

APPENDIX F
SUMMARY OF FISH AND MACROINVERTEBRATE STUDIES

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SUMMARY OF FISH AND BENTHIC INVERTEBRATE STUDIES COMPLETED IN CUMBERLAND GAP NATIONAL HISTORICAL PARK

Fish Studies

National Park Service Studies

Barbour et al. (1979) conducted a survey of fish in the park. Appendix D provides a detailed summary of this study. The following is a general summary of this study, excerpted from the report:

- Streams inside Cumberland Gap National Park are all small, seldom reaching third order. As a consequence, the abundance of fish species is low; many forms which are widely distributed within the Cumberland basin on the Kentucky side of the Park and in the Tennessee basin on the Virginia-Tennessee side, are absent within Park boundaries. Fern Lake, an impoundment lying just outside the Park, influences the fish faunal of Yellow Creek to some degree.
- Streams in the Park are clear and generally uncontaminated by pollutants of human origin. Considering their small size, they maintain good flow through the summer and autumn low stages. In many cases their high quality contrasts strikingly with streams they join just outside the Park. Streams of the Park constitute a valuable aquatic resource of the region.
- The fish survey of Cumberland Gap National Historical Park recorded 27 species inside the Park boundary. Yellow Creek with its tributary, Davis Branch, is the only stream within the Park to contain a complex species assemblage. Twenty-three species were captured there.
- No catfish were taken during this study. Black bullhead or yellow bullhead are suspected to occur in Yellow Creek, because Dr. Barbour observed a catfish at the Park boundary near the railway bridge. Channel catfish have been stocked in Fern Lake and are possibly native to Yellow Creek. The stonecat and brindled mad tom are two dwarf catfishes which might turn up in Yellow Creek.
- Several minnows, whitetail shiner (*Notropis galacturus*), rosefin shiner (*Notropis ardens*), rosyface shiner (*Notropis rubellus*), and possibly others are likely to appear occasionally in Yellow Creek.
- Besides the yellow perch and channel catfish, other species, including rainbow trout and smallmouth bass, have been stocked in Fern Lake. Specimens washed over the spillway will enter Yellow Creek.
- The rich fish fauna of the Tennessee River basin is virtually precluded access to the Park by the extremely small size of streams on that side of Cumberland Mountain. Gap Creek could be an exception to the rule because it is fed by a large, permanent spring. Sewage pollution in the past had been responsible for the reduction or elimination of fish in the creek. Only two forms, blacknose dace and banded sculpin, were caught during the survey. Since the creek sinks and reemerges before entering the Powell River, reinvasion could be indefinitely delayed. By mutual agreement the National Park Service and the Tennessee Department of Fish and wildlife could collect fishes from lower Gap Creek or a nearby stream of third or fourth order, and reintroduce these to upper Gap Creek with no danger of upsetting natural faunal relationships.

2004 Fish Inventory Project

An inventory of fish species was conducted in 2004 at Cumberland Gap National Historical Park by Albert W. Remley of Third Rock Consultants. Four warm-water and two cold-water reaches were sampled for a total of 1410 meters of stream length. 1,946 individuals representing 22 species were observed during this project. The species included nine minnows, six sunfish, four darters, two suckers, and one sculpin. The minnows were the most abundant group of fishes found during this survey.

Fish sampling was conducted during the month of September, 2004. The streams sampled included Davis Branch, Gap Creek, Little Yellow Creek, Martins Fork, Shillalah Creek, Sugar Run, and Station Creek. Due to the differences in habitat along Davis Branch, two sites were sampled; one site within the beaver ponds and one downstream of the beaver ponds. For the purpose of this study the site within the beaver pond was considered a wetland.

The warm-water reaches, Davis Branch, Sugar Run, Little Yellow Creek, and Station Creek, yielded the highest number of individuals (1593) and species (22) (Remley 2005). The cold-water reaches, Shillalah Creek and Martins Fork, were practically fishless, yielding only 2 creek chub individuals. No brook trout were present in either stream. The acidic nature of these streams may be a contributing factor to the absence of a viable fish population on the sections within the park.

The top three species found during the study were blacknose dace (*Rhinichthys atratulus*) 426 individuals, creek chub (*Semotilus atromaculatus*) 390 individuals, and redbreast sunfish (*Lepomis auritus*) 318 individuals (Remley 2005). Thirty one individuals of the federally threatened blackside dace (*Phoxinus cumberlandensis*) were found in the two Davis Branch reaches (Remley 2005). Only two individuals were found in the upstream beaver pond area.

The species found in previous surveys but not observed during this survey include arrow darter (*Etheostoma sagitta*), snubnose darter (*Etheostoma s. simoterum*), green sunfish (*Lepomis cyanellus*), whitetail shiner (*Notropis galacturus*), longear sunfish (*Lepomis megalotis*), and brook trout (*Salvelinus fontinalis*).

This study supports Stephens' studies that have observed a decrease in the blackside dace population in the upper reaches of Davis Branch. The habitat alteration by beaver has elevated water temperature, increased siltation in the substrate and reduced the canopy cover. Blackside dace prefer cool streams with rocky substrates and good canopy cover. In addition, the increases in the sunfish population in this section of the creek may be decreasing the blackside dace population through predation.

FISH SPECIES OF CUMBERLAND GAP NATIONAL HISTORICAL PARK BASED ON AN INVENTORY STUDY CONDUCTED IN 2004 – THIRD ROCK CONSULTANTS

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

Benthic Invertebrate Studies

Copeland et al. (1992) prepared a report on benthic macroinvertebrates collected at five stations on Little Yellow Creek, two on Gap Creek, five on Davis Branch, two on Tunnel Creek, one on Dark Ridge Creek, and one on Sugar Run (total of 16 stations). They measured taxa richness, species diversity, equitability or evenness, relative abundance, the Ephemeroptera/Plecoptera/Trichoptera Index (EPT Index), and the functional feeding group of each organism. Sampling was conducted during June and October, 1990, and April, 1991. Appendix E provides excerpts from their study for each of the major stream features. The following is an overall summary of this information:

- With the possible exception of Tunnel Creek and the portion of Yellow Creek which receives water from Tunnel Creek, the streams that were studied are in good condition.
- Sedimentation is changing substrates within Tunnel Creek and Little Yellow Creek downstream of the confluence of Tunnel Creek as gravel, cobble, and rock are covered with silt.
- They predicted that after the tunnel project was completed, the streams should recover.
- The observed low taxa richness and species diversity is typical of headwater streams.
- The percentage of taxa richness composed of Ephemeroptera/Plecoptera/Trichoptera (EPT) is high.

Skelton and Eisenhour (1993) summarized results from the 16 stations for data collected between July, 1993 and February, 1994. This was a continuation of the study by Copeland et al. (1992). Quarterly sampling was conducted in Little Creek, Yellow Creek, Gap Creek, Davis Branch, Tunnel Creek, Dark Ridge Creek, and Sugar Run. However, the study by Skelton and Eisenhour (1995) added two "reference" stations in Martins Fork and Shillalah Creek in January, 1992 because they were remotely located and were not visibly impacted by man's activities. Two stations were also added in Lewis Hollow and Station Creek because of planned construction associated with U.S. Rt. 58. The following is a summary of the study:

- Davis Branch – Overall decrease in taxa diversity between 1991 (the previous study by Copeland et al.) and February, 1993. The number of species was similar to the previous study by Copeland et al (1992). The EPT taxa were 60% of the total species present, similar to the previous study. The stream was estimated to be in good condition. However, it's proximity to KY 988 and U.S. 25-E was predicted to cause degradation of the benthic populations and the blackside dace.
- Dark Ridge – While no impacts appeared to be affecting this creek, taxa richness had decreased by about 50% beginning in May, 1992. However, the percentage of EPT taxa was fairly stable and actually increased over the last two collecting periods. Sampling methods may have affected these results.
- Gap Creek – Did not appear to have changed since the last study, except at one station below the U.S. 25 construction zone. The creek did not appear to be severely degraded and was expected to improve over time.
- Lewis Hollow – This stream was characterized by low taxa richness, but water quality appeared to be good. 89% of the organisms collected were EPT taxa.
- Martins Fork – This is one of the two control creeks. Benthic populations in this stream were about average in comparison to other streams sampled in the park. 70% of the organisms sampled

were EPT. The remote nature of this stream should help insure the continued good health of benthic populations.

- Shillalah Creek – This is one of the two control creeks. Taxa richness was not very high, but 80% of the organisms collected in February were EPT taxa.
- Sugar Run – Appeared to be in good health in February 1992. The EPT taxa made up at least 50% of the samples collected. This stream was predicted to exhibit good health since no projects are planned that could affect it. Outside the park, it is affected by highway runoff.
- Station Creek – This stream appeared to be healthy. Sampling appeared to have been hindered, however. Future construction associated with U.S. Route 58 was predicted to have impacts on this stream.
- Tunnel Creek – This stream was described as intermittent, depending on weather, which was supported by the sampling results. This stream was strongly affected by the construction of the U.S. 25E tunnel, since all runoff associated with construction was directed to this creek. Only three taxa were collected here. Recovery of benthic populations was expected to occur over time, however.
- Little Yellow Creek – This stream was seriously affected by the construction of the U.S. 25E tunnel. Severe degradation of benthic populations was observed below the confluence of Little Yellow Creek and Tunnel Creek. However, recovery was observed and improvements were predicted over time as silt washed out of the stream.

Skelton and Fraley (1995) summarized the results of continued monitoring in the park. The following is a summary of the results of this study:

- The same 16 stations sampled by Skelton and Eisenhour were sampled quarterly between July, 1993 and February, 1994. Not all of the same stations were sampled. Additional types of EPT statistics were included to more accurately reflect changes in pH and increased siltation. Changes in EPT taxa were described as being especially important, although all the other indicators are also important.
- Dry Branch – Only one station was sampled just above the confluence with Little Yellow River. No change in the healthy condition of this stream was noted.
- Gap Creek – Based on the stations sampled, the diversity at this station remained relatively stable during the study. The high percentage of EPT taxa indicate the stream was in good health.
- Lewis Hollow – This was a control stream for future highway activities associated with U.S. Highway 58. Limited sampling and small size of the stream were said to affect the low number of taxa observed.
- Martins Fork – This is a small control stream located in a remote section of the park. Sampling on one occasion indicated the stream is still in good health and has not changed significantly since the last sampling event.
- Shillalah Creek – This is also a control stream. The stream was characterized as being in good ecological condition, with high numbers of diversity and EPT statistics.

- Station Creek – This is being monitored to detect potential effects of U.S. Highway 58 construction in the future. It would also be affected by any construction in the Wilderness Road Campground. This is a medium gradient stream that was sampled only once during the study. The overall condition of the creek had improved since the previous study, although one station (ST10) experienced a large drop in the total number of specimens collected between November, 1993 and February, 1994.
- Sugar Run – A sharp drop in the number of specimens collected in July, 1993 (33 specimens collected versus a previous low number of specimens collected of 72 in October, 1992). Only 10 taxa were collected; half as many as were collected previously. This was possibly attributed to sampling. Additional sampling was recommended to assess the situation further.
- Tunnel Creek – This stream has continuously been affected by tunnel construction runoff. Wide variations in pH and sediment loads were said to severely impact benthic populations. As a result the benthic populations were reduced to 3-4 taxa.
- Little Yellow Creek – This stream was used to monitor for effects of tunnel and highway construction. The upper reaches were characterized as being fairly healthy. Diversity remained stable during the course of the study. The stations below the construction area were severely affected, however. Changes in pH and sediment loading are the two primary factors that affected benthic populations. Rapid re-colonization from upstream control areas was thought to occur, however, although it would take longer as the distance from the control areas increased. It was predicted that the area would recover over the long term.

The overall conclusion of this study was that the benthic populations had generally remained the same. Tunnel Creek and Yellow Creek were still in the process of recovery. The pH levels had stabilized at the time, but siltation probably was still affecting Tunnel Creek and the lower stations of Little Yellow Creek. All statistics had risen since the last sampling, which was said could potentially represent a marked improvement in the areas previously, severely affected by tunnel runoff.

Tennessee Department of Environment and Conservation Studies

As part of the analyses of allegations of the Fern Lake lands unsuitable for mining petition, an interagency team conducted a biological survey of Little Yellow Creek upstream of Fern Lake. The Tennessee Department of Environment and Conservation (TDEC, 1995) reported on the results of this study. The following is an excerpted summary of this study:

- Quantitative assessment of fish community structure and qualitative assessment of benthic macroinvertebrate communities were conducted in conjunction with aquatic and riparian habitat assessment at four sampling locations on Little Yellow Creek upstream of Fern Lake.
- The 1995 investigation by TDEC was conducted in part to assess the health of a population of blackside dace (*Phoxinus cumberlandensis*), cyprinid (minnow) (listed under The Endangered Species Act as threatened by the U.S. Fish and Wildlife Service) (52 FR 22580) and as endangered in the State of Tennessee (Eager and Hatcher, 1983). The presence of blackside dace in Little Yellow Creek was initially identified by McCoy and McCoy Environmental Consultants (1993) as part of baseline environmental information provided in an application by Appolo Fuels, Inc., to conduct surface mining in the Little Yellow Creek watershed.
- The TDEC (1995) study indicated that fish community diversity was reduced in Little Yellow Creek upstream of Fern Lake. Eight species of fish were identified, dominated by creek chub

(*Semotilus atromaculatus*). The primary stress to aquatic communities in upper Little Yellow Creek is sedimentation and stream size. Qualitative field assessment of the stream channel bedload indicated a high ratio of sand to gravel sized substrate. Small particle size substrate is undesirable because of instability during storm flow and because of habitat reduction associated with filling of interstices between cobble and boulder sized particles. The increased sediment and gravel loading in the Little Yellow Creek watershed is primarily attributable to previous coal mining activity and to a lesser extent, road construction and logging activity.

- Although results of the TDEC and McCoy and McCoy investigations indicated moderate stress to the uppermost reaches of Little Yellow Creek, a thriving population of blackside dace persists in Little Yellow Creek above Fern Lake. Blackside dace were common at all sampling locations, third in frequency of occurrence only to the creek chub and blacknose dace. The continued survival of a healthy population of blackside dace can be attributed to the presence of silt free areas downstream of riffles, which afford suitable spawning habitat, and to an undisturbed zone of riparian vegetation, the shading of which attenuates stream temperature increase during the summer months.
- Little Yellow Creek was impounded to form Fern Lake. As a result of impoundment, aquatic habitat in Little Yellow Creek was altered. A biological survey of Fern Lake has not been conducted; however, biological community structure following impoundment of upland streams shifts from minnow and darter dominated stream species to lacustrine species such as bass, bream, and catfish. As a consequence of impoundment, the downstream extent of the blackside dace population in Little Yellow Creek is limited by Fern Lake. In addition, Fern Lake is a barrier to downstream "seeding" of blackside dace to lower reaches of the Yellow Creek watershed. Consequently exchange of genetic information is not possible without direct intervention through transplanting or rearing. Although Fern Lake is a limiting factor to blackside dace, the lake serves as a pollutant sink for moderate siltation and chemical loading associated with upstream land use activity.
- In summary, Yellow Creek upstream of Fern Lake is a moderately stressed aquatic system supporting a reduced assemblage of aquatic fauna. The predominant stress to the stream is sediment loading and erosion associated with land use activity in the watershed; primarily coal mining and logging. In addition, poorly sustained stream flow is a limiting factor, resulting in a fish community comprised of drought tolerant species. Impoundment by Fern Lake attenuates upstream impacts through dilution and settling. Little Yellow Creek, immediately downstream of Fern Lake, is largely unstressed; however, construction activity at the Cumberland Gap tunnel has reduced the fishery community of Little Yellow Creek further downstream. Davis Branch, a tributary to Little Yellow Creek is largely unstressed, supporting the most diverse assemblage of fish in the entire Yellow Creek watershed. The Kentucky Division of Water has identified Little Yellow Creek and Davis Branch as important refuges for "nursery stock" of fish for lower reaches of the Yellow Creek watershed, which is stressed by various municipal activities, channel alteration, and land use activities such as coal mining, timbering, and road construction.

Study by Stephens (1993, 2006/2007)

The relative health of Little Yellow Creek upstream of Fern Lake can be judged by comparison to Davis Branch, a tributary to Little Yellow Creek downstream of Fern Lake. Stephens (1993) surveyed Davis Branch as part of an ongoing blackside dace population assessment by the National Park Service. Davis Branch is an upland (second order), cool water stream with a moderate gradient and a forested watershed that lies wholly within the boundary of the Cumberland Gap National Historical Park

(CGNHP). Stephens (1993) reported that Davis Branch supported a diverse fishery community comprised of 15 species, including the blackside dace.

In comparison to previous investigations, the 1993 survey of Davis Branch indicated stable species composition and community structure. Stephens described Davis Branch as moderately silted, primarily due to bank erosion. Although erosion is evident, silt-free areas downstream of riffles were observed that are suitable for spawning by blackside dace. Consequently, a healthy blackside dace population was present throughout the length of Davis Branch, with the exception of the lowermost sampling station near the mouth. At that point, habitat requirements for the blackside dace are marginal because of increased numbers of predator species, reduced stream gradient, and reduced overstory canopy cover.

After the 1993 survey, beaver began to build dams in the upper reaches of Davis Branch. In the following years, Stephens observed that the blackside dace population in the upper reaches of Davis Branch changed significantly as a result of beaver activity (1994). The beaver ponds altered the physical structure of the habitat by increasing the temperature of the water, increasing siltation downstream, and contributing to the increase of the redbreast sunfish population, a predator of blackside dace (Stephens 1999). There was a general shift of the declining population to downstream sections of Davis Branch (Stephens 2002, 2006/2007). An additional survey during the spring of 2007, upstream of the standard sampling stations, revealed a small population of dace above the beaver ponds and has restored some hope for the blackside dace population in Davis Branch.

Kentucky Department of Environmental Protection, Division of Water/ Kentucky Division of Water Quality Studies

In addition to the previously discussed investigations by TDEC and Stephens, additional investigations have been conducted in the Yellow Creek watershed. A biological and water quality investigation of the Yellow Creek watershed was conducted by the Kentucky Department of Environmental Protection, Division of Water (KYDW) in 1988 and 1990 as part of an ongoing assessment of water quality in the Yellow Creek watershed.

Previous investigations in the Yellow Creek watershed by the Kentucky Division of Water Quality (DOWQ, 1978) and Harker, et al. (1979), indicated adverse impacts associated with coal mine runoff and municipal wastewater effluents in the Yellow Creek watershed. The principal focus of the investigation was to assess the extent of water quality improvement associated with upgrading of the Middlesboro Wastewater Treatment Plant in 1986, but the survey included sampling points throughout the Yellow Creek watershed, including Little Yellow Creek.

The 1988 and 1990 investigations by the Division of Water Quality (1978) indicated a general trend of improvement when compared to previous water quality assessments in the Yellow Creek watershed (Harker, et al., 1979). However, physiochemical and biological data indicated continued nutrient loading to Yellow Creek associated with discharges from the wastewater plant and additional adverse impacts associated with surface mining, sedimentation, and stream channelization. Analyses of physiochemical conditions and biological communities indicated moderate to slight impairment of water quality throughout most of the Yellow Creek watershed, with the exception of Little Yellow Creek and Davis Branch. KYDW concluded that only Little Yellow Creek remained unimpaired, fully supporting designated warm water aquatic habitat use. Yellow Creek and Bennett's Fork were moderately to slightly impaired, partially supporting warm water aquatic habitat use.

U.S. Army Corps of Engineers Studies

More recently, the U.S. Army Corps of Engineers (COE) conducted additional biological investigations in the Yellow Creek watershed as part of an Environmental Assessment of proposed flood control measures in the Yellow Creek watershed in Middlesboro, Kentucky (COE, 1995). Benthic macroinvertebrate and fish communities at sampling points throughout the watershed indicated severely stressed conditions in Yellow Creek proper as the result of sediment loading and organic enrichment. The COE investigation indicated that, with the exception of a short stream reach immediately downstream of the Yellow Creek bypass, conditions in Yellow Creek had degraded since the previous investigations by the Kentucky Division of Water Quality (1978). Although biological communities in Yellow Creek proper were depressed, Little Yellow Creek below Fern Lake supported a diverse benthic macroinvertebrate community. However, only four species of fish were identified in Little Yellow Creek. The apparent reduction in the fish community in comparison with the KYDW study (15 species) was attributed to construction activities at the Cumberland Gap tunnel and associated point and non-point source discharges.

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