



Cumberland Piedmont Network Water Quality Report; Third Serial *Cowpens National Battlefield*



Water Quality Monitoring Site - Little Buck Creek (LBLE)
17°N 0425156 3888728 289 m WGS 84 N

COWP
2004/11/16 2:43pm

ON THE COVER

Little Buck Creek, November 16, 2004

Photograph by: Shepard McAninch

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Joe Meiman
National Park Service
P.O. Box 8
Mammoth Cave, KY 42259

January 2008

U.S. Department of the Interior
National Park Service
Southeast Regional Office
Atlanta, Georgia

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Please cite this publication as:

Meiman, Joe 2008. Cumberland Piedmont Network Water Quality Report; Third Serial: Cowpens National Battlefield. National Park Service, Atlanta, Georgia.

January 2008

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Introduction

This is the third report on water quality of Cowpens National Battlefield (COWP) generated by the Cumberland-Piedmont Network (CUPN) Water Quality Monitoring Program (contact the CUPN office for details on program design). The first report, submitted to the park in February 2005, presented the initial results of the water quality inventory, beginning in December 2002. The second report included these data along with those collected during fiscal year 2005. This report incorporates those early findings as well as data gathered in fiscal year 2007 and displays these results in graphic form (accompanied with a brief interpretation), and concludes with a water quality summary and recommendations. Water quality is measured four times per year (quarterly) on alternate years at four sites; Long Branch of Island Ford Creek, Little Buck Creek, Suck Creek #2 and Suck Creek #3. Based upon program requirements and findings of the water quality inventory, a set of parameters were chosen for long-term monitoring; including the field measures of water temperature, specific conductance, pH, and dissolved oxygen. Samples were also collected for laboratory analysis for bacteria (*Escherichia coli*) and acid neutralizing capacity. An additional sample was collected from one site per round as a quality assurance – quality control provision.

Sampling Sites

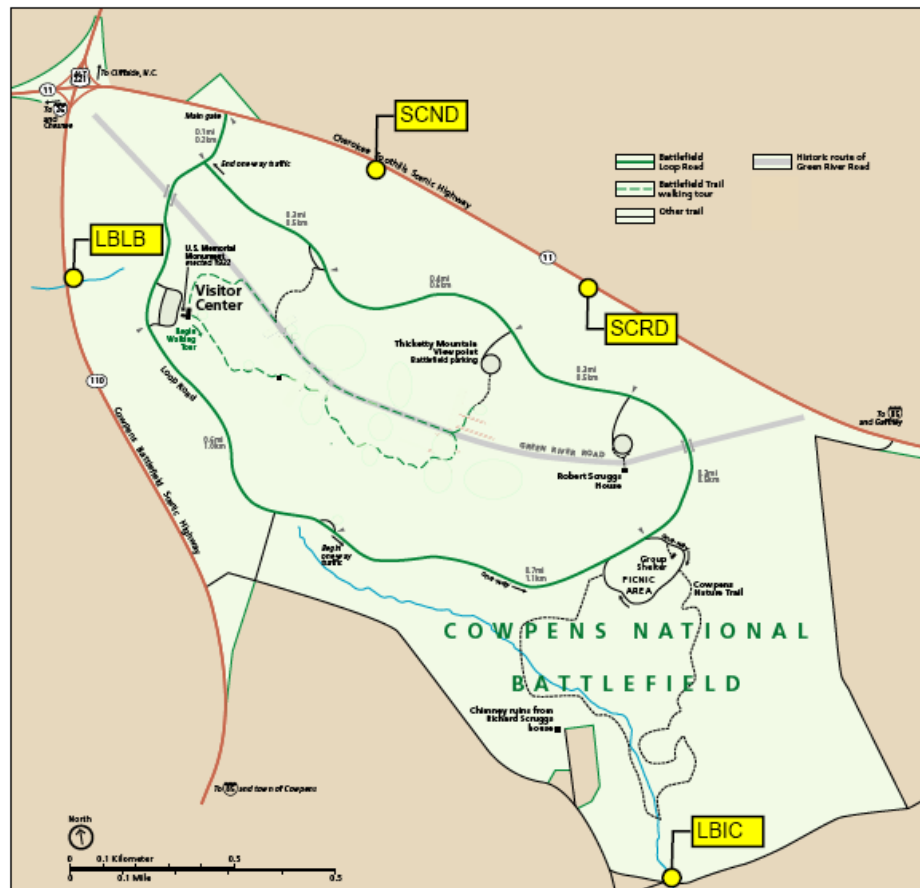


Figure 1. Map of water quality sampling sites at COWP

Description of Sampling Sites

Long Branch of Island Creek (LBIC)

Located at the southern edge of the park this site is the largest watershed in the park. This creek and its tributaries drain the nature trail and Picnic Grounds areas. Access is gained from State Route 36 (Bonner Road).

Little Buck Creek (LBLB)

Located in the northwestern portion of the park this site is accessed from State Route 110. Samples are taken before water enters the drainage culvert under State Route 110.

Suck Creek #2 (SCND)

Located in the northeastern portion of the park this site is accessed from State Route 11. Samples are taken before water enters the drainage culvert under State Route 11.

Suck Creek #3 (SCRD)

Located in the eastern portion of the park this site is accessed from State Route 11. Samples are taken before water enters the drainage culvert under State Route 11.

Stream Designated Uses

Each water body sampled within the CUPN has either been assigned a designated use by the state, or, by using the same ranking criteria, by this author. The USEPA, besides mandating these rankings, also directed the states to develop water quality standards for each designated use. We can use these water quality standards as a minimum to track water quality trends in CUPN parks. By adapting the state standards, we can also track park water quality trends within the states, regions, or watersheds. New NPS nationwide GPRA goals are now tied to state water quality standards and designated uses. For more information on South Carolina water quality standards, please see:

South Carolina: Water Classifications and Standards (R.61-68) Classified Waters (R.61-69).

Table 1. The table below shows that none of the park's four sites are officially listed – a state is not required to list designated uses for all waters. The author, using the same criteria used by the state process, “listed” for purposes of water quality comparison, each park site.

<i>Park</i>	<i>Code</i>	<i>Site</i>	<i>State</i>	<i>Designated Use</i>
COWP	LBIC	Long Branch Island Creek	SC	<i>Freshwater</i>
COWP	LBLB	Little Buck Creek	SC	<i>Freshwater</i>
COPW	SCND	Suck Creek #2	SC	<i>Freshwater</i>
COPW	SCRD	Suck Creek #3	SC	<i>Freshwater</i>

Results

Quarterly sampling commenced in December 2002 and continued until September 2003. There were two sets of field data collected in September 2003. Laboratory samples were lost in shipment for the September 16, 2003 round and the park was re-sampled on September 30, 2003 – thus two sets of field data were collected. Both sets of September 2003 data are included in this report. After a one-year hiatus four more rounds were collected between November 2004 and August 2005, followed by another one year break and another round of quarterly samples between November 2006 and August 2007. This annual “off and on” sampling routine follows a set rotation. A total of 13 sampling events are included in this report – the extent of water quality data collected at COWP under this monitoring program.

Water quality results are displayed in time series graphs showing all data for each site for a given parameter. As the Water Quality Program continues, trends will emerge from these time series graphs – some are beginning to show at this time. The datasets for ANC (acid neutralizing capacity) and *Escherichia coli* are abbreviated as they represent new protocols which are not directly comparable with old methods.

If state standards exist for a particular parameter they will be displayed. In addition, in a cursory attempt to show an element of data error, each plot is assigned error bars, representing the minimum potential error associated with the measurement.

Over the years a set rotational program such as this should sample extremes of the flow continuum; from flood to drought and the common flows in between. Throughout the southeastern United States a drought persisted during the late summer and autumn of 2007. Streams of the Piedmont and foothills of the Blue Ridge were greatly reduced in flow (some dried out completely) as the drought went from moderate, through severe and into extreme levels. These low flow conditions are reflected in flow conditions and water quality taken during this period.

As a final note to this preamble, special recognition to Shepard McAninch, CUPN Ecologist/Data Manager, who collected and analyzed these samples over the years. The efforts of CUPN Data Manager, Brenda Wells are greatly appreciated as well. The generation of accurate field measures and careful management of the data are not only critical to this program, but also make reporting an easier task.

Water Temperature

Water temperatures of COWP are considered to be within range to support native aquatic life. The range of water temperatures are, of course, a reflection of the seasons. The maximum allowable freshwater temperature for a South Carolina stream is 32.2 °C, or no more than 2.8 °C above natural conditions. The hot late summer of the Piedmont is seen in the highest water temperature during the period of record in August 2007.

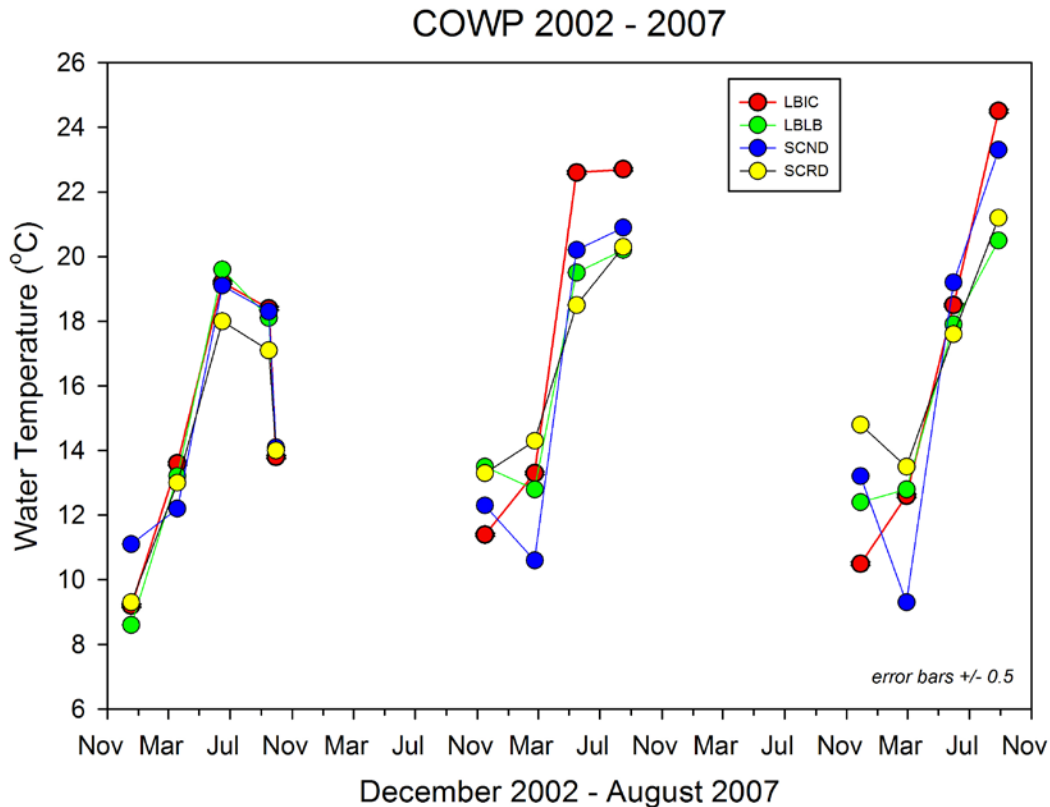


Figure 2. Water Temperature at COWP

Specific Conductance

The distribution of specific conductance (SpC) of COWP is reflective of low ionic-strength waters. The lithology of the park is largely crystalline and are relatively insoluble, thus the dissolved load is limited. The slightly higher SpC of Little Buck Creek (LBLB) is typically high compared to the other sites, indicative of a slightly higher amount of dissolved ions. Generally speaking, the waters of COWP carry a very small load of dissolved ions. There is no state standard for SpC.

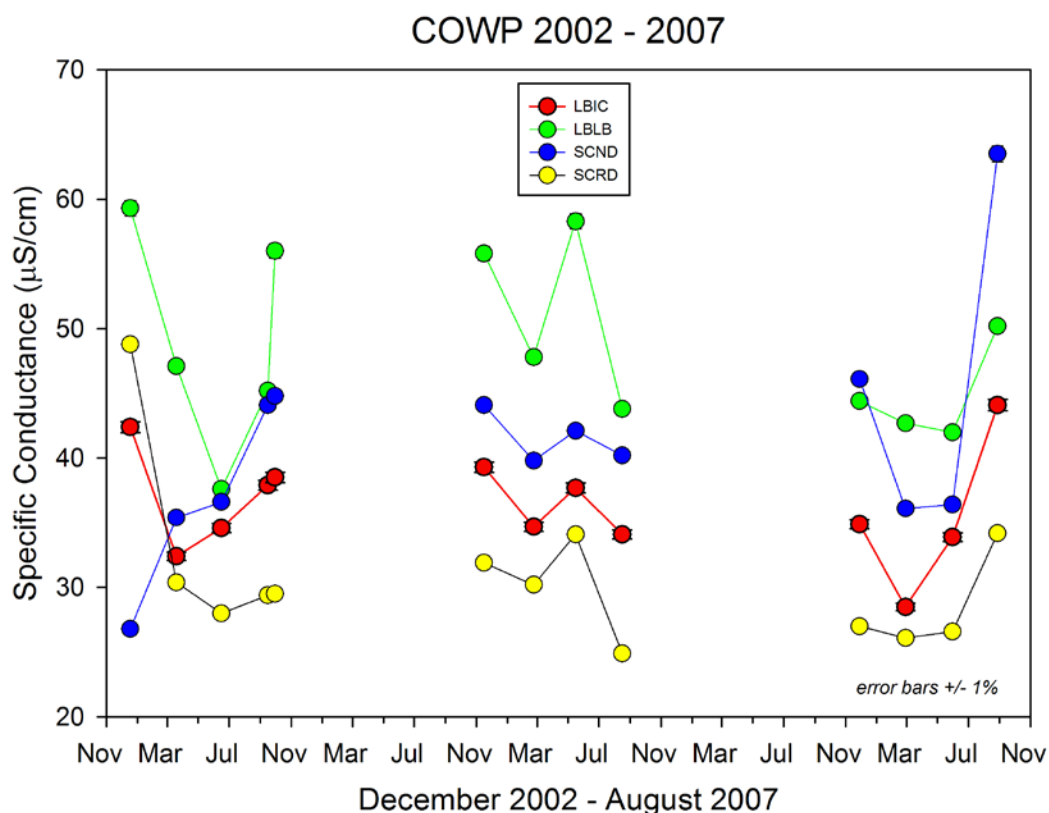


Figure 3. Specific Conductance at COWP

pH

Waters of COWP are slightly to moderately acidic. State standards for freshwater pH is between 6.0 and 8.5 SU. We can see that every site sampled has exceeded the lower limit. COWP waters do not come into contact with buffering agents, such as carbonate rock, thus their pH levels are naturally depressed. It is interesting that all pH values were low for the February 2005 sample. Shepard McAninch notes (in addition to double-checking the calibration of the pH sensor) that all streams were scoured by a large rainfall event the previous week. He also observes that the streams were generally rich in (brown) algae. These very low values were not found during the FY 2007 samples. pH values rebounded during the FY 2007 round. This rebound was also seen at Carl Sandburg Home National Historic Site and Kings Mountain National Military Park.

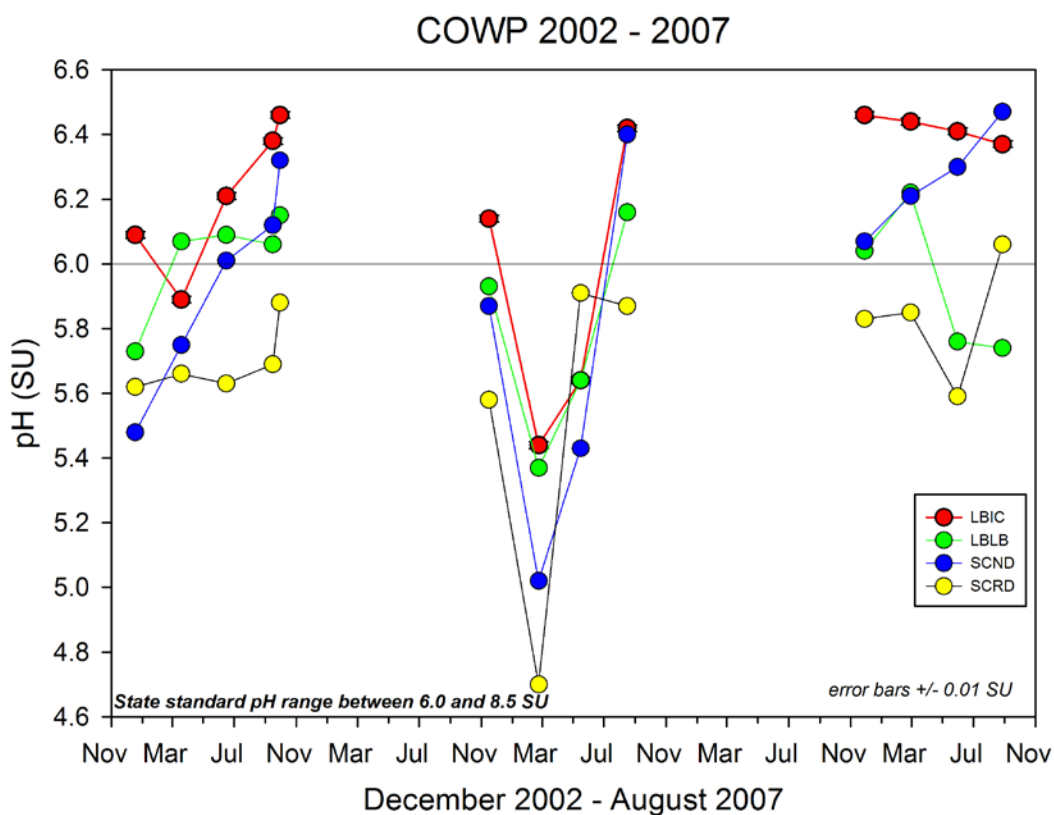


Figure 4. pH levels at COWP

Dissolved Oxygen

All waters monitored at COWP are generally well oxygenated. Even when dipping into the 4 mg/l range, these waters are capable of supporting aquatic life. State standards require freshwaters to contain at least 4.0 mg/l oxygen. The Suck Creek #3 September 30, 2003 sample was close to this lower limit. This level of DO is quite a decrease when compared with the reading only two weeks prior (September 16). The apparent decrease in DO of Suck Creek #3 is likely due to an equipment/operator error. All other data from this re-sample event were very close – signifying that the hydrologic conditions were largely unchanged during these two weeks. The extreme drought during the summer of 2007 saw a gradual decline in DO in all streams. This is due to low flows, high temperatures and limited aeration. DO levels should rebound in response to rainfall.

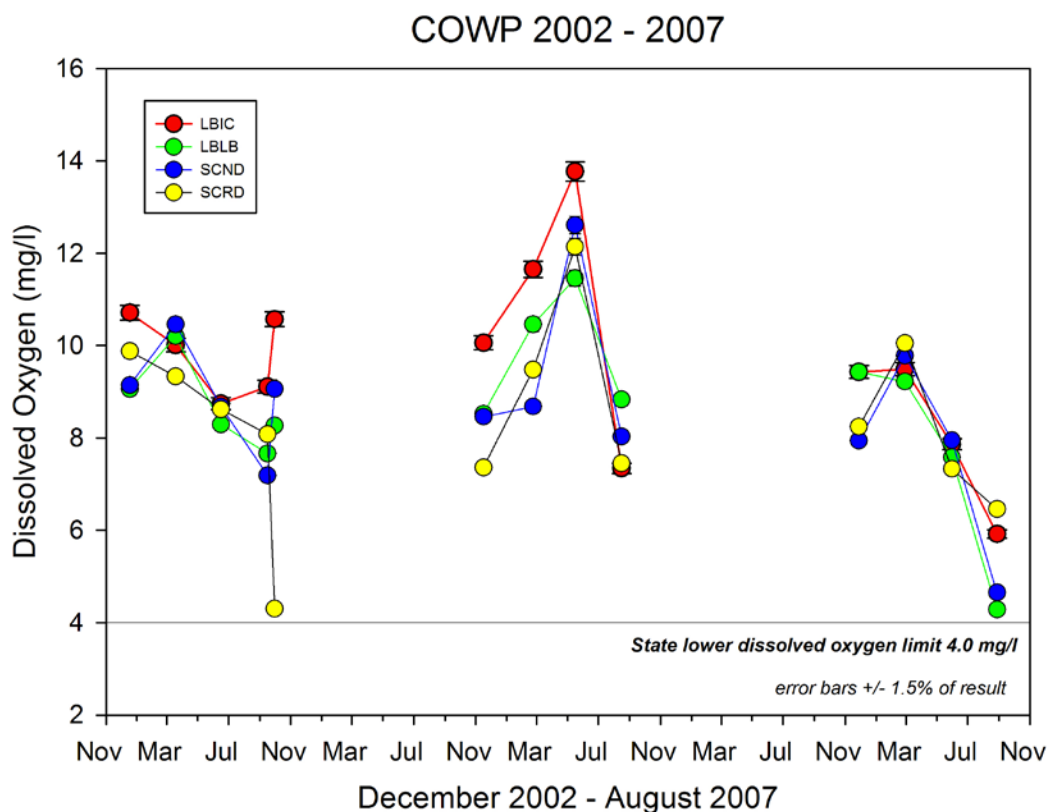


Figure 5. Dissolved Oxygen levels at COWP

Acid Neutralizing Capacity

Acid neutralizing capacity (ANC) of COWP waters is fairly low, indicating a lack of contact with carbonate strata or other sources of bicarbonate. Low ANC levels make waters more susceptible to acid precipitation as there are limited amounts of bicarbonates available to counter additional acids. This graph shows only the four sampling rounds of FY 2007. During protocol review a better method was adopted for ANC analysis. Old data are not included in this graph as their accuracy is doubtful. It is interesting that as there is a general increase of ANC as the streams waned during the drought. This pattern has been observed in other CUPN low-pH, low-ANC waters. There is no state ANC standard.

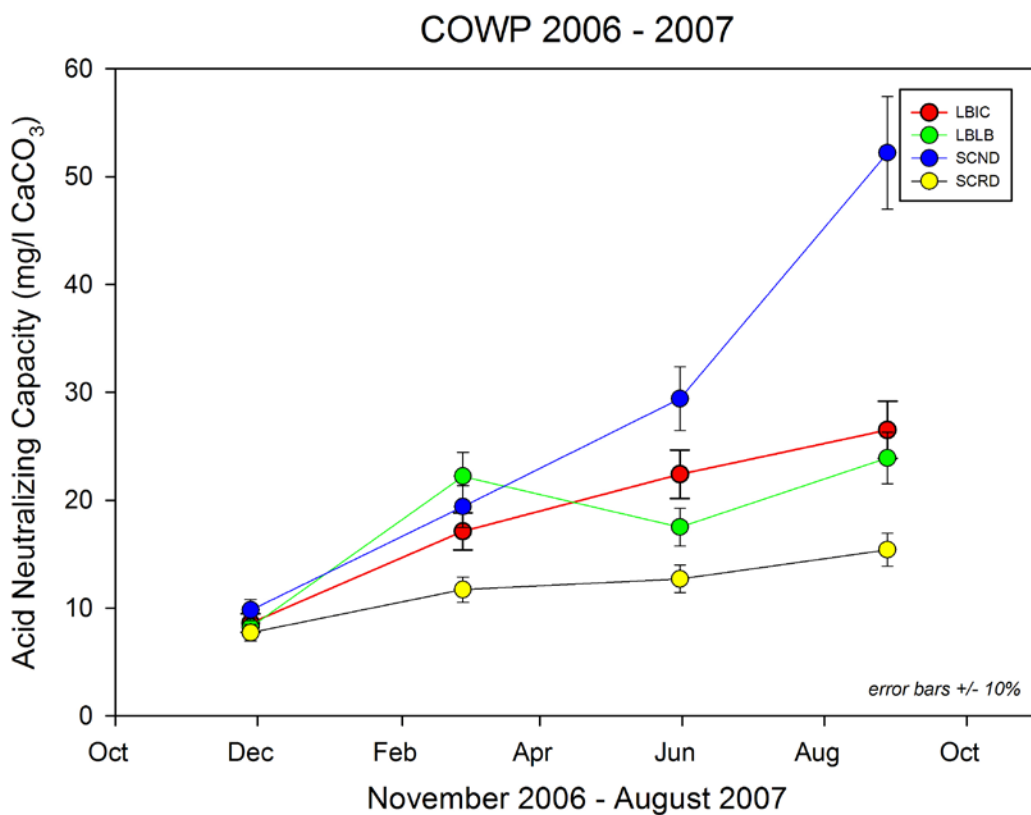


Figure 6. Acid Neutralizing Capacity at COWP

Bacteria

Similar to the truncated ANC graph, the record of bacteria presented below is limited. During protocol review it was determined that the fecal coliform tests originally done were both highly variable and not as representative as an indicator bacteria as *Escherichia coli* (*E. coli*). While the park does not promote recreational contact with its waters we have included this measure to monitor what should be a natural bacteria level.

In general, *E. coli* levels at COWP are relatively high for an undeveloped area. As there is no development within the watersheds – with exception of park buildings within LBLB, we can assume that wildlife is the primary, if not sole contributor to these bacteria. Wildlife certainly frequent the park streams. With exception of an animal defecating directly into a stream prior to sampling, high bacteria should only be seen following a run-off producing rainfall event. As seen in the following Discharge graph (Figure 8), the March 2007 sample was taken during slightly higher flow conditions. Bacteria levels were low during the drought.

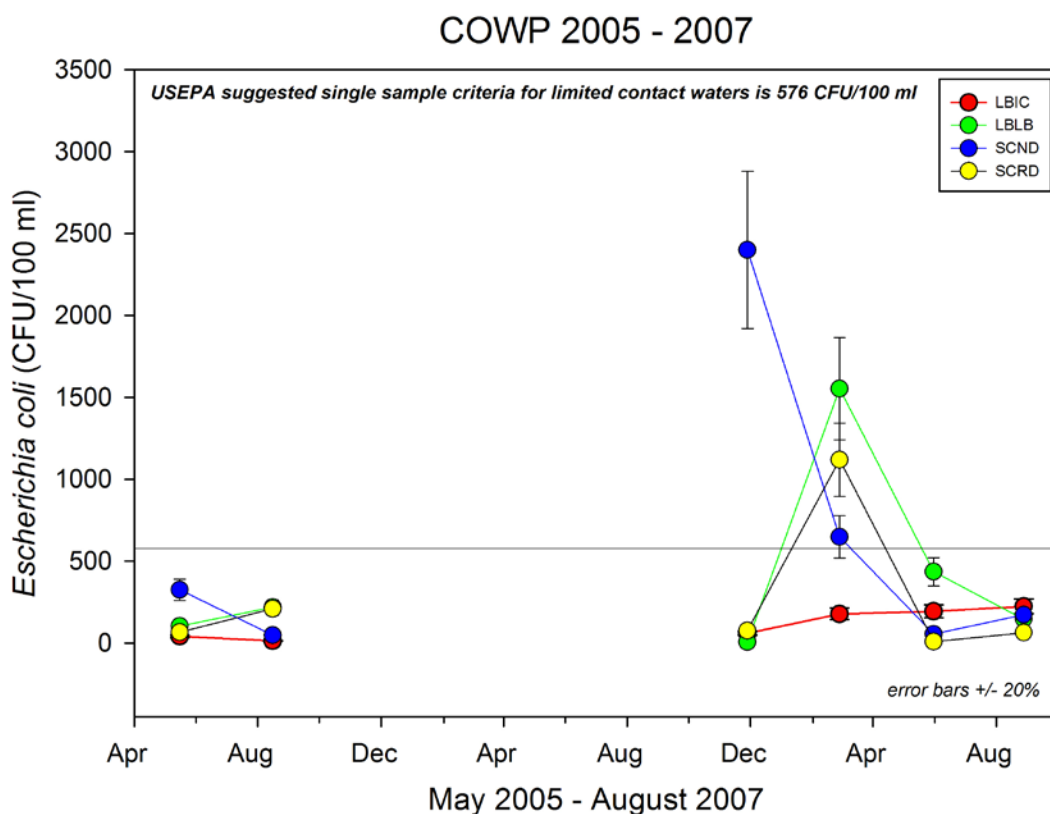


Figure 7. Bacteria levels at COWP

Discharge

With each sample taken, the stream's discharge is measured. If discharge (flow) is known, it puts the results in context with the state of flow during the sampling event. Over several rounds of set-date sampling (as used by this program) samples will be taken during normal, low and flood states. The relative size of the watershed is seen, especially in the middle dataset, as the larger Long Branch of Island Creek has a larger area from which to contribute flow. It is interesting that during the drought of 2007, the flow of this stream was equivalent to the much smaller park streams.

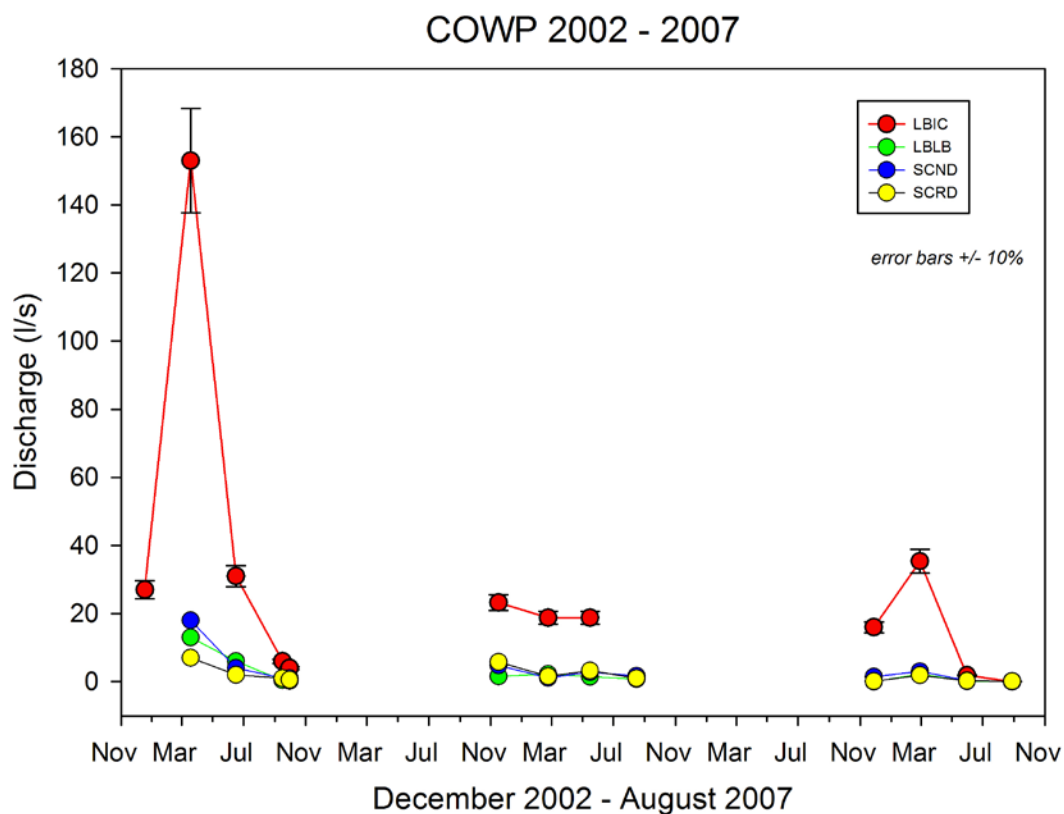


Figure 8. Discharge measured at COWP.

General Water Quality Status

The water quality of the four sites sampled at COWP is fairly good. Waters of COWP are naturally low in ANC, and pH. The historically and naturally low ANC and pH values are not much of an issue. However, with the increase in acid precipitation over the past decades, streams with low buffering capacity and low pH, such as those at COWP are susceptible to becoming more acidic.

It is obvious that the pH of most of the waters sampled at COWP are below the state standard of 6.0 SU. In the most general sense this is a violation of standard for Freshwaters, thus non-attainment of designated uses under the Clean Water Act. It has been demonstrated through this monitoring program that the waters of COWP, due to their headwater position within a granitic watershed are naturally acidic – at or below 6.0 SU. This claim is also supported by low ANC values. South Carolina, as with most states sensible to natural hydrologic conditions has a provision in its statutes for waters which are naturally in violation of standards. *Regulation 61-68 C.9: “Because of natural conditions some surface and ground waters may have characteristics outside the standards established by this regulation. Such natural conditions do not constitute a violation of water quality standards; however, degradation of existing water quality is prohibited unless consistent with Section D.4. of this regulation.”*

Future Water Quality Monitoring Recommendations

The CUPN is required in accord with the national water quality program to monitor water temperature, specific conductance, pH, and dissolved oxygen. In addition, there is sufficient reason to continue to monitor *Escherichia coli* and ANC, as long-term data may serve to alert the park to impending water quality issues.

It should also be noted that the two streams that according to Scott; Inventory of Fishes in Cowpens National Battlefield (2006), contain both the largest and rarest fishes have been monitored under this program since its inception. These streams, Suck Creek #2 and Long Branch of Island Creek represent the majority of individuals, fish species and are home to the two South Carolina Species of Concern in the park: the fantail darter and the highback chub.