

Fish Inventory of Cumberland Gap National Historical Park

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v. Summary

This report summarizes an inventory of fish species and evaluation of fish habitat conducted in 2004 at Cumberland Gap National Historical Park. Fish surveys were conducted on reaches located on warm-water and cold-water streams within the park. Four warm-water stream reaches and two cold-water stream reaches were sampled in conjunction with a wetland and a subterranean stream which represented specialized habitat. A total of 1410 meters of stream length were sampled within the park.

1,946 individuals representing 22 species were collected during this study. Observed species included nine minnows, six sunfish, four darters, two suckers, and one sculpin. Minnows were the most abundant group of fishes encountered during this survey, comprising 66 percent of the total number of individuals. The cold-water and subterranean streams were found to be almost entirely fishless during our survey.

vi. Acknowledgements

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1. Introduction

National park lands represent some of the least disturbed environments within the United States. Due to their relatively pristine condition, national parks provide refugia for sensitive species and can provide baseline information for biological communities.

To protect these natural resources, knowledge of the current biodiversity, abundance, and distribution of species within national parks is essential for proper management. To gather this information, the National Park Service (NPS) has created inventory and monitoring networks. Inventory information will assist park managers with the identification of potential impacts to sensitive species, along with giving them the ability to monitor species population trends. Both of these factors will affect preservation of park ecosystems. Additionally, monitoring of species population trends is important because it may reflect environmental changes. The Cumberland Piedmont Network (CPN) and Appalachian Highlands Network (AHN) facilitate inventories of seven southeastern states containing seventeen NPS units. The Cumberland Gap National Historical Park (CGNHP) is located within the CPN. This report covers the results of a fish inventory of the CGNHP.

The objective of this study was to document the fish fauna within the park in terms of species richness, distribution, and relative abundance. Specifically, the goal of the study was to document 90 percent of the fish species reasonably expected to occur within the

park. Identification and description of fish habitat within the park, including physiochemical conditions and habitat assessments, were included in the survey.

Hrichak conducted an early fish survey on Little Yellow Creek within CGNHP in 1974. A total of 21 species were recorded from this survey, including seven sunfish species (Centrarchidae), three catfish species (Ictaluridae), and two minnow species (Cyprinidae). Barbour *et al.* (1979) surveyed the fish fauna from nine streams within and adjacent to CGNHP. They recorded 27 species from streams within or adjacent to the park, including 10 minnow species, 6 sunfish species, 4 darters (Percidae), and 2 suckers (Catostomatidae). A few of the species (e.g. yellow perch (*Perca flavescens*)) collected were probably introduced species that escaped from Fern Lake, a reservoir located upstream of the park (Barbour *et al.* 1979). The federally threatened blackside dace (*Phoxinus phoxinus*) was collected from Davis Branch. Also, brook trout (*Salvelinus fontinalis*), a cold-water habitat fish species, was collected from Martins Fork and Shillalah Creek during their survey. Stephens (2002a) has monitored blackside dace populations within Davis Branch on an annual basis since 1990. Since the invasion of beavers (*Castor canadensis*) into Davis Branch in 1993, Stephens (2002a) has noticed a reduction in numbers of blackside dace. Stream alteration caused by the construction of beaver ponds has impaired blackside dace habitat (Stephens 2002a). Several previous studies on Gap Creek conducted by Stephens (2002b) recorded 15 species from the creek within CGNHP and adjacent areas, including seven minnow species, three sunfish species, two sucker species, and one species each of trout (Salmonidae), sculpin (Cottidae), and darter.

2. Study Area

CGNHP is situated along an approximate 15-mile segment of Cumberland Mountain, a northeast-southwest oriented ridge that creates a natural border between Bell and Harlan Counties, Kentucky and Lee County, Virginia. Additionally, a portion of Clairborne County, Tennessee occupies the southwest corner of the park (Figure 1). The park was authorized by Congress in 1940 and encompasses 8,274 hectares. Cumberland Gap, located at the southwestern end of the park, represents a rare break in Cumberland Mountain. This natural pass through the mountains was first used as a game trail by migratory animals and later became an important transportation corridor for Native Americans and early settlers.

The trail through the pass eventually became US 25E, which linked the town of Middlesboro, Kentucky to Cumberland Gap, Tennessee. The wilderness trail was restored after the completion of the Cumberland Gap tunnel, a 4,600-foot long portal that passes under Cumberland Gap between Kentucky and Tennessee.

The park is located within the Cumberland Mountain Thrust Block ecoregion, which is characterized by high, steep ridges, hills, coves, narrow valleys, and the Pine Mountain Overthrust Fault (Woods 2002). Forests are usually more mesophytic than in the rest of the Appalachian Plateau but vary in composition based on aspect, slope, and past land use. Pennsylvanian sandstone, siltstone, shale, conglomerate, and coal underlie this area. Sedimentation from coal mining activities and logging have degraded the biological integrity and productivity of streams. Small streams are common, with high gradients, waterfalls, frequent riffles, few pools, and cobble/boulder substrates. Streams tend to be

less alkaline, less productive, and cooler than the Dissected Appalachian Plateau ecoregion located to the north.

The steep slopes of the park are covered in second or third growth forests dominated by mixed mesophytic species. The park contains over 20 caves, a number of streams and headwater tributaries, historical settlement, rock outcrops, and several unique high elevation bogs. Elevations within the park range from approximately 1,100 feet along Little Yellow Creek to over 3,200 feet along the ridge trail near Hensley Settlement. The park occupies portions of five United States Geological Survey 7.5 minute quadrangles: Ewing, Middlesboro North, Middlesboro South, Varillia, and Wheeler.

Cumberland Gap has hot and humid summers and moderately cold winters. The average summer (July) high temperature is 30.4° Celsius (C), with overnight lows averaging 16.8°C. In January, the average high temperature is 7.0°C, with an average low of – 4.4°C. Mean annual precipitation is 130.3 centimeters (cm) and is evenly distributed throughout the year (WKU 2003).

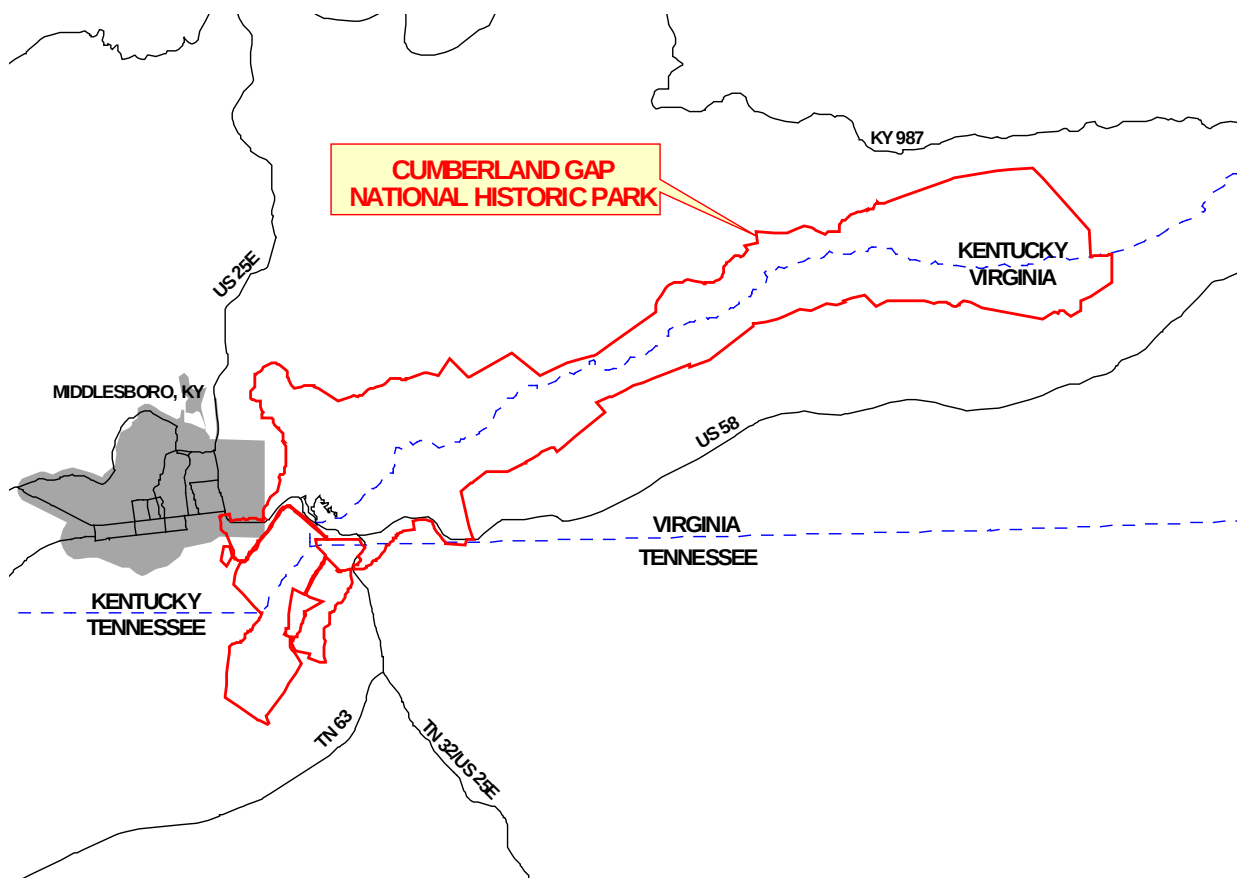


Figure 1 – Outline Map of Cumberland Gap National Historical Park

3. Methods

A species list of potential occurrences within the park was compiled before field surveys were begun. Species were categorized as “likely to occur”, “possibly present”, and “unlikely to be present”. “Likely to occur” species had been collected during previous surveys of the park. “Possibly present” species have been collected in areas adjacent to the park. Because of their recorded proximity to the park, it is probable that these species could be collected. “Unlikely to be present” species have not been collected within the park or adjacent areas but may be found in proximal habitat within the park. Additionally, a list of federally threatened or endangered species known to occur within the park or adjacent counties was compiled. Lists of all three species categories and federally listed species are provided in Appendix A. A preliminary species list of potential occurrence was determined from Barbour *et al.* (1979). More current studies (Stephens 2002a, 2002b) and distributional records (Burr and Warren 1986, Etnier and Starnes 1993, Jenkins and Burkhead 1993) were utilized to modify the species potential occurrence list. A species list generated from an early survey within the park (Hrichak 1974) was also reviewed in preparing the list of potential species. However, based on known species distributions (Burr and Warren 1986) some of these records are thought to be questionable and therefore were not included in the list. Kentucky, Tennessee, and Virginia sensitive species distribution records were reviewed to compile the federally threatened and endangered list (KDFWR 2004, TDEC 2004, VNHP 2004). Common and scientific names follow nomenclature listed in Robins *et al.* (1991).

Potential fish habitat within the park was identified from previous field surveys by Third Rock personnel, historical survey data, and communication with park staff.

Potential habitat types were categorized as stream, pond, wetland, or subterranean stream. Stream habitats were further characterized by their drainage area size, stream order, substrate type, whether they were considered to be cold-water or warm-water habitat, and riparian vegetation. Stream order was determined using USGS topographic mapping. Drainage areas were estimated using ESRI Arc GIS 9.0 software. Habitats were sampled at a frequency relative to their abundance and their potential to contain specific fish assemblages.

Dissolved oxygen, pH, water temperature, and specific conductance were measured in the field at each stream using a Hydrolab Quanta™ multi-probe water quality meter. Water quality equipment was calibrated prior to use in the field. Available habitat was evaluated at each stream reach sampled. Visual assessments were made of riffle and pool substrates, stream channelization, riparian conditions, and instream cover. Habitat characteristics were then scored on a habitat assessment field data sheet modified from EPA 841-B-99-002 (Barbour *et al.* 1999). A habitat score of 0 to 200 was assigned for each site (KDOW 2002). For streams of the Central Appalachian Ecoregion, a habitat score below 144 indicates non-support for designated uses. Scores between 145 and 155 indicate partial support, scores between 156 and 164 indicate support but are threatened, and scores above 164 indicate full support of designated uses. Additionally, a physical characterization/water quality field data sheet, modified from EPA 841-B-99-002 (Barbour *et al.* 1999) was completed for each stream reach sampled. Photos of each stream reach are included in Appendix B.

Fish sampling was conducted on 13 September, 2004, and from 20 to 24 September, 2004. Fish sampling was accomplished mostly through the use of a generator powered Smith-Root backpack electroshocker. Small mesh seines were also used in conjunction with the backpack shocker or by exclusively (e.g., subterranean stream sampling). During stream sampling stationary seines were placed both upstream and downstream of the sample reach to serve as barriers to prevent fish from escaping. Sample reaches were at least 20 times the wetted width of the streams and contained at least two riffles and two pools. Two passes were made through each reach from the downstream section to upstream section. Two people were involved with the fish sampling effort. One person operated the backpack shocker, while the other carried a bucket to hold captured fish. Both persons carried dip nets to capture stunned fish. Riffle areas were sampled using the backpack shocker with a seine located downstream of the riffle to capture affected fish. In larger streams, or streams with numerous fish, the reach was further divided into sub-sections by placing additional seines between the beginning and ending of each reach. Fish would be enumerated and identified from each of these sub-sections and then released downstream of the barrier for the next sub-section. This was done to prevent fish mortality during prolonged sampling events. Stream reach length was estimated using a Bushnell rangefinder. The length of the shocking event was recorded for each reach. Fish species and numbers of individuals were recorded in a field notebook for each stream reach.

The only habitat in which the backpack shocker was not utilized to sample fish was the subterranean stream reach. Carbon monoxide emitted from the gas-powered generator

posed a serious safety issue to researchers as well as causing possible harm to the cave ecosystem. Seines were employed to sample this habitat.

Digital photography was used to document voucher specimens. Photographs of voucher specimens are included in Appendix B. Some voucher specimens that were difficult to identify in the field were retained for lab inspection. Only one representative individual of each of these species was collected. Specimens were preserved in the field with 10 percent buffered formalin and transferred to a 70 percent ethanol solution for permanent preservation. No sensitive species individuals were collected as voucher specimens.

4. Results

Four distinct types of fish habitat were sampled within CGNHP. They included warm-water streams, cold-water streams, a subterranean stream, and a wetland (Table 1) (Exhibit A). Warm-water streams were the most dominant type of fish habitat within the park, and constituted the majority of the fish sampling effort. A total of 850 meters of stream length were sampled for this type of habitat. Warm-water streams sampled included reaches on Davis Branch (Reach #2) (Exhibit B), Little Yellow Creek (Exhibit B), Station Creek (Exhibit C), and Sugar Run (Exhibit D). Cold-water streams sampled included Martins Fork (Exhibit E) and Shillalah Creek (Exhibit F). The Kentucky Division of Water (2004) defines cold-water aquatic habitat as streams and associated substrate that will support indigenous aquatic life or self-sustaining and/or reproducing trout populations on a year-round basis. A total of 350 meters of stream length were sampled for this type of habitat. The subterranean section of Gap Creek, within Gap Cave I, was also selected for sampling (Exhibit G). Davis Branch contained two different habitats, therefore reaches were sampled within each of these two habitat types. Davis Branch Reach # 1 was located in the headwater section of the stream (Exhibit D). The habitat of the stream at this reach had been severely altered by beaver activity. Dam building had impounded this section of Davis Branch changing it from a shallow, free flowing, riffle/run dominated stream with cobble/gravel substrates to a pool dominated, low flow stream, with a silt/sand dominated substrate. This section also contains a beaver pond and dam. Therefore this section of Davis Branch was classified as a wetland. Except for this wetland section of Davis Branch, all other stream reaches within the park had a substrate dominated either by cobble/gravel or cobble/boulder.

Table 1 - xxxxxxxxx

Drainage areas, stream order, and dominant substrate type for each sampling reach is presented in Table 1. Exhibits are included in Appendix C.

Potential fish habitat not sampled within the CGHNP included several ponds (Exhibit B), and a highland bog (Exhibit E). These sites were not selected for sampling due to previous observations indicating an absence of fish (herpetofaunal survey [Meade 2003]).

Except for Davis Branch Reach #1, habitat scores indicated that all streams within the park scored high enough to meet designated uses (Table 1). The habitat score for Davis Branch Reach #1 (122) was well below the minimum score required to at least partially meet designated uses (>144). Habitat scores ranged from 122 to 182 (Davis Branch Reach #1 and Reach #2, respectively). Water temperatures ranged from 13.2°C (Martins Fork and Gap Creek) to 21.4°C (Davis Branch Reach #1). Dissolved oxygen levels were above minimum water quality standards (> or = 5 mg/L) for all sampled reaches. The pH range was neutral or acidic (6.8 to 4.1 standard units) for all streams within the park. Martins Fork and Shillalah Creek were the most acidic (4.9 and 4.1 standard units, respectively). Specific conductance levels were low for all streams, however, the specific conductance of Station Creek (281 μ S) appeared to be somewhat elevated compared to other streams in the park. Copies of habitat sheets and physical characterization sheets are provided in Appendix D.

A total of 1,946 individuals representing 22 species were captured during this study (Tables 2 and 3). Juvenile sunfish, too immature for species identification, were not included in taxa counts. Catch per unit effort (CPUE) varied from 0 to 0.259 fish individuals per second of shocking time. Number of seconds sampled and CPUE are presented in Table 3 for each stream. The most individuals (1593) and taxa (22) were collected from warm-water streams. Warm-water stream habitat produced 82 percent of the total number of individuals. All of the taxa collected during the park survey were present within warm-water stream habitat. Wetland habitats produced the next highest number of individuals (351) and taxa (9). Cold-water streams were practically fishless, yielding only 2 creek chub (*Semotilus atromaculatus*) individuals. No brook trout were present within either stream. The subterranean stream habitat sampled within the park was completely fishless.

Minnows were the most abundant type of fish collected within the park representing 66 percent of the total individuals, and 41 percent of the total taxa collected within the park. Sunfish and darters were the next most common groups representing 19 percent and 6 percent of the total number of individuals.

Blacknose dace (*Rhinichthys atratulus*) (426 individuals), creek chub (390 individuals), and redbreast sunfish (*Lepomis auritus*) (318 individuals) were the most common species encountered. Blacknose dace were limited to 2nd order warm-water streams, whereas creek chubs were found in every habitat that contained fish.

TABLE 2. FISH SPECIES OF CUMBERLAND GAP NATIONAL HISTORICAL PARK BASED ON AN INVENTORY STUDY CONDUCTED IN 2004

Common Name	Scientific Name
Minnows	
Central stoneroller	<i>Campostoma anomalum</i>
Silverjaw minnow	<i>Ericymba buccata</i>
Striped shiner	<i>Notropis chrysocephalus</i>
Rosyface shiner	<i>Notropis rubellus</i>
Blackside dace	<i>Phoxinus cumberlandensis</i>
Southern redbelly dace	<i>Phoxinus erythrogaster</i>
Bluntnose minnow	<i>Pimephales notatus</i>
Blacknose dace	<i>Rhinichthys atratulus</i>
Creek chub	<i>Semotilus atromaculatus</i>
Suckers	
White sucker	<i>Catostomus commersoni</i>
Northern hogsucker	<i>Hypentelium nigricans</i>
Sculpins	
Banded sculpin	<i>Cottus Carolinae</i>
Sunfish	
Rock bass	<i>Ambloplites rupestris</i>
Redbreast sunfish	<i>Lepomis auritus</i>
Bluegill	<i>Lepomis macrochirus</i>
Warmouth	<i>Lepomis gulosus</i>
Spotted bass	<i>Micropterus punctulatus</i>
Largemouth bass	<i>Micropterus salmoides</i>
Darters	
Greenside darter	<i>Etheostoma blennoides</i>
Rainbow darter	<i>Etheostoma caeruleum</i>
Fantail darter	<i>Etheostoma flabellare</i>
Stripetail darter	<i>Etheostoma kenicotti</i>

*Common and scientific nomenclature follows Robins *et al.* (1991).

Table 2 - xxxxxxxx

Thirty-one individuals of the federally threatened blackside dace were collected at two sampling reaches on Davis Branch. Blackside dace were more abundant at the downstream reach (29 individuals), than on the upstream reach (2 individuals) of Davis Branch. No other sensitive species were encountered during this survey.

Seven voucher individuals were collected during this study. They included silver jaw minnow (*Ericymba buccata*), rosyface shiner (*Notropis rubellus*), banded sculpin (*Cottus carolinae*), juvenile and adult bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and fantail darter (*Etheostoma flabellare*).

5. Discussion

The major goal of this study was to document 90 percent of the fish species thought to be present within CGNHP. In this study, approximately 73 percent or 16 of the 22 species thought “likely to occur” within the park were found. An additional five species, or 18 percent of those species categorized as “possibly present” were encountered during the survey. Additionally, a greenside darter (*Etheostoma blennoides*) that was listed as an “unlikely to be present” species, was observed during the survey.

Two of the species thought “likely to occur” that were not collected during this study have been collected during recent surveys. Arrow darters (*Etheostoma sagitta*) have been recently collected by Stephens (2002a) on Davis Branch, although in very few numbers. Snubnose darters (*Etheostoma s. simoterum*) have been collected recently (Stephens 2002b) on Gap Creek. Only the subterranean section of Gap Creek was surveyed during this study. Snubnose darters were found below this section of Gap Creek (Stephens 2002b). Even though these two species were not collected during this survey it is likely that they are still present within the park. Two green sunfish (*Lepomis cyanellus*) individuals were collected from a 1996 survey of Gap Creek (Stephens 2002b). Green sunfish have not been collected from Gap Creek during more recent surveys conducted by Stephens (2002b). Distributional records would indicate that green sunfish are rarely found within the CGNHP. Whitetail shiner (*Notropis galacturus*) individuals collected during the 1979 survey (Barbour *et al.*) were caught in untypical habitat. Therefore their absence from collections during this survey is not unexpected. Two species included on the “likely to occur” list, tangerine darter (*Percina aurantiaca*) and western sand darter

(*Ammocrypta clara*), should have been placed on the “possibly present” list rather than the “likely to occur” list. Longear sunfish (*Lepomis megalotis*) were encountered on Little Yellow Creek (Barbour *et al.* 1979) but not during this survey. It is plausible that longear sunfish have been replaced by redbreast sunfish (*Lepomis auritus*) on this section of Little Yellow Creek. During this survey, redbreast sunfish were the most commonly encountered fish (103 individuals) from Little Yellow Creek.

Brook trout have apparently been extirpated from the park. Brook trout were previously stocked in Martins Fork and Shillalah Creek within the park boundaries (Barbour *et al.* 1979). Impassible barriers, such as very steep drops in elevation, have apparently prevented invasion of other fish species into both Martins Fork and Shillalah Creek. The acidic nature of both streams may also be a contributing factor to the absence of a viable fish community within these streams on park property.

Since blackside dace prefer cool streams with rocky substrates and good canopy cover (Starnes and Starnes 1981) the recent beaver activity on the upper section of Davis Branch (Reach #1) has negatively impacted blackside dace habitat. Substrates were covered in silt, water temperatures were elevated, and canopy cover was greatly reduced compared to the downstream reach (Reach #2). Numbers of blackside dace encountered during this survey were significantly lower for Reach #1 (2 individuals) than Reach #2 (29 individuals). This study supports the observation by Stephens (2002a) that beaver activity appears to be negatively impacting the blackside dace population within Davis Branch. Predation may also be detrimental to the dace population of Davis Branch Reach #1.

Ten times the number of sunfish individuals was present within Reach #1 on Davis Branch (201 individuals) as compared to Reach #2 (21 individuals). The larger number of sunfish could represent increased risk of predation for blackside dace of this stream reach. Other sensitive species listed for Clairborne County, Tennessee and Lee County, Virginia (Appendix A) have not been encountered within the park boundaries either during this study or past surveys (Hrichak 1974, Barbour *et al.* 1979, Stephens 2002a, Stephens 2002b).

Fish capture rates were similar between warm-water stream habitats (0.125 individuals per second) and wetland habitats (0.121 individuals per second). Fish capture rates for cold-water streams were very low (0.001 individuals per second).

6. Conclusions

Although the primary goal of 90 percent of the expected species was not met, this study yielded six additional species believed to be either possibly present or unlikely to occur within the CGNHP. The most abundant fish habitat available within the park is warm-water streams. All fish species captured were found to occur within this habitat.

Specialized habitat sampling did not yield any species that were not also present in warm-water streams. Subterranean and cold-water stream habitats did not provide viable fish habitat within the park. Viable brook trout populations were not found and are probably no longer present within Martins Fork or Shillalah Creek inside CGNHP boundaries. The federally listed blackside dace is present in Davis Branch within CGNHP boundaries.

Blackside dace habitat in the headwater section of Davis Branch is being negatively affected by beaver dam construction. Removal of beaver and their dams should allow this section of stream to return to more suitable conditions for blackside dace.

Substrates were similar at all stream reaches except for the subterranean section of Gap Creek and Davis Branch Reach #1. Riparian vegetation protection and width was considered optimal to sub-optimal for all stream reaches except Davis Branch Reach #1. Acidic pH readings for Martins Fork and Shillalah Creek are presumed to be naturally occurring due to the lack of mining activity within their respective watersheds. Specific conductance levels for Station Creek were elevated compared to other streams within the park. Portions of Station Creek's watershed are located within agricultural areas adjacent to the park. Runoff from these areas could be responsible for elevated conductivity readings on Station Creek.

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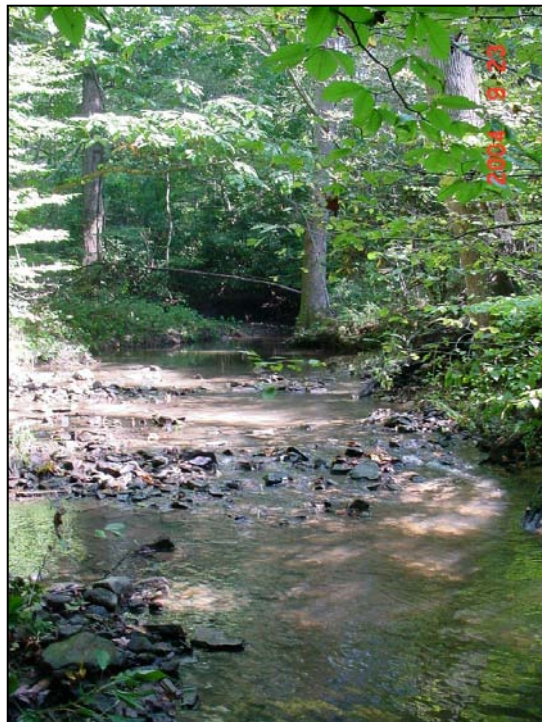
Appendix A. List of Potential Fish Species Occurrences Within CGNHP.

Appendix B. Photographs of species.

Stream Photos



Davis Branch Reach 1



Davis Branch Reach 2



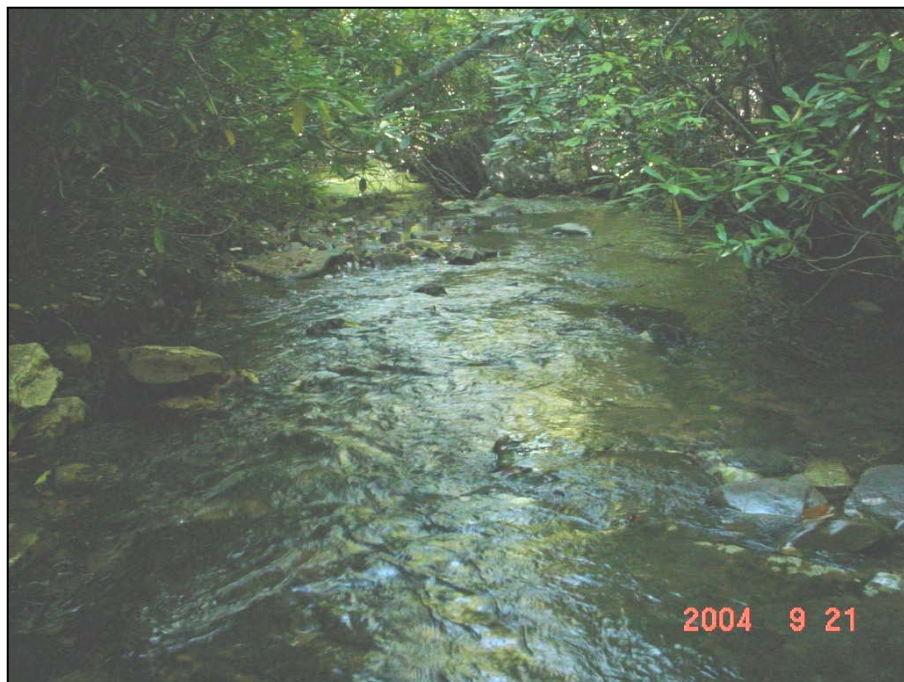
Gap Creek Within Gap Cave I



Little Yellow Creek



Martin's Fork



Shillalah Creek



Station Creek



Sugar Run

Minnows



Central Stoneroller, *Campostoma anomalum*
Location Captured: Davis Branch Reach #1



Silverjaw Minnow, *Ericymba buccata*
Location Captured: Little Yellow Creek,
preserved Specimen



Striped shiner, *Notropis chrysocephalus*
Location Captured: Davis Branch Reach #1



Rosyface shiner, *Notropis rubellus*
Location Captured: Little Yellow Creek,
Preserved Specimen



Blackside dace, *Phoxinus cumberlandensis*
Location Captured: Davis Branch Reach #1



Southern redbelly dace, *Phoxinus erythrogaster*
Location Captured: Davis Branch Reach #1



Bluntnose minnow, *Pimephales notatus*
Location Captured: Little Yellow Creek



Blacknose dace, *Rhinichthys atratulus*
Location Captured: Sugar Run



Creek Chub, *Semotilus atromaculatus*
Location Captured: Davis Branch Reach #1

Suckers



White Sucker, *Catostomus commersoni*
Location Captured: Little Yellow Creek



Northern Hogsucker, *Hypentelium nigricans*
Location Captured: Little Yellow Creek

Sculpins



Banded sculpin, *Cottus carolinae*
Location Captured: Station Creek, Preserved Specimen

Sunfish



Rock bass, *Ambloplites rupestris*
Location Captured: Little Yellow Creek



Redbreast sunfish, *Lepomis auritus*
Location Captured: Little Yellow Creek



Bluegill, *Lepomis macrochirus*
Location Captured: Little Yellow Creek,
Preserved Specimen



Warmouth, *Lepomis gulosus*
Location Captured: Little Yellow Creek



Spotted bass, *Micropterus punctulatus*
Location Captured: Little Yellow Creek



Largemouth bass, *Micropterus salmoides*
Location Captured: Little Yellow Creek, Preserved Specimen

Darters



Greenside darter, *Etheostoma blennoides*
Location Captured: Little Yellow Creek



Rainbow darter, *Etheostoma caeruleum*
Location Captured: Little Yellow Creek



Fantail darter, *Etheostoma flabellare*
Location Captured: Station Creek,
Preserved Specimen



Stripetail darter, *Etheostoma kenicotti*
Location Captured: Sugar Run

Appendix C. Exhibits

Appendix D. Physical characterization and habitat assessment field data sheets.