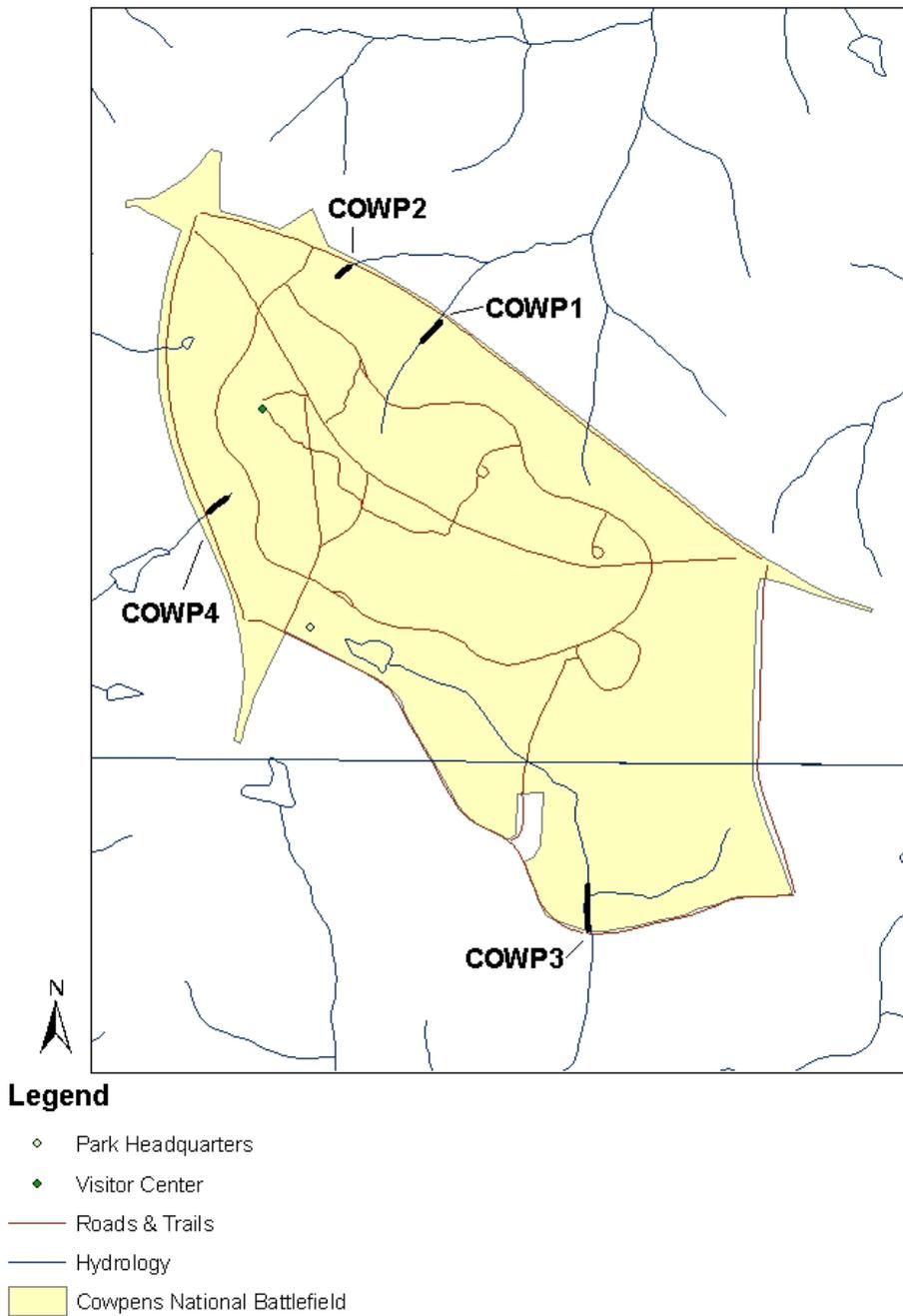


Figure 1. Map of Cowpens National Battlefield, hydrological features, road network, and locations of fish collections on four headwater streams. Stream names associated with each site are: COWP1 - Suck Creek # 2; COWP2 - Suck Creek # 1; COWP3 - Long Branch of Island Creek; COWP4 - Zekial Creek.