BASINWIDE ASSESSMENT REPORT

FRENCH BROAD RIVER BASIN

NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT
AND NATURAL RESOURCES
Division of Water Quality
Environmental Sciences Section

April 2008

This page was intentionally left blank

TABLE OF CONTENTS

LIST OF APPENDICIES

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION TO PROGRAM METHODS

The Division of Water Quality uses a basinwide approach to water quality management. Activities within the Division, including permitting, monitoring, modeling, nonpoint source assessments, and planning are coordinated and integrated for each of the 17 major river basins within the state. All basins are re-assessed every five years. The French Broad River basin has been sampled by the Environmental Sciences Section (ESS) four times for basinwide monitoring: 1992, 1997, 2002, and 2007.

The ESS collects a variety of biological, chemical, and physical data that can be used in a myriad of ways within the basinwide-planning program. In some program areas there may be adequate data to allow a fairly comprehensive analysis of ecological integrity or water quality. In other areas, data may be limited to one program area, such as only benthic macroinvertebrate data or only fisheries data, with no other information available. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality. The primary program areas from which data were drawn for this assessment of the French Broad River basin include benthic macroinvertebrates and fish community for the period 2002 - 2007. Details of biological sampling methods (including habitat evaluation) and rating criteria can be found in the appendices of this report. Technical terms are defined in the Glossary.

The document is structured with physical, geographical, and biological data discussions presented by hydrologic units (HUCs). General water quality conditions are given in an upstream to downstream format. Lakes data, ambient chemistry data and aquatic toxicity data, with summaries, are presented in separate reports.

BASIN DESCRIPTION

The French Broad River basin covers 2,842 square miles with approximately 4,113 miles of streams and is the ninth largest river basin in the state. This basin is located in the Blue Ridge Mountains and contains numerous level-IV ecoregions including the Southern Crystalline Ridges and Mountains, a tiny portion in each of the Southern Sedimentary Ridges and Southern Metasedimentary Mountains, High Mountains, and Broad Basins. The basin includes part or all of Transylvania, Buncombe, Henderson, Madison, Haywood, Yancey, Mitchell and Avery counties (Figure 1).

Figure 1. **The French Broad River Basin**

Much of the basin lies within the 1.2 million acre Pisgah National Forest or Pisgah Game Lands while the northwest corner of Haywood County is in the Great Smoky Mountains National Park. Over one-half of the basin is forested and the steep slopes limit the area suitable for development and crop production although valley areas generally support high concentrations of agricultural and urban uses. In most parts of this basin which are located near large towns, there is substantial activity associated with vacation home building. The basin is composed of three major drainages, the French Broad, Pigeon, and Nolichucky Rivers, which individually flow north into Tennessee. Streams found in valley areas tend to be of moderate (sometimes low) gradients with a good mix of substrates including rock, gravel, sand and silt. Conversely, streams found at higher elevations, above the valley streams, have much higher gradients and typically lack large amounts of silt and sand are proportionately more comprised of bedrock, boulder, and gravel.

The uppermost portions of this river basin (Subbasins 01, 02, 03, and 04, HUC 06010105) contain the headwaters of the French Broad River and originates at the confluence of the West and North Forks of the French Broad River near the Town of Rosman. This area of the basin includes the Broad Basins and Southern Crystalline Ridges and Mountains Level-IV ecoregions (Figure 2). Historically, NCDWQ maintains long-term benthic macroinvertebrate sampling points in Transylvania, Henderson, Buncombe, and Madison counties. Most of the landuse in this segment of the river basin is forest although in the valley areas there are large amounts of pasture and agricultural activity. The urban areas of Hendersonville, Brevard, Asheville, Weaverville, and Mars Hill are found here.

The largest single tributary of the French Broad River in North Carolina is the Pigeon River (Subbasin 05, HUC 0601006) and within this area NCDWQ maintains numerous historic benthic macroinvertebrate stations in Haywood County. Level-IV ecoregions found here include Southern Metasedimentary Mountains, Broad Basins, and Southern Crystalline Ridges and Mountains (Figure 2). With the exception of the urban area of Waynesville, Canton, and Maggie Valley, the majority of this portion of the basin is

forested and includes large tracts of protected lands associated with Great Smoky Mountains National Park as well as Pisgah National Forest.

The remaining portion of the French Broad basin that occurs within North Carolina can be found in HUC 06010108 (Subbasins 06, and 07) where NCDWQ maintains historic benthos monitoring stations in Avery, Mitchell, and Yancey counties. This area also includes the Southern Crystalline Ridges and Mountains Level-IV ecoregions. Much of the watershed is undeveloped and is encompassed within the Pisgah National Forest although high concentrations of agriculture and pasture can be found in some of the valley areas. The largest towns are Spruce Pine, Burnsville and Bakersville.

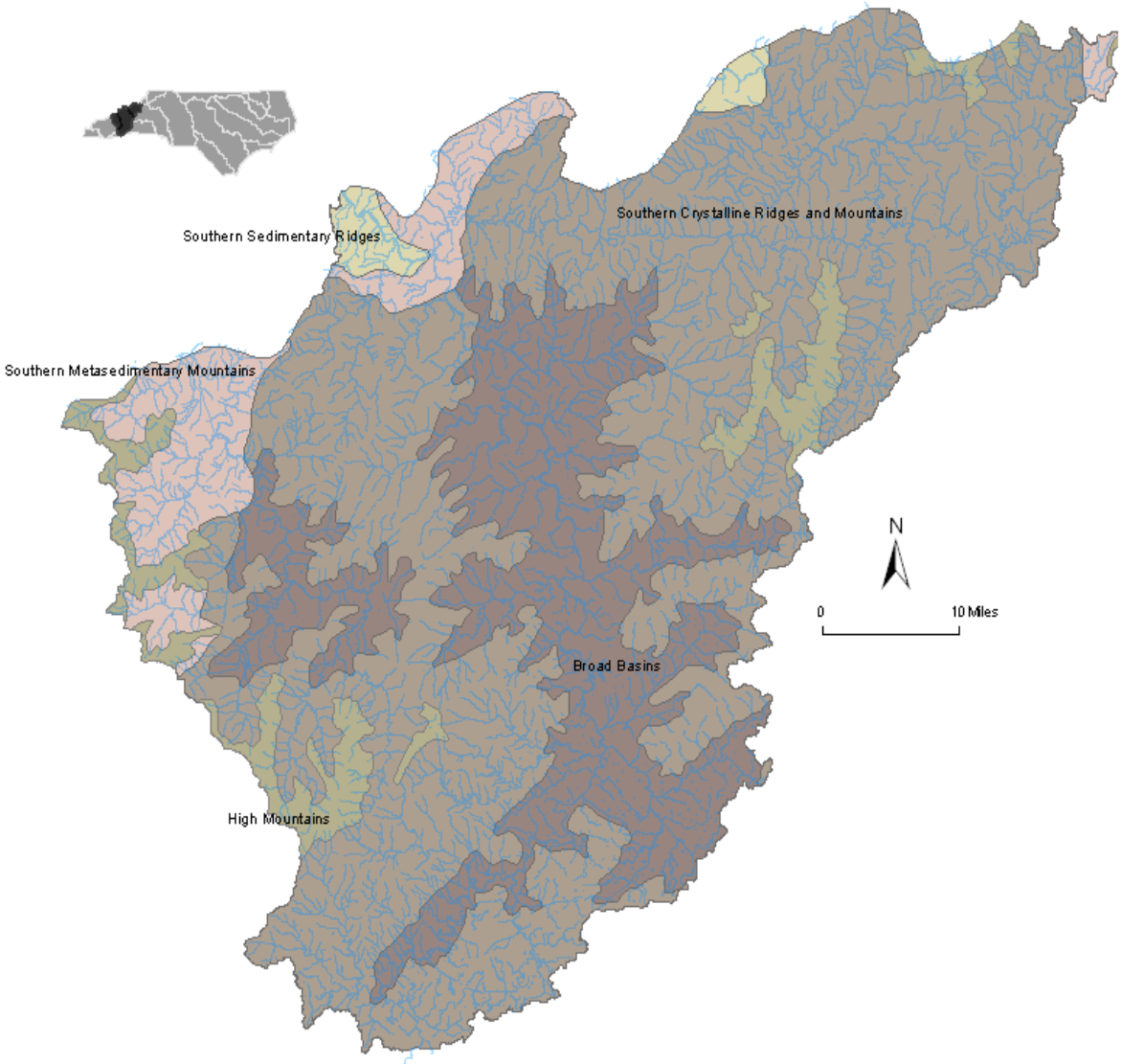


Figure 2. Level IV Ecoregions of French Broad River Basin

FRENCH BROAD RIVER HUC 06010105 – FRENCH BROAD RIVER

Description

The French Broad River basin HUC 06010105 contains DWQ's Subbasins from 04-03-01 to 04-03-04 and encompasses the 1,658 square mile French Broad River watershed from its headwaters in western Transylvania County to the North carolina-Tennessee state line northwest of the Town of Hot Springs in Madison County (Figure FRB05. Also included in this HUC are Henderson, Buncombe, and a very small portion of Haywood counties. Sizeable subwatersheds include the Davidson, Mills, and Swannanoa rivers and Ivy, Big Laurel, and Spring creeks.

The French Broad River originates near the Town of Rosman with the joining of the West Fork and North Fork of the French Broad River; just below the town is river's confluence with the East Fork of the French Broad River. These three streams generally drain minimally affected, Pisgah National Forest watersheds. The first major tributary to join the river below Rosman is the Davidson River which also drains a forested watershed. Downstream and below the Town of Brevard, is the confluence with the Little River. The headwaters of the Little River drain an area of Whiteside granite. This type of geology is associated with naturally sandy streams, although poor riparian buffers and nonpoint source runoff also contribute to the large amounts of sand and silt in the Little River. This portion of the French Broad River is low gradient and flows through a broad agricultural valley with row crops drained by the Mills River and Boylston Creek.

From the Mills River confluence to the City of Asheville, several medium size tributaries join the river – Mud Creek which drains the City of Hendersonville, Cane Creek, and Hominy Creek and the Swannanoa River which drain the southwest and the eastern portions of the Asheville metropolitan area, respectively. Northwest from the City of Asheville, smaller tributaries, such as Newfound, Reems, Flat, and Sandymush creeks drain forested areas and rural agricultural lands supporting dairy operations, apple orchards, corn, tomatoes, and burley tobacco. All of these areas are increasingly being encroached upon by the expansion of the Asheville metropolitan area. From the Buncombe-Madison County line to the state line, the river again flows through more rural and some very remote areas, especially many of the tributaries draining the high elevations along the Madison County borders. Major tributaries include Ivy, Big Laurel, Big Pine, and Spring creeks.

There are five Level IV ecoregions in this HUC of which the Southern Crystalline Ridges and Mountains and the Broad Basins encompass most of the area (Griffith, *et al* 2002). Three lesser ecoregions are at the periphery of the HUC – the Southern Metasedimentary Mountains and Southern Sedimentary Ridges near the state line and the High Mountains near the juncture of Haywood, Transylvania, Buncombe, and Henderson counties.

In this HUC, 16 watersheds, such as portions of the West Fork, North Fork, and East Fork French Broad River, North Fork and South Fork Mills River, and Ivy Creek, have been afforded additional water quality protection with supplemental water quality classifications such as High Quality Waters (HQW) or Outstanding Resource Waters (ORW) (Basinwide Information System query, February 01, 2008). Many of the watershed are also supplementally classified as Trout Waters. Priority watersheds for habitat conservation in this HUC include the Little River, Mills River, and upper French Broad River (in Transylvania County) (NCWRC 2005).

Public lands in this HUC include the North Carolina Division of Forest Resources' DuPont State Forest and the U.S. Forest Service's Pisgah National Forest. Portions of the Pisgah National Forest are managed by the North Carolina Wildlife Resources Commission as gamelands, including large tracts in each of the counties.

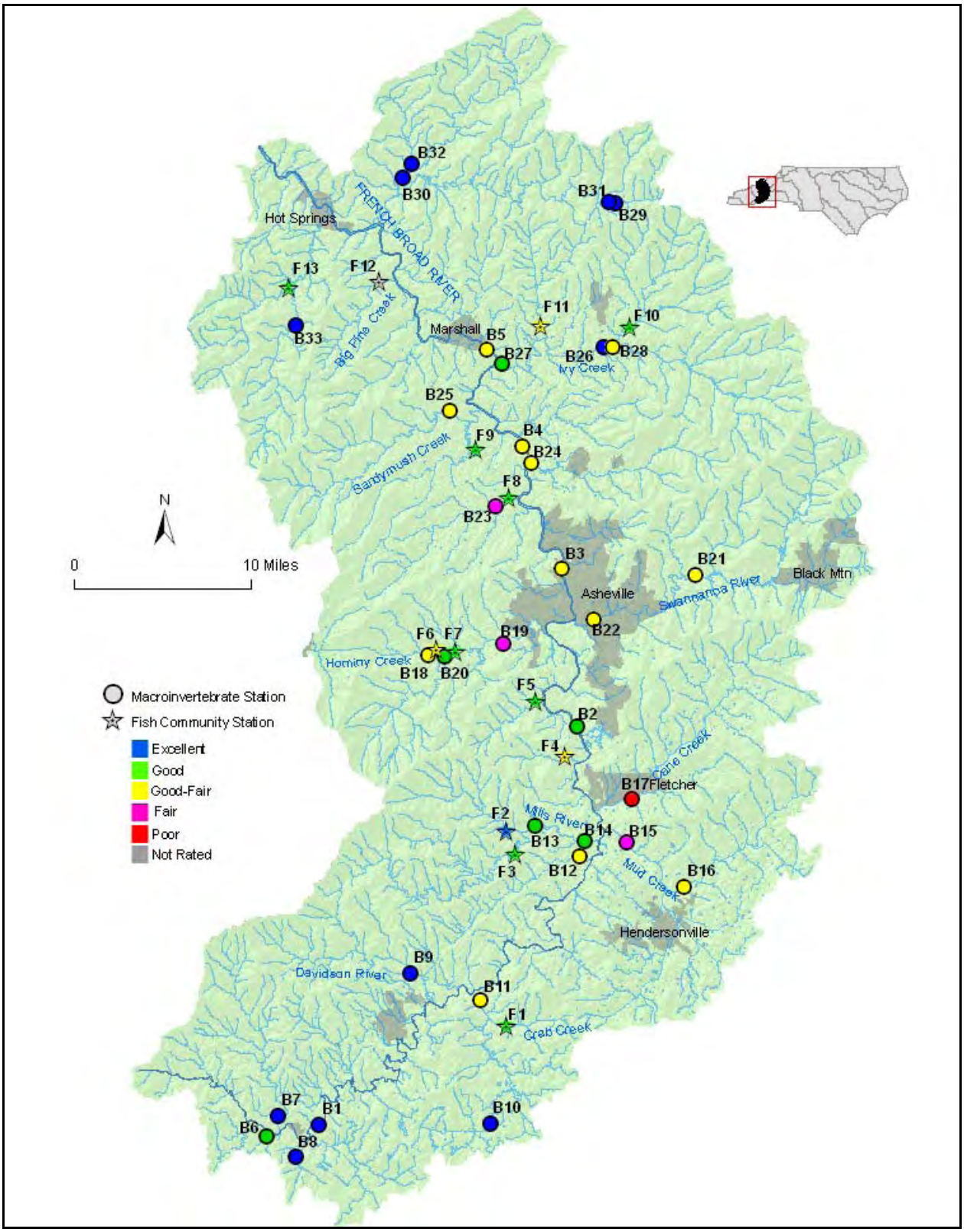


Figure FRB05. Sampling sites in HUC 06010105 in the French Broad River basin. Monitoring sites are listed in Table FRB05.

Major urban and metropolitan areas include the Town of Brevard, the City of Hendersonville, the City of Asheville, and the Interstate 40-Interstate 26 corridors. Smaller towns include Rosman, Mars Hill, Marshall, and Hot Springs. There are five major (> 0.5 MGD) permitted dischargers in this HUC discharging a total of 80.8 MGD: the Metropolitan Sewerage District of Buncombe County (40.5 MGD to the French Broad River), the Ecusta Business Development Center (27.5 MGD to the French Broad River), the City of Hendersonville (6.5 MGD) to Mud Creek, Progress Energy Carolinas, Inc. (4.8 MGD to the French Broad River), and the City of Brevard (2.5 MGD to the French Broad River) (Basinwide Information System query, February 01, 2008). There are 146 smaller facilities discharging a total of 4.472 MGD to the French Broad River and many of the smaller tributaries. One hundred seven miles of streams are on the 2006 impaired stream list (NCDENR 2007). Impaired waters that were monitored during the current basinwide cycle included Mud, Clear, Cane, Hominy, Newfound, and Little Ivy creeks and the Swannanoa River.

Overview of Water Quality

Forty-six benthic macroinvertebrate and fish community samples, representing 43 different streams were collected from the French Broad River and its tributaries during the 2007 basinwide cycle (Table FRB05 and Figure FRB05). Six of the sites qualified as new fish community regional reference sites -- North Fork Mills River, South Fork Mills River, Bent Creek, Little Ivy Creek, Big Pine Creek, and Meadow Fork. In 2007, 57 percent of the sites were rated as either Good or Excellent; 33 percent as Good-Fair, 9 percent as Fair or Poor; and one site was Not Rated. Sites rating Fair or Poor -- Mud, Cane, lower Hominy, and upper Newfound creeks -- also rated Fair or Poor in 2002. Three sites on Hominy, South Hominy, and Little Ivy creeks were sampled for both benthic macroinvertebrates and fish. The two programs ratings for Hominy and South Hominy creeks were in agreement; the fish community rating for Little Ivy Creek was Good, whereas the benthic macroinvertebrate rating was Good-Fair.

Thirty-nine sites sampled in 2007 were sampled previously in 2002. The biological ratings of 59 percent of the sites did not change; 28 percent improved and in all cases increased by one rating; and 13 percent declined and in all cases decreased by one rating. For the 11 sites that improved (from Good to Excellent, or Good-Fair to Good, or Fair to Good-Fair, or Poor to Fair), the improvement was attributed to unknown causes at eight sites and to low flow conditions because of the drought lessening nonpoint source impacts at three sites. For the five sites that declined (from Excellent to Good, or Good to Good-Fair, or Fair to Poor), the decline was attributed to unknown cause at three sites; possible decline due to overall decline in water quality or seasonality factors at one site; and possible decline due to overall decline in water quality or flow at one site.

Based upon their consistent and long-term Excellent biological ratings, several basinwide watersheds qualify for supplemental reclassification to HQW or ORW, if so petitioned. These watersheds are: 1) Transylvania County -- the French Broad River at SR 1129, the North Fork French Broad River at SR 1322, the Middle Fork French Broad River at SR 1131, and the Davidson River at US 276 and 2) Madison County -- Big Laurel Creek at SR 1503 and at NC 208, Shelton Laurel Creek at NC 208, and Spring Creek at NC 209. [Note: some of these watersheds are in the process of being reclassified; please refer to the Special Studies section.]

Table FRB05. Waterbodies monitored in HUC 06010105 in the French Broad River basin for basinwide assessment, 2002 and 2006/2007.

Map #[1]	Waterbody	County	Location	2002	2007
B-1	French Broad R	Transylvania	SR 1129	Excellent	Excellent
B-2	French Broad R	Buncombe	NC 146	Good-Fair	Good
B-3	French Broad R	Buncombe	SR 1348	Good	Good-Fair
B-4	French Broad River	Buncombe	SR 1634	Fair	Good-Fair
B-5	French Broad R	Madison	NC 213	Good-Fair	Good-Fair
B-6	W Fk French Broad R	Transylvania	US 64	Excellent	Good
B-7	N Fk French Broad R	Transylvania	SR 1322	Excellent	Excellent
B-8	M Fk French Broad R	Transylvania	SR 1131	Excellent	Excellent
B-9	Davidson R	Transylvania	US 276	Excellent	Excellent
B-10	Little R	Transylvania	SR 1560	Good	Excellent
B-11	Little R	Transylvania	SR 1533	Good-Fair	Good-Fair
B-12	Boylston Cr	Henderson	SR 1314	Good-Fair	Good-Fair
B-13	Mills R	Henderson	SR 1337	Good	Good
B-14	Mills R	Henderson	SR 1353	Good-Fair	Good
B-15	Mud Cr	Henderson	US 25	Poor	Fair
B-16	Clear Cr	Henderson	SR 1513	Fair	Good-Fair
B-17	Cane Cr	Henderson	SR 1006	Fair	Poor
B-18	Hominy Cr	Buncombe	SR 1123	Good (NC 151)	Good-Fair
B-19	Hominy Cr	Buncombe	SR 3412	Fair	Fair
B-20	S Hominy Cr	Buncombe	NC 151	Good-Fair	Good
B-21	Swannanoa R	Buncombe	SR 2416	Fair	Good-Fair
B-22	Swannanoa R	Buncombe	US 25	Good-Fair	Good-Fair
B-23	Newfound Cr	Buncombe	SR 1622	Fair	Fair
B-24	Reems Cr	Buncombe	NC 251	Good-Fair	Good-Fair
B-25	Sandymush Cr	Madison	SR 1114	Good	Good-Fair
B-26	Ivy Cr	Buncombe	SR 2150	Good	Good
B-27	Ivy Cr	Madison	US 25/70	Good-Fair	Good
B-28	Little Ivy Cr	Madison	SR 1610	Good-Fair	Good-Fair
B-29	Big Laurel Cr	Madison	SR 1503	Excellent	Excellent (2006)
B-30	Big Laurel Cr	Madison	NC 208	Good	Excellent (2006)
B-31	Puncheon Fork	Madison	SR 1503	Excellent	Excellent
B-32	Shelton Laurel Cr	Madison	NC 208	Good	Excellent (2006)
B-33	Spring Cr	Madison	NC 209/SR 1172	Excellent	Excellent (2006)
F-1	Crab Cr	Transylvania	SR 1532	Good	Good
F-2	N Fk Mills R	Henderson	SR 1341	---	Excellent
F-3	S Fk Mills R	Henderson	SR 1340	---	Good
F-4	Avery Cr	Buncombe	off SR 3498	---	Good-Fair
F-5	Bent Cr	Buncombe	off NC 191	---	Good
F-6	Hominy Cr	Buncombe	NC 151	Good-Fair	Good-Fair
F-7	S Hominy Cr	Buncombe	NC 151/SR 3449	Good	Good
F-8	Newfound Cr	Buncombe	SR 1641	Good	Good
F-9	Turkey Cr	Buncombe	SR 1629	Good	Good
F-10	Little Ivy Cr	Madison	SR 1547	---	Good
F-11	Bull Cr	Madison	SR 1574	Good-Fair	Good-Fair
F-12	Big Pine Cr	Madison	off SR 1151	---	Not Rated
F-13	Meadow Fk	Madison	NC 209	---	Good

[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.

River and Stream Assessment

All benthic macroinvertebrate sites scheduled to be sampled were sampled in 2007. Four fish community sites scheduled to be sampled were not because of insufficient time or due to excessive turbidity resulting from late afternoon thunderstorms the previous day: 1) Buncombe County -- Newfound Creek at NC 63 and 2) Madison County -- Shelton Laurel Creek at NC 208, Big Laurel Creek at SR 1318, and Spillcorn Creek at SR 1330.

Specific site summaries of the 46 benthic macroinvertebrate and fish community samples may be found at this link: **06010105**.

Special Studies

Impacts from Trout Farm Discharge, West Fork French Broad River, Transylvania County
The Modeling/TMDL Unit requested that the fish communities at three sites along the West Fork French Broad River be evaluated in August 2003 to determine any impacts from the Whitewater Trout Farm discharge. One-half mile of the river from above to below the trout farm was on the 2002 303 (d) list of biologically impaired streams. The cause of impairment was given as "cause unknown" with "aquaculture" also given as the potential source. The impacts of a trout farm discharge upon the aquatic communities in the river had been documented since 1990. The discharge, along with degraded riparian habitats in the vicinity of the farm, affected the water chemistry, enriched periphytic growths, degraded the benthic community, and artificially stimulated the fish community. Enrichment and degradation of the stream by cattle wastes also could not be ruled out as a factor affecting the aquatic communities of the upper West Fork French Broad River (BAU Memorandum F-20031120).

Wetlands Restoration Program Project, South Hominy Creek Watershed, Buncombe County
Four sites in the South Hominy Creek watershed were sampled in November 2003 for the purpose of evaluating the fish communities at the request of the Wetlands Restoration Program. Land alterations in the valleys in the middle portion of the watershed had lead to degraded stream riparian zones, embedded substrates, a general lack of pools, and open canopies. The fish communities in upper South Hominy Creek and Stony Fork were least impacted by watershed alterations. At Beaverdam and Warren Creeks the fish communities were impacted by nearby landuse practices. Nutrients did not seem to be an issue at any of the sites. Reproducing and multiple age class populations of trout were found in South Hominy Creek, Beaverdam Creek and Stony Fork. Select sites in this watershed would benefit from restoration efforts to reduce sediment inputs, increase canopy cover and riparian zones, and return the stream channels to a more functional state (BAU Memorandum F-20040326).

Impacts from the 2004 Hurricanes
In late 2004, the impacts from the catastrophic flooding created by the remnants of the September 2004 hurricanes (Frances, Ivan, and Jeanne) on the benthic macroinvertebrate and fish communities in the French and Watauga River basins were investigated. Comparisons of habitat scores for pre- and post-hurricane sampling showed the biggest change in scores in the more developed watersheds, such as the Swannanoa River and South Hominy Creek. Water chemistry values showed little change. The eight benthic macroinvertebrate samples all declined one bioclassification following the hurricane flooding compared to the most recent sample (either 2002 or 2004). Mayfly taxa richness and abundance showed the largest declines and was the most consistent pattern across sites. Caddisflies generally were reduced, especially net spinning hydropsychids, but this pattern was not as consistent. Winter stoneflies and ephemerellid mayflies were the dominant taxa at all sites, and most likely hatched after the flooding. Where full scale samples were collected, the beetles and odonates were dramatically reduced, most likely because they are found most often on woody debris which was swept away in the floods.

The three fish community sites sampled showed a more varied pattern. Big Crabtree Creek (Mitchell County) maintained it's Excellent rating, while the benthos rating for Big Crabtree Creek declined from Excellent to Good. Cove Creek (Watauga River Basin) declined from Good-Fair to Fair (benthos changed from Good to Good-Fair). South Hominy Creek (Buncombe County) NCIBI scores decreased from 50 to 38 and the bioclassification changed from Good to Fair (benthos declined from Good-Fair to Fair). Overall, the benthos and fish communities showed a decline in bioclassification following the September 2004 hurricanes flooding. Before sampling, it was expected that the benthos, due to their inability to move far and their dependence on the bottom substrates, would show far greater impact than was found (BAU Memorandum F-20050404).

Use Attainability/Reclassification Study, Upper Boylston Creek, Transylvania and Henderson counties
A Use Attainability/Reclassification Study was conducted to determine if there were wild, reproducing populations of trout in the upper Boylston Creek watershed. There was ample evidence collected by multiple researchers to document that two species of trout inhabit and reproduce within the Boylston Creek watershed. Brook Trout inhabit the higher elevation/upper reaches in Sutton Creek, Osborne

Branch, and Woody Branch. The lower elevations and reaches in Boylston Creek and Dog Creek are populated by Rainbow Trout. Based upon DWQ methods and criteria, reclassification of the Boylston Creek watershed from Class C to Class C, Tr (trout) waters was recommended (BAU Memorandum F-20060829).

Ecosystem Enhancement Program Project, Lewis and Clear Creeks, Henderson County
In October 2006, four EPT samples were collected from two sites on Lewis Creek and two sites on Clear Creek. Both Lewis Creek sites were rated Fair (borderline Poor) with low EPT taxa richness and abundance values. The sparse fauna suggested toxicity, but the very poor habitat was also likely reducing the fauna. Clear Creek above Lewis Creek was rated Good-Fair and had some intolerant taxa, but the lack of stoneflies suggested chronic water quality rather than habitat problems. Below Lewis Creek, Clear Creek was rated Fair; but it had a more diverse and intolerant benthic community than either Lewis Creek site (BAU Memorandum B-20061116).

Use Attainability/Reclassification Study, Big Laurel Creek Watershed, Madison County
A Use Attainability/Reclassification study was conducted at 15 sites in the Big Laurel Creek watershed in 2006 to determine if the watershed qualified as HQW or ORW. All sites, except one, were rated Excellent based upon the benthic macroinvertebrate community; Little Creek at SR 1318 was rated as Good. The entire Big Laurel Creek watershed qualified for reclassification to HQW (BAU Memorandum B-20061129).

Use Attainability/Reclassification Study, Spring Creek Watershed, Madison County
A Use Attainability/Reclassification study was conducted at four sites in the Spring Creek watershed in 2006 to determine if the watershed qualified as HQW or ORW. All sites were rated Excellent based upon the benthic macroinvertebrate community. The entire Spring Creek watershed qualified for reclassification to HQW (BAU Memorandum B-20061129).

Improper Use of Pesticides, South Fork Mills River, Transylvania County
A fish kill of at least 1,000 fish in the South Fork Mills River on or about July 26, 2007 was attributed to the misapplication of a pesticide (chlorothalonil) to tomato fields. Benthic macroinvertebrate samples showed a substantial impact from the pesticide. At an upstream sites, off SR 1338, the community was rated Excellent; downstream at SR 13340, the community was rated Fair (BAU Memorandum B-20070925).

Use Attainability/Reclassification Study, Upper French Broad River Watershed, Transylvania County
A Use Attainability/Reclassification study was conducted at 11 sites in the upper French Broad River Basin in 2007 to determine if the watersheds qualified as HQW or ORW. Watersheds that qualified as HQW were: 1) Flat Creek, 2) North Fork French Broad River, Middle Fork French Broad River, 3) Gladys Fork, and 4) Cherryfield Creek. Watersheds that did not qualify as HQW were: 1) Parker Creek and 2) Diamond Creek (BAU Memorandum B-20080211).

Use Attainability/Reclassification Study, Lower French Broad River Watershed, Madison County
A Use Attainability/Reclassification study was conducted at 5 sites in the lower French Broad River Basin in 2007 to determine if the watersheds qualified as HQW or ORW. Watersheds that qualified as HQW were: 1) the upper Bull Creek catchment; 2) Little Pine Creek, 3) Big Pine Creek, and 4) Doe Branch. Shut-in Creek qualified as ORW (BAU Memoranda B-20071203; B-20080211).

FRENCH BROAD RIVER HUC 06010106—PIGEON RIVER

Description

This HUC encompasses the Pigeon River watershed (Figure FRB06). Many of the undeveloped watersheds are in the Great Smoky Mountains National Park or the Pisgah National Forest. The Shining Rock and Middle Prong Wilderness areas are located in the watersheds of the Middle Fork, East Fork, and Little East Fork Pigeon Rivers and are also undeveloped.

In terms of ecoregions (Griffith *et al* 2002), this is among the most heterogeneous areas in the entire State with four Level-IV ecoregions present: Southern Crystalline Ridges and Mountains (elevations of between 1,200 and 4,500 feet with high precipitation rates and largely forested with some pasture, apple orchard, and Christmas tree farms), Broad Basins (lower elevation and relief, and therefore often have large concentrations of anthropogenic disturbances relative to the other three Level-IV ecoregions in this region), Southern Metasedimentary Mountains (steep relief and densely forested) and High Mountains (extremely steep, elevations in excess of 4,500 feet).

While most of this HUC remains forested, there are notable urban and suburban areas associated with Waynesville and the Towns of Clyde, Canton, and Maggie Valley. In addition, there are continued impacts associated with ongoing vacation home building in and around the suburban centers. In total, there are more than 20 dischargers in this subbasin. The major facilities include Waynesville's WWTP (6 MGD), Maggie Valley's WWTP (1 MGD), and Blue Ridge Paper Products, Inc. (29.9 MGD).

Overview of Water Quality

The Blue Ridge Paper Products facility (the largest discharger in this HUC) has undergone many upgrades to its wastewater treatment process since 1990. However, recent sampling in 2006 indicates that the benthic macroinvertebrate community in the Pigeon River just downstream of the mill at SR 1642 (and slightly further downstream at SR 1519) continues to be comprised primarily of pollution tolerant organisms (Table FRB06). The SR 1519 location is likely impacted by the combined effluents of Blue Ridge Paper Products as well as the City of Waynesville's WWTP discharge. Specifically, the Pigeon River at SR 1642 (near Clyde) was rated Good-Fair rating in 1997, but decreased to Fair in 1999 and Poor in 2002 but improved slightly to Fair in 2006. The site near Hepco (SR 1338) continued to be rated Good-Fair in 2007 and the Waterville site (NC 215) improved to Good in 2007 from the 2002 Good-Fair collection.

Richland Creek near the City of Waynesville has shown signs of improving water quality in recent years based upon benthic macroinvertebrates and for 2007 this trend has also been documented in the fish community data. Recent work undertaken by the Asheville Regional Office (ARO) in the Richland Creek watershed during February and March 2007 has further contributed to improved benthic macroinvertebrate bioclassifications along some segments of Richland Creek. This improvement was most pronounced at the SR 1184 location, which improved from Good-Fair in 2002 to Good in 2007. Specifically, work undertaken by the ARO included the identification and subsequent repair of numerous leaking sewer lines adjacent to Richland Creek as well as those found on several tributaries (e.g., Hyatt Creek). Some degradation, usually from nonpoint sources such as dairy farms, also has been found in some of the smaller tributaries (e.g., Fines Creek).

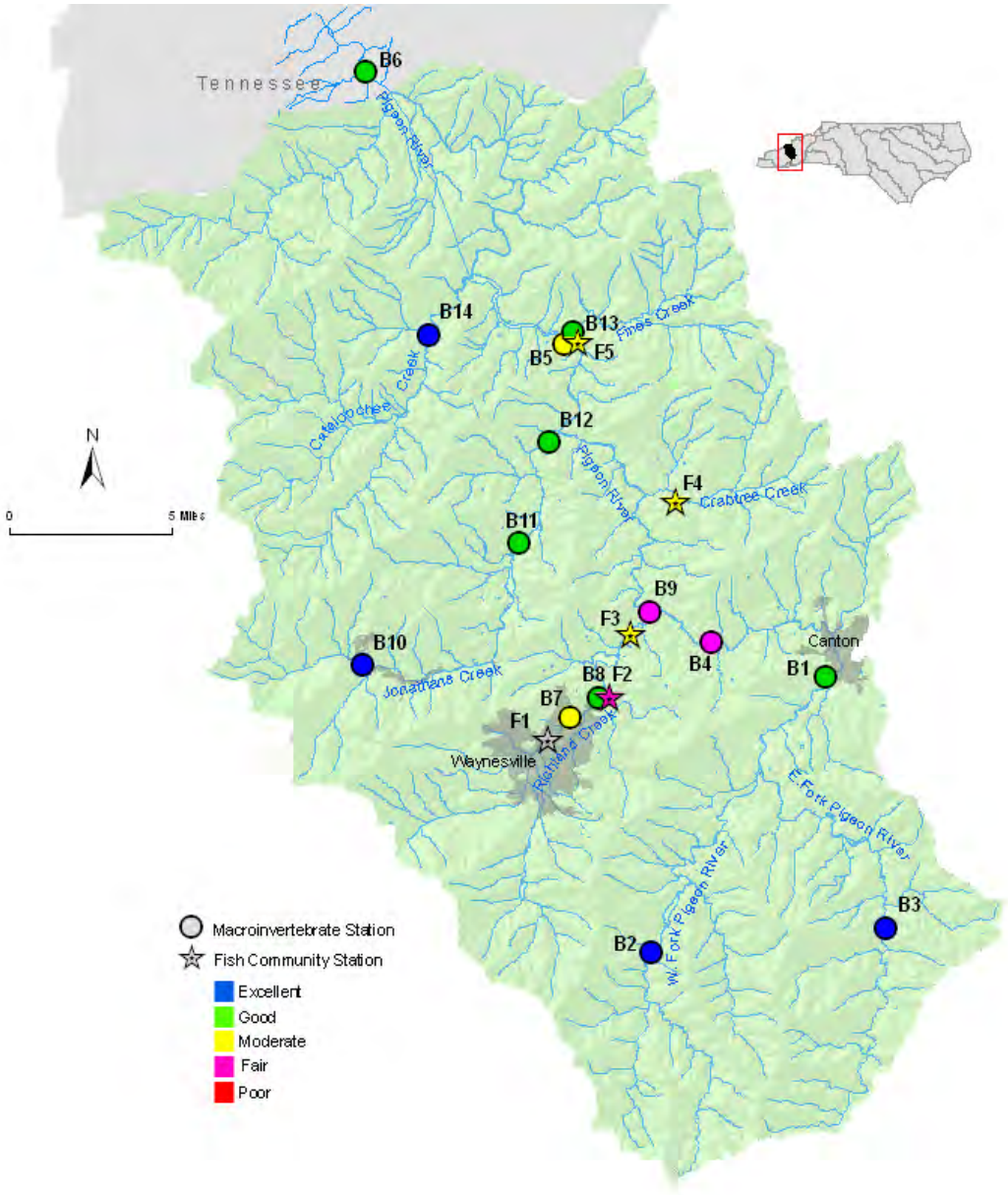


Figure FRB06. Sampling sites in HUC 06010106 in the French Broad River basin. Monitoring sites are listed in Table FRB06.

Overall, bioclassifications based on benthic macroinvertebrate data improved from 2002 to 2007 in this HUC at sites comprised primarily of non-point pollution inputs. In most instances, this was due to the record drought conditions and a subsequent decrease in run-off derived pollution. The most notable example of this occurred at Fines Creek, which improved from Good-Fair in 2002 to Good in 2007. Conversely, many sites that were below large point-source dischargers declined in bioclassification based on benthic macroinvertebrates due to a concentration of effluent due to the drought. The most noteworthy example of this occurred at Johnathans Creek at SR 1322, which declined from Excellent in 2002 to Good in 2007. Generally speaking, benthic macroinvertebrate data suggest Good to Excellent water quality in most of the waterbodies contained in this HUC with the primary exceptions being noted at Richlands Creek (SR 1519) and the Pigeon River (SR 1642 and SR 1519). The most diverse and pollution intolerant benthic macroinvertebrate communities were found at Cataloochee Creek (designated ORW along with tributaries) and West Fork Pigeon River (which has been designated HQW as well as its

tributaries). Other waters designated as Native and Special Native Trout Waters (and thus also HQW) include the upper portion of the Little East Fork Pigeon River and tributaries, the upper portion of East Fork Pigeon River and tributaries, portions of Rough Creek, and Rocky Branch.

Fish community samples were collected from five sites during the 2007 assessment (Table XX). Three sites on Richland Creek ranged from Not Rated (Boyd Avenue) to Fair (SR 1184) to Good-Fair (Walnut Trail Road). The SR 1184 and Walnut Trail Road sites both improved from earlier collections (in 2001 and 2002 respectively), which received Poor bioclassifications. The remaining two fish samples in this HUC were collected at Crabtree Creek (Good-Fair; unchanged from 2002) and Fines Creek (Good-Fair, improved from Fair in 2002).

There was one fish kill reported between 2002 and 2007 in this HUC. The kill occurred on the Pigeon River, just below Canton, on September 27, 2007 as a combined effect of low flow, low dissolved oxygen and high water temperatures which was likely induced by the ongoing drought. Additional fish kill information can be found in Appendix XX.

Table FRB06. Waterbodies monitored in HUC 06010106 in the French Broad River basin for basinwide assessment, 2002 and 2007.

Map #[1]	Waterbody	County	Location	2002	2007
B-1	Pigeon R	Haywood	NC 215	Good-Fair	Good[2]
B-2	W Fk Pigeon R	Haywood	SR 1216	Excellent	Excellent
B-3	E Fk Pigeon R	Haywood	US 276	Excellent	Excellent[2]
B-4	Pigeon R	Haywood	SR 1642	Poor	Fair[2]
B-5	Pigeon R	Haywood	SR 1338	Good-Fair	Good-Fair[2]
B-6	Pigeon R	Cocke Co, TN	At Browns Bridge	Good	Good
B-7	Richland Cr	Haywood	US 23	Good	Good-Fair
B-8	Richland Cr	Haywood	SR 1184	Good-Fair	Good
B-9	Richland Cr	Haywood	SR 1519	Good-Fair	Fair
B-10	Jonathans Cr	Haywood	SR 1306	Excellent	Excellent
B-11	Jonathans Cr	Haywood	SR 1322	Excellent	Good
B-12	Jonathans Cr	Haywood	SR 1349	Good	Good
B-13	Fines Cr	Haywood	SR 1355	Good-Fair	Good
B-14	Cataloochee Cr	Haywood	SR 1395	Excellent	Excellent
F-1	Richland Cr	Haywood	Boyd Ave.	Poor	Not Rated
F-2	Richland Cr	Haywood	SR 1184	Poor	Fair
F-3	Richland Cr	Haywood	Walnut Trail	Poor	Good-Fair
F-4	Crabtree Cr	Haywood	NC 209	Good-Fair	Good-Fair
F-5	Fines Cr	Haywood	SR 1355	Fair	Good-Fair

[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.
[2]Data taken in 2006. [3]Data taken in 2001

River and Stream Assessment

Specific site summaries of the 19 benthic macroinvertebrate and fish community samples may be found at this link: **06010106**.

Special Studies

Pigeon River

Blue Ridge Paper Products (BRPP) NPDES No. NC0000272) operates a mill in Canton, NC . Among the decisions under consideration with permit renewal are whether to continue variances from the temperature and color standards. BRPP contracted biologists at the University of Tennessee at Knoxville to conduct a balanced and indigenous species study report and a temperature model for the Pigeon River (BRPP 2006). BRPP's balanced and indigenous species study found that the Pigeon River benthic community was impacted only directly below the mill as well as below the confluence of Richland Creek, which empties into the Pigeon River upstream of Waynesville's municipal wastewater discharge. A request was made by BRPP to consider the 2005 data in use support assessment of the Pigeon during the BRPP NPDES permit renewal process. Resampling by BAU biologists in July of 2006 was done as a special study to assess the Pigeon River during normal flow.

The rating of the Pigeon River at NC 215, Canton upstream of the BRPP mill received a bioclassification of Good. The rating given in 2002 for the location one-quarter mile upstream this site was Good-Fair, possible due to lower flows. Pigeon River at SR 1642 was given a rating of Fair. The community is dominated by tolerant taxa. This rating is an improvement from 2002 when this site was rated as Poor, possibly due to concentrated mill effluent and lack of habitat. Downstream of Clyde and Waynesville's wastewater effluent, the Pigeon River at SR 1519 also rated Fair. A similar tolerant community to that found at SR 1642 was found. The Pigeon River at SR 1338 was given a rating of Good-Fair, the same as found in 2002. It appears that distance from major dischargers and dilution of the Pigeon River by tributaries contributes to the higher classification than the two upstream sites. (BAU Memo-060914).

Richland Creek: Reclassification Study
Numerous sites in the Richland Creek watershed were sampled for the presence of trout for purposes of reclassification to Trout (Tr) waters. As a result of this study, Shiny Creek, Old Bald Creek, Cherry Cove Creek, Winchester Creek, Medford Branch, Rocky Branch, Richland Creek (SR 1160/1168), Richland Creek (US 23 Business) and Richland Creek (Boyd Avenue) all met Trout Waters criteria and were recommended for reclassification to Tr waters. In addition, Rebank Branch, Nolen Creek, Drift Branch, Little Branch, Allen Creek Reservoir, Long Branch, Cold Spring Branch, Deep Gap Creek, Steestachee Branch, Bearpen Branch, and Rocky Branch (From source to dam at old Waynesville Reservoir) were also recommended for reclassification.

Streams not qualifying for reclassification included Factory Branch, Racoon Branch, Shelton Branch, Farmer Branch, Hyatt Creek, Richland Creek (SR 1184), Lake Junaluska, Shingle Cove Branch, Ratcliffe Branch, Mauney Cove Branch, and McElroy Branch.

Fines Creek: Reclassification Study
A total of four sites in the Fines Creek watershed were sampled for the presence of trout for purposes of reclassification to Trout (Tr) waters. As a result of this study, all sites were found to be supporting a wild or naturalized and stocked trout population on a year-round basis. Moreover, it was determined that the entire Fines Creek watershed is also supporting a wild or naturalized and stocked trout population on a year-round basis and therefore the entire Fines Creek watershed should also be reclassified to Trout waters.

FRENCH BROAD RIVER HUC 06010108 – NOLICHUCKY RIVER

Description

HUC 06010108 is comprised of French Broad River Subbasins 06 and 07 and includes the Nolichucky River and its main tributaries, the Cane River and the North Toe River (Figure FRB08). The South Toe River, along with its tributary Big Crabtree Creek, flow into the North Toe River while the other major streams, Bald Mountain Creek and Big Rock Creek flow into the Cane and North Toe River respectively.

The majority of this hydrologic unit lies within the Southern Crystalline Ridges and Mountains ecoregion although sections of the High Mountain ecoregion are also present, particularly in the southwestern portion of the HUC. Much of the Nolichucky watershed is forested and contained within Pisgah National Forest. Agricultural land is generally located along the river corridors and is sparse in the northern portion of the watershed and more intense near the Towns of Spruce Pine and Burnesville. Additionally, small urban communities are scattered within this area of which Spruce Pine and Burnsville are the largest. Active industrial mining facilities are present on the North Toe River and are the largest permitted NPDES dischargers in the area. Various other minor NPDES permitted facilities exist in the watershed and are dominated by WWTPs from small community developments. In all, there are many point and non-point sources which can affect the water quality of streams in this area.

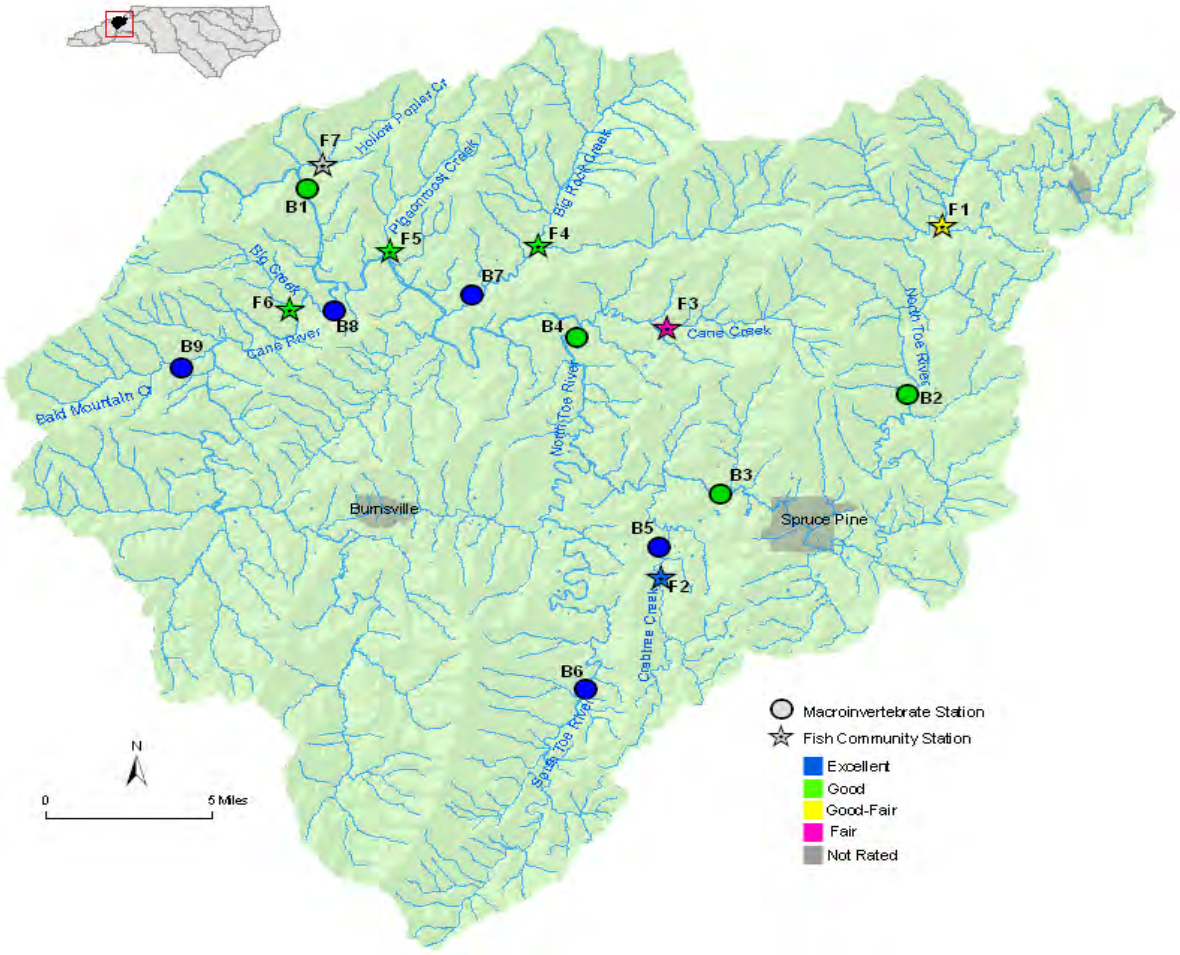


Figure FRB08. Sampling sites in HUC 06010108 in the French Broad River basin. Monitoring sites are listed in Table FRB08.

Table FRB08. Waterbodies monitored in HUC 06010108 in the French Broad River basin for basinwide assessment, 2002 and 2007.

Map #[1]	Waterbody	County	Location	2002	2007
B-1	Nolichucky R	Mitchell	SR 1321	Good	Good
B-2	North Toe R	Avery	US 19E	Good	Good
B-3	North Toe R	Mitchell	SR 1162	Fair	Good (2006)
B-4	North Toe R	Yancey	SR 1314	Good	Good
B-5	Big Crabtree Cr	Mitchell	US 19E	Excellent	Excellent
B-6	South Toe R	Yancey	SR 1167	Excellent	Excellent
B-7	Big Rock Cr	Mitchell	NC 197	Excellent	Excellent
B-8	Cane R	Yancey	US 19W	Excellent	Excellent
B-9	Bald Mountain Cr	Yancey	SR 1408	Excellent	Excellent
F-1	N Toe R	Avery	SR 1121	---	Good-Fair
F-2	Big Crabtree Cr	Mitchell	SR 1002	---	Excellent
F-3	Cane Cr	Mitchell	SR 1211	---	Fair
F-4	Big Rock Cr	Mitchell	NC 226	---	Good
F-5	Pigeonroost Cr	Mitchell	SR 1349/NC 197	Excellent	Good
F-6	Big Cr	Yancey	SR 1444	---	Good
F-7	Hollow Poplar Cr	Mitchell	NC 197	---	Not Rated

[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.

Overview of Water Quality

Benthic macroinvertebrate samples have been collected at 36 sites in HUC 06010108 (25 in subbasin 06, 11 in subbasin 07) since 1983. Eight sites were sampled in 2007 and one in 2006 as part of the basin assessment program and rated Good or Excellent (Table FRB08). Although no serious habitat or physical-chemical problems, independent of exceptional drought, were prevalent throughout the basin, lack riparian vegetation was the most common deficiency shared by the majority of streams sampled. No streams in this HUC are listed on the NC impaired streams 303(d) list.

The Nolichucky River has consistently received a Good bioclassification since 1986. Small scale fluctuations in community composition and overall tolerance over the last 15 years have been documented but otherwise water quality remains stable.

Water quality in the North Toe River has remained relatively stable with a Good rating since basinwide monitoring began, with the exception of the sampling site at SR 1162 in Mitchell County. The latter site has historically varied between Fair (6 ratings) and Good (3 ratings). The most recent Fair rating, received during the last basinwide assessment, was attributed to a petroleum spill into the river a short time before sampling. The site returned to Good in 2007. This site is also downstream of 5 major NPDES dischargers and the Town of Spruce Pine which likely contribute to the variable ratings not seen at the other benthic stations on the North Toe River.

The South Toe River, classified as ORW, maintained its Excellent rating since it received a Good rating in 1983. Additionally, the secondary tributaries to the Nolichucky, Big Mountain Creek and Big Rock Creek, retained their Excellent bioclassifications indicating stable conditions within their catchments.

Benthic samples have been collected in the Cane River and its tributary Bald Mountain Creek since 1992. The Cane River has remained Excellent since 1992. Bald Mountain Creek has shown improvements in water quality as indicated by the bioclassification increase from Good-Fair (1992) to Good (1997) to Excellent (2002-2007).

Fish community samples were collected at seven streams (Table FRB08) within the Nolichucky watershed.

The North Toe River has maintained a Good-Fair rating since it was last sampled in 1997 though fewer fish species were collected in 2007. The moderately rich community was dominated by mottled sculpin and the river supported populations of both large wild and hatchery supported trout.

A regional reference site, Big Crabtree Creek has retained its Excellent bioclassification for over 10 years. Also, a hellbender (*Cryptobranchus alleganiensis*), a species of special concern in NC, was noted in this stream.

Cane Creek and Big Rock Creek, both tributaries to North Toe River, received a Fair and Good bioclassification, respectively. These ratings and the respective biotic indices have remained the same for each stream since they were last sampled (1997 for Cane Creek, 1998 for Big Rock Creek) indicating stable water conditions.

The rating for Pigeonroost Creek fell from the Excellent received in 2002, to Good for 2007. The Good rating for 2007, however, is borderline in that it may have scored an Excellent rating had one more intolerant fish species been collected.

Big Creek, a Cane River tributary, rated Good and Hollow Poplar Creek, a tributary to the Nolichucky River, received a Not Rated bioclassification. While Hollow Poplar Creek was Not Rated, the water quality is typical of a high elevation, high gradient trout stream. Both streams were sampled for the first time in 2007.

There was one fish kill reported between 2002 and 2007 in this HUC. The kill occurred on White Oak Creek, near Bakersfield, on May 1, 2007. This die-off is most likely attributed to pesticide use within the catchment. Additional fish kill information can be found in Appendix XX.

River and Stream Assessment

Two basinwide streams sampled in 2002, Jacks Creek and Price Creek, were not sampled in 2007 due to insufficient manpower resources. Specific site summaries of the 16 benthic macroinvertebrate and fish community samples may be found at this link: **06010108**.

Special Studies

Post Hurricane Biological Sampling

The effect of catastrophic flooding caused by hurricanes on the fish and benthic macroinvertebrate community was assessed in the French Broad and Watauga River Basins in late 2004. Sampling was done on November 30 through December 2, 2004 on eight streams, of which two, Big Crabtree Creek and the South Toe River, are within the Nolichucky watershed.

Big Crabtree Creek maintained an Excellent rating for the fish community but dropped from Excellent to Good when based on the macroinvertebrate fauna. No fish sampling was performed in the South Toe River, but macroinvertebrate sampling resulted in a decrease from an Excellent to Good bioclassification. See the DQW memorandum BAU-04042005 for more information.

Bald Creek Watershed Assessment

An assessment the macroinvertebrate community of the Bald Creek watershed was made at the request of the Ecosystem Enhancement Program. A total of 6 streams were sampled in this study (2 sites on Bald Creek, Elk Wallow Creek, Lickskillet Branch, Possumtrot Creek, Bowlens Creek and Bald Mountain Creek). Three streams, Bald Creek (at SR 1399), Lickskillet Branch, and Possumtrot Creek, were assigned Not Impaired ratings due to their small size. Bald Creek (at US 19W) and Elk Wallow Creek, a tributary to Bald Creek, both rated Good. The 2 reference sites, Bald Mountain Creek and the Bowlens Creek, both rated excellent. For more information see memorandum BAU-01202005.

GLOSSARY

$7Q_{10}$	A value which represents the lowest average flow for a seven day period that will recur on a ten year frequency. This value is applicable at any point on a stream. $7Q_{10}$ flow (in cfs) is used to allocate the discharge of toxic substances to streams.
Bioclass or Bioclassification	Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups (EPT) and the Biotic Index value.
cfs	Cubic feet per second, generally the unit in which stream flow is measured.
CHL *a*	Chlorophyll *a*.
Class C Waters	Freshwaters protected for secondary recreation, fishing, aquatic life including propagation and survival, and wildlife. All freshwaters shall be classified to protect these uses at a minimum.
Conductivity	In this report, synonymous with specific conductance and reported in the units of µmhos/cm at 25 ^{o}C. Conductivity is a measure of the resistance of a solution to electrical flow. Resistance is reduced with increasing content of ionized salts.
Division	The North Carolina Division of Water Quality.
D.O.	Dissolved Oxygen.
Ecoregion	An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, vegetation, and soil type. Examples include Mountains, Piedmont, Coastal Plain, Sand Hills, and Carolina Slate Belt.
EPT	The insect orders (Ephemeroptera, Plecoptera, Trichoptera); as a whole, the most intolerant insects present in the benthic community.
EPT N	The abundance of Ephemeroptera, Plecoptera, Trichoptera insects present, using values of 1 for Rare, 3 for Common and 10 for Abundant.
EPT S	Taxa richness of the insect orders Ephemeroptera, Plecoptera and Trichoptera. Higher taxa richness values are associated with better water quality.
HQW	High Quality Waters. Waters which are rated Excellent based on biological and physical/chemical characteristics through Division monitoring or special studies, primary nursery areas designated by the Marine Fisheries Commission, and all Class SA waters.
Major Discharger	Greater than or equal to one million gallons per day discharge (≥ 1 MGD)
MGD	Million Gallons per Day, generally the unit in which effluent discharge flow is measured.
Minor Discharger	Less than one million gallons per day discharge (< 1 MGD).
NPDES	National Pollutant Discharge Elimination System.

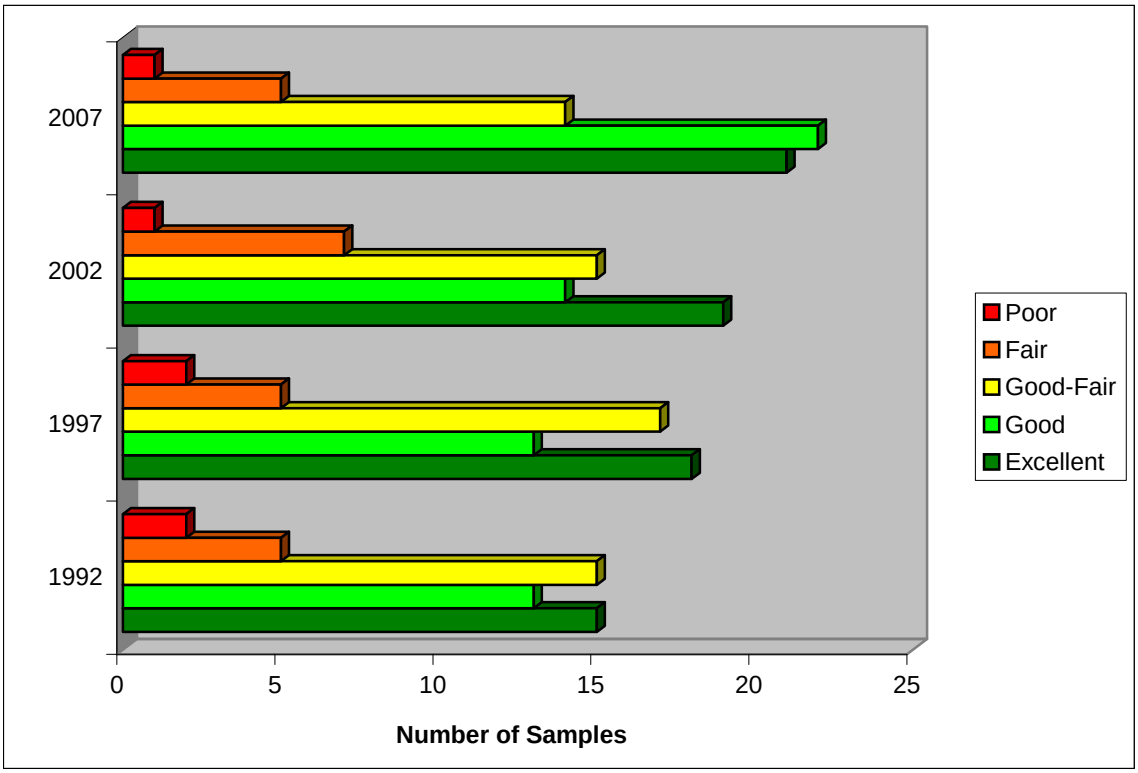
NCBI (EPT BI)	North Carolina Biotic Index, EPT Biotic Index. A summary measure of the tolerance values of organisms found in the sample, relative to their abundance. Sometimes noted as the NCBI or EPT BI.
NCIBI	North Carolina Index of Biotic Integrity (NCIBI); a summary measure of the effects of factors influencing the fish community.
NSW	Nutrient Sensitive Waters. Waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs.
ORW	Outstanding Resource Waters. Unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses.
SOC	A consent order between an NPDES permittee and the Environmental Management Commission that specifically modifies compliance responsibility of the permittee, requiring that specified actions are taken to resolve non-compliance with permit limits.
Total S (or S)	The number of different taxa present in a benthic macroinvertebrate sample.
UT	Unnamed tributary.
WWTP	Wastewater treatment plant

Appendix B-1. Summary of benthic macroinvertebrate data, sampling methods and criteria.

Overall French Broad River Basin Summary:

For 2007, 57 long-term benthic macroinvertebrate samples were sampled in the French Broad River Basin as part of the Basinwide Assessment program. Graphical representations of bioclassification trends from 2007-1992 among these long-term basinwide benthos sites for each of the HUCS (**Figures XX-XX**), subbasins (**Figures XX-XX**), as well as for the entire French Broad River basin (**Figure XX**) can be found below. As can be seen from this data, the 2007 benthic macroinvertebrate community bioclassifications have generally improved from previous levels. In many of these instances, the improvement is attributable to drought and this trend was most pronounced in areas of the basin where point source dischargers were rare and where the largest potential source of stress to aquatic invertebrate communities were due to non-point sources. In general, during droughts, invertebrate communities below large point source dischargers tend to become less diverse and more pollution tolerant in composition as effluent is concentrated as a result of lowered precipitation and groundwater inputs. Conversely, during drought conditions, less runoff from non-point sources is introduced from land into waterbodies and this typically results in the development of a more diverse, and less pollution tolerant invertebrate community.

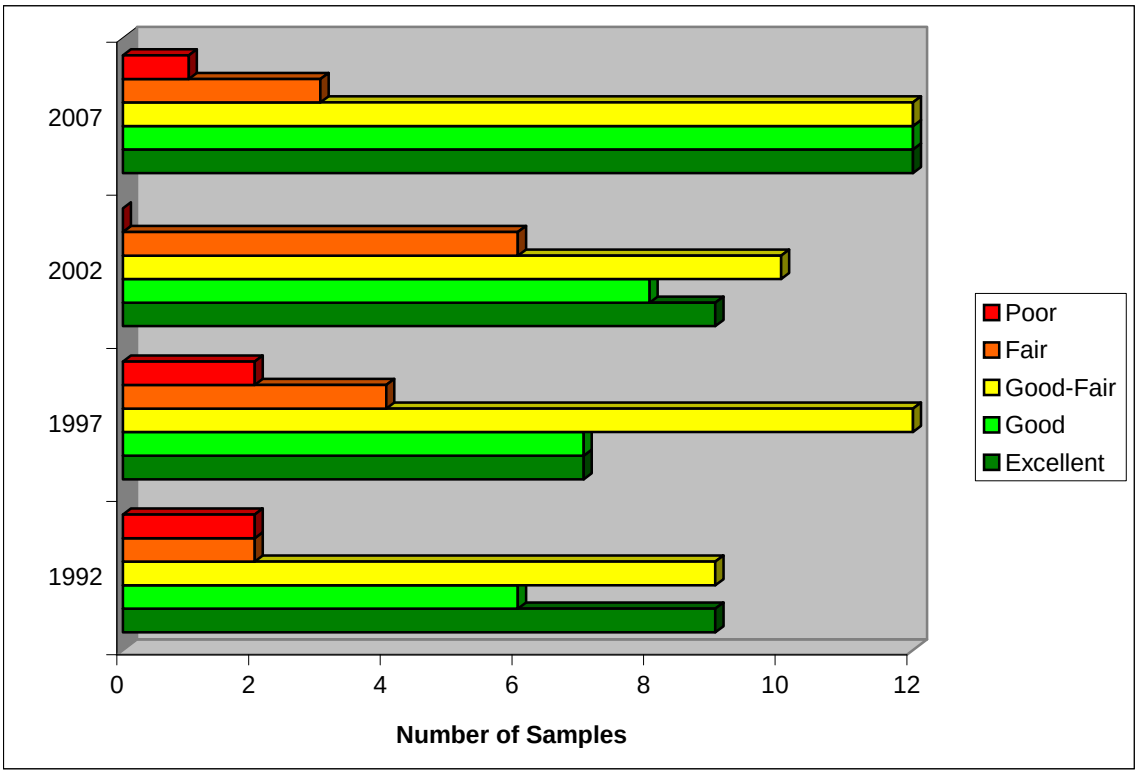
Figure XX. French Broad River Basin Bioclassification Trends: (2007-1992).



HUC 06010105 (French Broad River) Summary

The bioclassification trends for all of HUC 06010105 from 2007-1992 can be seen below (**Figure B-1.1**). This large HUC is comprised of a mix of forest, agriculture, and urban areas. Subbasins 01, 03, and 04 are largely forested with some agricultural uses. There are few large NPDES dischargers or large municipalities in these subbasins. Conversely, subbasin 02 is mostly a combination of agriculture and urban areas associated with the City of Asheville with several large NPDES dischargers present. In general, sites in subbasins 01, 03, and 04 that have largely forested watersheds maintained Excellent bioclassifications in 2007 from earlier Excellent samples. A few examples of this included West Fork French Broad River (US 64), Davidson River (US 276) and Big Laurel Creek (SR 1503). In addition, many sites in Subbasin 02 whose catchments are largely agriculture and suburban improved slightly in 2007 from earlier samples as a result of reduced impacts associated with non-point sources of pollution. Examples of this included French Broad River (SR 1634), Mud Creek (US 25), Clear Creek (SR 1513), South Hominy Creek (NC 151), and Swannanoa River (SR 2416). The one notable exception was Cane Creek (SR 1006), which received a Poor bioclassification in 2007 for the first time.

Figure B-1.1. **French Broad River Basin HUC 06010105 (Subbasins 01, 02, 03, & 04) Bioclassification Trends (2007-1992)**



Graphical Summaries by Subbasin

Figure B-1.2. French Broad River Subbasin 01 (HUC 06010105): Bioclassification Trends (2007-1992)

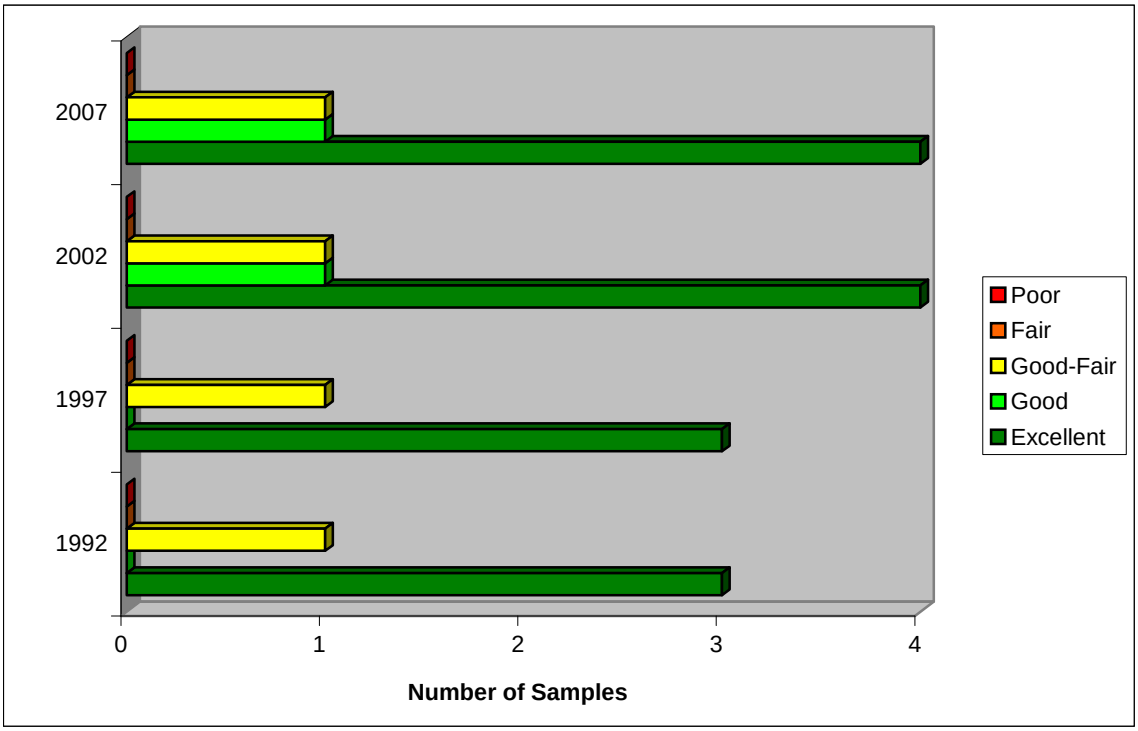


Figure B-1.3. French Broad River Subbasin 02 (HUC 06010105): Bioclassification Trends (2007-1992)

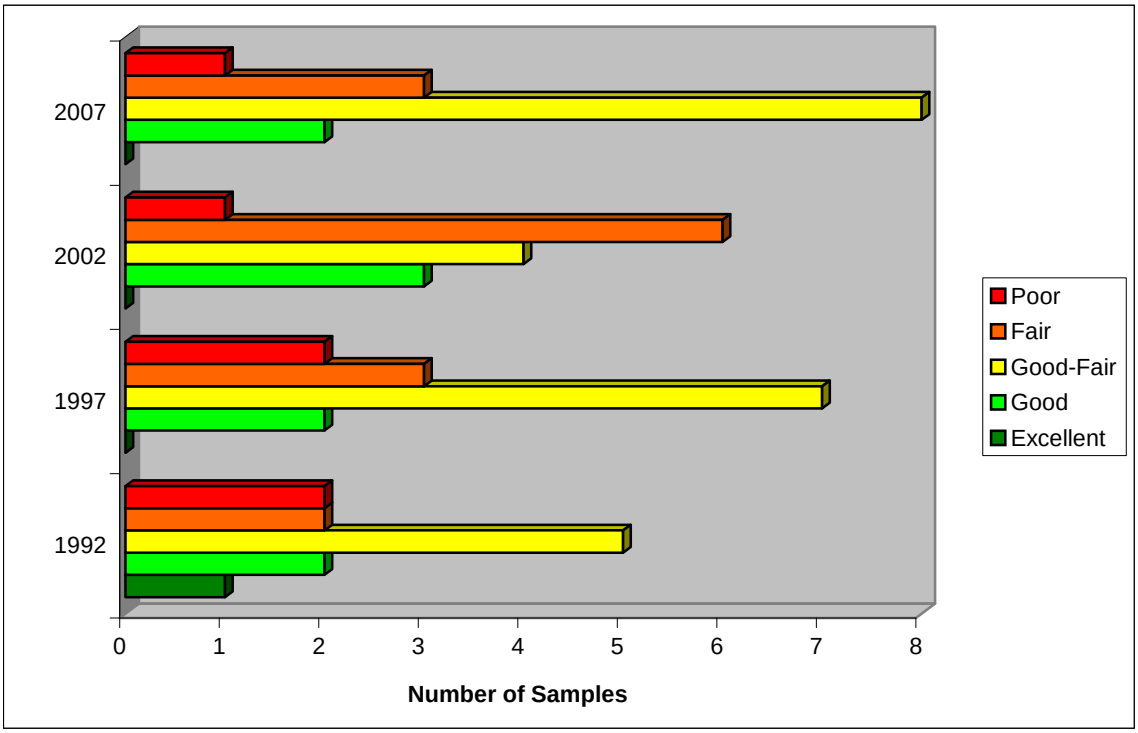


Figure B-1.4. **French Broad River Subbasin 03 (HUC 06010105): Bioclassification Trends (2007-1992)**

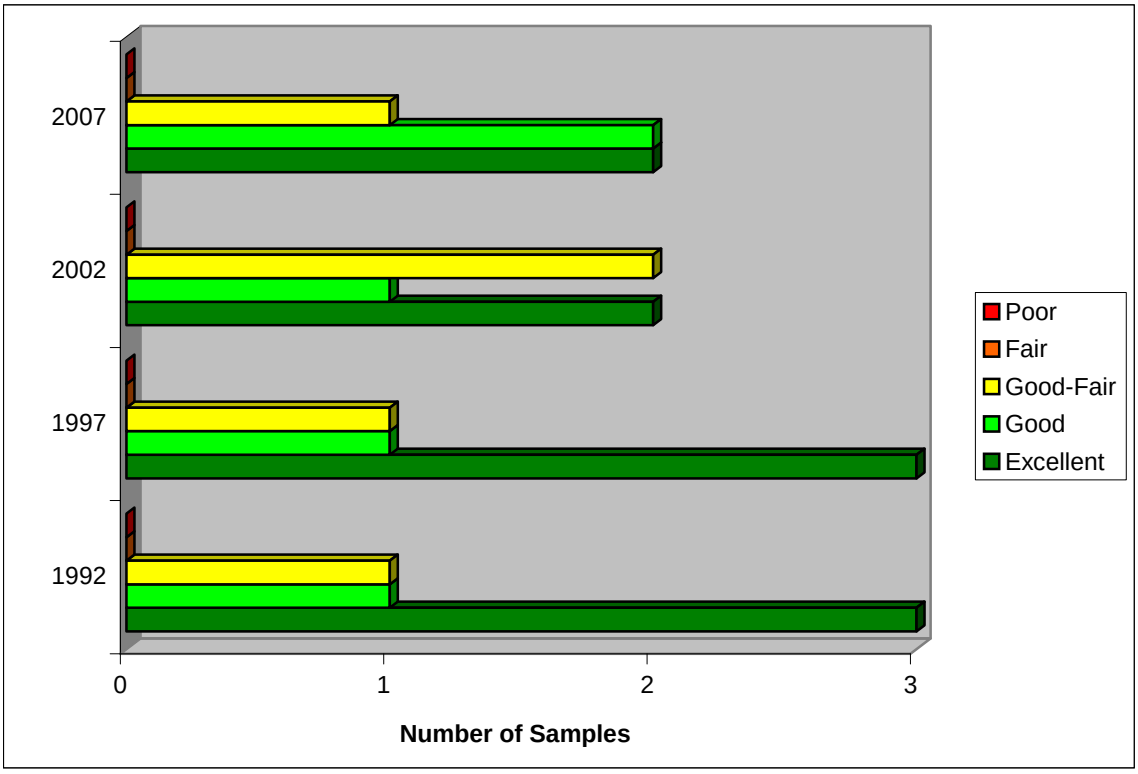
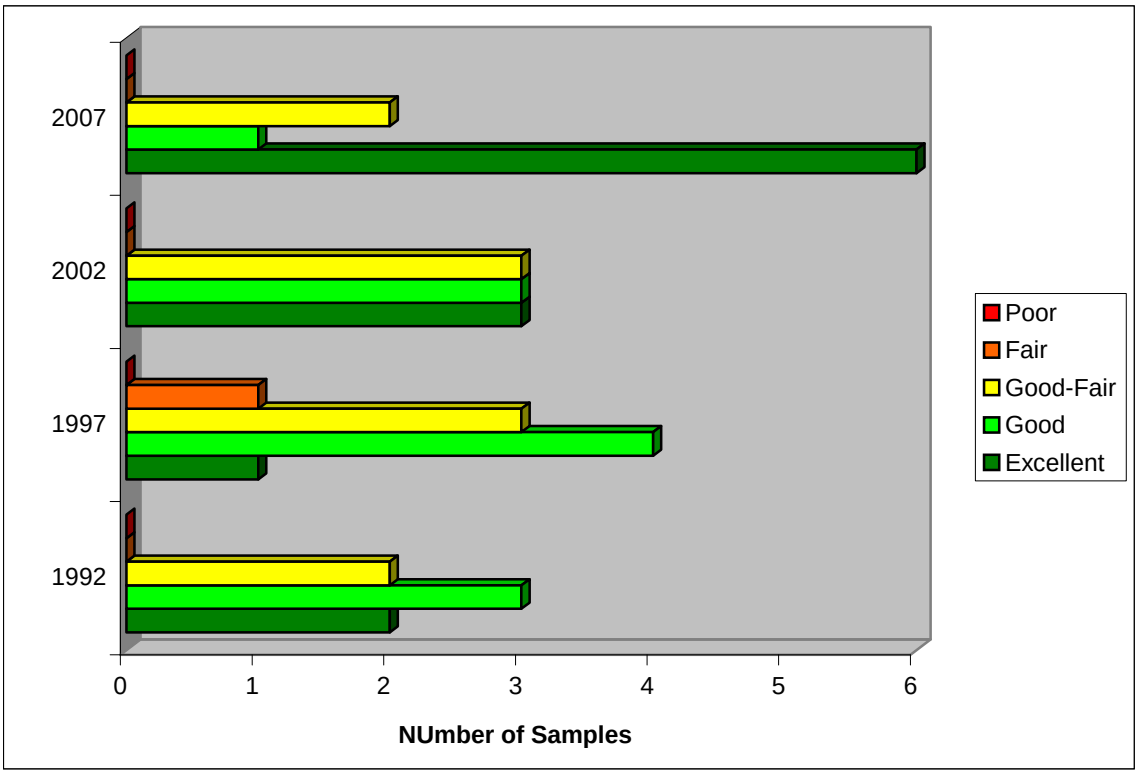


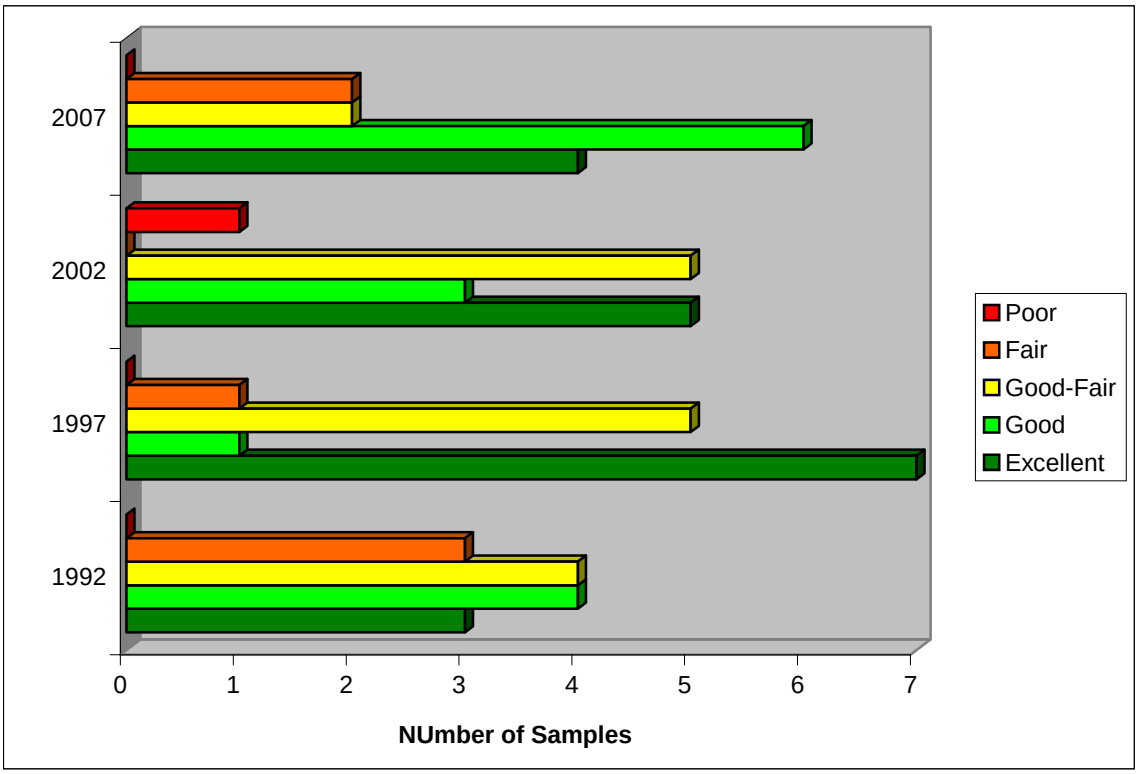
Figure B-1.5. **French Broad River Subbasin 04 (HUC 06010105): Bioclassification Trends (2007-1992)**



HUC 06010106 (Pigeon River) Summary

The bioclassification trends for all of HUC 06010106 from 2007-1992 can bee seen below in Figure B-1.6. As can be seen below, the number of Excellent bioclassifications declined slightly, but this was strongly offset by the large increase in the number of Good bioclassifications. With the exception of Canton and Waynesville, most of this HUC is comprised of forest and agriculture with few point source dischargers present. In general, streams in these areas of the HUC improved from earlier samples as a result of lessened non-point impacts due to drought. Examples of these streams include Fines Creek (SR 1355) and Pigeon River (NC 215). Conversely, some sites located below large NPDES dischargers decreased slightly in bioclassification as a result of effluent concentration due to drought and included Jonathans Creek (SR 1322). Streams with watershed comprised nearly entirely of forest maintained Excellent bioclassifications in 2007 from previous Excellent collections and included Cataloochee Creek (SR 1395), West Fork Pigeon River (SR 1216) and East Fork Pigeon River (US 276).

Figure B-1.6. **French Broad River Basin HUC 06010106 (Subbasin 05): Bioclassification Trends (2007-1992)**



HUC 06010108 (Nolichucky River) Summary

The bioclassification trends for all of HUC 06010108 from 2007-1992 can be seen below in Figure B-1.7. Most of the landuse in this HUC is a mix of forest and agriculture with few areas of suburbanization and few large NPDES dischargers. As can be seen below for 2007, bioclassifications have stayed largely unchanged in this HUC from previous samples. The one site that changed significantly from 2002 was the North Toe River (SR 1162), which improved to Good from Fair in 2002 as a result of continued recovery from a hydrocarbon spill in 2002.

Figure B-1.7. **French Broad River Basin HUC 06010108 (Subbasins 06 & 07): Bioclassification Trends (2007-1992)**

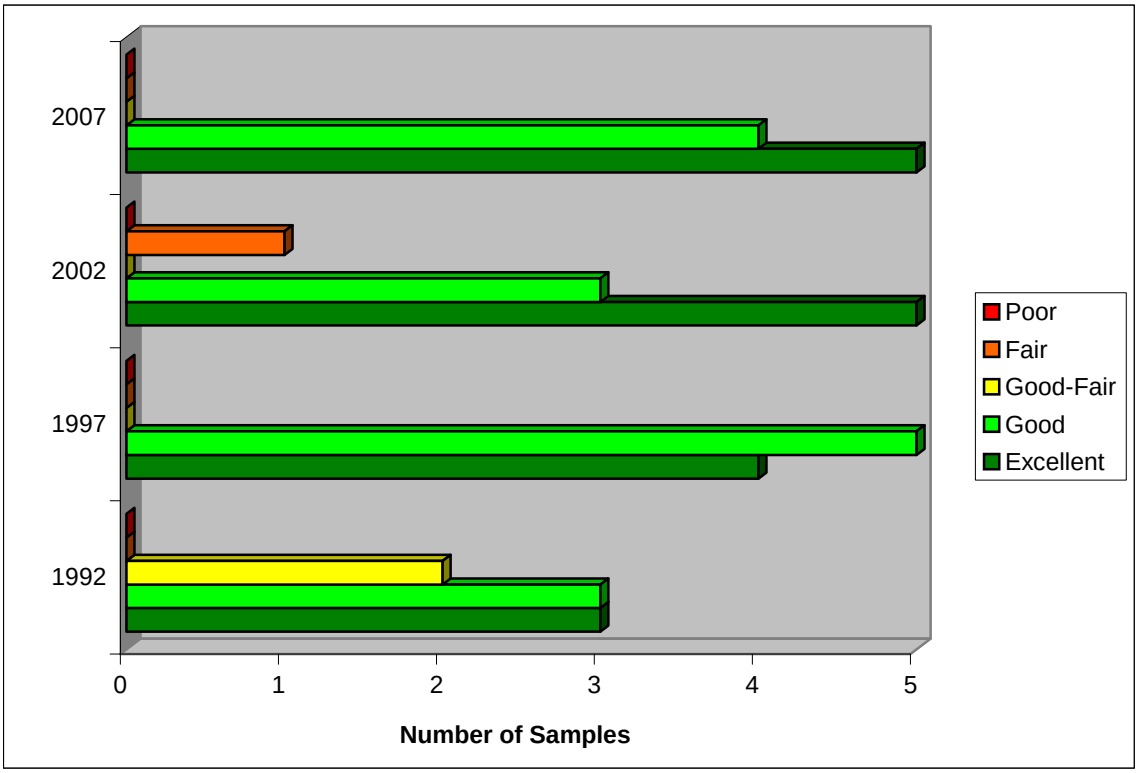


Figure B-1.8. **French Broad River Basin 06 (HUC 06010108): Bioclassification Trends (2007-1992)**

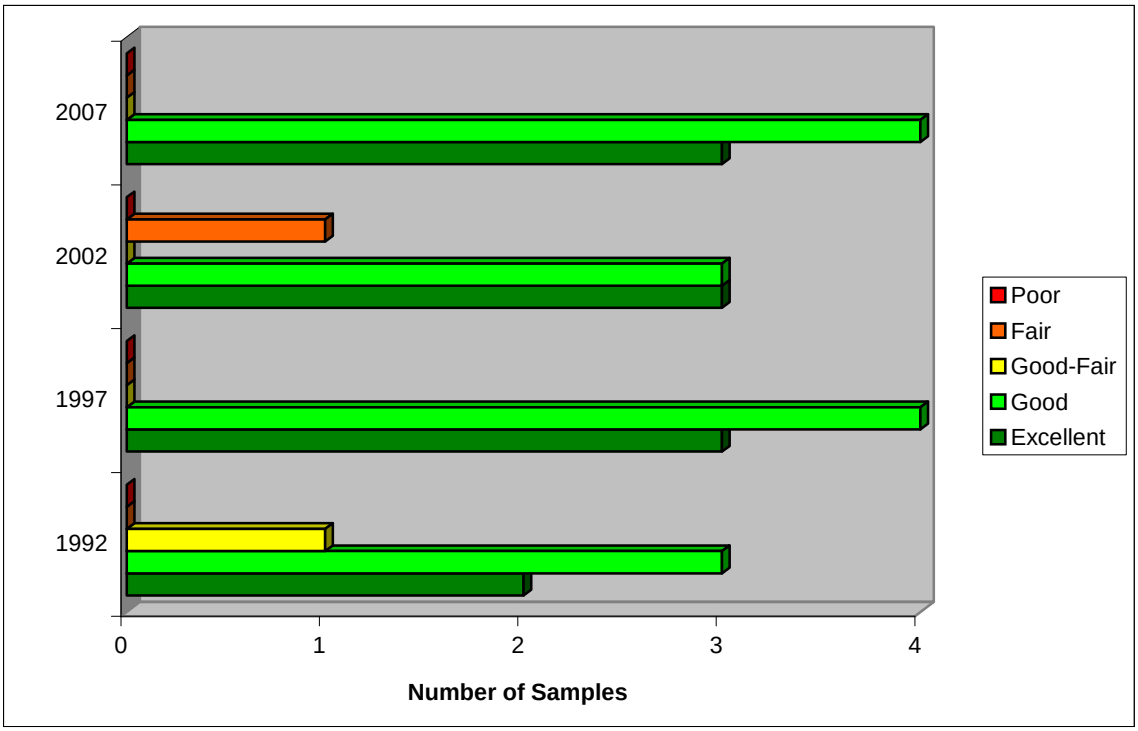
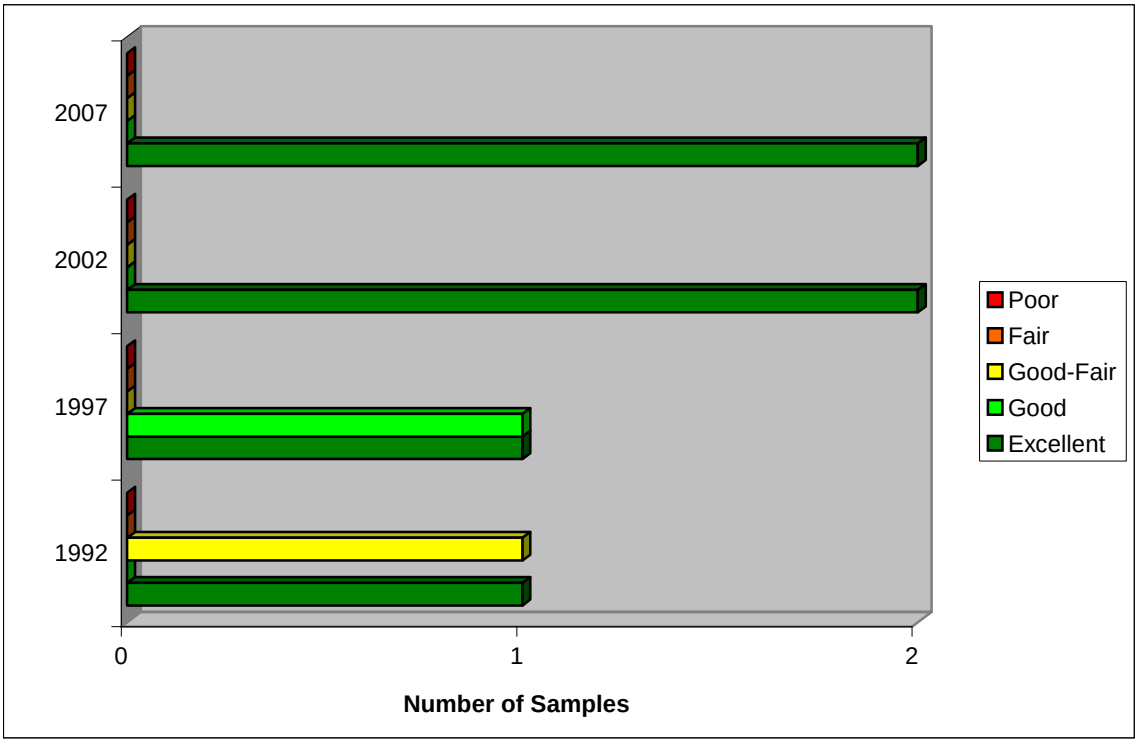


Figure B-1.9. **French Broad River Basin 07 (HUC 06010108): Bioclassification Trends (2007-1992)**



There were numerous rare invertebrate taxa collected in the French Broad River basin in 2007 (Table 1).

Table 1. Rare invertebrate taxa: French Broad River Basin, 2002-2007.

Taxon	Number of DWQ Collections	Collection Location(s)	First Collection in FRB?
Mayfly**: *Litobrancha recurvata***	37	Beaverdam Creek (SR 3449, *Buncombe*), Bad Fork (FSR 479, *Henderson*)	No
Mayfly**: *Serratella spiculosa***	19	Carson Creek (SR 1103, *Transylvania*), South Toe River (SR 1167, *Yancey*)	No
Mayfly**: *Ameletus cryptosimulans***	8	Big Bearpen Branch (FSR 475B, *Transylvania*), Lower Creek (FSR 472, *Yancey*), Hollow Poplar Creek (SR 1321, *Mitchell*)	No
Mayfly**: *Drunella longicornis***	18	Lower Creek (FSR 472, *Yancey*)	No
Stonefly**: *Rasvena terna***	1	Log Hollow Branch (FSR 475B, *Transylvania*)	Yes
Stonefly**: *Isoperla lata***	28	Big Laurel Creek (SR 1318, *Madison*), Meadow Fork (NC 209, *Madison*), Puncheon Fork (SR 1502, *Madison*), Shelton Laurel Creek (NC 208, *Madison*), Spring Creek (SR 1172, *Madison*)	
Stonefly**: *Agnetina flavescens***	27	Sout Toe River (SR 1167, *Yancey*)	No
Stonefly**: *Agnetina capitata***	29	Big Pine Creek (SR 1151, *Madison*), Bull Creek (SR 1370, *Madison*), Charley Branch (NC 209, *Madison*), Foster Creek (SR 1318, *Madison*), Little Laurel Creek (NC 208, *Madison*), Meadow Fork (NC 209, *Madison*), Mill Creek (SR 1313, *Madison*), Spillcorn Creek (SR 1330, *Madison*), Spring Creek (SR 1172, NC 209, *Madison*), Walnut Creek (SR 1395, *Madison*)	No
Stonefly**: *Pteronarcys biloba***	34	Little River (SR 1560, *Transylvania*), Hominy Creek (SR 1123, *Buncombe*), Mud Creek (SR 1126, *Henderson*), Big Laurel Creek (SR 1318, *Madison*), Big Pine Creek (SR 1151, *Madison*)	No

Table 1. Significantly Rare Invertebrate Taxa: Frenchbroad River Basin, 2002-2007 (Continued).

Taxon	Total Number of DWQ Collections	Collection Location(s)	First Time Collected in Frenchbroad Basin?
Stonefly**: *Pteronarcys comstocki***	4	North Toe River (SR 1314, *Yancey*), Ivy Creek (SR 2150, *Madison*)	Yes
Caddisfly**: *Ceratopsyche bifida***	1	Ivy Creek (US 25/70, *Madison*)	Yes
Caddisfly**: *Rhyacophila appalachia***	3	Laurel Branch (NC 215, *Transylvania*, Little River (SR 1560, *Transylvania*)	Yes
Caddisfly**: *Rhyacophila amicus***	8	West Fork Pigeon River (SR 1216, *Haywood*), Big Crabtree Creek (US 19, *Mitchell*)	
Caddisfly**: *Platycentropus* Sp**	39	Hominy Creek (NC 112, *Buncombe*)	No
Caddisfly**: *Agarodes* Sp**	41	Tucker Creek (SR 1325, *Transylvania*), Parker Creek (SR 1310, *Transylvania*)	No
Caddisfly**: *Parapsyche apicalis***	15	Hollow Poplar Creek (SR 1321, *Mitchell*)	No
Caddisfly**: *Psilotreta labida***	40	Bearwallow Branch (FSR 1206, *Transylvania*), Big Bearpen Branch (FSR 475B, *Transylvania*), Cold Spring Branch (NC 208, *Madison*), East Prong Hickory Fork (SR 1310, *Madison*), West Fork Pigeon River (SR 1216, *Haywood*)	No
Caddisfly**: *Matrioptila jeanae***	18	Stony Fork (NC 151, *Buncombe*), Beaverdam Creek (SR 3449, *Buncombe*), Baldmountain Creek (SR 1408, *Yancey*)	
Caddisfly**: *Oecetis avara***	30	Nolichucky River (NC 197, *Mitchell*)	Yes

Sampling Methods

Standard Qualitative (Full Scale) Method

Benthic macroinvertebrates can be collected from wadeable, freshwater, flowing waters using three sampling procedures. The Biological Assessment Unit's standard qualitative (Full Scale) sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs (NCDENR 2003). The samples are picked on-site. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant (≥ 10 specimens).

EPT Method

Benthic macroinvertebrates can also be collected using the EPT sampling procedure. Four rather than 10 composite qualitative samples are taken at each site: 1 kick, 1 sweep, 1 leafpack and visual

collections (NCDENR 2006). Only EPT taxa are collected and identified and only EPT criteria are used to assign a bioclassification.

Habitat Evaluation

An assessment form has been developed by the Biological Assessment Unit to better evaluate the physical habitat of a stream. The habitat score, which ranges between 1 and 100, is based on the evaluation of channel modification, amount of instream habitat, and type of bottom substrate, pool variety, bank stability, light penetration, and riparian zone width. Higher numbers suggest better habitat quality, but no criteria have been developed to assign impairment ratings.

Data Analysis

Criteria for bioclassifications for standard qualitative samples in piedmont ecoregions are given below and are based on EPT S and the NCBI.

Tolerance values for individual species and biotic index values have a range of 0 - 10, with higher numbers indicating more tolerant species or more polluted conditions. Water quality scores (5 = Excellent, 4 = Good, 3 = Good-Fair, 2 = Fair and 1 = Poor) assigned with the biotic index numbers are averaged with EPT taxa richness scores to produce a final bioclassification. Criteria for piedmont and coastal plain streams are used for the Neuse River basin. EPT abundance and Total taxa richness calculations also are used to help examine between-site differences in water quality.

EPT S and BI values can be affected by seasonal changes. DWQ criteria for assigning bioclassification are based on summer sampling: June - September. For samples collected outside summer, EPT S can be adjusted by subtracting out winter/spring Plecoptera or other adjustment based on resampling of summer site. The BI values also are seasonally adjusted for samples outside the summer season.

Table 2. Biotic Index Criteria for Standard Qualitative (Full Scale) Samples.

	BI Values	BI Values
Score	**Mountain**	**Piedmont**
5	<4.00	<5.14
4.6	4.00—4.04	5.14—5.18
4.4	4.05—4.09	5.19—5.23
4	4.10—4.83	5.24—5.73
3.6	4.84—4.88	5.74—5.78
3.4	4.89—4.93	5.79—5.83
3	4.94—5.69	5.84—6.43
2.6	5.70—5.74	6.44—6.48
2.4	5.75—5.79	6.49—6.53
2	5.80—6.95	6.54—7.43
1.6	6.96—7.0	7.44—7.48
1.4	7.01-7.05	7.49—7.53
1	>7.05	> 7.53

Table 3. EPT Criteria for EPT samples.

	EPT Values	EPT Values
Score	**Mountain**	**Piedmont**
Excellent	>35	>27
Good	28-35	21-27
Good-Fair	19-27	14-20
Fair	11-18	7-13
Poor	0-10	0-6

Table 4. Benthic macroinvertebrate data collected from French Broad River Basin, 2002-2007. Basinwide sites sampled in 2007 are in bold font.

HUC/Waterbody	Location	County	Index No	Date	ST	EPT	BI	EPT BI	BioClass
06010105									
French Broad R	SR 1129	Transylvania	6-(1)	8/16/2007	105	46	4.2	3	Excellent
				7/8/2002	96	54	3.6	2.9	Excellent
French Broad R	NC 146	Buncombe	6-(54.5)	8/15/2007	63	27	4.8	3.7	Good
				9/10/2002	65	25	5.6	4.4	Good-Fair
French Broad R	SR 1348	Buncombe	6-(54.5)	8/16/2007	77	30	5.3	4.1	Good-Fair
				7/10/2002	73	30	4.7	3.9	Good
French Broad R	SR 1634	Buncombe	6-(54.5)	8/14/2007	77	28	5.6	4.1	Good-Fair
				7/10/2002	57	18	5.7	4.8	Fair
French Broad R	NC 213	Madison	6-(54.5)	7/31/2007	79	32	4.9	3.7	Good-Fair
				6/26/2002	81	26	5.8	4.5	Good-Fair
Parker Cr	OFF SR 1310 UPS	Transylvania	6-2-4	10/10/2007	35	35	2.2	2.2	Good
Flat Cr	SR 1319	Transylvania	6-2-10	10/9/2007	39	39	2.7	2.7	Excellent
	SR 1319	Transylvania		7/8/2002	38	38	2.4	2.4	Excellent
N Fk French Broad R	SR 1322	Transylvania	6-3-(6.5)	8/17/2007	95	43	3.9	2.8	Excellent
	SR 1322	Transylvania		7/9/2002	79	41	3.5	2.7	Excellent
Big Mountain Br	NC 215	Transylvania	6-3-13	10/10/2007	32	32	1.4	1.4	Excellent
Diamond Cr	off SR 1322	Transylvania	6-3-16	10/11/2007	24	24	1.6	1.6	Not Impaired
M Fk French Broad R	SR 1131	Transylvania	6-5	8/16/2007	43	43	2.2	2.2	Excellent
				8/13/2007	41	41	3.1	3.1	Excellent
				7/8/2002	51	51	2.1	2.1	Excellent
Peter Weaver Cr	SR 1195	Transylvania	6-10	8/28/2007	61	27	5.2	4.5	Not Impaired
Morgan Mill Cr	OFF SR 1195	Transylvania	6-10-1	8/28/2007	57	19	5.9	5	Not Impaired
Cherryfield Cr	SR 1128	Transylvania	6-11	10/11/2007	46	46	3.2	3.2	Excellent
Glady Fk	OFF SR 1105	Transylvania	6-16-3	10/10/2007	43	43	2.3	2.3	Excellent
Log Hollow Br	FSR 475B	Transylvania	6-34-12-1-3	4/22/2005	71	44	1.9	1.2	Not Impaired
Big Bearpen Br	FR 475B	Transylvania	6-34-12-3	4/22/2005	92	44	2.5	1.2	Not Impaired
Little R	SR 1560	Transylvania	6-38-(1)	8/16/2007	45	45	3.3	3.3	Excellent
	SR 1560	Transylvania		7/9/2002	35	35	3.5	3.5	Good
Little R	SR 1533	Transylvania	6-38-(20)	8/16/2007	24	24	3.9	3.9	Good-Fair
	SR 1533	Transylvania		7/11/2002	24	24	4.2	4.2	Good-Fair
Mill Pond Cr	SR 1309	Henderson	6-51	8/29/2007	27	4	6.6	6.3	Not Rated
				8/28/2002	35	6	5.6	5.1	Not Rated
Boylston Cr	SR 1314	Henderson	6-52-(0.5)	8/15/2007	22	22	3.9	3.9	Good-Fair
				7/22/2002	62	26	4.8	3.6	Good-Fair
Mills R	SR 1337	Henderson	6-54-(1)	8/15/2007	89	34	4.4	2.7	Good
				6/25/2002	74	39	4.3	3.1	Good
Mills R	SR 1353	Henderson	6-54-(5)	8/15/2007	72	33	4.4	3	Good
				6/24/2002	58	28	5.5	3.9	Good-Fair
Davidson R	US 276	Transylvania	6-54-(15.5)	8/9/2007	37	37	2.5	2.5	Excellent
				8/16/2007	37	37	2.5	2.5	Excellent
				7/22/2002	37	37	3.2	3.2	Excellent
Bad Fk	FSR 479	Henderson	6-54-2-6-1	5/25/2006	64	40	2.5	2	Excellent
S Fk Mills R	Off SR 1338	Henderson	6-54-3-(17.5)	8/29/2007	46	46	2.5	2.5	Excellent
S Fk Mills R	SR 1340	Henderson	6-54-3-(17.5)	8/27/2007	17	17	4.1	4.1	Fair
				6/25/2002	73	38	4.5	3.2	Good
Mud Cr	SR 1126	Henderson	6-55	8/29/2007	50	18	5.9	5	Fair
Mud Cr	US 25	Henderson	6-55	8/15/2007	67	16	6.3	5	Fair
Bat Fk	SR 1803	Henderson	6-55-8-1	5/26/2006	47	9	5.7	5.7	Not Rated
King Cr	US 25	Henderson	6-55-8-1-2	5/26/2006	36	12	5.5	4.8	Not Impaired
Clear Cr	Bearwallow Rd	Henderson	6-55-11-(1)	10/31/2006	22	22	3.7	3.7	Good-Fair
Clear Cr	Gilliam Rd	Henderson	6-55-11-(1)	10/31/2006	17	17	4	4	Fair
Clear Cr	SR 1513	Henderson	6-55-11-(5)	8/13/2007	23	23	4.8	4.8	Good-Fair
Lewis Cr	Pilot Mt Rd	Henderson	6-55-11-6	10/31/2006	11	11	4.2	4.2	Fair
Lewis Cr	Pryor Dr	Henderson	6-55-11-6	10/31/2006	11	11	4.7	4.7	Fair
Cane Cr	SR 1006	Henderson	6-57-(9)	8/13/2007	7	7	4.8	4.8	Poor
				8/28/2003	15	15	5	5	Fair
				7/11/2002	11	11	4.2	4.2	Fair
Bent Cr	FSR 479	Henderson	6-67-(1)	8/29/2007	64	26	3.7	2.8	Good

Table 4 (continued).

HUC/Waterbody	Location	County	Index No	Date	ST	EPT	BI	EPT BI	BioClass
06010105									
Ledford Br	FSR 479	Buncombe	6-67-8	5/23/2006	58	30	2.4	1.7	Not Impaired
Hominy Cr	SR 1123	Buncombe	6-76	8/17/2007	81	31	5	4	Good-Fair
				8/16/2007	72	21	5.8	4.3	Fair
S Hominy Cr	NC 151	Buncombe	6-76-5	8/17/2007	98	37	4.7	3	Good
				11/29/2004	18	18	2.6	2.6	Fair
				8/28/2002	26	26	2.7	2.7	Good-Fair
S Hominy Cr	SR 1105	Buncombe	6-76-5	7/8/2004	28	28	1.4	1.4	Good
Glady Fk	SR 3452	Buncombe	6-76-5-5	7/9/2004	29	29	2.5	2.5	Good
Smith Cove Br	SR 3449	Buncombe	6-76-5-6	7/9/2004	23	23	3.2	3.2	Not Impaired
Boyd Br	FSR 479	Buncombe	6-76-6	5/23/2006	53	33	2.6	2.2	Not Impaired
Moore Cr	SR 1224	Buncombe	6-76-8	5/24/2006	70	16	5.7	4.7	Not Rated
Moore Br	AMBOY RD	Buncombe	6-77	5/23/2006	30	2	7.6	5.5	Not Rated
Swannanoa R	SR 2500	Buncombe	6-78	8/28/2003	51	19	5	4.3	Fair
	SR 2500	Buncombe		8/27/2002	62	19	5.4	4.2	Fair
Swannanoa R	SR 2416	Buncombe	6-78	8/16/2007	87	25	5.9	5	Good-Fair
				8/28/2003	73	25	5.3	4	Good-Fair
				8/27/2002	75	24	5.8	4.5	Fair
Swannanoa R	US 25	Buncombe	6-78	8/15/2007	82	30	5.6	4.1	Good-Fair
				11/29/2004	42	12	5.3	3.9	Fair
				8/28/2002	73	26	5.7	4.7	Good-Fair
Newfound Cr	SR 1622	Buncombe	6-84	8/14/2007	75	11	6.5	4.8	Fair
				7/12/2002	70	23	6.1	4.9	Fair
Reems Cr	NC 251	Buncombe	6-87-(10)	8/14/2007	23	23	3.7	3.7	Good-Fair
				7/10/2002	27	27	3.6	3.6	Good-Fair
Sandymush Cr	SR 1114	Madison	6-92-(9)	8/14/2007	22	22	3.9	3.9	Good-Fair
				11/30/2004	31	31	3.2	3.2	Good-Fair
				7/10/2002	32	32	3.5	3.5	Good
Ivy Cr	SR 2150	Madison	6-96-(0.5)	8/6/2007	38	38	4.4	4.4	Excellent
				7/9/2002	32	32	4.1	4.1	Good
Ivy Cr	US 25-70 BUS	Madison	6-96-(11.7)	8/6/2007	85	32	4.7	3.3	Good
				6/26/2002	80	30	4.9	3.7	Good-Fair
L Ivy Cr	SR 1610	Madison	6-96-10	8/6/2007	26	26	4.3	4.3	Good-Fair
				5/29/2002	78	27	6.2	4.6	Good-Fair
Crooked Cr	SR 1526	Madison	6-96-10-1-8	7/30/2007	34	34	3.3	3.3	Good
Bull Cr	OFF SR 1370	Madison	6-96-16	7/30/2007	37	37	3	3	Excellent
L Pine Cr	OFF SR 1135	Madison	6-104	7/31/2007	36	36	3.3	3.3	Excellent
Big Pine Cr	SR 1151	Madison	6-108	8/1/2007	37	37	2.6	2.6	Excellent
Doe Br	SR 1152	Madison	6-110	8/1/2007	29	29	2.2	2.2	Excellent
Big Laurel Cr	SR 1503	Madison	6-112	9/18/2006	44	44	2.7	2.7	Excellent
				7/8/2002	45	45	2.3	2.3	Excellent
Big Laurel Cr	OFF SR 1318	Madison	6-112	9/19/2006	40	40	3.3	3.3	Excellent
				7/8/2002	80	42	3.3	2.8	Excellent
Big Laurel Cr	NC 208	Madison	6-112	9/21/2006	47	47	3.3	3.3	Excellent
Puncheon Fk	SR 1502	Madison	6-112-5	9/18/2006	38	38	2.8	2.8	Excellent
Puncheon Fk	SR 1503	Madison	6-112-5	8/1/2007	40	40	2.4	2.4	Excellent
				7/8/2002	40	40	2.8	2.8	Excellent
Foster Cr	SR 1318	Madison	6-112-11	9/19/2006	36	36	3.1	3.1	Excellent
Spillcorn Cr	SR 1330	Madison	6-112-21	9/19/2006	38	38	2.7	2.7	Excellent
Shelton Laurel Cr	NC 208	Madison	6-112-26	9/19/2006	44	44	3.4	3.4	Excellent
				6/27/2002	32	32	3.6	3.6	Good
Shelton Laurel Cr	Off NC 208	Madison	6-112-26	9/21/2006	51	51	3.5	3.5	Excellent
Mill Cr	SR 1313	Madison	6-112-26-1	9/20/2006	42	42	2.1	2.1	Excellent
Big Cr	SR 1312	Madison	6-112-26-2	9/20/2006	42	42	1.7	1.7	Excellent
E Pr Hickory Fk	OFF SR 1310	Madison	6-112-26-7-2	9/20/2006	41	41	1.9	1.9	Excellent
L Laurel Cr	NC 208	Madison	6-112-26-13	9/20/2006	42	42	3	3	Excellent
L Hurricane Cr	Old US 25-70	Madison	6-112-28	9/21/2006	36	36	2.2	2.2	Excellent
Bearwallow Br	FSR 1206	Transylvania	6-118-1	4/21/2005	78	42	2.6	1.4	Not Impaired
Little Cr	SR 1318	Madison	6-118-7	9/18/2006	35	35	2.5	2.5	Good
Friezeland Cr	NC 63	Madison	6-118-10	11/1/2006	37	37	2.7	2.7	Excellent
Meadow Fk	NC 209	Madison	6-118-19	11/1/2006	45	45	2.4	2.4	Excellent

Table 4 (continued).

HUC/Waterbody	Location	County	Index No	Date	ST	EPT	BI	EPT BI	BioClass
06010105									
Charley Br	NC 209	Madison	6-118-20	11/1/2006	39	39	2.2	2.2	Excellent
Spring Cr	NC 209	Madison	6-118-(27)	6/27/2002	37	37	3.3	3.3	Excellent
Spring Cr	SR 1172	Madison	6-118-(27)	11/1/2006	41	41	3	3	Excellent
Roaring Fk	SR 1343	Madison	6-112-9	9/19/2006	36	36	2.6	2.6	Excellent
Shut-In Cr	OFF SR 1183	Madison	6-125	7/31/2007	45	45	1.7	1.7	Excellent
Laurel Br	NC 215	Transylvania	6-6-6	10/11/2007	32	32	1.1	1.1	Excellent
Tucker Cr	OFF SR 1325	Transylvania	6-3-10	10/10/2007	47	47	2.5	2.5	Excellent
UT French Broad R	SR 1314	Henderson	6-(54.5)	5/22/2007	59	7	6.2	6.7	Not Rated
UT French Broad R	SR 1332	Buncombe	6-(54.5	5/23/2006	51	16	5.2	3.5	Not Rated
UT French Broad R	SR 3495	Buncombe	6-(54.5	5/25/2006	35	7	6.5	4.3	Not Rated
UT Mud Cr	US 25	Henderson	6-55	5/25/2006	52	11	6.2	5.4	Not Rated
UT Wash Cr	FSR 479	Henderson	6-55-7	5/25/2006	67	39	2.4	1.8	Not Impaired
W Fk French Broad R	SR 1312	Transylvania	6-2-(7.5)	10/9/2007	39	39	2.1	2.1	Excellent
W Fk French Broad R	US 64	Transylvania	6-2-(7.5)	8/28/2007	96	39	3.6	2.3	Good
				7/9/2002	91	51	3	2.3	Excellent
Walnut Cr	OFF SR 1395	Madison	6-106	7/31/2007	32	32	3.2	3.2	Good
Warren Cr	off NC 151	Buncombe	6-76-5-4	7/8/2004	27	27	2.4	2.4	Good-Fair
Youngs Cove Cr	SR 3452	Buncombe	6-76-6-3	7/8/2004	18	18	2.6	2.6	Not Rated
06010106									
W Fk Pigeon R	SR 1216	Haywood	5-2	8/8/07	---	46	---	1.9	Excellent
				11/29/04	69	42	2.5	2.0	Good
				7/25/02	---	37	---	2.4	Excellent
E Fk Pigeon R	Off US 276	Haywood	5-3-(0.5)	7/12/06	104	49	3.0	1.9	Excellent
				7/22/02	---	41	---	2.5	Excellent
Pigeon R	Off I-40	Cocke. Co., TN.	5-(7)	8/8/07	84	34	4.9	3.7	Good
				7/23/02	76	38	5.0	3.9	Good
Pigeon R	NC 215	Haywood	5-(7)	7/12/06	86	34	4.6	3.7	Good
				7/25/02	61	31	4.8	3.7	Good-Fair
Pigeon R	SR 1642	Haywood	5-(7)	7/13/06	71	16	6.3	4.7	Fair
				9/10/02	49	9	6.8	5.2	Poor
Pigeon R	SR 1338	Haywood	5-(7)	7/13/06	94	30	5.4	4.2	Good-Fair
				9/9/02	56	19	5.6	4.3	Good-Fair
Richland Cr	US 23	Haywood	5-16-(1)	8/7/07	---	27	---	2.8	Good-Fair
				7/29/02	---	31	---	2.9	Good
Richland Cr	SR 1184	Haywood	5-16-(11.5)	8/7/07	---	29	---	3.4	Good
				7/24/02	---	19	---	4.3	Good-Fair
Richland Cr	SR 1519	Haywood	5-16-(16)	8/7/07	---	16	---	4.4	Fair
				7/25/02	45	20	5.4	4.4	Good-Fair
Jonathans Cr	SR 1306	Haywood	5-26-(5.5)	8/7/07	---	38	---	1.7	Excellent
				7/24/02	---	37	---	1.5	Excellent
Jonathans Cr	SR 1322	Haywood	5-26-(7)	8/8/07	---	35	---	2.9	Good
				7/25/02	---	40	---	3.6	Excellent
Jonathans Cr	SR 1349	Haywood	5-26-(7)	8/8/07	---	33	---	2.9	Good
				9/9/02	---	34	---	3.8	Good
Fines Cr	SR 1355	Haywood	5-32	8/8/07	---	29	---	3.1	Good
				7/24/02	---	25	---	3.5	Good-Fair
Cataloochee Cr	SR 1395	Haywood	5-41	8/8/07	120	59	3.3	2.1	Excellent
				7/24/02	---	42	---	1.5	Excellent
06010108									
Nolichucky R	SR 1321	Mitchell	7	8/14/07	88	37	4.51	3.52	Good
				6/19/06	97	48	4.33	3.49	Excellent
				7/9/02	89	43	4.37	3.62	Good
Roaring Cr	US 19E	Avery	7-2-15	7/10/02	---	37	---	1.73	Excellent
Jones Cr	SR 1100	Avery	7-2-24	9/11/85	75	29	3.75	2.23	Good
N Toe R	US 19E	Avery	7-2-(27.3)	8/13/07	95	43	4.09	3.39	Good
				7/10/02	89	39	4.92	3.86	Good
N Toe R	SR 1162	Mitchell	7-2-(27.7)	6/21/06	116	49	4.92	3.74	Good
				7/10/02	60	22	5.90	4.15	Fair

Appendix F-1. Fish community sampling methods and criteria.

Sampling Methods

At each sample site, a 600 ft. section of stream was selected and measured. Fish within the delineated stretch of stream were then collected using two backpack electrofishing units and usually, two persons netting the stunned fish. A seine was also used where there were substantial riffles. During the 2007 basinwide assessment BAU staff were assisted by staff from the DENR's Natural Heritage Program, DENR's Ecosystem Enhancement Program, DWQ's Asheville Regional Office, and a summer intern from North Carolina State University. After collection, all readily identifiable fish were examined for sores, lesions, fin damage, and skeletal anomalies, measured (total length to the nearest 1 mm), and then released. Those fish that were not readily identifiable were preserved and returned to the laboratory for identification, examination, and total length measurement. These fish have been deposited as voucher specimens with the North Carolina State Museum of Natural Sciences in Raleigh. All young-of-year were excluded from the analyses.

NCIBI Analysis

The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr, *et al*. (1986). The IBI method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not directly correlate to water quality. For example, a stream with excellent water quality, but with poor or fair fish habitat, would not be rated excellent with this index. However, in many instances, a stream which rated excellent on the NCIBI should be expected to have excellent water quality.

The Index of Biological Integrity incorporates information about species richness and composition, trophic composition, fish abundance, and fish condition. The NCIBI summarizes the effects of all factors that influence aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While change within a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicate additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

The assessment of biological integrity using the North Carolina Index of Biotic Integrity (NCIBI) is provided by the cumulative assessment of 12 parameters or metrics. The values provided by the metrics are converted into scores on a 1, 3, or 5 scale. A score of 5 represents conditions which would be expected for undisturbed reference streams in the specific river basin or ecoregion, while a score of 1 indicates that the conditions deviate greatly from those expected in undisturbed streams of the region. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score. Finally, the score (an even number between 12 and 60) is then used to determine the ecological integrity class of the stream from which the sample was collected.

The NCIBI has been revised (NCDENR 2006). Currently, the focus of using and applying the NCIBI has been restricted to wadeable streams that can be sampled by a crew of four persons. In 2001, the bioclassifications and criteria were recalibrated against regional reference site data (Biological Assessment Unit Memorandum F-20010922) (Tables 1 – 5). To qualify as a reference site, the site had to satisfy all seven criteria in the order listed in Table 1. Reference sites represented the least impacted or the most minimally impacted streams and the overall biological conditions of the fish communities that could be attained (Table 2).

Table 1. Reference site selection hierarchy -- a watershed-based approach for streams.

Criterion	Qualification
1 -- Habitat	Total habitat score ≥ 65
2 – NPDES dischargers	No NPDES dischargers ≥ 0.01 MGD above the site or if there are small dischargers (~≤ 0.01 MGD), the dischargers are more than one mile upstream
3 – Percent urbanization	< 10% of the watershed is urban or residential areas
4 – Percent forested	≥ 70% of the watershed is forested or in natural vegetation
5 – Channel incision	At the site, the stream is not incised beyond natural conditions
6 – Riparian zone integrity	No breaks in the riparian zones or, if there are breaks, the breaks are rare
7 – Riparian zone width	Mountain streams -- width of the riparian zone along both banks is ≥ 6m
Exception 1	If the site satisfied Criteria 1 - 6, except one of the two riparian widths was less than one unit optimal, then the site still qualified as a reference site
Exception 2	If the site satisfied Criteria 1 - 3 and 5 - 7, but the percentage of the watershed in forest or natural vegetations was ≥ 60% (rather than ≥ 70%), then the site still qualified as a reference site. [Note: in the New River Basin this last exception is ≥ 50%.]

Table 2. Regional fish community reference sites in the French Broad River basin.

HUC/Waterbody	Station	County	Level IV Ecoregion
06010105 French Broad River			
W Fk French Broad R	off NC 281	Transylvania	Southern Crystalline Ridges and Mountains
W Fk French Broad R	SR 1309	Transylvania	Southern Crystalline Ridges and Mountains
Mills R	SR 1337	Henderson	Broad Basins
N Fk Mills R	SR 1341	Henderson	Southern Crystalline Ridges and Mountains
S Fk Mills R	SR 1340	Henderson	Southern Crystalline Ridges and Mountains
S Hominy Cr	NC 151/SR 3449	Buncombe	Broad Basins
Big Ivy Cr	SR 2150	Buncombe	Broad Basins
Little Ivy Cr	SR 1547	Madison	Broad Basins
Big Pine Cr	off SR 1151	Madison	Southern Crystalline Ridges and Mountains
Shelton Laurel Cr	NC 208/212	Madison	Southern Metasedimentary Mountains
Little Laurel Cr	NC 208	Madison	Southern Metasedimentary Mountains
Meadow Fk	NC 209	Madison	Southern Crystalline Ridges and Mountains
06010106 Pigeon River			
Winchester Cr	off SR 1157	Haywood	Southern Crystalline Ridges and Mountains
Cherry Cove Cr	above reservoir	Haywood	Southern Crystalline Ridges and Mountains
Shiny Cr	above reservoir	Haywood	Southern Crystalline Ridges and Mountains
Old Bald Cr	above reservoir	Haywood	Southern Crystalline Ridges and Mountains
Medford Br	off SR 1140	Haywood	Southern Crystalline Ridges and Mountains
06010108 Nolichucky River			
Big Crabtree Cr	SR 1002	Mitchell	Southern Crystalline Ridges and Mountains
Big Crabtree Cr	SR 1002	Mitchell	Southern Crystalline Ridges and Mountains
Big Rock Cr	NC 226	Mitchell	Southern Crystalline Ridges and Mountains
Pigeonroost Cr	SR 1349/NC 197	Mitchell	Southern Crystalline Ridges and Mountains
Bald Mountain Cr	SR 1408	Yancey	Southern Crystalline Ridges and Mountains
Hollow Poplar Cr	NC 197	Mitchell	Southern Crystalline Ridges and Mountains

Table 3 **Scoring criteria for the NCIBI for wadeable streams in the Western and Northern Mountains of the French Broad (including the Pigeon River), Hiwassee, Little Tennessee, New, and Watauga River basins with watersheds ranging between 3.1 and 161 mi^2.**

No.	Metric		Score
1	**No. of species**		
	≥ 16 species		5
	12-15 species		3
	< 12 species		1
2	**No. of fish**		
	320-1,000 fish		5
	205-319 fish		3
	< 205 fish		1
	> 1,000 fish		3
3	**No. of species of darters**		
	French Broad & Little Tennessee River Basins	New River, Pigeon River, Watauga & Hiwassee River Basins	
	≥ 4 species	≥ 3 species	5
	2 or 3 species	1 or 2 species	3
	0 or 1 species	0 species	1
4	**No. of species of rock bass, smallmouth bass, and trout**		
	≥ 2 species		5
	1 species		3
	0 species		1
5	**No. of species of cyprinids**		
	All basins, except Pigeon River Basin	Pigeon River Basin	
	≥ 8 species	≥ 6 species	5
	6 or 7 species	4 or 5 species	3
	≤ 5 species	≤ 3	1
6	**No. of intolerant species**		
	All basins, except New River Basin	New River Basin	
	≥ 3 species	≥ 5 species	5
	2 species	3 or 4 species	3
	0 or 1 species	0, 1, or 2 species	1
7	**Percentage of tolerant individuals**		
	≤ 2%		5
	2-10%		3
	> 10%		1
8	**Percentage of omnivorous + herbivorous individuals**		
	10-36%		5
	37-50%		3
	> 50%		1
	< 10%		1
9	**Percentage of insectivorous individuals**		
	55-85%		5
	40-54%		3
	< 40%		1
	> 85%		1
10	**Percentage of species with multiple age groups**		
	≥ 65% of all species have multiple age groups		5
	45-64% all species have multiple age groups		3
	< 45% all species have multiple age groups		1

Table 4. Tolerance ratings and adult trophic guild assignments for fish in the French Broad River basin. Species collected in 2007 are highlighted in blue. Common and scientific names follow Nelson, *et al*. (2004).

Family/Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Petromyzontidae	**Lampreys**		
Ichthyomyzon bdellium	Ohio Lamprey	Intermediate	Parasitic
I. castaneus	Chestnut Lamprey	Intermediate	Parasitic
I. greeleyi	Mountain Brook Lamprey	Intermediate	Non-feeding
Lampetra appendix	American Brook Lamprey	Intermediate	Non-feeding
Polyodontidae	**Paddlefishes**		
Polyodon spathula	Paddlefish	Intermediate	Planktivore
Lepisosteidae	**Gars**		
Lepisosteus osseus	Longnose Gar	Tolerant	Piscivore
Hiodontidae	**Mooneyes**		
Hiodon tergisus	Mooneye	Intermediate	Insectivore
Clupeidae	**Herrings**		
Dorosoma cepedianum	Gizzard Shad	Intermediate	Omnivore
D. petenense	Threadfin Shad	Intermediate	Omnivore
Cyprinidae	**Carps And Minnows**		
Campostoma anomalum	Central Stoneroller	Intermediate	Herbivore
Carassius auratus	Goldfish	Tolerant	Omnivore
Clinostomus funduloides	Rosyside Dace	Intermediate	Insectivore
Ctenopharyngodon idella	Grass Carp	Tolerant	Herbivore
Cyprinella galactura	Whitetail Shiner	Intermediate	Insectivore
C. spiloptera	Spotfin Shiner	Intermediate	Insectivore
Cyprinus carpio	Common Carp	Tolerant	Omnivore
Erimystax insignis	Mountain Blotched Chub	Intermediate	Omnivore
Hybopsis amblops	Bigeye Chub	Intermediate	Insectivore
Luxilus chrysocephalus	Striped Shiner	Intermediate	Omnivore
L. coccogenis	Warpaint Shiner	Intermediate	Insectivore
Nocomis leptocephalus	Bluehead Chub	Intermediate	Omnivore
N. micropogon	River Chub	Intermediate	Omnivore
Notemigonus crysoleucas	Golden Shiner	Tolerant	Omnivore
Notropis leuciodes	Tennessee Shiner	Intermediate	Insectivore
N. micropteryx	Highland Shiner	Intolerant	Insectivore
N. photogenis	Silver Shiner	Intolerant	Insectivore
N. rubricroceus	Saffron Shiner	Intermediate	Insectivore
N. spectrunculus	Mirror Shiner	Intermediate	Insectivore
N. telescopus	Telescope Shiner	Intolerant	Insectivore
N. volucellus	Mimic Shiner	Intolerant	Insectivore
Phenacobius crassilabrum	Fatlips Minnow	Intermediate	Insectivore
Pimephales notatus	Bluntnose Minnow	Tolerant	Omnivore
P. promelas	Fathead Minnow	Tolerant	Omnivore
Rhinichthys cataractae	Longnose Dace	Intermediate	Insectivore
R. obtusus	Western Blacknose Dace	Intermediate	Insectivore
Semotilus atromaculatus	Creek Chub	Tolerant	Insectivore
Catostomidae	**Suckers**		
Carpiodes carpio	River Carpsucker	Intermediate	Omnivore
C. cyprinus	Quillback	Intermediate	Omnivore
Catostomus commersoni	White Sucker	Tolerant	Omnivore
Erimyzon oblongus	Creek Chubsucker	Intermediate	Omnivore
Hypentelium nigricans	Northern Hogsucker	Intermediate	Insectivore
Ictiobus bubalus	Smallmouth Buffalo	Intermediate	Omnivore
I. niger	Black Buffalo	Intermediate	Omnivore
Moxostoma anisurum	Silver Redhorse	Intermediate	Insectivore
M. breviceps	Smallmouth Redhorse	Intermediate	Insectivore
M. carinatum	River Redhorse	Intermediate	Insectivore
M. duquesnei	Black Redhorse	Intermediate	Insectivore
M. erythrurum	Golden Redhorse	Intermediate	Insectivore
Ictaluridae	**Catfishes**		
Ameiurus catus	White Catfish	Tolerant	Omnivore
A. nebulosus	Brown Bullhead	Tolerant	Omnivore
A. platycephalus	Flat Bullhead	Tolerant	Insectivore
Ictalurus punctatus	Channel Catfish	Intermediate	Omnivore
Noturus eleutherus	Mountain Madtom	Intermediate	Insectivore
N. flavus	Stonecat	Intermediate	Insectivore
Pylodictis olivaris	Flathead Catfish	Intermediate	Piscivore

Table 4 (continued).

Family/Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Esocidae	**Pikes**		
Esox masquinongy	Muskellunge	Intermediate	Piscivore
E. niger	Chain Pickerel	Intermediate	Piscivore
Salmonidae	**Trouts And Chars**		
Oncorhynchus mykiss	Rainbow Trout	Intolerant	Insectivore
Salmo trutta	Brown Trout	Intermediate	Piscivore
Salvelinus fontinalis	Brook Trout	Intolerant	Insectivore
Poeciliidae	**Livebearers**		
Gambusia affinis	Western Mosquitofish	Tolerant	Insectivore
G. holbrooki	Eastern Mosquitofish	Tolerant	Insectivore
Cottidae	**Sculpins**		
Cottus bairdi	Mottled Sculpin	Intermediate	Insectivore
C. carolinae	Banded Sculpin	Intermediate	Insectivore
Moronidae	**Temperate Basses**		
Morone chrysops	White Bass	Intermediate	Piscivore
Centrarchidae	**Sunfishes**		
Ambloplites rupestris	Rock Bass	Intolerant	Piscivore
Lepomis auritus	Redbreast Sunfish	Tolerant	Insectivore
L. cyanellus	Green Sunfish	Tolerant	Insectivore
L. gibbosus	Pumpkinseed	Intermediate	Insectivore
L. gulosus	Warmouth	Intermediate	Insectivore
L. macochirus	Bluegill	Intermediate	Insectivore
L. microlophus	Redear Sunfish	Intermediate	Insectivore
Lepomis sp.	Hybrid Sunfish	Tolerant	Insectivore
Micropterus dolomieu	Smallmouth Bass	Intolerant	Piscivore
M. punctulatus	Spotted Bass	Intermediate	Piscivore
M. salmoides	Largemouth Bass	Intermediate	Piscivore
Pomoxis annularis	White Crappie	Intermediate	Piscivore
P. nigromaculatus	Black Crappie	Intermediate	Piscivore
Percidae	**Perches**		
Etheostoma acuticeps	Sharphead Darter	Intolerant	Insectivore
E. blennioides	Greenside Darter	Intermediate	Insectivore
E. chlorobranchium	Greenfin Darter	Intolerant	Insectivore
E. flabellare	Fantail Darter	Intermediate	Insectivore
E. fusiforme	Swamp Darter	Intermediate	Insectivore
E. guttselli	Tuckasegee Darter	Intermediate	Insectivore
E. jessiae	Blueside Darter	Intolerant	Insectivore
E. rufilineatum	Redline Darter	Intermediate	Insectivore
E. swannanoa	Swannanoa Darter	Intermediate	Insectivore
E. vulneratum	Wounded Darter	Intolerant	Insectivore
E. zonale	Banded Darter	Intermediate	Insectivore
Perca flavescens	Yellow Perch	Intermediate	Piscivore
Percina aurantiaca	Tangerine Darter	Intolerant	Insectivore
P. burtoni	Blotchside Logperch	Intolerant	Insectivore
P. caprodes	Logperch	Intermediate	Insectivore
P. evides	Gilt Darter	Intolerant	Insectivore
P. sciera	Dusky Darter	Intermediate	Insectivore
P. squamata	Olive Darter	Intolerant	Insectivore
Stizostedion canadense	Sauger	Intermediate	Piscivore
S. vitreum	Walleye	Intermediate	Piscivore
Sciaenidae	**Drums and Croakers**		
Aplodinotus grunniens	Freshwater Drum	Intermediate	Insectivore

Table 5. Scores and classes for evaluating the fish community of a wadeable stream using the North Carolina Index of Biotic Integrity in the French Broad, Hiwassee, Little Tennessee, New, and Watauga River basins.

NCIBI Scores	NCIBI Classes
58 or 60	Excellent
48, 50, 52, 54, or 56	Good
40, 42, 44, or 46	Good-Fair
34, 36, or 38	Fair
≤ 32	Poor

Criteria and ratings are applicable only to wadeable streams in the French Broad River basin. Metrics are the same as those for the Hiwassee, Little Tennessee, New, and Watauga River basins. Metrics and ratings should not be applied to non-wadeable streams nor to small, wadeable Southern Appalachian type trout streams in each of these basins. General characteristics of Southern Appalachian type trout streams include high gradient, certain visual aspects of the stream and riparian zones (e.g., *Rhododendron*-, *Leucothoe*-, and *Tsuga*-lined), presence of boulder and rock outcrop plunge pools, overall faunal characteristics (naturally low fish diversity), low specific conductance (often less than 25µS/cm), temperature (often less than 20˚C), clarity (gin-clear), elevation (which will vary from basin to basin and within a basin), and stream order (1st – 3rd). These streams are currently not rated.

Blackspot and Other Diseases

Blackspot and yellow grub diseases are naturally occurring, common infections of fish by an immature stage of flukes. The life cycle involves fish, snails, and piscivorous birds. Heavy, acute infections can be fatal, especially to small fish. However, fish can carry amazingly high worm burdens without any apparent ill effects (Noga 1996). The infections may often be disfiguring and render the fish aesthetically unpleasing (Figure 1).

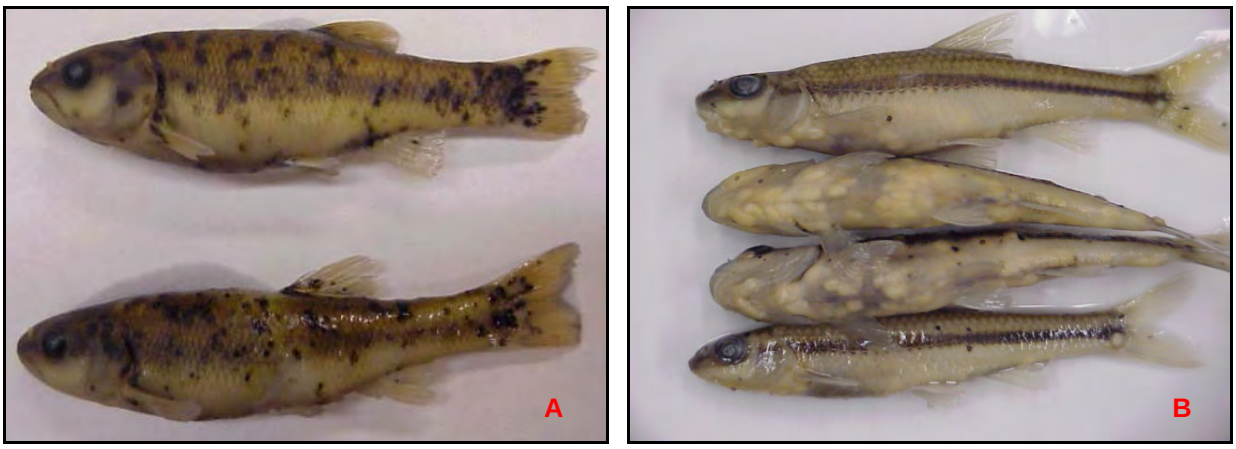


Figure 1. Heavy infestation of blackspot disease in creek chub (A) and yellow grub in bigeye chub (B).

Although some researchers incorporate the incidence of black spot and yellow grub into indices of biotic integrity (e.g., Steedman 1991), others, because of a lack of a consistent inverse relationship to environmental quality, do not (e.g., Sanders *et al*. 1999). The diseases are not considered in the NCIBI because it is widespread, affecting fish in all types of streams.

Appendix F-2. A summary of fish community assessment data.

Monitoring efforts from 2003 to 2007 can be summarized as:

- Thirty-nine samples were collected as part of the basinwide monitoring cycle or as special studies.
- Twenty-five of the sites were considered to be basinwide sites and covered the period from June 11 to June 22, 2007.
- Nine of the 25 basinwide sites had not been previously sampled. Some of these sites were in rural watersheds where there were no NPDES dischargers and were selected as potential candidates for fish community regional reference sites (e.g. South Fork Mills River, North Fork Mills River, Bent Creek, *etc*.). Seven sites possessed the instream, riparian, and watershed characteristics of exceptionally high quality to qualify as new fish community regional reference sites (Appendices F-1 and F-6). These sites were North Fork Mills River, South Fork Mills River, Bent Creek, Little Ivy Creek, Big Pine Creek, Meadow Fork, and Hollow Poplar Creek.
- The remaining 16 sites had been sampled during the last basinwide cycle in 2002, during the first basinwide cycle in 1997, or as part of special studies conducted in 1998 and 2001 (Appendix F-3).
- Seven sites were scheduled to be sampled in 2006, but were not due to insufficient time or due to excessive turbidity resulting from late afternoon thunderstorms the previous day:
    - Buncombe County -- Newfound Creek at NC 63;
    - Haywood County -- Raccoon Creek at SR 1890;
    - Madison County -- Shelton Laurel Creek at NC 208, Big Laurel Creek at SR 1318, and Spillcorn Creek at SR 1330; and
    - Avery County -- Plumtree Creek at US 19 and Roaring Creek at US 19.
- Three streams sampled in 2007 were on the impaired waters list (NCDENR 2007):
    - Little Ivy Creek from California Creek to SR 1547;
    - Fines Creek from source to Pigeon River; and
    - Richland Creek from source to Jones Cove Branch.
- From 2003 to 2007, 14 sites were sampled as part of special studies (Appendix F-3):
    - In 2003:
        - one site on Raccoon Creek (Haywood County) was sampled to verify results obtained in 2002;
        - three sites in the Bald Creek watershed (Yancey County) and four sites in the South Hominy Creek watershed (Buncombe county) were sampled in support of the Wetlands Restoration Program; and
        - three sites on the West Fork French Broad River (Transylvania County) were sampled as part of a study to determine the impacts from a trout farm discharge;
    - in 2004 two sites on South Hominy Creek and Big Crabtree Creek (Buncombe and Mitchell counties, respectively) were sampled as part of a regional study on the impacts from the 2004 hurricane-induced flooding; and
    - in 2006, one site on Boylston Creek (Henderson County) was sampled as part of a use attainability/trout supplemental re-classification study.
- The drainage areas of the assessed watersheds in 2007 ranged from 6.0 to 64.7 square miles (Appendix F-4).
- The most widely distributed species were the Central Stoneroller and Northern Hogsucker (Appendix F-5). The most abundant species was the Central Stoneroller; this species constituted almost one-fourth of all the fish collected.
- All sites, except three, were evaluated and rated using the North Carolina Index of Biotic Integrity (NCIBI) (Appendices F-1, F-3, and F-4). The NCIBI scores ranged from 36 to 60 and the NCIBI ratings ranged from Fair to Excellent (Figures 1 and 2).
- Two streams and their watersheds, Big Crabtree Creek and Pigeonroost Creek, may qualify as new High Quality Waters or Outstanding Resource Waters, if so petitioned.

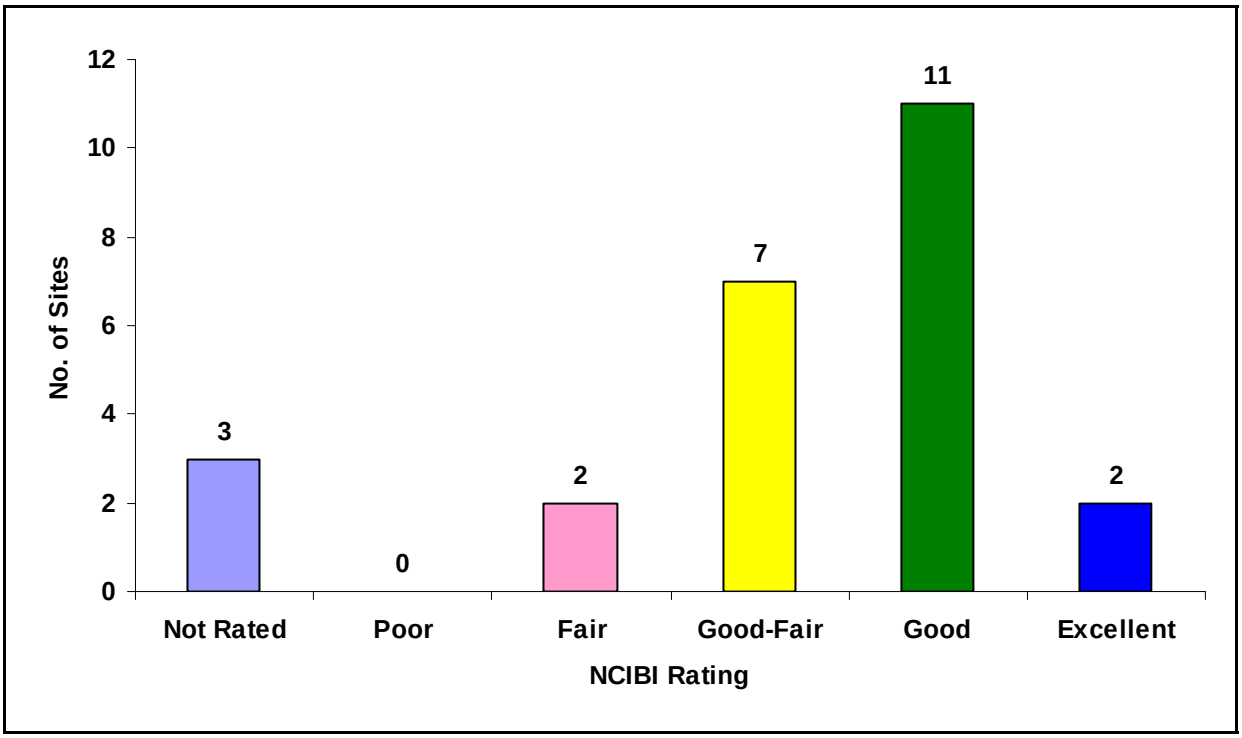


Figure 1. Distribution of the ratings of 25 fish community basinwide sites in the French Broad River basin, 2007.

- Of the 16 sites sampled previously, the ratings did not change appreciably at 12 of the sites since the last assessment; four sites improved since the last assessment (Figure 3). Three of these sites were in the Richland Creek watershed where watershed improvements projects have been implemented.
- The instream and riparian habitat assessment scores at the 25 sites ranged from 68 to 99 (Appendix F-6). Fish communities rated Excellent had the highest quality instream and riparian habitats contrasted to communities rated Good, Good-Fair, Fair, or Poor. Sites with minimal shading had a greater median percentage of omnivores+ herbivores than sites with partial or good shading. A more intact and wider riparian zone was also significantly correlated with a decrease in the percentage of omnivores+herbivores.
- No dissolved oxygen concentrations were less than the water quality standard of 5 mg/L.
- Specific conductance ranged from 13 µS/cm at South Fork Mills River to 151 µS/cm at Little Ivy Creek. The reading at Little Ivy Creek, a WS-II, HQW watershed, was the highest ever of any fish site in the basin and there are no known point source dischargers in this watershed. Elevated readings in the basin were associated with nonpoint source runoff from agricultural areas.
- The pH was less than 6.0 s.u. at four sites.

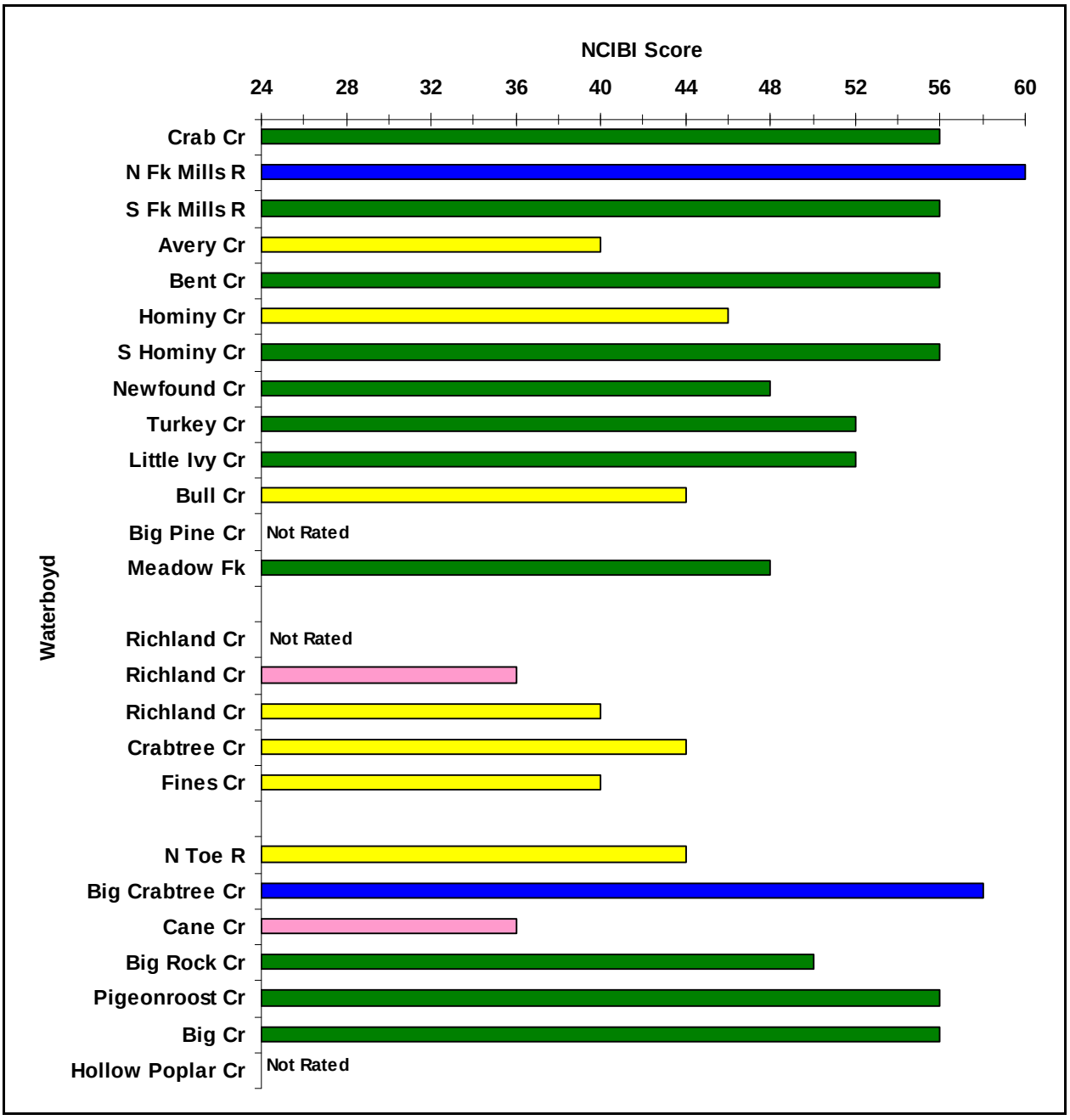


Figure 2. **NCIBI scores and ratings of 25 fish community basinwide sites in the French Broad River basin, 2007. Blue = Excellent, Green = Good, Yellow = Good-Fair, and Rose = Fair sites.**

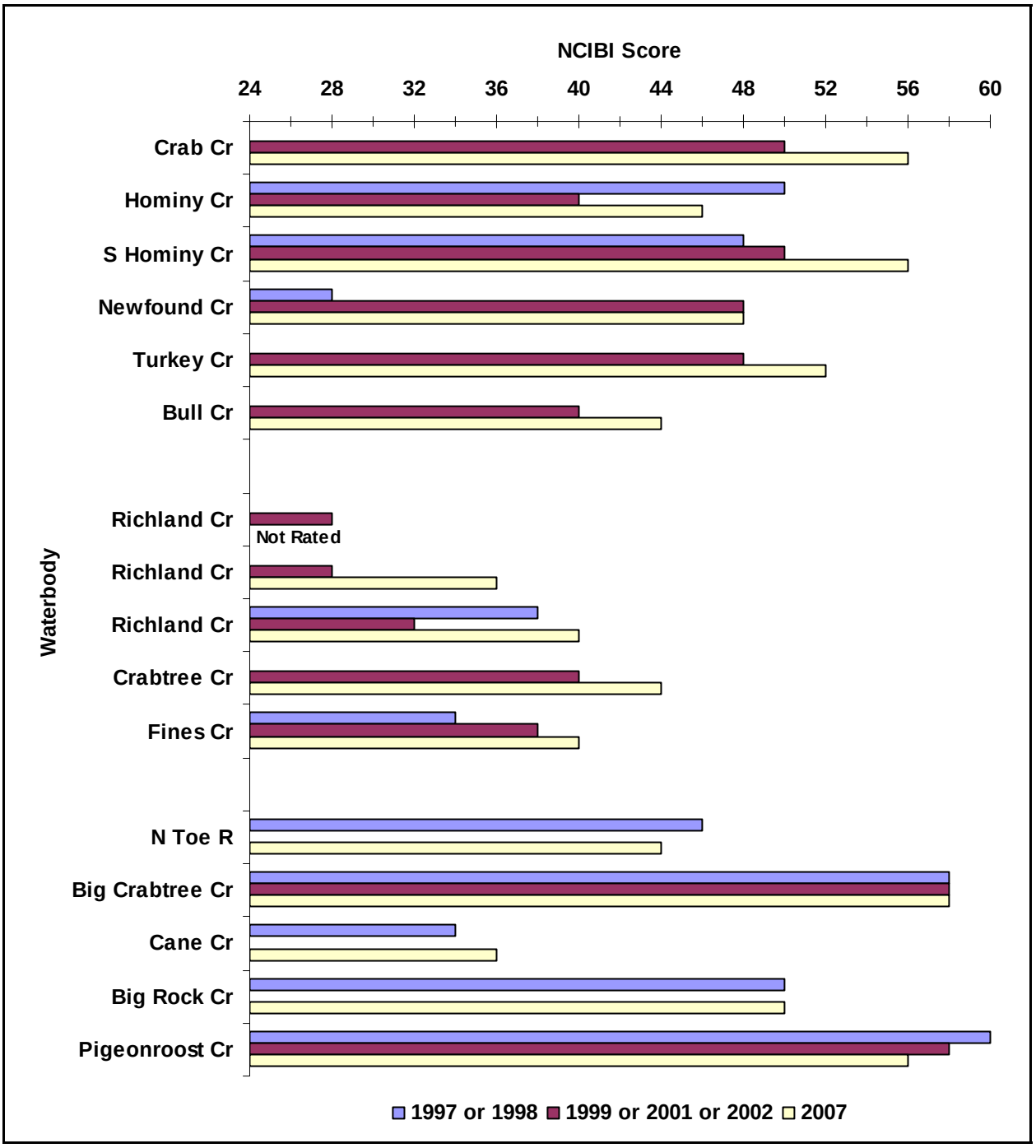


Figure 3. **NCIBI scores and ratings of 16 repeat fish community sites in the French Broad River basin, 1997 - 2007.**

Appendix F-3. Fish community data collected from the French Broad River basin, 1993 – 2007. Basinwide sites sampled in 2007 are in bold font.

HUC/Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
06010105 French Broad River						
W Fk French Broad R	off NC 281	Transylvania	6-2-(0.5)	08/28/03	---	Not Rated
W Fk French Broad R	SR 1306	Transylvania	6-2-(0.5)	08/27/03	---	Not Rated
W Fk French Broad R	NC 281	Transylvania	6-2-(0.5)	08/27/03	---	Not Rated
W Fk French Broad R	SR 1309	Transylvania	6-2-(7.5)	10/23/97	---	Not Rated
Little R	SR 1533	Transylvania	6-38-(20)	06/03/02	40	Good-Fair
				10/23/97	46	Good-Fair
Crab Cr	SR 1532	Transylvania	6-38-23	06/13/07	56	Good
				06/03/02	50	Good
Boylston Cr	SR 1328	Henderson	6-52-(6.5)	07/17/06	---	Not Rated
Boylston Cr	SR 1314	Henderson	6-52-(6.5)	06/04/02	52	Good
				09/15/97	56	Good
Mills R	SR 1337	Henderson	6-54-(1)	09/15/97	58	Excellent
Mills R	SR 1337	Henderson	6-54-(1)	10/19/94	---	Not Rated
Mills R	SR 1337	Henderson	6-54-(1)	06/29/93	---	Not Rated
N Fk Mills R	SR 1341	Henderson	6-54-2-(9)	06/13/07	60	Excellent
S Fk Mills R	SR 1340	Henderson	6-54-3-(17.5)	06/13/07	56	Good
Mud Cr	SR 1647	Henderson	6-55	06/04/02	22	Poor
				09/16/97	20	Poor
Bat Fk	SR 1779	Henderson	6-55-8-1	06/04/02	14	Poor
				09/16/97	24	Poor
Clear Cr	SR 1587	Henderson	6-55-11-(1)	10/02/01	44	Good-Fair
Clear Cr	SR 1586	Henderson	6-55-11-(1)	10/02/01	36	Fair
Clear Cr	SR 1513	Henderson	6-55-11-(5)	10/02/01	44	Good-Fair
Cane Cr	US 25	Henderson	6-57-(9)	06/04/02	50	Good
				09/16/97	46	Good-Fair
Avery Cr	off SR 3498	Buncombe	6-60	06/12/07	40	Good-Fair
Bent Cr	off NC 191	Buncombe	6-67-(7)	06/12/07	56	Good
Hominy Cr	NC 151	Buncombe	6-76	06/12/07	46	Good-Fair
				09/24/02	40	Good-Fair
				09/17/97	50	Good
S Hominy Cr	SR 1103	Buncombe	6-76-5	11/12/03	---	Not Rated
S Hominy Cr	NC 151/SR 3449	Buncombe	6-76-5	06/12/07	56	Good
				11/30/04	---	Not Rated
				09/23/02	50	Good
				04/09/97	48	Good
Warren Cr	off NC 151	Buncombe	6-76-5-4	11/12/03	---	Not Rated
Stony Fk	NC 151	Buncombe	6-76-5-6	11/14/03	---	Not Rated
Beaverdam Cr	SR 3446	Buncombe	6-76-5-8	11/14/03	---	Not Rated
Swannanoa R	SR 2435	Buncombe	6-78	06/18/02	48	Good
				09/19/97	40	Good-Fair
Swannanoa R	US 25	Buncombe	6-78	06/28/93	32	Poor
Beetree Cr	SR 2427	Buncombe	6-78-15-(6)	06/25/97	32	Poor
Newfound Cr	SR 1641	Buncombe	6-84	06/11/07	48	Good
				06/17/02	48	Good
				04/09/97	28	Poor
Reems Cr	NC 251	Buncombe	6-87-(10)	06/18/02	50	Good
				09/17/97	52	Good
				11/17/93	44	Good-Fair
Flat Cr	SR 1742	Buncombe	6-88	06/18/02	50	Good
				04/10/97	56	Good
Sandymush Cr	SR 1107	Madison	6-92-(9)	06/19/02	48	Good
				09/17/97	50	Good
				11/16/93	50	Good
Turkey Cr	SR 1629	Buncombe	6-92-13	06/11/07	52	Good
				06/17/02	48	Good
Big Ivy Cr	SR 2150	Buncombe	6-96-(0.5)	06/18/02	60	Excellent
				09/18/97	58	Excellent
				11/17/93	60	Excellent
Ivy R	US 25/70	Madison	6-96-(11.7)	11/16/93	52	Good
Little Ivy Cr	SR 1547	Madison	6-96-10	06/18/07	52	Good
Bull Cr	SR 1574	Madison	6-96-16	06/19/07	44	Good-Fair
				06/19/02	40	Good-Fair
Big Pine Cr	off SR 1151	Madison	6-108	06/19/07	32	Poor
Big Laurel Cr	NC 208	Madison	6-112	09/18/97	46	Good-Fair

Appendix F-3 (continued).

HUC/Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
Shelton Laurel Cr	NC 208/212	Madison	6-112-26	06/20/02	58	Excellent
				06/03/97	58	Excellent
Little Laurel Cr	NC 208	Madison	6-112-26-13	05/04/99	58	Excellent
				09/29/98	60	Excellent
Meadow Fk	NC 209	Madison	6-118-19	06/19/07	48	Good
06010106 Pigeon River						
Richland Cr	SR 1160/1168	Haywood	5-16-(1)	07/17/01	---	Not Rated
Richland Cr	Bus US 23	Haywood	5-16-(1)	07/17/01	---	Not Rated
Richland Cr	Boyd Ave	Haywood	5-16-(1)	06/15/07	---	Not Rated
				07/17/01	28	Poor
Richland Cr	SR 1184	Haywood	5-16-(1)	06/15/07	36	Fair
				07/17/01	28	Poor
Richland Cr	Walnut Trail Rd	Haywood	5-16-(16)	06/14/07	40	Good-Fair
				09/24/02	32	Poor
				10/22/97	38	Fair
Winchester Cr	off SR 1157	Haywood	5-16-3	07/18/01	---	Not Rated
Hyatt Cr	SR 1165	Haywood	5-16-6	07/18/01	---	Not Rated
Cherry Cove Cr	above reservoir	Haywood	5-16-7-2	07/19/01	---	Not Rated
Shiny Cr	above reservoir	Haywood	5-16-7-3	07/19/01	---	Not Rated
Old Bald Cr	above reservoir	Haywood	5-16-7-6	07/19/01	---	Not Rated
Rocky Br	SR 1147 & 1219	Haywood	5-16-7-9-(2)	07/18/01	---	Not Rated
Medford Br	off SR 1140	Haywood	5-16-8-1	07/18/01	---	Not Rated
Farmer Br	Brown & Georgia Ave	Haywood	5-16-11	07/18/01	---	Not Rated
Shelton Br	Marshall St	Haywood	5-16-13	07/16/01	---	Not Rated
Raccoon Cr	Bus US 23	Haywood	5-16-14	08/26/03	24	Poor
				07/16/01	34	Fair
Factory Br	US 19	Haywood	5-16-15	07/16/01	---	Not Rated
Crabtree Cr	NC 209	Haywood	5-22	06/14/07	44	Good-Fair
				09/24/02	40	Good-Fair
				06/03/97	28	Poor
Jonathans Cr	US 276	Haywood	5-26-(7)	10/22/97	46	Good-Fair
Fines Cr	SR 1355	Haywood	5-32	09/24/02	38	Fair
				10/22/97	34	Fair
Fines Cr	off SR 1355	Haywood	5-32	06/14/07	40	Good-Fair
06010108 Nolichucky River						
N Toe R	SR 1121	Avery	7-2-(0.5)	06/22/07	44	Good-Fair
				06/23/97	46	Good-Fair
Big Crabtree Cr	SR 1002	Mitchell	7-2-48	06/18/07	58	Excellent
				12/01/04	58	Excellent
				05/04/99	58	Excellent
				09/30/98	58	Excellent
Big Crabtree Cr	SR 1002	Mitchell	7-2-48	06/24/97	58	Excellent
Cane Cr	SR 1211	Mitchell	7-2-59	06/21/07	36	Fair
				06/24/97	34	Fair
Jacks Cr	SR 1337	Yancey	7-2-63	06/21/02	38	Fair
				10/20/97	34	Fair
Big Rock Cr	NC 226	Mitchell	7-2-64	06/20/07	50	Good
				09/30/98	50	Good
Pigeonroost Cr	SR 1349/NC 197	Mitchell	7-2-69	06/20/07	56	Good
				06/21/02	58	Excellent
				10/20/97	60	Excellent
Price Cr	SR 1126/1136	Yancey	7-3-21	06/20/02	52	Good
				10/21/97	46	Good-Fair
Bald Cr	US 19/SR 1399	Yancey	7-3-22	11/13/03	---	Not Rated
Bald Cr	US 19W	Yancey	7-3-22	11/13/03	50	Good
Possumtrot Cr	SR 1128	Yancey	7-3-22-7	11/13/03	---	Not Rated
Bald Mountain Cr	SR 1408	Yancey	7-3-32	10/21/97	---	Not Rated
Big Cr	SR 1444	Yancey	7-3-40-(2.5)	06/21/07	56	Good
Hollow Poplar Cr	NC 197	Mitchell	7-10	06/21/07	---	Not Rated

Appendix F-4. Fish community metric values from 25 wadeable streams in the French Broad River basinwide monitoring program, 2007[1].

Subbasin Waterbody	Location	County	d. a. (mi^2)	Date	No. Species	No. Fish	No. Sp. Darters	No. Sp. RST	No. Sp. Cyprinids	No. Intol. Sp.	% Tolerant	% Omni. +Herb.	% Insect.	% MA
06010105 French Broad River														
Crab Cr	SR 1532	Transylvania	7.0	06/13/07	600	21	4	3	8	3	11	18	79	86
N Fk Mills R	SR 1341	Henderson	23.1	06/13/07	642	21	6	2	8	3	1	19	79	67
S Fk Mills R	SR 1340	Henderson	39.6	06/13/07	562	19	5	2	8	3	1	10	88	84
Avery Cr	off SR 3498	Buncombe	8.1	06/12/07	296	23	7	0	9	1	17	22	69	57
Bent Cr	off NC 191	Buncombe	10.7	06/12/07	555	22	5	2	6	3	5	23	75	73
Hominy Cr	NC 151	Buncombe	30.2	06/12/07	1062	15	2	1	8	1	1	23	77	80
S Hominy Cr	NC 151/SR 3449	Buncombe	38.3	06/12/07	597	20	2	3	9	2	2	16	81	70
Newfound Cr	SR 1641	Buncombe	34.2	06/11/07	390	19	4	2	8	2	15	37	63	47
Turkey Cr	SR 1629	Buncombe	27.4	06/11/07	647	16	2	2	8	2	5	25	70	88
Little Ivy Cr	SR 1547	Madison	42.1	06/18/07	608	14	1	3	9	3	0	23	75	79
Bull Cr	SR 1574	Madison	20.7	06/19/07	1870	15	2	3	7	3	0	60	40	80
Big Pine Cr	off SR 1151	Madison	15.8	06/19/07	1749	9	0	2	6	1	0	63	36	67
Meadow Fk	NC 209	Madison	22.7	06/19/07	421	11	2	3	5	3	0	18	68	91
06010106 Pigeon River														
Richland Cr	Boyd Ave	Haywood	43.4	06/15/07	410	7	0	2	3	1	0	24	73	71
Richland Cr	SR 1184	Haywood	48.0	06/15/07	603	12	0	3	4	2	11	44	54	58
Richland Cr	Walnut Trail Rd	Haywood	64.7	06/14/07	224	10	1	2	3	2	4	29	59	80
Crabtree Cr	NC 209	Haywood	19.1	06/14/07	893	13	0	3	7	2	1	56	42	85
Fines Cr	off SR 1355	Haywood	25.7	06/14/07	754	16	2	3	5	2	7	57	41	63
06010108 Nolichucky River														
N Toe R	SR 1121	Avery	29.5	06/22/07	1242	15	2	2	6	2	1	47	48	73
Big Crabtree Cr	SR 1002	Mitchell	12.3	06/18/07	474	20	4	3	9	4	4	18	80	100
Cane Cr	SR 1211	Mitchell	16.2	06/21/07	1516	13	0	2	8	1	2	71	28	77
Big Rock Cr	NC 226	Mitchell	33.1	06/20/07	708	14	2	2	7	2	0	26	73	71
Pigeonroost Cr	SR 1349/NC 197	Mitchell	14.1	06/20/07	1553	22	5	1	13	3	0	25	74	68
Big Cr	SR 1444	Yancey	8.1	06/21/07	767	19	3	5	9	6	0	16	83	63
Hollow Poplar Cr	NC 197	Mitchell	6.0	06/21/07	264	2	0	1	1	1	0	0	100	100

[1]Abbreviations are d. a. = drainage area, No. = number, Sp. = species, RST = rockbass, smallmouth bass, and trout, Intol. = intolerants, Omni. + Herb. = omnivores+herbivores, Insect. = insectivores, and MA = species with multiple age groups.

Appendix F-5. Fish distributional records for the French Broad River basin.

Based upon Menhinick (1991), NC DWQ's data, and data from other researchers, approximately 98 species have been collected from the French Broad River basin (Table 5 in Appendix F-1). The known species assemblage now includes 27 species of minnows, 11 species of suckers, 7 species of catfish, 12 species of sunfish and bass, and 20 species of darters. Only three new county distributional records were recorded in 2007 from DWQ's fish community monitoring efforts (Table 1).

Table 1. New distributional records for the French Broad River basin.

Family/Species	Common Name	County
Cyprinidae	**Carps and Minnows**	
Clinostomus funduloides	Rosyside Dace	Transylvania
Centrarchidae	**Sunfishes**	
Lepomis cyanellus	Green Sunfish	Avery
Percidae	**Perches**	
Etheostoma fusiforme	Swamp Darter	Haywood

Twenty-one of the 98 species (21 percent of the total basin fauna) are nonindigenous (exotic) species and were introduced either as sportfish, forage fish, baitfish, or for reasons unknown (Table 2). In 2006, 10 of the 43 species collected were exotic species. The more commonly collected nonindigenous species included Rainbow Trout, Brown Trout, and Redbreast Sunfish. All of the streams had at least one nonindigenous species present. At Hollow Polar Creek, a trout stream, only two species were present, Western Blacknose Dace and Rainbow Trout; almost two-thirds of the fish collected were Rainbow Trout. At Cane Creek 43 percent of all the fish were Bluehead Chub.

Table 2. Nonindigenous species in the French Broad River basin. Species collected in 2007 are highlighted in blue.

Family/Species	Common Name	Family/Species	Common Name
Clupeidae	**Herrings**	**Salmonidae**	**Trouts and Salmons**
Dorosoma petenense	Threadfin Shad	*Oncorhynchus mykiss*	Rainbow Trout
Cyprinidae	**Carps and Minnows**	*Salmo trutta*	Brown Trout
Carassius auratus	Goldfish	**Poeciliidae**	**Livebearers**
Clinostomus funduloides	Rosyside Dace	*Gambusia holbrooki*	Eastern Mosquitofish
Ctenopharyngodon idella	Grass Carp	**Moronidae**	**Temperate Basses**
Cyprinus carpio	Common Carp	*Morone chrysops*	White Bass
Nocomis leptocephalus	Bluehead Chub	**Centrarchidae**	**Sunfishes**
Pimephales promelas	Fathead Minnow	*Lepomis auritus*	Redbreast Sunfish
Catostomidae	**Suckers**	*L. cyanellus*	Green Sunfish
Erimyzon oblongus	Creek Chubsucker	*L. gibbosus*	Pumpkinseed
Ictaluridae	**North American Catfishes**	*L. microlophus*	Redear Sunfish
Ameiurus catus	White Catfish	**Percidae**	**Perches**
A. platycephalus	Flat Bullhead	*Etheostoma fusiforme*	Swamp Darter
Esocidae	**Pikes**	*Perca flavescens*	Yellow Perch
Esox niger	Chain Pickerel		

Special protection status has been given to 17 of the 98 species by the U. S. Department of the Interior, the NC Wildlife Resources Commission, or the NC Natural Heritage Program under the NC State Endangered Species Act (G.S. 113-331 to 113-337) (LeGrand *et al*. 2006; Menhinick and Braswell 1997) (Table 3). None of these were collected in 2007.

Table 3. Species of fish listed as state threatened (T), state endangered (E), or of special concern (SC) in the French Broad River basin.

Species	Common Name	State Rank	Comment
Lampetra appendix	American Brook Lamprey	T, S1	Madison Co.
Polyodon spathula	Paddlefish	E, SH	Madison Co.
Hiodon tergisus	Mooneye	SC, SH	Madison Co.
Luxilus chrysocephalus	Striped Shiner	T, S2	Buncombe & Yancey Cos.
Carpiodes carpio	River Carpsucker	SC, SH	Buncombe, Madison, & Yancey Cos.
Noturus eleutherus	Mountain Madtom	SC, SH	Extirpated in NC
Noturus flavus	Stonecat	E, S1	Madison & Yancey Cos.
Cottus carolinae	Banded Sculpin	T, S1	Madison Co.
Etheostoma acuticeps	Sharphead Darter	T, S1	Yancey Co.
E. jessiae	Blueside Darter	SC, SH	Extirpated in NC
E. simoterum	Snubnose Darter	SC, SH	Madison Co.
E. vulneratum	Wounded Darter	SC, S1	Haywood Co.
Percina burtoni	Blotchside Logperch	E, S1	Yancey Co.
P. caprodes	Logperch	T, S1	Madison & Haywood Cos.
P. sciera	Dusky Darter	E, SH	Extirpated in NC
P. squamata	Olive Darter	SC, S2	Haywood, Madison, Mitchell, & Yancey Cos.
Aplodinotus grunniens	Freshwater Drum	T, S1	Madison Co.

[1]S1 = critically imperiled in North Carolina because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from North Carolina; S2 = imperiled in North Carolina because of rarity or because of some factor(s) making it very vulnerable to extirpation from North Carolina; and SH = of historical occurrence in North Carolina, perhaps not having been verified in the past 20 years and suspected to be still extant (LeGrand *et al*. 2006).

In 2007, 43 of the 98 species were collected. Species not collected included those with preferences for the larger rivers and mainstem portions of the rivers (e.g., French Broad, Toe, Cane, Nolichucky and Pigeon rivers) in Madison, Yancey, and Mitchell counties. The most widely distributed species, collected at 24 of the 25 sites, were the Central Stoneroller and Northern Hogsucker. Species less widely distributed and collected only at 1 or 2 sites included Rosyside Dace, Blotched Chub, Bluehead Chub, Telescope Shiner, Fatlips Minnow, Fathead Minnow, Brook Trout, Redear Sunfish, and Swamp Darter.

The most abundant species was the Central Stoneroller; this species constituted almost one-fourth of all the fish collected. At Bull Creek, 1,046 specimens of the Central Stoneroller were collected, the most fish of any species ever collected in DWQ's wadeable streams fish community assessment program. By contrast, some of the rarer species (less than five specimens collected) included Blotched Chub, Fatlips Minnow, Fathead Minnow, Brook Trout, Redear Sunfish, and Swamp Darter.

Appendix F-6. Habitat evaluations and stream and riparian habitats at 25 fish community monitoring sites in the French Broad River basin, 2007.

Habitat Assessments

A method and scoring system has been developed to evaluate the physical habitats of a stream (NCDENR 2006). The narrative descriptions of eight habitat characteristics, including channel modification, amount of instream habitat, type of bottom substrate, pool variety, riffle frequency, bank stability, light penetration, and riparian zone width, are converted into numerical scores. The total habitat score ranges between 1 and 100. Higher numbers suggest better habitat quality, but criteria have not been developed to assign ratings. Scores greater than 65 generally represent moderate to high quality habitat site, whereas scores less than 65 generally represent low to poor quality habitat sites (DWQ unpublished data).

Fish community sampling was conducted in 2007 at 25 sites. All of the streams assessed had overall moderate to high quality habitats (score ≥ 65); none of the sites had overall low to poor quality habitats (score < 65) (Figure 1 and Tables 1 and 2). Habitat scores ranged from 68 at Crabtree Creek to 99 at Meadow Fork.

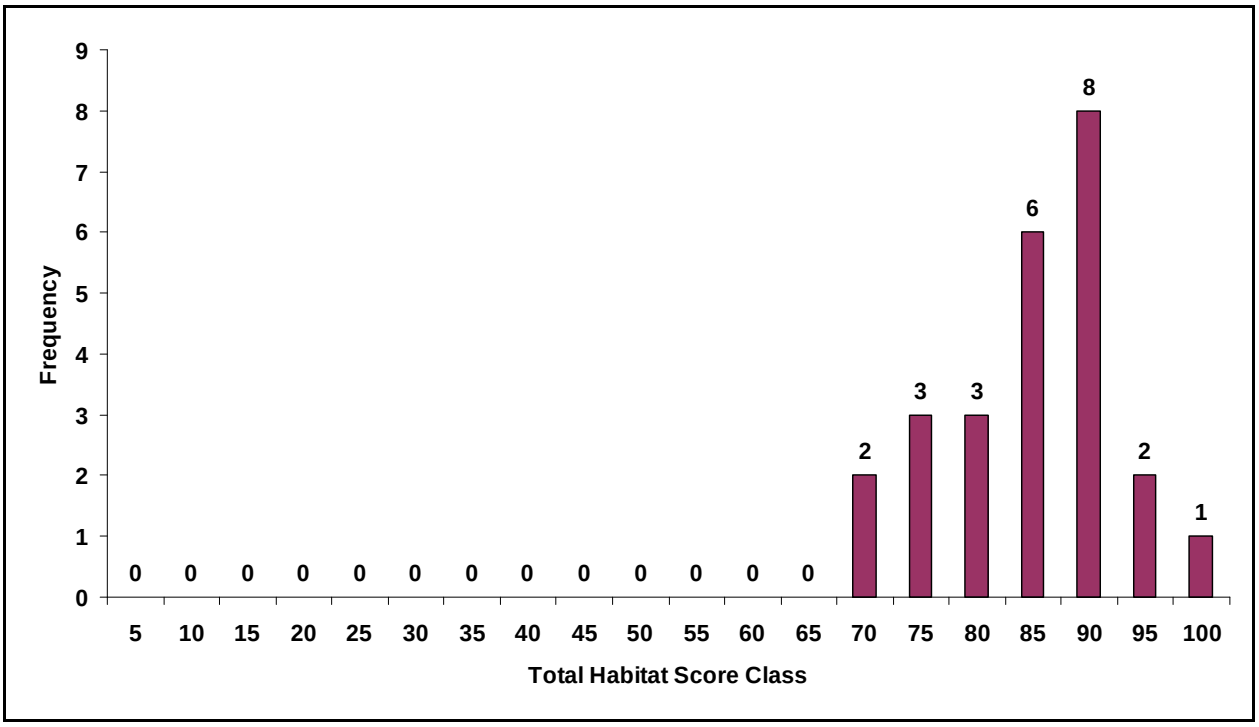


Figure 1. Distribution of the total habitat scores at 25 fish community sites in the French Broad River basin, 2007.

Table 1. **Habitat evaluations at 25 basinwide fish community sites in the French Broad River basin, 2007. Red bold denotes less than optimal habitat conditions.**

HUC	Waterbody	Location	County	Channel	Instream Habitat	Substrate	Pools	Riffles	Bank Stability-L	Bank Stability-R	Shade	Riparian Zone-L	Riparian Zone-R	Total Score
06010105 French Broad River														
	Crab Cr	SR 1532	Transylvania	5	18	**6**	8	16	5	4	7	**2**	**2**	73
	N Fk Mills R	SR 341	Henderson	5	19	15	**4**	16	6	6	**5**	3	**2**	81
	S Fk Mills R	SR 1340	Henderson	5	19	15	6	16	6	6	8	3	3	87
	Avery Cr	SR 3498	Buncombe	5	18	8	**4**	15	7	7	10	4	5	83
	Bent Cr	off NC 191	Buncombe	5	19	12	**4**	14	7	7	10	5	5	88
	Hominy Cr	NC 151	Buncombe	5	16	**6**	**4**	14	7	6	9	5	3	75
	S Hominy Cr	NC 151/SR 3449	Buncombe	5	19	12	9	16	6	6	8	4	5	90
	Newfound Cr	SR 1641	Buncombe	5	16	12	**4**	14	6	6	7	5	4	79
	Turkey Cr	SR 1629	Buncombe	5	18	8	7	12	7	7	7	5	4	80
	Little Ivy Cr	SR 1547	Madison	5	16	8	6	14	6	6	7	3	**2**	73
	Bull Cr	SR 1574	Madison	5	18	12	6	15	6	6	9	4	5	86
	Big Pine Cr	off SR 1151	Madison	5	18	12	6	16	6	6	7	4	3	83
	Meadow Fk	NC 209	Madison	5	20	15	9	16	7	7	10	5	5	99
06010106 Pigeon River														
	Richland Cr	Boyd Ave	Haywood	5	18	13	6	16	6	6	8	**2**	3	83
	Richland Cr	SR 1184	Haywood	5	18	12	8	16	7	4	8	5	**2**	85
	Richland Cr	Walnut Trail Rd	Haywood	5	18	13	6	12	5	5	9	3	3	79
	Crabtree Cr	NC 209	Haywood	5	16	12	6	14	4	4	**5**	**1**	**1**	68
	Fines Cr	off SR 1355	Haywood	5	20	12	10	16	6	6	7	5	**2**	89
06010108 Nolichucky River														
	N Toe R	SR 1121	Avery	5	20	15	6	16	5	4	**4**	4	3	82
	Big Crabtree Cr	SR 1002	Mitchell	5	18	12	10	15	7	7	8	5	5	92
	Cane Cr	SR 1211	Mitchell	5	18	8	6	12	5	5	7	**2**	**2**	70
	Big Rock Cr	NC 226	Mitchell	5	18	12	7	16	6	6	10	4	3	87
	Pigeonroost Cr	SR 1349/NC 197	Mitchell	5	20	15	8	16	6	6	8	4	4	92
	Big Cr	SR 1444	Yancey	5	19	15	6	16	5	6	7	4	3	86
	Hollow Poplar Cr	NC 197	Mitchell	5	19	15	6	16	6	6	7	3	3	86
Maximum possible scores				**5**	**20**	**15**	**10**	**16**	**7**	**7**	**10**	**5**	**5**	**100**

Table 2. Rankings of 25 waterbodies in French Broad River basin according to the total habitat scores, 2007.

HUC	Waterbody	Location	County	Ecoregion	Score
High to Moderate Quality Habitats					
06010105	Meadow Fk	NC 209	Madison	Southern Crystalline Ridges & Mountains	99
06010108	Big Crabtree Cr	SR 1002	Mitchell	Southern Crystalline Ridges & Mountains	92
06010108	Pigeonroost Cr	SR 1349/NC 197	Mitchell	Southern Crystalline Ridges & Mountains	92
06010105	S Hominy Cr	NC 151/SR 3449	Buncombe	Broad Basins	90
06010106	Fines Cr	off SR 1355	Haywood	Broad Basins	89
06010105	Bent Cr	off NC 191	Buncombe	Broad Basins	88
06010108	Big Rock Cr	NC 226	Mitchell	Southern Crystalline Ridges & Mountains	87
06010105	S Fk Mills R	SR 1340	Henderson	Southern Crystalline Ridges & Mountains	87
06010108	Big Cr	SR 1444	Yancey	Southern Crystalline Ridges & Mountains	86
06010105	Bull Cr	SR 1574	Madison	Broad Basins	86
06010108	Hollow Poplar Cr	NC 197	Mitchell	Southern Crystalline Ridges & Mountains	86
06010106	Richland Cr	SR 1184	Haywood	Broad Basins	85
06010105	Avery Cr	SR 3498	Buncombe	Broad Basins	83
06010105	Big Pine Cr	off SR 1151	Madison	Southern Crystalline Ridges & Mountains	83
06010106	Richland Cr	Boyd Ave	Haywood	Broad Basins	83
06010108	N Toe R	SR 1121	Avery	Southern Crystalline Ridges & Mountains	82
06010105	N Fk Mills R	SR 341	Henderson	Southern Crystalline Ridges & Mountains	81
06010105	Turkey Cr	SR 1629	Buncombe	Broad Basins	80
06010105	Newfound Cr	SR 1641	Buncombe	Broad Basins	79
06010106	Richland Cr	Walnut Trail Rd	Haywood	Broad Basins	79
06010105	Hominy Cr	NC 151	Buncombe	Broad Basins	75
06010105	Crab Cr	SR 1532	Transylvania	Broad Basins	73
06010105	Little Ivy Cr	SR 1547	Madison	Broad Basins	73
06010108	Cane Cr	SR 1211	Mitchell	Southern Crystalline Ridges & Mountains	70
06010106	Crabtree Cr	NC 209	Haywood	Broad Basins	68
Low to Poor Quality Habitats					
None					

Although all the sites in 2007 had moderate to high quality habitats (Table 2), in previous monitoring cycles (NCDENR 2003) major differences between the high to moderate and the low to poor quality habitat types were in the substrates, riffles, and bank stabilities (Table 3). Differences were not as pronounced in the instream habitat, abundance of pools, extent of canopy cover (shade), or width of riparian zones.

Table 3. Mean habitat scores for 80 fish community sites in the French Broad River basin, 2001 – 2007.

Habitat characteristics	Low - Poor Quality Habitat	Moderate - High Quality Habitat	Maximum score
Channel modification	3.9	4.7	5
Instream habitat	13.8	17.6	20
Substrate	6.6	11.2	15
Pools	4.9	7.1	10
Riffles	8.7	14.4	16
Bank stability (right & left)	7.1	11.1	14
Shade	5.9	8.0	10
Riparian zone width (right & left)	2.8	6.5	10
Sample size	17	63	80

Characteristics of moderate to high quality habitat streams are:

- instream habitats composed of rocks, sticks, leafpacks, snags and logs, and undercut banks and root mats;
- a substrate of gravel, cobble, and boulders with low embeddedness;
- frequent pools and riffles of varying depths and widths; and
- stable banks with a good tree canopy and a medium to wide riparian zone with no or rare breaks in the riparian zone (Figure 2).

Figure 2. **High quality instream habitats and wide riparian zones offering a good tree canopy, Meadow Fork, NC 209, Madison County.**

Low to poor quality habitat characteristics include (Figures 3 - 5):

- livestock frequently having access to the stream causing bank erosion, trampling of riparian vegetation, fecal contamination, and nutrient deposition;
- an absence of cobble riffles; if present, they are usually caused by embedded, coarse woody debris in the current;
- an open canopy and the riparian zone has been cleared of native vegetation and replaced with a lawn; and
- excessive turbidity following heavy downpours.

Figure 3. **Fencing excluding cattle from mainstem channel but allowing wastes to enter the stream and the continuance of riparian degradation at Crab Creek at SR 1532, Transylvania County (left) and livestock with total access to the stream at Crabtree Creek at NC 209, Haywood County (right).**

Figure 4. **Grass covered riparian zones with eroding banks, Crabtree Creek at NC 209, Haywood County (left) and an absence of canopy and mowed banks at Big Creek at SR 1444, Yancey County (right).**

Figure 5. **Turbidity at the confluence of Shelton Laurel Creek and Big Laurel Creek at NC 208, Madison County (left) and at Spillcorn Creek at SR 1330, Madison County (right).**

Habitat and NCIBI Relationships

Since 1997, 86 rateable fish community samples with associated habitat evaluations have been collected throughout the basin. [One data point – Beetree Creek (1997) was excluded from the data set because the site was below a reservoir with no minimum flow requirements.] This data set showed that communities rated Excellent had the highest quality instream and riparian habitats as contrasted to communities rated Good-Fair, Fair, or Poor (Figure 6). The median total habitat score for Excellent sites was 85; Good, Good-Fair, and Fair sites was approximately 75; and Poor sites had a median total habitat score of 62.

One of the fish community responses to the loss of tree canopy in the riparian zone and nutrient addition is an increase in the percentage of omnivores+herbivores (Metric No. 8). The 1997 – 2007 data set (n = 82) showed that sites with minimal shading (canopy scores of 2-4) had a greater median percentage of omnivores+ herbivores than sites with partial (canopy scores of 5-7) or good (canopy scores of 8-10) canopy (Figure 7). These median percentages (51.0, 27.5, and 23.0%, respectively) corresponded to NCIBI metric scores of 1, 5, and 5, respectively (Table 3 in Appendix F-1). A more intact and wider riparian zone was also significantly correlated with a decrease in the percentage of omnivores+herbivores (Figure 8).

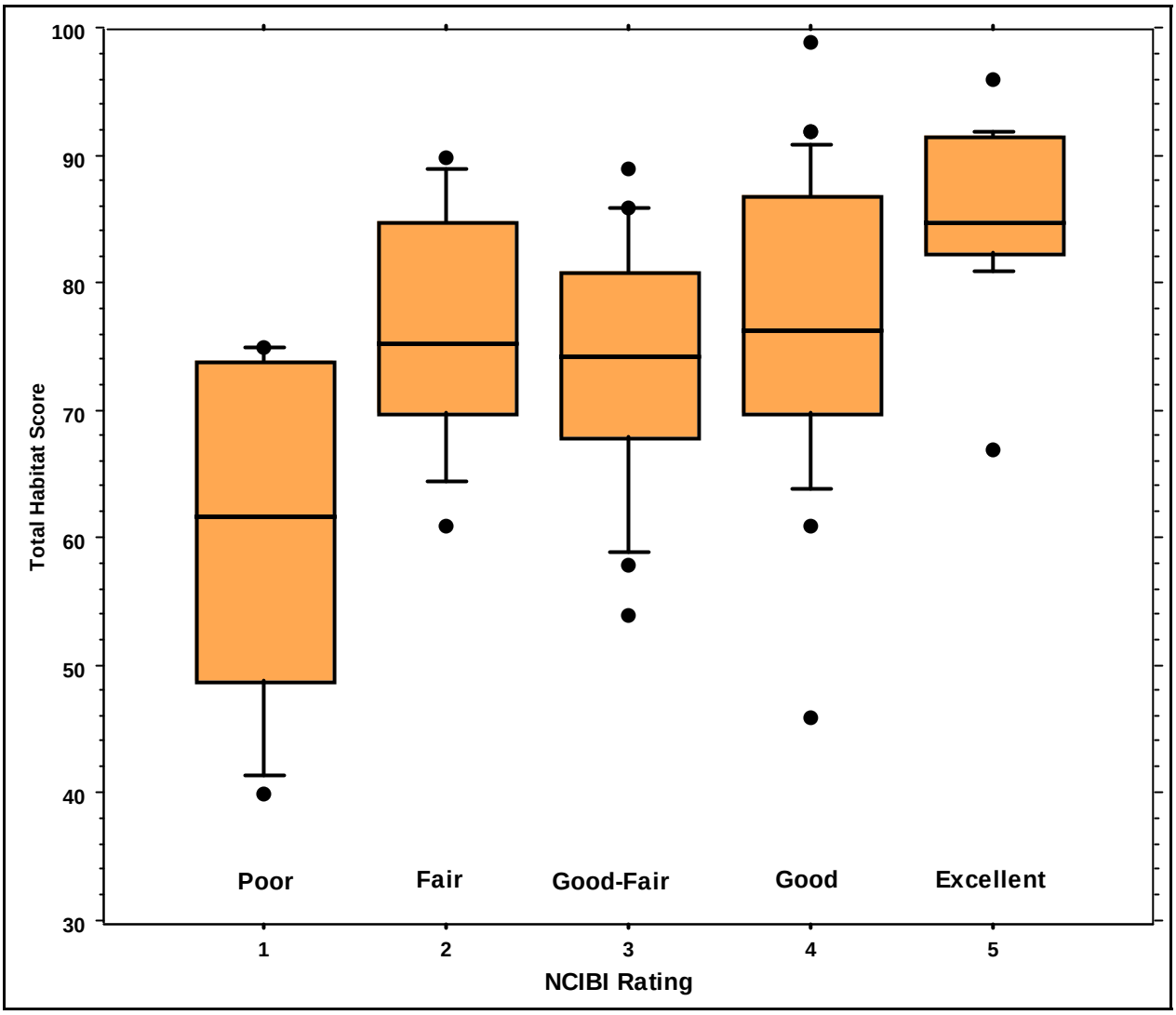


Figure 6. **Relationship between total habitat scores and NCIBI ratings in the French Broad River basin, 1997 - 2007.**

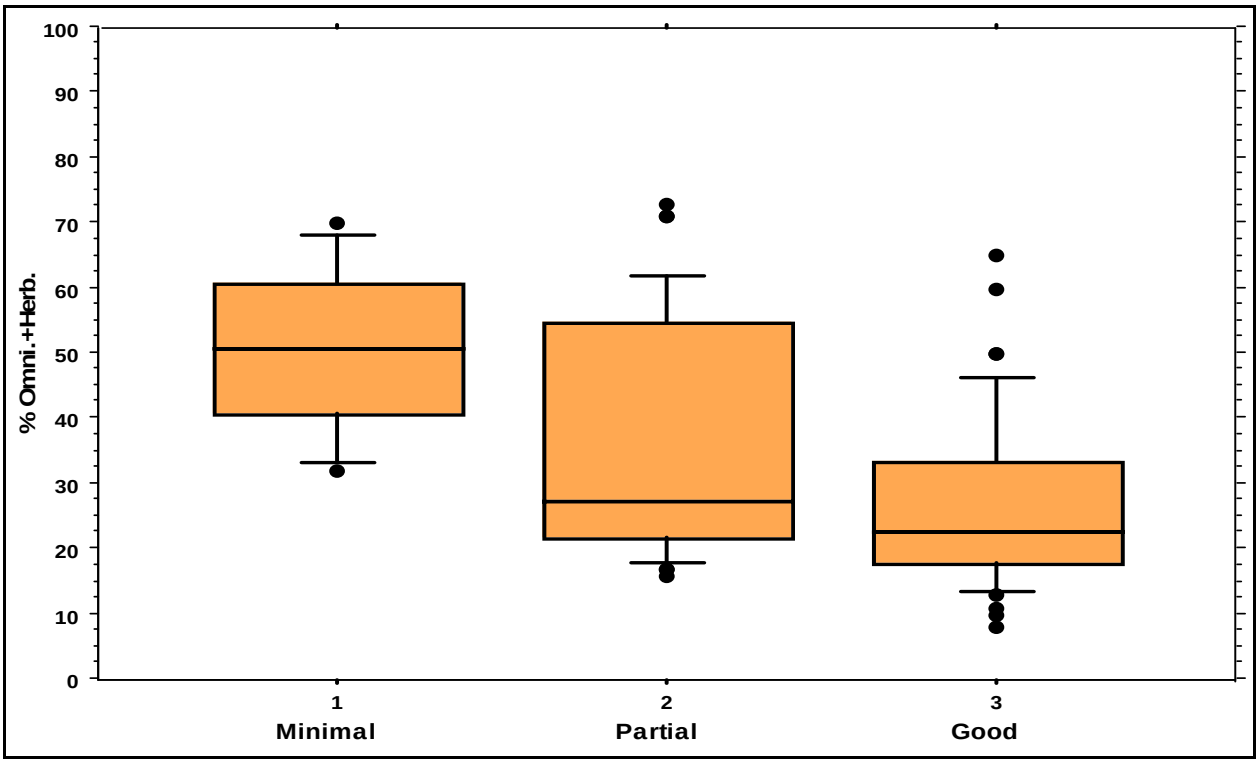


Figure 7. **Relationship between the percentage of omnivores+herbivores and streamside shading in the French Broad River basin, 1997 - 2007.**

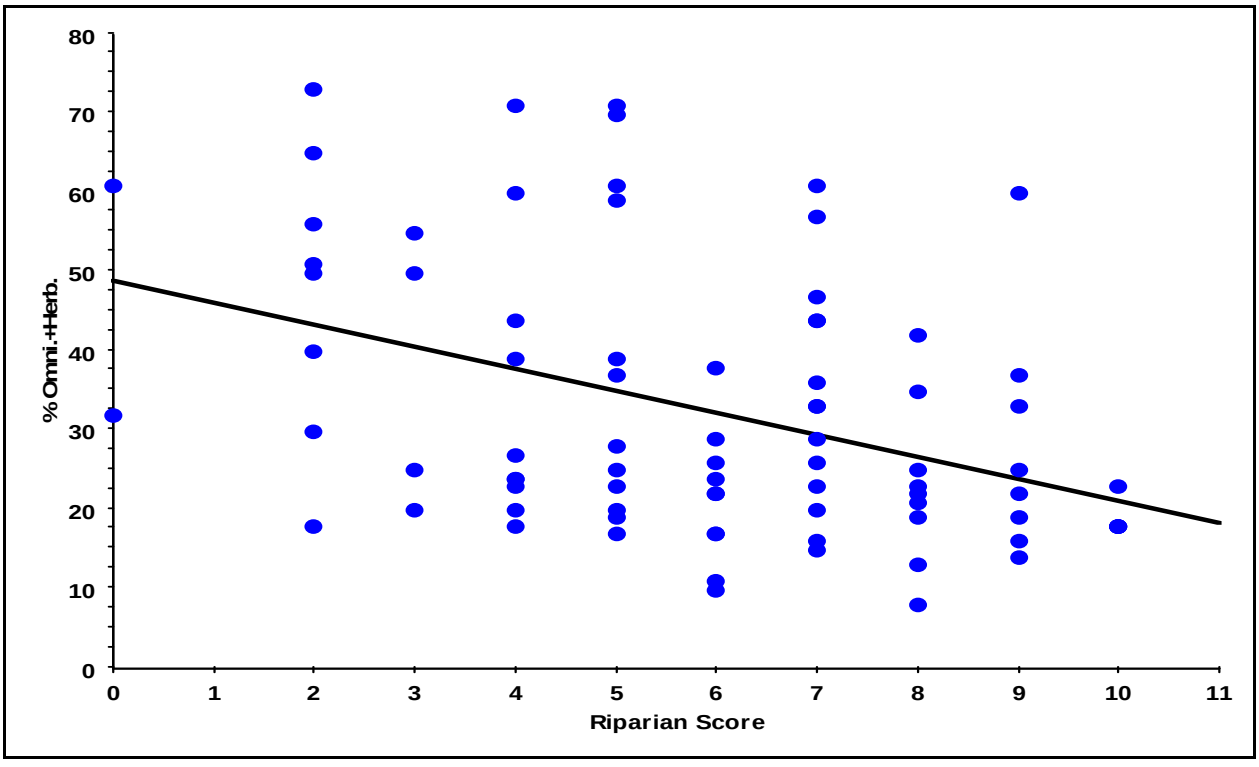


Figure 8. **Relationship between the percentage of omnivores+herbivores and the riparian scores in the French Broad River basin, 1997 - 2007.**

Appendix F-7. Water quality at 25 fish community sites in the French Broad River basin, 2007.

In 2007 water quality data (temperature, specific conductance, dissolved oxygen, and pH) were collected at every site during fish community assessments (Table 1). No dissolved oxygen concentrations were less than the water quality standard of 5 mg/L. Dissolved oxygen saturation ranged from 74 percent at Richland Creek at Walnut Trail Road (below Lake Junaluska) to 100 percent at Little Ivy Creek which was associated with the late afternoon photosynthesis by periphyton. Sixteen percent of the pH measurements (5 of the 25 measurements) were less than 6.0 s.u. The highest pH value, at Little Ivy Creek, similar to dissolved oxygen saturation, was associated with the late afternoon photosynthesis by the periphyton. Conductivity (specific conductance) ranged from 13 µS/cm at South Fork Mills River to 151 µS/cm at Little Ivy Creek (Table 1 and Figure 1). The reading at Little Ivy Creek, a WS-II HQW watershed, was the highest ever of any fish site in the basin and there are no known point source dischargers in this watershed. Elevated readings (e.g. at Newfound, Little Ivy, and Bull creeks) were associated with nonpoint source runoff from agricultural areas.

Table 1. Water quality measurements at 25 fish community sites in the French Broad River basin, 2007. Red bold denotes less than the water quality standard.

HUC/ Waterbody	Location	County	Date	Temperature (˚C)	Specific conductance (µS/cm)	Dissolved oxygen (mg/L)	Saturation (%)	pH (s.u.)
06010105 French Broad River								
Crab Cr	SR 1532	Transylvania	06/13/07	15.4	27	8.8	88	**5.5**
N Fk Mills R	SR 1341	Henderson	06/13/07	17.4	16	8.9	93	**5.6**
S Fk Mills R	SR 1340	Henderson	06/13/07	16.1	13	9.3	94	6.3
Avery Cr	off SR 3498	Buncombe	06/12/07	20.8	38	8.3	93	**5.9**
Bent Cr	off NC 191	Buncombe	06/12/07	20.2	21	8.1	89	6.5
Hominy Cr	NC 151	Buncombe	06/12/07	17.5	91	8.7	91	6.7
S Hominy Cr	NC 151/SR 3449	Buncombe	06/12/07	17.5	33	9.1	95	6.2
Newfound Cr	SR 1641	Buncombe	06/11/07	22.7	108	7.9	92	7.4
Turkey Cr	SR 1629	Buncombe	06/11/07	20.5	97	8.2	91	7.3
Little Ivy Cr	SR 1547	Madison	06/18/07	24.6	151	8.3	100	8.4
Bull Cr	SR 1574	Madison	06/19/07	18.7	103	8.1	87	6.3
Big Pine Cr	off SR 1151	Madison	06/19/07	21.5	58	8.1	92	6.7
Meadow Fk	NC 209	Madison	06/19/07	18.8	41	8.5	91	6.2
06010106 Pigeon River								
Richland Cr	Boyd Ave	Haywood	06/15/07	16.6	50	9.0	92	6.9
Richland Cr	SR 1184	Haywood	06/15/07	16.5	56	8.3	85	6.2
Richland Cr	Walnut Trail Rd	Haywood	06/14/07	22.7	60	6.4	74	**5.8**
Crabtree Cr	NC 209	Haywood	06/14/07	17.1	65	8.7	90	7.6
Fines Cr	off SR 1355	Haywood	06/14/07	16.0	71	9.0	91	6.8
06010108 Nolichucky River								
N Toe R	SR 1121	Avery	06/22/07	14.0	64	9.3	90	7.0
Big Crabtree Cr	SR 1002	Mitchell	06/18/07	18.5	32	8.3	89	6.1
Cane Cr	SR 1211	Mitchell	06/21/07	14.7	68	9.1	90	6.9
Big Rock Cr	NC 226	Mitchell	06/20/07	20.2	65	9.0	99	6.9
Pigeonroost Cr	SR 1349/NC 197	Mitchell	06/20/07	17.4	39	9.0	94	6.8
Big Cr	SR 1444	Yancey	06/21/07	18.8	40	8.4	90	6.8
Hollow Poplar Cr	NC 197	Mitchell	06/21/07	17.1	41	8.8	91	6.9

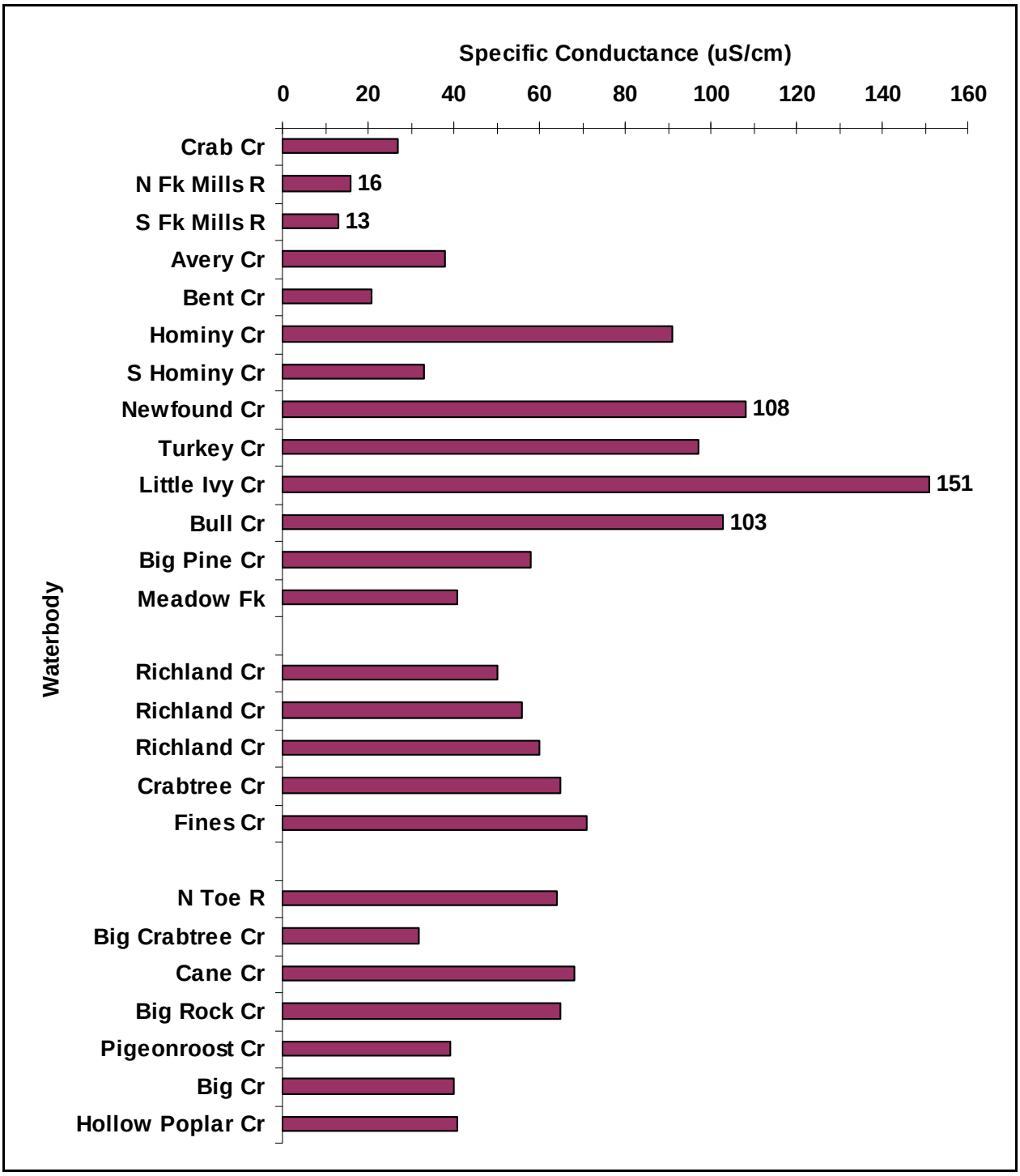


Figure 1. Specific conductance at 25 fish community sites in the French Broad River basin, 2007.

Since 1993, 92 rateable fish community samples with associated conductivity evaluations have been collected throughout the basin, primarily since 1997. [One data point – Beetree Creek (1997) was excluded from the data set because the site was below a reservoir with no minimum flow requirements.] This data set showed that communities rated Excellent had the lowest conductivity measurements (Figure 2). Median measurements for Excellent, Good, Good-Fair, Fair, and Poor sites were 33, 55, 61, 68, and

68 µS/cm, respectively. This data set also shows Little Laurel Creek (Excellent, conductivity = 84 µS/cm) and Little Ivy Creek (Good, conductivity = 151µS/cm) as outliers and may indicate nonpoint source runoff or illegal discharges (“straight pipes”).

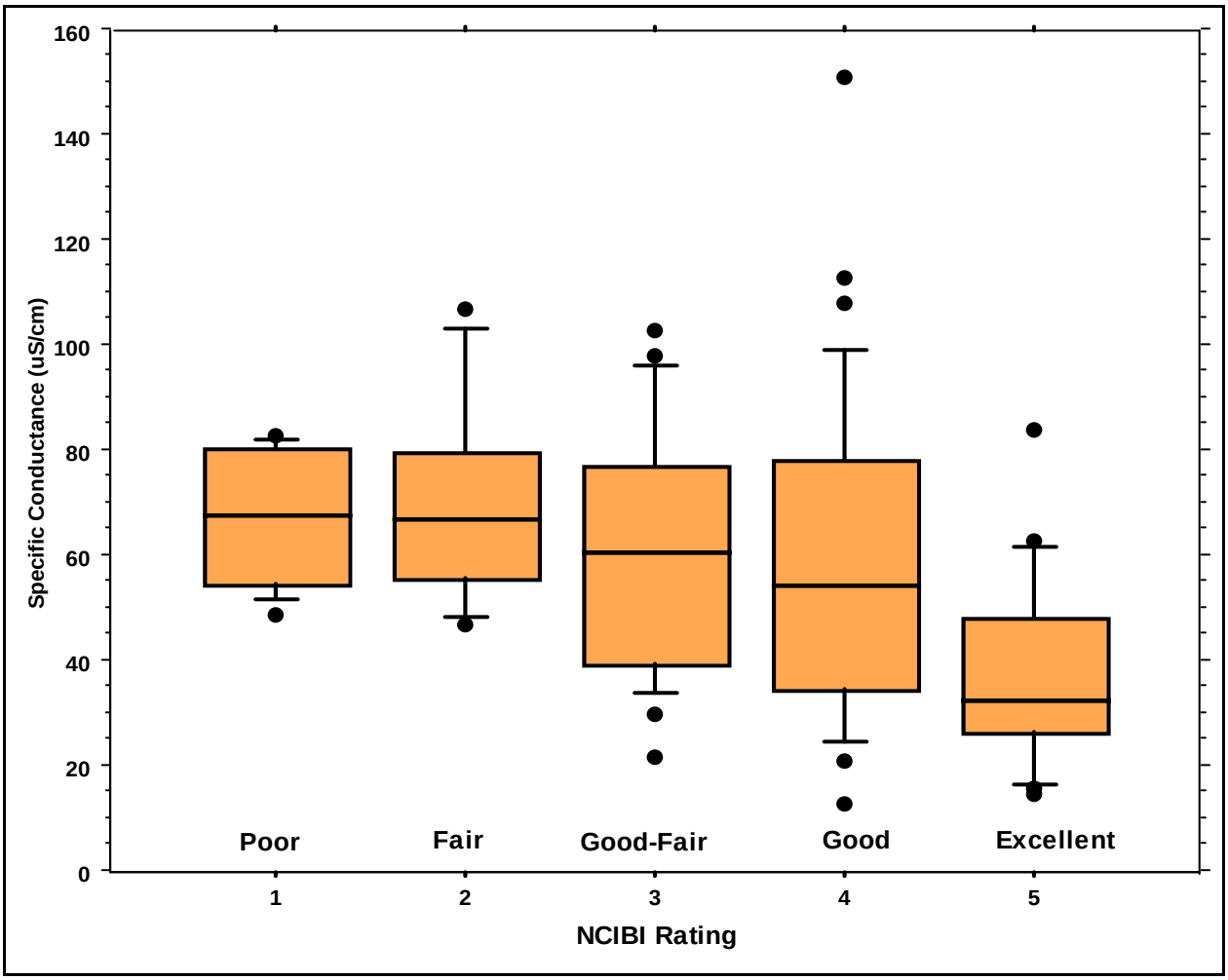


Figure 2. **Relationships between conductivity (µS/cm) and NCIBI ratings in the French Broad River basin, 1993 – 2007.**

Appendix F-8. Fish kills in the French Broad River Basin, 2003- 2007.

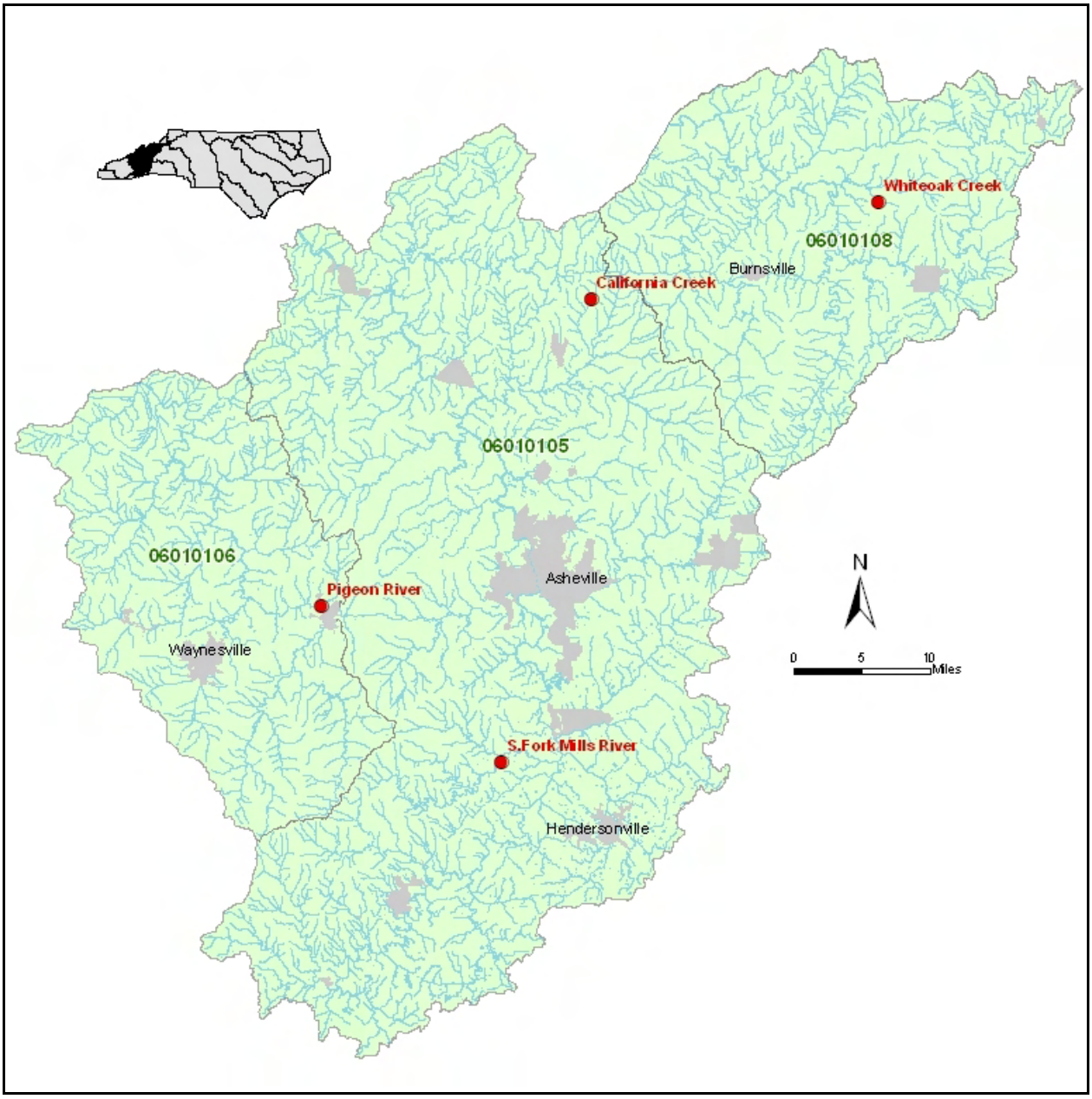


Figure 1. Locations of fish kills in the French Broad River Basin, 2003 – 2007.

Table 1. Fish kills in the French Broad River Basin, 2003 – 2007.

Date	Kill Number	Waterbody	Location	County	Subbasin	Species	Mortality
1/7/2003	AS03001	California Creek	north of Mars Hill	Madison	040304	Redhorse Bass Rockbass Sunfish Darters Minnows Trout Stonerollers	83000
Notes: Kill caused by a tanker truck spill of propionic acid directly into California Creek. NCWRC performed investigation and assessed a fine of around $16000 for time and cost of fish. Fine forwarded to DWQ for collection.							
5/1/2007	AS07001	Whiteoak Creek	near Bakersville	Mitchell	040306	Chubs	250
Notes: Sediment pesticide sample (organochlorine, organophosphorus, nitrogen) collected at most upstream site on White Oak Creek where dead fish observed. Pesticide sample collected due to Christmas Tree farm in the watershed.							
7/27/2007	AS07003	S Fork Mills River	near Mills River	Henderson	040303	Rainbow Trout Sculpin Darters Redhorse Sucker Chubs	1000
Notes: Investigators suspected event was related to pesticide application in adjacent tomato fields. DWQ water samples showed the presence of Chlorothalonil in field runoff and samples collected from the river. The event occurred after heavy rain following pesticide application. Majority of affected fish were identified as rainbow trout. Event also had significant effects on the aquatic insect population. This area of the South Mills River supports a documented population of the federally listed Appalachian elktoe mussel (Alasmidonta raveneliana), an endangered species. A follow up survey conducted on July 29 indicated that all located mussels were in good condition.							
9/7/2007	AS07004	Pigeon River	below Canton	Haywood	040305	Darters Suckers	8000
Notes: Kill event attributed to low flow/DO and high water temperatures brought on by ongoing drought conditions. Investigators observed numerous live fish during the investigation							

Appendix F-9. Web links.

NC Division of Water Quality, Stream Fish Community Assessment (including Habitat Assessment) Standard Operating Procedures
http://www.esb.enr.state.nc.us/BAU.html

NC Division of Water Resources, Drought Monitoring
http://www.ncwater.org/Drought_Monitoring/

NC Division of Water Quality (native and exotic freshwater fish in North Carolina)
http://www.esb.enr.state.nc.us/www.esb.enr.state.nc.us/Native and Introduced Freshwater Fish in North Carolina.2-1.htm

National Weather Service and North carolina State University's Marine, Earth, and Atmospheric Sciences Case Studies
http://www.meas.ncsu.edu/nws/www/cases/

US Geological Survey (real-time streamflow data for North Carolina)
http://waterdata.usgs.gov/nc/nwis/current?type=flow

Appendix F-10. Fish community references.

Fels, J. 1997. North Carolina watersheds map. North Carolina State University Cooperative Extension Service. Raleigh, NC.

Griffith, G., Omernik, J. and J. Comstock. 2002. Ecoregions of North Carolina. United States Environmental Protection Agency. Research and Development. NHEERL. Western Ecology Division. Corvallis, OR.

Karr, J. R. 1981. Assessment of biotic integrity using fish communities. Fisheries. 6: 21 - 27.

_____, Fausch, K. D., Angermeier, P. L., Yant, P. R., and I. J. Schlosser. 1986. Assessing biological integrity in running water: a method and its rationale. Ill. Nat. Hist. Surv. Spec. Publ. 5.

LeGrand, H. E., Hall, S. P., McRae, S. E., and J. T. Finnegan. 2006. Natural Heritage Program list of the rare animal species of North Carolina. North Carolina Natural Heritage Program, Office of Conservation and Community Affairs, North Carolina Department of Environment and Natural Resources. Raleigh, NC.

Menhinick, E. F. 1991. The freshwater fishes of North Carolina. North Carolina Wildlife Resources Commission. Raleigh, NC.

_____ and A. L. Braswell (eds). 1997. Endangered, threatened, and rare fauna of North Carolina. Part IV. A reevaluation of the freshwater fishes. Occas. Papers N.C. State Mus. Nat. Sci. and N.C. Biol. Surv. No. 11. Raleigh, NC.

NCDENR. 2003. Basinwide assessment report. French Broad River basin. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Water Quality Section. Environmental Sciences Branch. Raleigh, NC.

_____. 2006a. Standard operating procedure. Biological monitoring. Stream fish community assessment program. Biological Assessment Unit. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Environmental Sciences Section. Raleigh, NC.

_____. 2007. North Carolina. Water quality assessment and impaired waters list (2006 integrated 305(b) and 303(d) report). Final. Approved May 17, 2007. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Planning Section. Raleigh, NC.

NCWRC. 2005. North Carolina wildlife action plan. North Carolina Wildlife Resources Commission. Raleigh, NC.

Nelson, J. S., Crossman, E. J., Espinosa-Pérez, H., Findley, L. T., Gilbert, C. R., Lea, R. N., and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD.

Noga, E. J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year Book, Inc. St. Louis, MO.

Sanders, R. E., Miltner, R. J., Yoder, C. O., and E. T. Rankin. 1999. The use of external deformities, erosion, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources: a case study of seven Ohio streams. pp. 25-246. *In* Simon, T. P. (ed.). Assessing the sustainability and biological integrity of water resources using fish communities. CRC Press. Boca Raton, FL.

Steedman, R. J. 1991. Occurrence and environmental correlates of blackspot disease in stream fishes near Toronto, Ontario. Trans. American Fisheries Soc. 120: 494 - 499.

Appendix F-10 (continued).

Weaver, J. C. 2005. The drought of 1998 – 2002 in North Carolina – precipitation and hydrologic conditions. U. S. Geological Survey. Scientific Investigations Report 2005-5053.

Appendix G-1. Flow measurement and flow conditions in the French Broad River basin.

The onset of the 2007 drought began to be noticed in early February 2007 when portions of the basin were first described as being abnormally dry. The drought intensified throughout the spring, summer, and fall so that by early October the entire basin was in an exceptional drought. An extreme and exceptional level of drought has persisted into 2008.

During fish community sampling in mid June 2007 flows were well below the median daily flows at nearby USGS gauge sites (Figures 1 – 3). During benthic macroinvertebrate sampling from July through August water levels were often well below median flow. However, even before the last basinwide monitoring cycle was completed in 2002, the French Broad River basin had been experiencing a prolonged drought which started in 1998 and continued through 2002 (NCDENR 2003; Table 1; Figures 1- 3). The 1998 – 2002 drought was most severe during summer 2002 (Weaver 2002). The lowest daily mean discharges flows ever recorded occurred in August and September 2002 at several sites in the basin (Table 1). The drought was abruptly halted by above normal precipitation in late 2002 and into 2003.

Table 1. Record-low daily mean discharges at select U. S. Geological Survey stream gaging stations. Data adopted from Weaver (2005).

			Lowest Daily Mean Discharge			
			Prior to 1988 Water Year		During 1998-2002 Water Year	
Station, County	Drainage Area (mi^2)	Annual 90% exceedances flow (ft^3/s)	Min (ft^3/s)	Date	Min (ft^3/s)	Date
French Broad River near Rosman, Transylvania	67.9	87	37	09/25/1954	47.6	08/12/2002
Davidson River near Brevard, Transylvania	40.4	42	14	09/28/1954	16	09/16/1999
Beetree Creek near Swannanoa, Buncombe	5.5	1.6	0.3	09/30/1954	0.37	09/12/2002
Swannanoa River at Biltmore, Buncombe	130	36	1.2	10/14/1941	4.9	09/13/2002
Pigeon River near Hepco, Haywood	350	205	95	09/30/1941	95	09/11/2002
South Toe river near Celo, Yancey	43.3	36	12	07/21/1986	9.5	09/12/2002

During a three week period in September 2004, the tropical storm remnants of three hurricanes (Frances, Ivan, and Jeanne) lead to wide-spread flooding throughout the central and northern mountains of western North Carolina in the Catawba, French Broad, and Watauga River basins. Rainfall estimates for the combined three storms totaled more than 20 - 30 inches in certain watersheds. Runoff from the storms produced flash-floods throughout the region with peak flows in excess of 10,000 cfs (approximately 500 times median flows) in upper tributary streams, peaks flows in some tributary rivers exceeded 50,000 cfs. Although several of the peak stream flows were within the 25 - 50 year recurrence interval (e.g., the Swannanoa River at Biltmore), others were within the 200 - 500 year recurrence interval (e.g., West Fork Pigeon River above Lake Logan) or greater than 500 year recurrence interval (e.g., Pigeon River near Canton). Flooding was particular acute in the watersheds of Hominy/South Hominy Creeks, the lower Swannanoa River at Biltmore Village, and the Pigeon River at Canton (Biological Assessment Unit Memorandum F-20050404).

Extremely high flows have been periodically recorded since then, until 2007 when the most recent drought commenced. In September 2007, the all time record low daily discharge, 10 cfs, was reached again at the gaging site on the West Fork Pigeon River above Lake Logan near Hazelwood (pers. comm. with Mr. J. Curtis Weaver, USGS North Carolina Water Science Center, Raleigh, NC, January 30, 2008).

Changes in the benthic macroinvertebrate community are often used to help assess between-year changes in water quality. However, some between-year changes in the communities may be due partly to changes in flow. High flows magnify the potential effects of nonpoint source runoff and in areas of high imperviousness, this can lead to scour, substrate instability, and reduced periphyton. Low flows may

accentuate the effect of point source dischargers by providing less dilution of wastes. Whether a change is flow-related is decided on a site-by-site basis, looking at:

- Flow. The daily flow patterns over a six to twelve month period prior to the collections are examined using the most comparable records from USGS gaging stations. Areas primarily affected by nonpoint source runoff are expected to have a decline in water quality after high flow, but may improve during low flow. The exception to this rule is the smaller headwater streams, which may cease flowing during extreme droughts. Streams affected primarily by point source dischargers may improve after high flow (with dilution of the effluent) and decline after low flows. These changes, however, occasionally produce a between-year change of only one bioclassification.
- Changes throughout the subbasin, especially at reference sites. Flow-related changes usually affect a whole group of sites, not just single sites.
- Changes in species composition. Real changes in water quality are usually reflected in a significant change in the composition of the invertebrate community.

Consequently, all between-year changes in the biological communities are considered in light of flow conditions. Daily flow information is obtained from the closest available USGS monitoring site and compared to the long-term median flows. High flow is defined by BUA Staff as a median flow greater than 140 percent of the long-term median for that time period, usually July or August. Low flow is defined as a median flow less than 60 percent of the long-term median, while normal flow is 60 - 140% of the median. Although broad scale regional patterns are often observed, there may be large geographical variation within the state and large variation within a single summer period.

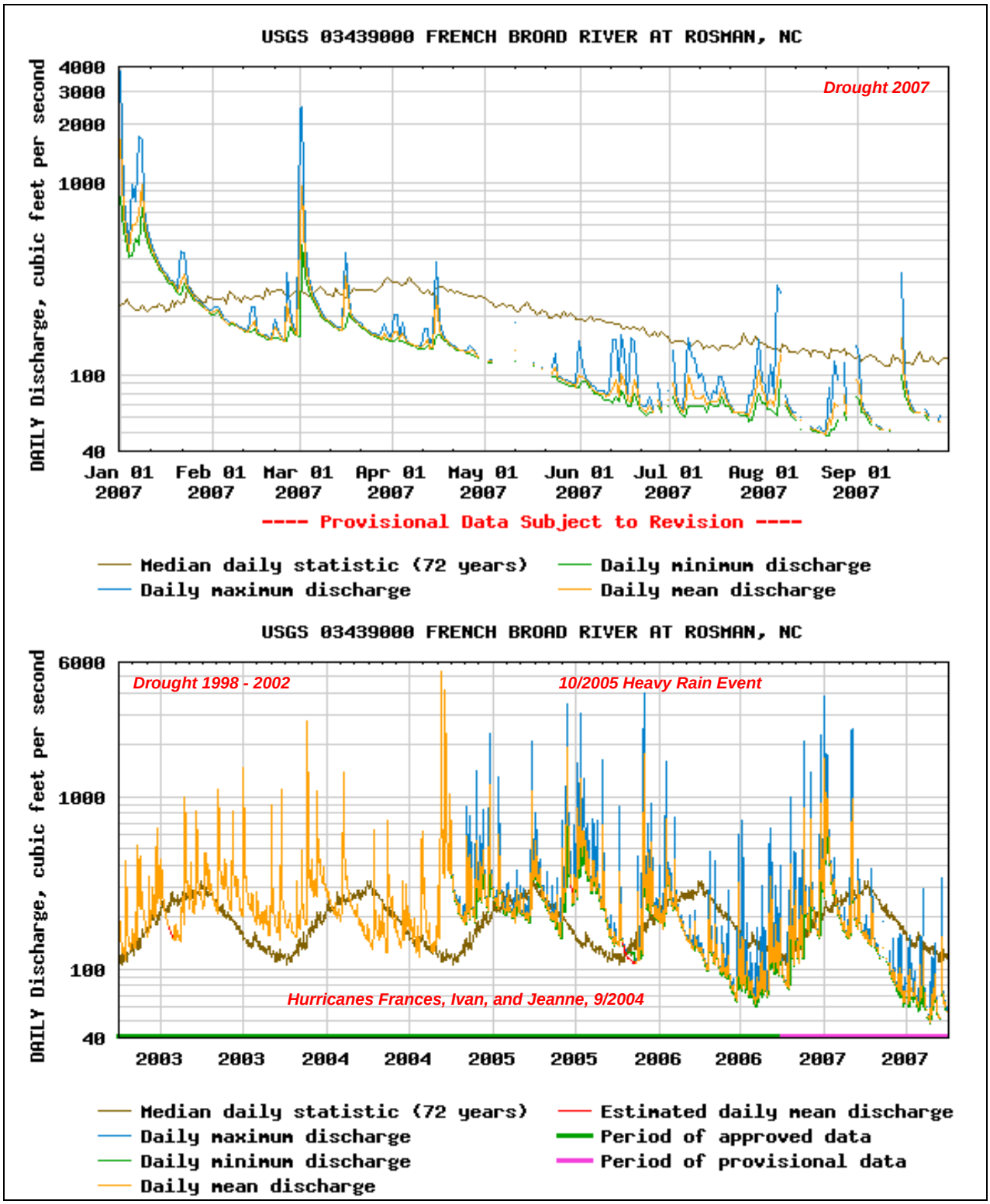


Figure 1. **Flows in the French Broad River at Rosman, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).**

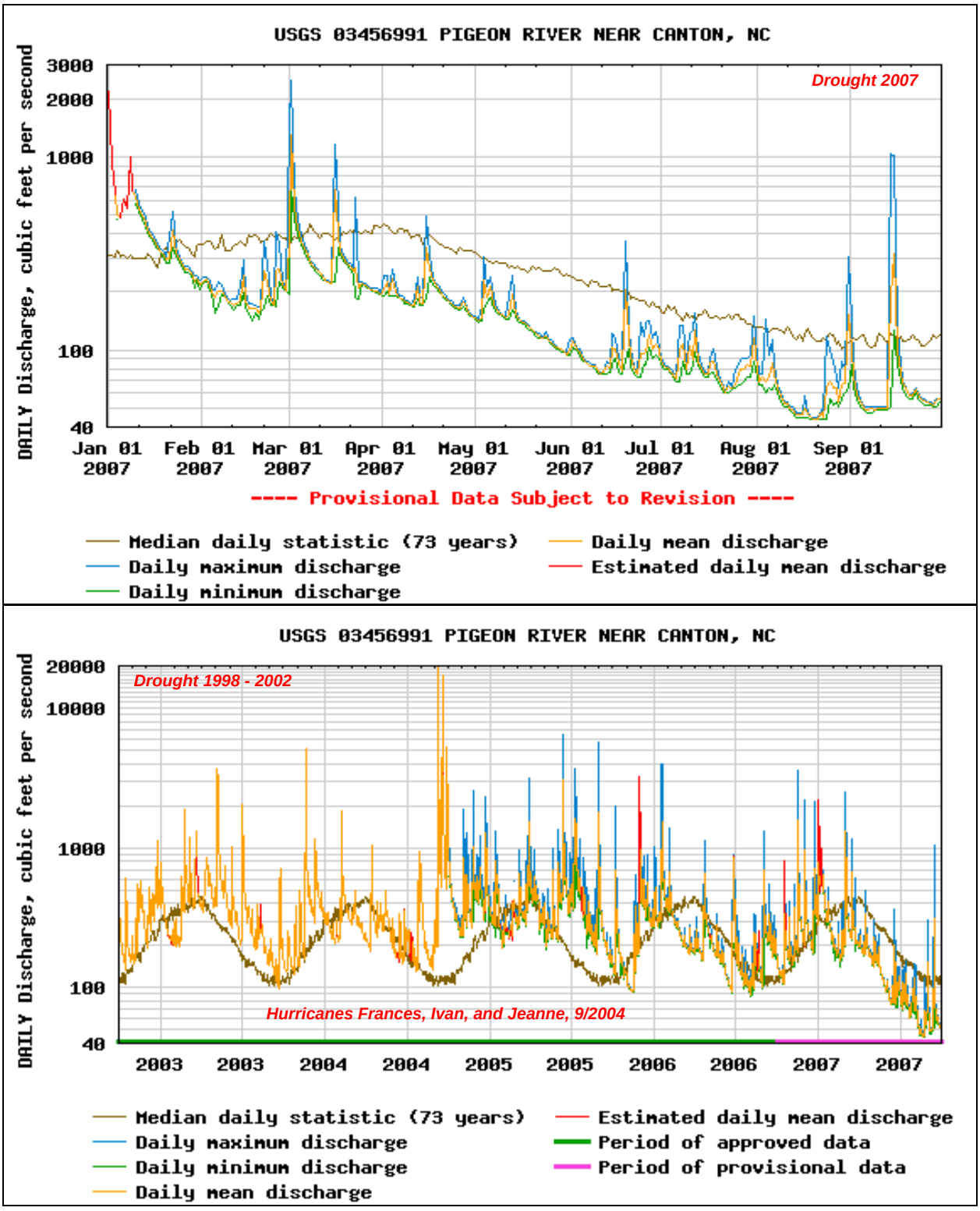


Figure 2. **Flows in the Pigeon River near Canton, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).**

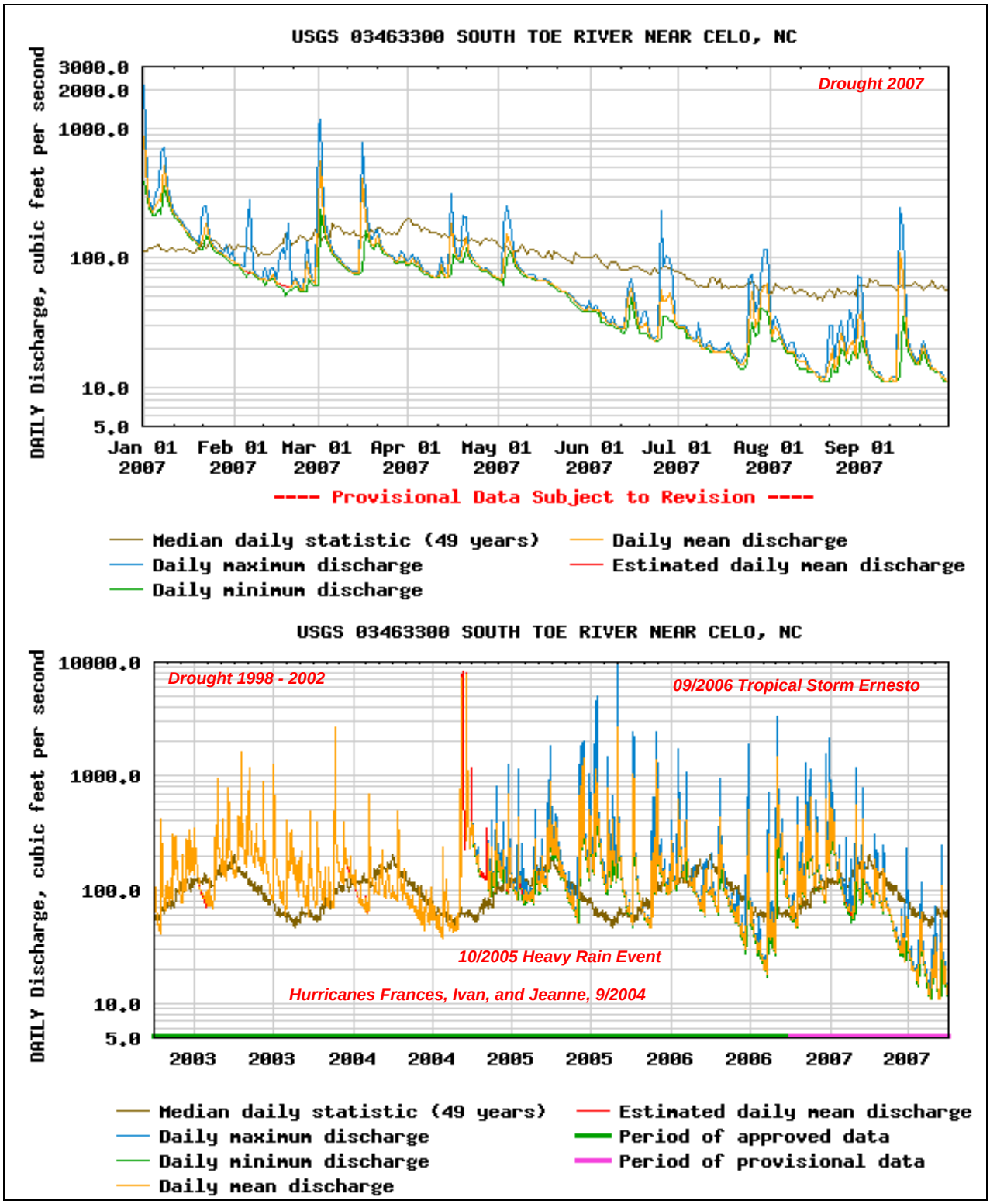


Figure 3. **Flows in the South Toe River near Celo, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).**

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FRENCH BROAD R	**SR 1129**	**EB10**	**08/16/07**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Transylvania	1	06010105	350855	824759	6-(1)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr	102	2200	26	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	0	0	50 (fallow)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Babcock Company LLC, Excelsior Packaging Plant / Rosman WWTP	NC0000108 / NC0021946	0.015 / 0.25

Water Quality Parameters

Temperature (°C)	25.2
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	21
pH (s.u.)	7.7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	10
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	6
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	66

Site Photograph

Substrate gravel, cobble, and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10333	105	46	4.3	3.0	Excellent
07/08/02	8848	96	54	3.6	3.0	Excellent
07/08/97	7317	92	51	3.5	2.8	Excellent
07/06/92	5873	108	51	3.8	2.6	Excellent

Taxonomic Analysis

A decrease in leptocerid caddisflies and ephemerellid mayflies from 2002 levels is primarily responsible for the decrease in EPT richness in 2007. The increase in the biotic index from 3.6 to 4.3 in 2007 is, in part, due to the increases in tolerant midges, such as *Polypedilum illinoense* gr. and *Tribelos jucundum* , as well as abundant lumbriculid oligochaetes. Despite this increase in the biotic index, many intolerant taxa were abundant such as *Serratella deficiens* , *S. serratoides* , *Acroneuria abnormis* , *Brachycentrus appalachia* , *Micrasema bennetti,* and *M. wataga* . This site is one of 5 locations within North Carolina where the rare mayfly *Barbaetis benfieldi* has historically been found. *Barbaetis benfieldi* was last collected in 1992.

Data Analysis

The sampling site lies on the edge of the Broad Basins ecoregion while the entire watershed upstream is contained within the Southern Crystalline Ridges and Mountains ecoregion. The headwaters of the French Broad River (North, West, East, and Middle Forks of the French Broad) all drain mostly undeveloped National Forest land. Regardless of being situated below Rosman and 2 minor dischargers, this site has maintained an Excellent rating. However, water quality does appear to be worsening slightly as indicated by the decrease in EPT and the substantial increase in the biotic index.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FRENCH BROAD R	**NC 146**	**EB89**	**08/15/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	352853	823328	6-(54.5)b	southern crystaline ridges and mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	658.4	2043	50	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	0	0	50 (I-26 corridor)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Asheville Steam Electric Power Plant	NC0000396	4.8
RFS Ecusta, Inc.	NC0000078	27.5
Brevard WWTP	NC0060534	2.5
Henderson WWTP	NC0025534	4.8

Water Quality Parameters

Temperature (°C)	26.1
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	42
pH (s.u.)	7.5
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	76

Site Photograph

Substrate Mixture of gravel, cobble, and boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10321	63	27	4.8	3.7	Good
09/10/02	8988	65	25	5.6	4.5	Good-Fair
07/08/97	7321	76	32	5.4	4.5	Good-Fair
07/08/92	5883	86	41	5.1	4.2	Good
07/26/90	5403	79	33	5.4	4.0	Good-Fair

Taxonomic Analysis

There were no stoneflies collected at this study location in 2007. Pollution intolerant, or "sensitive" taxa included the mayfly *Ephemera* sp., and the caddisfly *Brachycentrus numerosus* . Neither of these taxa have previously been collected at this site. Overall, the macroinvertebrate assemblage was dominated by facultative species.

Data Analysis

The bioclassification at NC 146 has improved slightly from Good-Fair in 2002 to Good in 2007. Although no stoneflies were collected at this location in either 2002 or 2007, their absence may be in part be attributable to adult emergence patterns rather than an effect of water quality. The infrequency of riffle habitats negatively affected the habitat score. However, due to the presence of abundant colonizable habitats at this location the bioclassification will likely remain Good unless water quality degrades.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FRENCH BROAD R	**SR 1348**	**EB90**	**08/16/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	353632	823441	6-(54.5)c	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	943	1960	50	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Asheville Steam Electric Power Plant	NC0000396	4.8
RFS Ecustra, Inc.	NC0000078	27.5
Brevard WWTP	NC0060534	2.5
Hendersonville WWTP	NC0025534	4.8

Water Quality Parameters

Temperature (°C)	26
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	62
pH (s.u.)	7.3
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	10
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	74

Site Photograph

Substrate Mix of bedrock, boulder, rubble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10324	77	30	5.34	4.15	Good-Fair
07/10/02	8867	73	30	4.76	3.98	Good
07/09/97	7323	72	32	5.03	4.02	Good-Fair
07/23/92	5934	73	32	5.24	4.30	Good-Fair
08/03/87	4190	70	23	5.26	4.02	Good-Fair

Taxonomic Analysis

No major changes in the benthic community were observed. Abundant taxa included *Baetis intercalaris*, *Heterocloeon anoka*, *H. curiosum*, *Maccaffertium ithaca*, *M. modestum*, *Stenacron pallidum*, *Tricorythodes*, *Brachycentrus numerosus*, *Cheumatopsyche*, *Hydropsyche venularis*, *Triaenodes ignitus*, *Ancyronyx variegatus*, *Macronychus glabratus*, *Argia*, *Calopteryx*, *Macromia*, *Polypedilum flavum*, *Rheotanytarsus*, *Simulium* and *Crangonyx*.

Data Analysis

This site is located in the city of Asheville. EPT richness has been fairly stable (30 or 32) since 1992, but a slight decline in the NCBI occurred in 2002 resulting in a Good bioclassification. No major water quality problems are indicated by the benthic community.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FRENCH BROAD R	**SR 1634**	**EB92**	**08/14/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	354230	823719	6-(54.d)d	Southern Crystaline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	1049.3	1786	50	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	0	0	30 (Residential)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
French Broad River WRF	NC0024911	40
Asheville Steam Electric Power Plant	NC0000396	4.8
RFS Ecusta, Inc.	NC0000078	27.5
Brevard WWTP	NC0060534	2.5
Henderson WWTP	NC0025534	4.8

Water Quality Parameters

Temperature (°C)	27.1
Dissolved Oxygen (mg/L)	7.4
Specific Conductance (µS/cm)	84
pH (s.u.)	7.5
Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	79

Site Photograph

Substrate Mixture of gravel, cobble, and boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10317	77	28	5.7	4.1	Good-Fair
07/10/02	8869	57	18	5.8	4.9	Fair
07/09/97	7325	55	18	5.6	4.7	Good-Fair
07/23/92	5935	53	19	6.1	4.8	Fair
07/24/90	5399	61	19	5.7	4.3	Fair

Taxonomic Analysis

Intolerant or "sensitive" taxa identified from the 2007 sample included the mayflies *Heptagenia marginalis, Stenacron pallidum, and Serratella deficiens,* and the caddisflies *Brachycentrus numerosus* and *Protoptila* sp. No stoneflies were collected at this site.

Data Analysis

The bioclassification of this study site has fluctuated between Fair and Good-Fair during the five sampling events between 1990 and 2007. The habitat score was negatively affected by an open stream canopy and by frequent gaps in the riparian zone. The operation of the French Broad River WRF was improved prior to 1997 sampling, and a trend of higher bioclassification at this location indicates a possible associated improvement in water quality. The recolonization of stoneflies would help this site in recieving a higher rating in the future.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
French Broad R	**NC 213**	**EB194**	**07/31/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	354710	823939	6-(54.5)f	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	1,330	1,697	75	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	60	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	34.3
Dissolved Oxygen (mg/L)	5.7
Specific Conductance (µS/cm)	60.9
pH (s.u.)	6.7
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	5
Light Penetration (10)	4
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	62

Site Photograph

Substrate Sand, rubble, gravel, bedrock, and boulder.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/31/07	10270	79	32	4.98	3.73	Good-Fair
06/26/02	8840	81	26	5.80	4.50	Good-Fair
07/07/97	7336	52	25	4.70	3.70	Good-Fair
07/23/92	5929	66	24	5.30	4.50	Good-Fair
07/24/90	5398	49	18	5.50	4.70	Good-Fair

Taxonomic Analysis

Although the bioclassification has been extremely stable at this location through time, the 2007 sample did produce the highest EPT taxa richness and lowest EPTBI suggesting slightly improved water quality here this year. Indeed, several EPT taxa were collected here for the first time in 2007 and included the mayflies *Plauditus punctiventris, Maccaffertium pudicum* , and the caddisflies *Agapetus* sp., *Brachycentrus numerosus* , *Brachycentrus spinae* , *Ceratopsyche bronta* , and *Polycentropus* sp.

Data Analysis

Including the 2007 sample, this segment of the French Broad River has been sampled on 10 occasions with all but two samples (Fair in 1985 and 1988) resulting in Good-Fair bioclassifications. This data suggests stable water quality conditions through time at this location although the 2007 sample set a record high for EPT taxa richness and a record low EPTBI. This improvement in EPT community metrics is likely the result of lowered pollution inputs due to drought as much of this catchment is most influenced by non-point inputs. Indeed, conductivity in 2007 (61µS/cm) was much lower than the level measured in 2002 (100 µS/cm)

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
W FK FRENCH BROAD R	**US 64**	**EB45**	**08/28/07**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Transylvania	1	06010105	350815	825105	6-2-(7.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr, HQW	27	2300	12	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.5
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	19
pH (s.u.)	6.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	81

Site Photograph

Substrate cobble, sand, and boulder; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/28/07	10338	96	39	3.6	2.3	Good
07/09/02	8851	91	51	3.0	2.3	Excellent
07/07/97	7314	94	50	3.0	2.1	Excellent
07/06/92	5871	87	47	3.5	2.4	Excellent

Taxonomic Analysis

A dramatic drop in EPT richness occurred since 2002 driven mostly by the occurance of fewer mayfly taxa, of which five of the absent taxa belonged to the family Ephemerellidae. Also, 3 taxa species in the genus *Rhyacophila (R. atrata, R. formosa, R. fuscula)* , an intolerant caddisfly group, were not collected in 2007. An increase in the biotic index is indicative of a slightly more tolerant benthic community with representatives like *Maccaffertium modestum* , abundant for the 1st time, and *Tribelos jucundum,* a tolerant midge, collected for the first time. EPT abundance values were also half those found in 2002 (157 vs. 329). Sensitve taxa of note included *Drunella allegheniensis* , *Paraleptophlebia* sp., *Paragnetina immarginata* , *Pteronarcys* sp., *Brachycentrus spinae* , *B. appalachia* , *Micrasema bennetti* , *M. rickeri* (63rd state record), *M. wataga* , and *Phylocentropus* sp.

Data Analysis

A mostly undeveloped watershed, this river drains a portion of Pisgah National Forest. Trout farms exist in the upper watershed and have been documented to have a localized effect on stream water quality (see BAU memos 20000925 and 20020125). This site was sampled approximately 7 seasonal weeks after the prior basinwide samples were collected. Many of the taxa that did not occur may have already emerged. Also, the biotic index is well within the Excellent range while only one more EPT taxon collected would have produced an bioclassification rating of Excellent for 2007. It is possible that seasonal emergence of insects, along with increased impacts of the trout farms on the stream in a drought year, may have both contributed to lowering the bioclassification rating to Good in 2007.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N FK FRENCH BROAD R	SR 1322	EB28	08/17/07	EXCELLENT

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Transylvania	1	06010105	350916	825024	6-3-(6.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr	35	2250	10	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	20	60	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	21.3
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	20
pH (s.u.)	6.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	9
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	2
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	69

Site Photograph

Substrate cobble, boulder, and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/07	10335	95	43	3.9	2.9	Excellent
07/09/02	8853	79	41	3.5	2.7	Excellent
07/07/97	7315	76	41	3.3	2.5	Excellent
07/06/92	5872	85	42	3.4	2.5	Excellent

Taxonomic Analysis

EPT richness in North Fork French Broad River has remained stable over the last 15 years. The biotic index, however, has risen since 1997 indicating that the benthos is slowly shifting towards a slightly more tolerant community (with increases in tolerant non-EPT taxa such as odonates and midges). Although intolerant taxa overwhelmingly dominated the community with *Epeorus vitreus* , *Paraleptophlebia* sp., *Acroneuria abnormis* , *Leuctra* sp., *Paragnetina immarginata* , *Brachycentrus appalachia* and *Dolophilodes* sp. being abundant, increases in the overall EPT biotic index also increased. Previously uncollected taxa were *Centroptilum* sp. *Molanna tryphena* , and *Rhyacophila carolina* . the caddisfly *Setodes* sp. and the stonefly *Perlesta* sp., as well as 3 ephemerellid mayflies, (Danella lita, Drunella lata, Serratella serrata) were not collected in 2007 as they were in years past.

Data Analysis

Draining National Forest land in Transylvania County, the North Fork French Broad River has little development and no dischargers to impact water quality. Cattle access to the river just downstream of the sampling site has severely eroded the banks of the river and is cause for concern. The stream has maintained an Excellent bioclassification rating for the fourth consecutive basinwide cycle with no water quality issues noted.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
M FK FRENCH BROAD R	SR 1131	EB21	08/16/07	EXCELLENT

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Transylvania	1	06010105	350716	824918	6-5	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr	4.9	2240	4	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	0	75	0	25

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	26
pH (s.u.)	6.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	10
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	73

Site Photograph

Substrate primarily cobble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10334	---	43	---	2.3	Excellent
07/08/02	8849	---	51	---	2.2	Excellent

Taxonomic Analysis

Eight fewer EPT were collected (5 mayflies, 1 stonefly, 1 caddisfly) in 2007 than were collected in 2002. In both sampling years almost all abundant taxa were sensitive species, although one third fewer taxa were abundant in 2007 (10 and 15 respectively). For 2007, intolerant taxa that were abundant included the mayfly *Epeorus vitreus* and the caddisflies *Micrasema wataga*, *Dolophilodes* sp., and *Brachycentrus spinae*. All 5 occuring taxa of stoneflies collected were abundant. Some new taxa in 2007 were *Neoephemera purpurea*, *Malirekus hastatus*, *Ceratopsyche slossonae*, *Micrasema bennetti*, *Neophylax mitchelli* and *Nyctiophylax celta*. Two of three species of *Rhyacophila* (*R. acutiloba* and *R. carolina*) collected in 2002 were not found in 2007.

Data Analysis

A new basinwide site in 2002, the Middle Fork French Broad River drains a portion of the Pisgah National Forest. The sampling site lies within a heavily developed residential zone which leaves a large potion of the stream corridor without substantial riparian vegetation. Despite this, the stream has retained its Excellent rating from 2002 partially due to the lessened urban runoff during a low precipitation year. No water quality problems are noted at this site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DAVIDSON R	**US 276**	**EB164**	**08/16/07**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Transylvania	3	06010105	351628	824251	6-34-(15.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV, B; Tr	40	2195	15	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	0	0	(30) campground

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

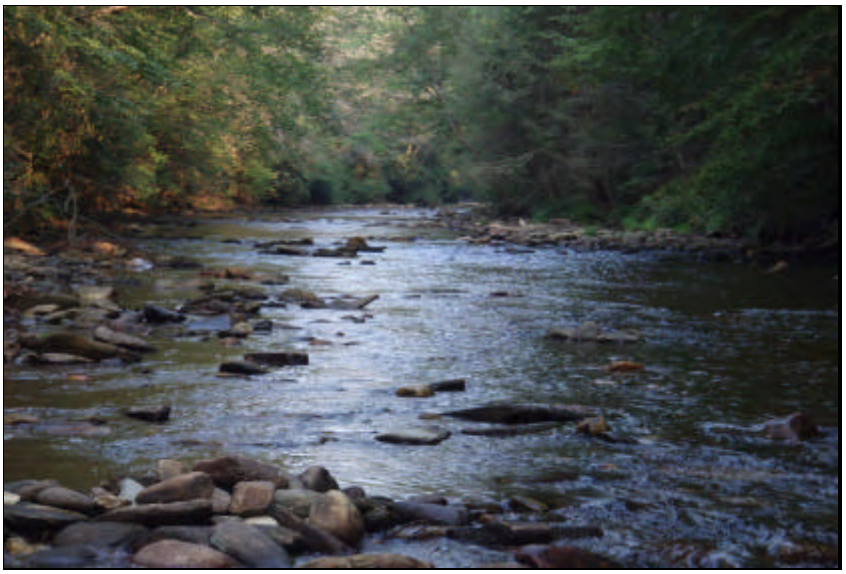
Water Quality Parameters

Temperature (°C)	19.6
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	22
pH (s.u.)	6.8
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	15
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	84

Site Photograph



Substrate cobble, boulder, and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10330	---	37	---	2.6	Excellent
07/22/02	8883	---	37	---	3.2	Excellent
07/22/97	7333	---	52	---	2.7	Excellent
07/07/92	5875	---	45	---	1.8	Excellent

Taxonomic Analysis

EPT richness in Davidson River maintained it's 2002 level, although it has historically been higher. The reduction of ephemerellid mayflies from 1992 (8) to 2002 (3) and 2007 (1) is the primary reason for the difference in EPT richness values. Many intolerant taxa were were abundant in 2007 and included 3 mayflies (*Epeorus vitreus* , *Heptagenia marginalis* , and *Maccaffertium pudicum*), 3 stoneflies (*Acroneuria abnormis* , *Paragnetina immmarginata* , and *Tallaperla* sp.), as well as 5 caddisflies (*Brachycentrus spinae* , *Ceratopsyche sparna* , *Dolophilodes* sp., *Glossosoma* sp., and *Neophylax consimilis*). The previously collected taxa *Triaenodes ignitus* , *Polycentropus* sp. and *Perlesta* sp. were not collected in 2007. Also, an animal of special concern in North Carolina, the hellbender (*Cryptobranchus alleganiensis*), was found at this site.

Data Analysis

The entire watershed of Davidson River lies within Pisgah National Forest and is completely undeveloped. This stream is a popular recreational stream and has undergone substantial habitat rearrangement by fishermman, although effects on the macroinvertebrate community are minimal. Davidson River has consistently maintained an Excellent rating and no water quality issues were identified.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LITTLE R	**SR 1560**	**EB18**	**08/16/07**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Transylvania	1	06010105	350918	823744	6-38-(1)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	16	2200	5	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	20	0	40 (fallow field)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	21.2
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	21
pH (s.u.)	6.6
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	3
Pool Variety (10)	7
Riffle Habitat (16)	4
Left Bank Stability (7)	3
Right Bank Stability (7)	3
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	4
Total Habitat Score (100)	53

Site Photograph

Substrate sand and woody debris

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10332	---	45	---	3.3	Excellent
07/09/02	8864	---	35	---	3.5	Good

Taxonomic Analysis

EPT richness increased by 10 taxa over the first basinwide sampling in 2002. This increase was due to more caddisflies being collected and, in turn, was responsible for lowering the EPT biotic index as the remainder of the 2007 benthic community was similar to that found in 2002. Caddisfly taxa not previously collected were *Dolophilodes* sp. (rare), *Glossosoma* sp. (abundant), *Hydroptila* sp. (rare), *Lype diversa* (common), *Micrasema wataga* (common), *Molanna tryphena* (rare), *Mystacides sepulchralis* (common), *Nyctiophylax moestus* (rare), *N. nephophilus* (common), *Rhyacophila appalachia* (rare), *R. fuscula* (common), and *Triaenodes ignitus* (abundant). Stoneflies were also diverse with 9 taxa of which *Acroneuria abnormis* , *Leuctra* sp. and *Tallaperla* sp. were abundant. Mayflies of note were *Baetisca* sp. (rare), *Drunella conestee* (common), *Hexagenia* sp. (common), and *Serratella deficiens* (abundant).

Data Analysis

Upstream of any dischargers, this site on the Little River receives water from a mostly forested watershed. Some residential development (including golf courses) and agriculture also exist within the watershed, potential non-point sources of pollution. This site received an Excellent bioclassification up from a previous Good rating. The previous Good rating, however, was only one taxon away from scoring an Excellent suggesting that the Little River at this site has only been slightly impacted. Of note is that both samplings occured during drought years thereby lessening the impact of non-point source runoff on the benthos. Habitat in this stream was poor due to the homogeneous substrate and lack of riffles further supporting the fact that a diverse macroinvertebrate community benefits from excellent water quality.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LITTLE R	**SR 1533**	**EB16**	**08/16/07**	**GOOD-FAIR**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
TRANSYLVANIA	1	06010105	351518	823835	6-38-(20)	Broad Basins

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	44	2135	11	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	0	30	50	20 (fallow field)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Eagle's Nest Foundation - camp	NC0051021	0.008

Water Quality Parameters

Temperature (°C)	21.3
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	17
pH (s.u.)	6.4
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	3
Left Bank Stability (7)	3
Right Bank Stability (7)	3
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	52

Site Photograph

Substrate sand and woody debris

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10331	---	24	---	4.0	Good-Fair
07/11/02	8870	---	24	---	4.2	Good-Fair
07/08/97	7318	---	25	---	4.3	Good-Fair
07/07/92	5874	---	26	---	4.2	Good-Fair

Taxonomic Analysis

EPT richness in the Little River has remained fairly constant since 1992. Pollution sensitive taxa in 2007 were represented by only one species of mayfly (*Serratella deficiens*), one species of stonefly (*Paragnetina fumosa*) and one species of caddisfly (*Brachycentrus nigrosoma*). Other abundant taxa were tolerant (*Cheumatopsyche* sp. and *Maccaffertium modestum*). Overall, fewer mayflies were collected in 2007 (4) as compared to other years (5-7). The previously collected stonefly, *Pteronarcys* sp., was not found in 2007. New taxa collected at this site were the burrowing mayfly *Hexagenia* sp. and the caddisfly *Polycentropus* sp.

Data Analysis

This sampling site on the Little River lies in the Broad Basins ecoregion while the vast majority of the watershed lies within the Southern Crystaline Ridges and Mountains ecoregion. The Little River has consistlenly rated Good-Fair at SR 1533 since the monitoring of this waterbody began in 1992. A major discharger upstream (Sterling Diagnostic Imaging) became inactive since the last sampling in 2002, although the sampling site is downstream of a small discharger. Water quality has not improved at this site and is most likely affected by the high degree of urbanization and intense agriculture surrounding the stream. Additionally, the lack of good macroinvertebrate habitat impedes the streams ability to recover and contributes to the lack of benthic diversity.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CRAB CR	**SR 1532**	**06/13/07**	**EF20**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
TRANSYLVANIA	1	06010105	35.23444444	-82.6175	6-38-23	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr,HQW	7	2090	6	0.3	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	15	0	85	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.4
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	27
pH (s.u.)	5.5

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	6
Pool Variety (10)	8
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	**73**

Site Photograph

Substrate Cobble, gravel, sand, and silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/13/07	2007-75	21	56	Good
06/03/02	2002-62	20	50	Good

Most Abundant Species Mottled Sculpin and Central Stoneroller

Exotic Species Rosyside Dace, Rainbow Trout, Brown Trout, and Redbreast Sunfish.

Species Change Since Last Cycle

Gains -- Rosyside Dace, Tennessee Shiner, Rainbow Trout, and Greenside Darter. **Losses** -- Mirror Shiner, Bluegill, and Redline Darter.

Data Analysis

Watershed -- a small tributary to the Little River; drains eastern Transylvania County; no municipalities in the rural agricultural and forested watershed; site is ~ 1.4 miles above the creek's confluence with the river. **Habitat** -- eroding banks with narrow riparian zones; shallow riffles common, but embedded; snags and deadfalls; some quality deep snag pools where large trout and suckers were found; cattle with access to the stream on the left. **2007** -- low conductivity; low pH measurement was verified; percentage of tolerant fish (Creek Chub, White Sucker, and Redbreast Sunfish) was much greater than expected; a very diverse community for a stream of its size; large specimens of Golden Redhorse and wild Rainbow Trout and Brown Trout. **2002 & 2007** -- conductivity was low for an agricultural area; an abundant and very diverse community; 24 species known from the site including 9 species of cyprinids, 5 species of darters, and 3 intolerant species; slightly greater score in 2007 than in 2002; dominant species has been the Central Stoneroller and Saffron Shiner.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BOYLSTON CR	**SR 1314**	**EB159**	**08/15/07**	**GOOD-FAIR**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Henderson	3	06010105	352231	823301	6-52-(6.5)	Broad Basins

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	16	2072	8	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	10	30	60	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.4
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	43
pH (s.u.)	7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	8
Riffle Habitat (16)	12
Left Bank Stability (7)	5
Right Bank Stability (7)	4
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	69

Site Photograph

Substrate primarily sand and gravel, some cobble; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10329	---	22	---	4.0	Good-Fair
07/22/02	8830	62	26	4.9	3.7	Good-Fair
07/21/97	7332	71	23	5.5	4.4	Good-Fair
07/07/92	5880	---	26	---	4.7	Good-Fair

Taxonomic Analysis

EPT richness in Boylston Creek fell by 4 taxa in 2007. However, an abbreviated EPT collection was employed because of time constraints. Abundant taxa collected were moderately intolerant (the mayfly *Isonychia* sp. and the caddisfly *Triaenodes ignitus*) to tolerant (the mayfly *Maccaffertium modestum* and the hydropsychid caddisfly *Cheumatopsyche* sp.). Intolerant taxa were low in abundance and included the mayflies *Heptagenia marginalis*, *Serratella deficiens*, and *Stenacron pallidum*; the stonefly *Acroneuria abnormis* and the caddisflies *Brachycentrus nigrosoma* (1st site collection), G*lossosoma* sp., *Neophylax consimilis* and *Pycnopsyche lepida*.

Data Analysis

The highly developed Boylston Creek catchment primarily drains agricultural fields and urban areas. Despite the abbreviated EPT method, this creek maintains its Good-Fair rating. The highly urban environment is likely responsible for the lower water quality in this stream as no NPDES permitted dischargers exist on this stream. Agricultural irrigation is prevalent in this area possibly allowing many pollutants to enter the stream even during low precipitation years. The lack of good riparian vegetation and erosion also contribute to the Good-Fair rating.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MILLS R	**SR 1337**	**EB167**	**08/15/07**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Henderson	3	06010105	352355	823542	6-54-(1)b	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; Tr, HQW	67	2130	23	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	21.5
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	18
pH (s.u.)	7.2
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	2
Right Riparian Score (5)	4
Total Habitat Score (100)	82

Site Photograph

Substrate boulder, cobble, and gravel; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10294	89	34	4.4	2.8	Good
06/25/02	8833	74	39	4.4	3.1	Good
07/21/97	7330	115	53	3.5	2.4	Excellent
07/08/92	5881	88	51	3.2	2.3	Excellent

Taxonomic Analysis

Fewer EPT taxa were collected in 2007 than in any other year. The decrease in EPT richness was small since 2002 (5 EPT) but dramatc since 1997 (19 EPT). This decrease is due, in part, to the fewer number of mayflies and stoneflies collected in 2007. In fact, stoneflies have decreased in diversity and abundance since monitoring began, dropping from 9 taxa in 1992 to 3 in 2007 with no abundant species. Also, ephemerellid mayflies were almost completely absent, represented only by a single *Serratella serratoides* specimen. None of the 5 species of *Drunella* previously collected occured. Abundant intolerants that were found included *Neoephemera purpurea* , *Maccaffertium pudicum* , *Brachycentrus appalachia* , *Lepidostoma* sp. and *Neophylax oligius* . An increase of tolerant midge taxa occured concurrently with the drop in EPT and were represented by the abundant *Polypedilum aviceps* , *P. flavum* , *Tribelos jucundum* , and *Chironomus* sp.

Data Analysis

This site was sampled a little over a mile downstream of the confluence of the HQW waters of North Fork and South Fork Mills Rivers. Some intensive agriculture surrounds Mills River and may be contributing to the decrease of water quality seen over the past 10 years by contributing silt to the stream. A large fish kill attributed to pesticide runoff occurred in late July in the South Fork Mills River. The benthos was negatively affected (see BAU memo 20070925), particularly the stoneflies. Lingering effects of that toxic event are likely resposible for the decrease in EPT observed in 2007. Furthermore, indicative of worsening water quality is the increase in the biotic index which changed most dramatically between 1997 and 2002 when the bioclassification fell from Excellent to Good.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MILLS R	**SR 1353**	**EB168**	**08/15/07**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Henderson	3	06010105	352316	823246	6-54-(5)	Broad Basins

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III	73	2066	11	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	0	0	100	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Henderson WTP	NC0042277	0.18

Water Quality Parameters

Temperature (°C)	24.9
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	22
pH (s.u.)	8.2
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	11
Pool Variety (10)	6
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	67

Site Photograph

Substrate sand, gravel, and cobble; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10328	72	33	4.5	3.1	Good
06/24/02	8831	58	28	5.5	4.0	Good-Fair
07/01/98	7773	19	2	6.7	6.0	Poor
07/21/97	7329	78	24	5.2	3.3	Good-Fair
07/08/92	5882	81	24	4.2	3.1	Good

Taxonomic Analysis

The addition of 5 caddisfly taxa was responsible for the increase in EPT richness to 33 from the 2002 level of 28. Five intolerant taxa were abundant in 2007 (4 caddisflies, *Brachycentrus appalachia* , *B. nigrosoma* , *Ceratopsyche sparna* , *Lepidostoma* sp. and one mayfly, *Neoephemera purpurea*) compared to only one intolerant taxon in 2002 (*Brachycentrus nigrosoma*). Only one individual stonefly specimen (*Pteronarcys sp.*) was collected in 2007, the least amount since none were collected in 1998, a year Mills River at SR 1353 received a Poor bioclassification rating. New taxa collected in 2007 were *Drunella allegheniensis* , *Heptagenia marginalis* , and *Oecetis persimilis* .

Data Analysis

Approximately 4 miles downstream of the Mills River sampling site at SR 1337, this site passes through an intensive agricultural area with active pesticide mixing stations. Mills River At SR 1353 has historically had extremely variable water quality with bioclasification ratings ranging from Poor to Good. Silty pools, a result of agricultural activity, were evident as they were in the upstream site. Pesticide runoff (late July 2007, see BAU memo 20070925) far upstream impacted this portion of Mills river less than at SR 1337, most likely due to increased dilution by various minor dischargers and additional tributaries. It appears that water quality has improved since 2002 based on the EPT richness and lower biotic index, although, because of the variable nature of this site, it will require further monitoring.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
N FK MILLS R	**SR 1341**	**06/13/07**	**EF69**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HENDERSON	3	06010105	35.393889	-82.624444	6-54-2-9	Southern Crystalline Ridges & Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II;Tr, HQW	23.1	2185	14	0.4	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	35	15 (rural residential)	50 (row crops)	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.4
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	16
pH (s.u.)	5.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	15
Pool Variety (10)	4
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	5
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	**81**

Site Photograph

Substrate Cobble and boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/13/07	2007-77	21	60	Excellent

Most Abundant Species Mottled Sculpin

Exotic Species Rainbow Trout, Brown Trout, and Redbreast Sunfish

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a large tributary to the Mills River and ultimately the French Broad River, drains northwest Henderson County, including the U.S. Forest Service's Pisgah National Forest; NCWRC Wild Trout Waters and Delayed Harvest Trout Waters in the headwaters; no municipalities in the watershed. **Habitat** -- primarily extensive, swift riffles; infrequent shallow pools; right riparian zone with tomato farms and other row crops (corn), left riparian zone with a residence; open canopy, but banks were stable. **2007** -- very low conductivity; low pH was a verified reading; a diverse and an abundant community, including 8 species of cyprinids and 6 species of darters; site is a popular local fishing stream.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
S FK MILLS R	SR 1340	06/13/07	EF68	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HENDERSON	3	06010105	35.375555	-82.614167	6-54-3-(17.5)	Southern Crystalline Ridges & Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II;Tr, HQW	39.6	2180	11	0.5	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	35	15 (rural residential)	50 (pasture)	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Camp Highlander (~1,000 ft. upstream)	NC0033251	0.0074

Water Quality Parameters

Temperature (°C)	16.1
Dissolved Oxygen (mg/L)	9.3
Specific Conductance (µS/cm)	13
pH (s.u.)	6.3

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	15
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	**87**

Site Photograph

Substrate Cobble and boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/13/07	2007-76	19	56	Good

Most Abundant Species Mottled Sculpin and Saffron Shiner

Exotic Species Brown Trout and Redbreast Sunfish

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a large tributary to the Mills River and ultimately the French Broad River; drains northwest Henderson County, including the U.S. Forest Service's Pisgah National Forest; no municipalities in the watershed; NCWRC Wild Trout Waters in the headwaters. **Habitat** -- very rocky with very swift deep runs, riffles, and chutes; open canopy at the bridge; residences being built within the riparian zones; overall, water was deep and fast considering the area was supposed to be in a drought. **2007** -- very low conductivity; a diverse and abundant community, including 8 species of cyprinids and 5 species of darters; percentage of insectivores slightly skewed (88%) and prevented the community from being rated Excellent; Rainbow Trout represented only by young-of-year; site was sampled six weeks prior to a fish kill caused by pesticide runoff from adjacent agricultural lands (Biological Assessment Unit Memorandum BAU B-20070925).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MUD CR	**US 25**	**EB123**	**08/15/07**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HENDERSON	2	06010105	352315	823015	6-55d	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	110	2040	16	1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Hendersonville WWTP	NC0025534	6.0
Mountain View WWTP	NC0074110	0.005

Water Quality Parameters

Temperature (°C)	22.1
Dissolved Oxygen (mg/L)	6.1
Specific Conductance (µS/cm)	97
pH (s.u.)	6.6
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	7
Left Bank Stability (7)	7
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	65

Site Photograph

Substrate Almost all sand with small amounts of rubble and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10320	67	16	6.33	5.09	Fair
07/13/00	8178	57	10	7.06	5.71	Poor
09/09/97	7464	54	12	6.72	5.71	Fair

Taxonomic Analysis

A slight decrease in the number of Baetid taxa occurred between 1997 and 2000. In 2007, the taxawere collected again along with two new Baetid taxa that had not been previously collected, *Plauditus punctiventris* and *Pseudocloeon propinquum*. In addition to new Baetid taxa, four new caddisfly taxa were also collected, *Brachycentrus nigrosoma*, *Oecetis persimilis*, *Ceratopsyche sparna* and *Triaenodes ignitus*.

Data Analysis

Mud Creek is a tributary to the French Broad River and drains the city of Hendersonville and its metropolitan area. There are two major dischargers in the watershed above this monitoring site. This site was rated Fair in 1997, Poor in 2002, and Fair in 2007. Between year changes, however, were small and there was no evidence of any significant decline in water quality.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CLEAR CR	SR 1513	EB73	08/13/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HENDERSON	2	06010105	352113	822640	6-55-11-(5)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	42	2080	8	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	25	0	75	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Greystone Subdivision	NC0068799	0.02
Pine Park Retirement Inn	NC0069370	0.03

Water Quality Parameters

Temperature (°C)	23.5
Dissolved Oxygen (mg/L)	6.8
Specific Conductance (µS/cm)	64
pH (s.u.)	6.6
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	10
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	3
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	72

Site Photograph

Substrate Mostly sand with some boulder, rubble, and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/07	10314	---	23	---	4.89	Good-Fair
07/12/00	8169	56	14	5.96	5.30	Fair
07/08/97	7319	---	8	---	5.11	Poor
07/07/92	5878	---	9	---	5.29	Poor

Taxonomic Analysis

Taxa observed in 2007 sampling indicated an increase in mayfly and caddisfly taxa. Taxa that were common or abundant that had not been previously collected include the mayflies, *Baetis pluto* , *Heterocloeon anoka* , *Pseudocloeon propinquum* and *Serratella deficiens* ; and the stonefly, *Leuctra* .

Data Analysis

Clear Creek's watershed contains numerous apple orchards and tomato farms. Improper pesticide use was thought to be associated with water quality conditions of the creek and was intensively sampled in 2000 and 2001 as part of the Mud Creek WARP study. Data from sites that bracketed orchards suggested that orchard runoff was responsible for the change in the invertebrate communities. Since 2000, EPT taxa richness has increased indicating a slight improvement in water quality.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CANE CR	**SR 1006**	**EB66**	**08/13/07**	**Poor**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HENDERSON	2	06010105	352523	822958	6-57-(9)a	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	80	2060	10	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	0	0	80 (driving range)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	25.6
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	63
pH (s.u.)	7.4
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	78

Site Photograph

Substrate Mostly rubble and gravel with small amounts of boulder and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/07	10315	---	7	---	4.90	Poor
08/28/03	9297	---	15	---	5.06	Fair
07/11/02	8871	---	11	---	4.28	Fair
07/08/97	7320	---	26	---	4.23	Good-Fair
07/07/92	5879	---	27	---	4.35	Good-Fair

Taxonomic Analysis

EPT taxa richness has declined since 1992. Mayfly taxa richness decreased from 17 taxa in 1992 to 14 taxa in 1997 to 6 taxa in 2002. In 2003, mayfly taxa richness had rebounded to 12 taxa but decreased again to 4 taxa in 2007. Stoneflies have disappeared from this site. No stoneflies were collected in 2003 or 2007 and only one taxon was collected in 2002; whereas, in previous years three (1997) or four (1992) taxa had been collected. Caddisfly taxa richness decreased from 6 taxa in 1992 to 3 taxa in 2007.

Data Analysis

Cane Creek, a tributary to the French Broad River, drains northern Henderson and southeast Buncombe counties. Although there an no dischargers directly uspstream of this site, there are six NPDES facilities in the watershed. In addition, this site is located in a broad valley with agricultural and commercial land uses. Since 1992, the water quality has been declining. The site rated Good-Fair in 1997 and 1997, dropped to Fair in 2002 and 2003, and continued to drop in 2007 to Poor. This portion of the state experienced drought conditions in 2002 and in 2007 and could have contributed to the decline.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
AVERY CR	off SR 3498	06/12/07	EF66	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	35.456389	-82.568333	6-60	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
B	8.1	2080	5	0.3	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	85	5 (rural residential)	10	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.8
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	38
pH (s.u.)	5.9
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	15
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**83**

Site Photograph

Substrate Sand, gravel, and cobble.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/12/07	2007-73	23	40	Good-Fair

Most Abundant Species Warpaint Shiner and River Chub

Exotic Species Flat Bullhead, Redbreast Sunfish, Green Sunfish, and Swamp Darter

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a small tributary to the French Broad River, drains the extreme south central portion of Buncombe County; rural/suburbia; stream is impounded ~ 1.6 miles upstream by Dubose Dam; site is ~ 1.0 mile above the creek's confluence with the river. **Habitat** -- shallow and short runs and riffles; woody debris and undercut snags; some silt; stable banks and forested riparian zones. **2007** -- conductivity generally low; a very diverse community for a stream of its size, including 9 species of cyprinids and 7 species of darters, but no Rock Bass, Smallmouth Bass or trout were present; White Sucker represented by only young-of-year; fewer fish were collected than expected; the percentage of tolerant fish (Creek Chub, Flat Bullhead, Redbreast Sunfish, and Green Sunfish) was high; only one intolerant species was present.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BENT CR	**off NC 191**	**06/12/07**	**EF67**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	35.5006616	-82.5994464	6-67-(7)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
B	10.7	2090	9	0.3	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.2
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	21
pH (s.u.)	6.5

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**88**

Site Photograph

Substrate Cobble, boulder, and gravel.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/12/07	2007-74	22	56	Good

Most Abundant Species Mottled Sculpin

Exotic Species Flat Bullhead and Redbreast Sunfish

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a small tributary to the French Broad River; drains southwestern Buncombe County, including the U.S. Forest Service's 9.4 square mile Bent Creek Experimental Forest; no municipalities in the watershed; NCWRC Hatchery Supported Trout Waters and Wild Trout Waters in the headwaters; site is within the UNC Arboretum property and is ~ 0.5 miles above the creek's confluence with the river. **Habitat** -- short, shallow riffles and runs; woody debris and snags; high quality instream and riparian habitats; one silty pool at the end of the reach. **2007** -- conductivity low; an abundant and diverse fish community for a stream of its size, including 5 species of darter and 4 species of suckers; however, the number of cyprinid species was slightly lower than expected and the percentage of tolerant fish (Creek Chub, White Sucker, Flat Bullhead, and Redbreast Sunfish) was slightly elevated.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HOMINY CR	**SR 1123**	**EB327**	**08/17/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	353204	824212	6-76b	southern crystaline ridges and mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	29.9	2131	6	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	30	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.3
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	106
pH (s.u.)	7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	11
Pool Variety (10)	8
Riffle Habitat (16)	16
Left Bank Stability (7)	3
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	80

Site Photograph

Substrate Mostly gravel and cobble

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/07	10326	81	31	5.0	4.0	Good-Fair
05/14/02	8735	71	36	4.3	3.9	Good
09/10/97	7468	71	32	5.1	4.1	Good-Fair
07/09/92	5901	28	28	3.3	3.3	Good

Taxonomic Analysis

Intolerant or "sensitive" taxa present at this study location included the mayflies *Neoephemera purpurea* and *Serratella deficiens;* the stoneflies *Acroneuria abnormis* , *Paragnetina immarginata* , and *Pteronarcys biloba;* and the caddisflies *Brachycentrus spinae* , and *Nyctiophylax celta* .

Data Analysis

The study location previously at NC 151 was moved to SR 1123 in 2007. This location has received a bioclassification of either Good-Fair or Good in each of the four years of sampling. These similar ratings suggest relatively consistent water quality over the span of 15 years bracketed by sampling dates. This apparent stability is encouraging considering that much of the upsteam land use is either agricultural operations or residential and that the sediment load at this location is often quite high after rain events as was documented in the 2003 report for this basin. These sediments are problematic because they ultimately settle from the water column and blanket streambed substrates.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
HOMINY CR	**NC 151**	**06/12/07**	**EF26**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	35.53555556	-82.69444444	6-76b	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	30.2	2095	7	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	60 (rual commercial)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	8.7
Specific Conductance (µS/cm)	91
pH (s.u.)	6.7

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	**75**

Site Photograph

Substrate Cobble, gravel, and sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/12/07	2007-71	15	46	Good-Fair
09/24/02	2002-84	16	40	Good-Fair
09/17/97	97-80	16	50	Good

Most Abundant Species Saffron Shiner and Mottled Sculpin

Exotic Species Redear Sunfish

Species Change Since Last Cycle

Gains -- Longnose Dace and Redear Sunfish. **Losses** -- Mountain Brook Lamprey, Brown Trout, and Redbreast Sunfish.

Data Analysis

Watershed -- a tributary to the French Broad River; drains southwestern Buncombe and a small part of eastern Haywood counties, 4 small dischargers upstream with a combined flow of 0.0714 MGD; site is ~ 500 ft. above its confluence with South Hominy Creek. **Habitat** -- riffles, chutes, and shallow plunge pools; silts in the pools; household debris in the channel; right riparian zone narrow with commercial land use. **2007** -- conductivity was elevated; an extremely abundant community, almost four times as many fish were collected in 2007 than in 2002 (n = 1,062 vs. 266), diversity metrics lower than expected; only 1 intolerant species present; between 2002 and 2007 the percentage of tolerant fish declined from 13% to 1% and the percentage of species with multiple age classes increased from 56% to 80%. **1997 - 200**7 -- conductivity has ranged form 78 to 98 µS/cm; habitat scores have ranged from 69 to 75; 18 species are known from the site, but only 2 species of darters; dominant species have been the Saffron Shiner and the Mottled Sculpin; 2002 was a drought year and in the intervening years were the 2004 hurricane-induced flash floods; community has recovered from the 2004 floods.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HOMINY CR	**SR 3412**	**EB105**	**08/16/07**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010202	353242	823806	6-76d	southern crystaline ridges and mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	91.1	2070	10	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	20	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	25.9
Dissolved Oxygen (mg/L)	8
Specific Conductance (µS/cm)	93
pH (s.u.)	7.3
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	6
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	60

Site Photograph

Substrate Mostly gravel and cobble

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10325	72	21	5.9	4.3	Fair
05/16/02	8744	65	21	5.6	5.0	Fair
09/09/97	7465	63	13	6.5	5.2	Fair
07/10/97	7328	13	13	4.1	4.1	Fair
07/09/92	5904	8	8	3.9	3.8	Poor

Taxonomic Analysis

The benthic macroinvertebrate community was dominated by species tolerant of water quality stressors. However, there were some sensitive taxa present including mayfly, stonefly, and caddisfly taxa (EPT taxa). Specifically, the mayfly *Stenacron pallidum* ; the stoneflies *Pteronarcys proteus* , *P. dorsata* , and *Paragnetina immarginata* ; and the caddisflies *Ceratopsyche morosa* . None of these taxa have previously been collected from this location. The number of EPT taxa have steadily increased during the 15 years of sampling SR 3412.

Data Analysis

This sampling location was given a bioclassification of Poor in 1992, and improved to Fair in 1997-2007. The low quality habitat at this site continues to be an issue; with limited colonizable substrates, a streambed composed primarily of silt, extensive bank erosion, and scarce riffle habitats. In addition, the specific conductance at this site is considered high for the ecoregion, suggesting that poor water quality is also affecting the benthic community. The combined effects physical and chemical stressors may dictate a slow improvement of this location after the closing of the BASF Corporation Plant in Enka (NC0000299) which was until recently discharging just above SR 3412.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
S HOMINY CR	**NC 151/SR 3449**	**06/12/07**	**EF50**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	35.53555556	-82.6925	6-76-5b	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	38.3	2095	14	0.4	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	85	15 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	33
pH (s.u.)	6.2

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	9
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**90**

Site Photograph

Substrate Cobble, gravel, sand, and boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/12/07	2007-72	20	56	Good
11/30/04	2004-140	14	38	Fair
09/23/02	2002-81	19	50	Good
04/09/97	97-16	16	48	Good

Most Abundant Species Mottled Sculpin and Saffron Shiner

Exotic Species Rainbow Trout and Brown Trout

Species Change Since Last Cycle

Gains -- Tennessee Shiner, Black Redhorse, Golden Redhorse, and Rainbow Trout. **Losses** -- Redbreast Sunfish. Gains and losses compared 2007 to 2002; not 2004.

Data Analysis

Watershed -- tributary to Hominy Creek; drains southwest Buncombe County; no municipalities in the rural watershed; site is ~1,000 ft. above the creek's confluence. **Habitat** -- high quality instream habitats; swift riffles, runs, and chutes; *Podostemum* in the riffles; deep boulder pools; open canopy, but that is a function of stream width; areas healed over from the 2004 hurricane-induced flash floods **2007** -- conductivity low; all species gained were collected for the first time ever in 2007; number of intolerant species increased by one and the percentage of tolerant decreased from 6% to 1.5% between 2002 and 2007; the fish community has recovered from the 2004 flash floods. **1997 - 2007** -- conductivity has ranged from 25 to 35 µS/cm; habitat scores have ranged from 70 to 90; 24 species are known from the site, including 10 species of cyprinids, but only two species of darters; dominant species are the Mottled Sculpin, Saffron Shiner, and River Chub; NCIBI score has gradually improved from 48 to 50 to 56, the basinwide ratings have been consistently Good; sampled in 2004 as part of the post hurricane biological monitoring special study (BAU Memorandum F-20050404).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
S HOMINY CR	**NC 151**	**EB135**	**08/17/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	353204	824132	6-76-5	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	39	2115	14	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	0	30	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.6
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	40
pH (s.u.)	6.9
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	72

Site Photograph

Substrate Mostly boulder and rubble with small amounts of gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/07	10327	96	37	4.77	3.00	Good
08/28/02	8991	---	26	---	2.73	Good-Fair
09/10/97	7467	38	8	6.35	5.32	Poor
07/09/92	5902	---	20	---	3.25	Good-Fair

Taxonomic Analysis

Caddisfly taxa richness has increased three fold since 1992. Three taxa were collected in 1992 and 1997; 12 taxa were collected in 2002; and 14 taxa were collected in 2007. Taxa collected in 2007 that had not been previously collected include *Brachycercus* , *Drunella allegheniensis* , *Heterocloeon anoka* , *Neureclipsis* , *Oecetis persimilis* , *Rhyacophila fuscula* and *Ceratopsyche morosa* .

Data Analysis

South Hominy Creek is a tributary to Hominy Creek and this site is located above the confluence with Hominy Creek. The water quality rating has fluctuated since 1992. In 1992, this site rated Good-Fair but dropped to Poor in 1997 due to an unknown toxic impact. It went back to Good-Fair in 2002 and rose to Good in 2007. With the exception of 2002, EPT taxa richness has increased suggesting that water quality is gradually improving.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SWANNANOA R	**SR 2416**	**EB142**	**08/16/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	353629	822641	6-78c	southern crystaline ridges and mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	80.7	2115	16	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	20	60	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.4
Dissolved Oxygen (mg/L)	6.9
Specific Conductance (µS/cm)	73
pH (s.u.)	6.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	7
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	74

Site Photograph

Substrate Mixture of gravel, cobble, and boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10323	87	25	5.9	5.1	Good-Fair
08/28/03	9298	73	25	5.4	4.0	Good-Fair
08/27/02	8982	75	24	5.9	4.6	Fair
10/07/87	4433	60	22	5.2	4.3	Fair

Taxonomic Analysis

There were several "sensitive" or pollution intolerant taxa collected at this study location; including the mayflies *Isonychia* sp. and *Serratella deficiens;* the stonefly *Acroneuria abnormis;* and the caddisflies *Ceratopsyche sparna* and *C. morosa.* The number of EPT taxa has increased slightly during the 20 years of sampling, but midges continue to be the dominant group. The mayflies *Pseudocloeon propinquum* , *Plauditus dubius* group, *Acentrella turbida* and the caddisfly *Triaenodes ignitus* were added to this site's taxa list in 2007.

Data Analysis

The bioclassification of this study site improved from Fair in 1987 and 2002 to Good-Fair in both 2003 and 2007. Overall the habitat was relatively good, but the riparian zones had frequent breaks and riffle habitats were infrequent and small. There aren't any major dischargers upstream or minor dischargers within 1 mile of the study site. Because upstream land use is mostly agricultural and residential, non-point source pollution is likely the largest contributor to water quality degredation at SR 2416. However, the exceptional drought of 2007 should have miminized the impact of these stressors. Therefore, it is unclear why the bioclassification of this location is not greater than Good-Fair.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SWANNANOA R	**US 25**	**EB145**	**08/15/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	353406	823242	6-78d	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	124	1980	14	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	0	100	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	26
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	83
pH (s.u.)	8.1
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	8
Pool Variety (10)	8
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	73

Site Photograph

Substrate Good mix of boulder, rubble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10322	82	30	5.63	4.18	Good-Fair
08/28/02	8990	73	26	5.80	4.71	Good-Fair
07/09/97	7322	62	28	5.44	4.26	Good-Fair
07/08/92	5884	72	27	5.74	4.44	Good-Fair
07/27/89	5017	60	15	6.29	4.48	Fair

Taxonomic Analysis

No major changes in the benthic community were observed. Abundant taxa included *Acentrella* , *Pseudocloeon propinquum* , *Maccaffertium mediopunctatum* , *Stenacron pallidum* , *Cheumatopsyche* , *Hydropsyche venularis* , *Micrasema wataga* , *Ceratopsyche sparna* , *Ancyronyx variegatus* , *Macronychus glabratus* , *Enallagma* , *Cricotopus vieriensis* group, *Polypedilum flavum* , *P. illinoense* group, *Phaenopsectra flavipes* , *Rheocricotopus robacki* , *Rheotanytarsus* , *Tanytarsus sp U* , *Simulium* , *Crangonyx* , *Corbicula fluminea* , *Helisoma anceps* and *Hydracarina* .

Data Analysis

The Swannanoa River, a tributary to the French Broad River, drains southeastern and eastern Buncombe County. This site, located in urban Asheville, has rated Good-Fair since 1992. Based on benthic data no major changes in water qualtiy have been observed.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEWFOUND CR	**SR 1622**	**EB129**	**08/14/07**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	353928	823847	6-84d	southern crystaline ridges and mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	25.4	1957	4	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	20	50	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.8
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	133
pH (s.u.)	7.8
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	8
Pool Variety (10)	8
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	71

Site Photograph

Substrate Mostly gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10319	75	11	6.6	4.9	Fair
07/12/02	8873	70	23	6.2	5.0	Fair
05/18/99	7849	98	38	5.4	4.3	Good-Fair
07/09/97	7326	20	20	5.0	5.0	Good-Fair
07/27/89	5018	17	17	5.1	5.1	Fair

Taxonomic Analysis

Of the 11 EPT taxa (mayflies, stoneflies, and caddisflies) collected in 2007, all but the stonefly *Paragnetina immarginata* (which was rare) and *Ceratopsyche sparna* are considered tolerant of poor water quality. The overall number of EPT taxa has declined considerably during the 18 years of sampling and the current sample had less than half the EPT taxa that were collected in 2002.

Data Analysis

Newfound Creek SR 1622 has historically been heavily affected by nutrient loading and sedimentation from dairy farming. Despite past remediation efforts, the currently measured specific conductivity of 133 suggests that there are still pollution issues. In addition to water quality issues, the stream is negatively affected by marginal habitats. After improving to Good-Fair in 1997 and 1999, the bioclassification has dropped to Fair in both 2002 and 2007. Lastly, the habitat and water quality stressors described above may have been compounded by the exceptional drought occuring in 2007.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
NEWFOUND CR	**SR 1641**	**06/11/07**	**EF37**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	35.66611111	-82.63416667	6-84e	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	34.2	1900	7	0.3	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	95	5 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.7
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	108
pH (s.u.)	7.4

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	**79**

Site Photograph

Substrate Cobble, gravel, sand, and boulder.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/11/07	2007-70	19	48	Good
06/17/02	2002-69	14	48	Good
04/09/97	97-17	10	28	Poor

Most Abundant Species Central Stoneroller

Exotic Species Flat Bullhead and Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Tennessee Shiner, White Sucker, Black Redhorse, Fantail Darter, and Banded Darter. **Losses** -- none.

Data Analysis

Watershed -- tributary to the French Broad River; drains agricultural western Buncombe County; site is ~ 1.1 miles above the creek's confluence with the river. **Habitat** -- short, shallow riffles; gravel runs; vegetated banks; open canopy in places; shallow pools with *Elodea;* channel filled with sediment; became very turbid when walking downstream, but cleared up quickly. **2007** -- conductivity elevated; an abundant and diverse community, but only 2 intolerant species were present; percentage of omnivores+herbivores (Central Stoneroller, River Chub, and White Sucker) was slightly elevated and increased between 2002 and 2007; percentage of tolerant fish (Creek Chub, White Sucker, Flat Bullhead, and Redbreast Sunfish) was much greater than expected; large specimens of suckers present. **1997 - 2007** -- conductivity has ranged from 83 to 113 µS/cm; habitat scores have ranged from 61 to 79; 19 species are known from the site, including 4 species of darters; species diversity has steadily increased from 10 to 14 to 19 as has the diversity of darters from 0 to 2 to 4; dominant species has been the Central Stoneroller.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
REEMS CR	**NC 251**	**EB131**	**08/14/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	354140	823647	6-87-(10)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	37	1790	5	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.7
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	104
pH (s.u.)	7.7
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	14
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	89

Site Photograph

Substrate Mostly boulder and rubble with some gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10318	---	23	---	3.74	Good-Fair
07/10/02	8865	---	27	---	3.69	Good-Fair
07/09/97	7324	---	30	---	3.33	Good
07/23/92	5936	---	20	---	3.37	Good-Fair

Taxonomic Analysis

Gains in the number of mayfly species since 1992 have been offset by a decline in the abundance of stoneflies. Overall EPT taxa richness was down slightly in 2007 from previous years and may be due to drought conditions this portion of the state was experiencing at the time of sampling. Abundant taxa included *Baetis flavistriga* , *B. intercalaris* , *Heptagenia marginalis* , *Maccaffertium ithaca* , *Acroneuria abnormis* , *Paragnetina immarginata* , *Leucotrichia pictipes* and *Ceratopsyche sparna* .

Data Analysis

Reems Creek drains the northwestern portion of Buncombe County including the town of Weaverville. There is no evidence of a long term change in water quality. This site has rated Good-Fair since 1992 with the anomalous exception of the Good rating it received in 1997.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SANDYMUSH CR	**SR 1114**	**EB137**	**08/14/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MADISON	2	06010105	354405	824144	6-92-(9)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	47	1860	10	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	95	5 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	21
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	110
pH (s.u.)	7.5
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph

Substrate Good mix of boulder, rubble, gravel, and sand with some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10316	---	22	---	3.98	Good-Fair
07/10/02	8868	---	32	---	3.51	Good
07/10/97	7327	---	30	---	4.03	Good
07/22/92	5933	---	36	---	4.32	Excellent

Taxonomic Analysis

EPT taxa richness has decreased since 1992. Taxa not collected in 2007 that were previously common or abundant include the mayflies, *Pseudocloeon propinquum*, *Brachycercus*, *Epeorus rubidus*, *Heptagenia marginalis* and *Maccaffertium modestum*; the stoneflies *Leuctra* and *Perlesta*, and the caddisfly *Ceratopsyche bronta*.

Data Analysis

Sandymush Creek drains the extreme northwest corner of Buncombe County and a small portion of southwest Madison County before entering the French Broad River. Based on decreased EPT taxa richness, water quality appears to be declining. The site rated Excellent in 1992, dropped to Good in 1997 and 2002 and further dropped in 2007 to Good-Fair. This stream was one of many that experienced extreme flooding in September 2004 when the remnants of three hurricanes passed over western North Carolina.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TURKEY CR	**SR 1629**	**06/11/07**	**EF59**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BUNCOMBE	2	06010105	35.70472222	-82.66888889	6-92-13	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	27.4	1885	8	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	95	0	5 (successional field)	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.5
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	97
pH (s.u.)	7.3

Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	7
Riffle Habitat (16)	12
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	**80**

Site Photograph

Substrate Cobble, boulder, and sand.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/11/07	2007-69	16	52	Good
06/17/02	2002-68	14	48	Good

Most Abundant Species Bigeye Chub and Central Stoneroller **Exotic Species** Redbreast Sunfish

Species Change Since Last Cycle **Gains** -- River Chub, Longnose Dace, and Black Redhorse. **Losses** -- Green Sunfish.

Data Analysis

Watershed -- tributary to Sandymush Creek; no municipalities in the rural, agricultural watershed; site is now part of the NCWRC's Sandymush Gamelands. **Habitat** -- riffles with *Podostemum,* shallow pools with *Elodea;* side boulder pools; good riparian zones with stable banks, especially at the end of the reach; water easily silted, sediment from upstream sources; cattle no longer with access to the stream as in 2002. **2007** -- conductivity elevated; turbid even though drought conditions prevailed; an abundant and diverse community, but the diversity of darters and the number of intolerant species was lower than expected; percentage of tolerant fish (Creek Chub, White Sucker, and Redbreast Sunfish) slightly elevated, large specimens of suckers, Rock Bass, and Smallmouth Bass were present. **2002 & 2007** -- conductivity elevated; has been ~ 90 µS/cm; habitat scores have been 67 and 80; 17 species known from the site, but only two species of darters; dominant species has been the Bigeye Chub; slight increase in the NCIBI score due to the collection of two additional species of cyprinids (River Chub and Longnose Dace); turbidity may be a chronic watershed problem.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Ivy Cr	**SR 2150**	**EB200**	**08/06/07**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	354728	823219	6-96-(0.5)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW	60.6	1,972	13	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	50	10	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	32.4
Dissolved Oxygen (mg/L)	6.8
Specific Conductance (µS/cm)	40
pH (s.u.)	8.3
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	7
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	75

Site Photograph

Substrate Rubble, boulder, gravel, sand, silt, and bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/07	10295	38	38	4.41	4.41	Excellent
07/09/02	8768	32	32	4.10	4.10	Good
07/07/97	7335	27	27	2.80	2.70	Good-Fair
07/22/92	5931	38	38	3.40	3.40	Excellent

Taxonomic Analysis

This site has exhibited large bioclassification oscillations ranging from Excellent to Good-Fair. The 2007 sample matched the previous high EPT species richness mark of 38 that was first set in 1992. EPT taxa collected for the first time in 2007 included the mayfly *Plauditus cestus* , *Acroneuria arenosa* , *Pteronarcys comstocki* , and *P. proteus* , and the caddisflies *Micrasema wataga* , *Neophylax oligius* , *Oecetis persimilis (edge taxon)* , *Pycnopsyche* sp.(edge taxon), and *Triaenodes ignitus (edge taxon). T* he presence of these edge taxa suggest that lower water levels due to the drought do not seem to be adversely affecting habitat at this location.

Data Analysis

The Ivy Creek watershed upstream of this location is a mix of forest, residential, and agricultural uses and as a result non-point pollution is likely the greatest potential stressor here. As would be expected in watersheds where non-point pollution is prevalent and where significant NPDES point sources are largely absent, reduced run-off due to drought conditions typically results in improved community metrics. The improvement seen in 2002 (mild drought) and 2007 (severe drought) from the 1997 sample support this conclusion. Indeed, in 1997 the average discharge of Ivy Creek near Marshall (approximately 8 miles downstream of this location) was 156.8 cubic feet per second (cfs) and was 184 cfs and 172.6 cfs in 1996 and 1995 respectively. While in 2002, 2001, and 2000 the annual discharge was 100.5 cfs, 97.3 cfs, and 112.2 cfs respectively. Annual discharge data for 2007 data are not yet available.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Ivy Cr	**US 25-70 Bus**	**EB201**	**08/06/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	354629	823843	6-96-(11.7)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	160.7	1,750	20	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	10	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	30.9
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	87.3
pH (s.u.)	7.2
Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	7
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	80

Site Photograph

Substrate Boulder, rubble, sand, gravel, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/07	10296	85	32	4.76	3.30	Good
06/26/02	8839	80	30	4.90	3.70	Good-Fair
07/07/97	7337	59	28	4.72	3.54	Good-Fair
09/02/93	6406	33	33	3.31	3.31	Good
07/22/92	5930	87	36	4.67	3.63	Good

Taxonomic Analysis

Consecutive samples in 1997 and 2002 were the two lowest rated collections at this location. However, community metrics observed in 2007 are much more comparable to those seen from samples in 1993 and 1992 and represents marked improvements from 1997 and 2002. EPT taxa collected for the first time in 2007 include the mayflies *Heterocloeon curiosum*, the stonefly *Pteronarcys dorsata*, and the caddisflies *Ceratopsyche bifida and Brachycentrus numerosus.* These taxa combined to narrowly produce the lowest EPTBI ever measured here.

Data Analysis

The Ivy Creek watershed upstream of this road crossing is comprised of a mix of agriculture, forest, and suburban uses. As would be expected in a catchment where non-point pollution is the major stressor, reduced runoff due to the record 2007 drought has resulted is slightly improved community metrics relative to 2002 and 1997.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
LITTLE IVY CR	SR 1547	06/18/07	EF71	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MADISON	4	06010105	35.8085416	-82.5187343	6-96-10a	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II;HQW	42.1	2065	9	0.4	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	65	5 (rural residential)	30	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	24.6
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	151
pH (s.u.)	8.4

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	**73**

Site Photograph

Substrate boulder, slick bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/18/07	2007-84	14	52	Good

Most Abundant Species Whitetail Shiner

Exotic Species Rainbow Trout

Species Change Since Last Cycle N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a tributary to Ivy Creek and ultimately the French Broad River; located almost 3 miles above its confluence with Ivy Creek; drains the eastern corner of Madison County. Hatchery Supported Trout Waters. **Habitat** -- primarily riffle-runs, with slick bedrock and *Podostemum*; the elevated conductivity and periphyton covered substrates are consistent with the non-point agricultural influences within this catchment. **2007** -- an abundant (n = 608) and moderately diverse fish community was collected, but with no tolerant species, and only one darter species (Fantail Darter); the fish fauna were dominated by intermediately tolerant species including Whitetail Shiner (31%), Northern Hogsucker (23%), and Central Stoneroller (22%); several fish species were also represented by young-of-year specimens, a measure of good reproductive function; White Sucker and Swannanoa Darter were only represented by young-of-year, bringing the total species count to 16. Notwithstanding the predominant agricultural land use, this watershed is maintaining good water quality.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L Ivy Cr	**SR 1610**	**EB205**	**08/06/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	354732	823219	6-96-10b	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW	46.5	1,974	7	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	30	30	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	32.1
Dissolved Oxygen (mg/L)	7
Specific Conductance (µS/cm)	130
pH (s.u.)	8.3
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	10
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	74

Site Photograph

Substrate Bedrock, rubble, boulder, gravel, snad, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/07	10258	26	26	4.34	4.34	Good-Fair
05/29/02	8755	78	27	6.10	4.60	Good-Fair
07/07/97	7334	16	16	3.90	3.90	Fair
07/22/92	5932	35	35	3.90	3.90	Good

Taxonomic Analysis

EPT taxa richness in 1997 was the lowest measured at this site and was likely related to increased non-point pollution run-off as USGS annual average discharge data from nearby Ivy Creek (near Marshall) indicate that 1997, 1996, and 1995 were fairly wet. Conversely, the 2002 and 2007 samples were taken during droughts, and the reduced run-off was likely the reason for the rebound in the EPT taxa richness metric. EPT taxa collected in 2002 and or 2007 but not found in 1997, included the mayflies *Leucrocuta* sp., *Acroneuria abnormis* , *Pteronarcys* sp., , and the caddisflies *Neophylax mitchelli* , *Nyctiophylax celta* , *Oecetis persimilis* , and *Triaenodes ignitus* .

Data Analysis

The watershed upstream of this segment is a mix of agriculture, residential, and forest use with no NPDES dischargers. As would be expected in a watershed characterized by non-point pollution inputs, the drought years of 2007 and 2002 decreased runoff and therefore pollution inputs. This was reflected in the invertebrate community as EPT richness during the drought years of 2002 and 2007 were improved over the EPT richness measured in the wetter year of 1997. Although there are no permitted NPDES dischargers in the catchment, the conductivity was quite high in both 2002 and 2007 (131 µS/cm and 130 µS/cm respectively) which may suggest straight piping. Indeed, the 130 µS/cm was the second highest conductivity measured in this subbasin in 2007. Moreover, the pH was extremely high in 2002 (8.9) and 2007 (8.3) which suggest that excessive nutrient inputs are fueling high photosynthetic rates.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BULL CR	**SR 1574**	**06/19/07**	**EF13**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MADISON	4	06010105	35.80722222	-82.60916667	6-96-16	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	20.7	1900	7	0.3	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	20 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.7
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	103
pH (s.u.)	6.3

Water Clarity	Very slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	15
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**86**

Site Photograph

Substrate cobble, boulder, gravel, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/19/07	2007-85	15	44	Good-Fair
06/19/02	2002-74	14	40	Good-Fair

Most Abundant Species Central Stoneroller

Exotic Species Redbreast Sunfish and Rainbow Trout

Species Change Since Last Cycle **Gains** -- Rainbow Trout and Western Blacknose Dace. **Losses** -- White Sucker.

Data Analysis

Watershed -- a tributary to Ivy Creek located about one mile above its confluence; drains part of central Madison County, west of Mars Hill. **Habitat** -- boulder runs, short riffles, chutes, and a few shallow pools; conductivity was high and the stream became very turbid when disturbed during sampling. **2007** -- an extremely abundant fish community (n = 1870) with moderate species richness; the Central Stoneroller (an herbivore that thrives in nutrient-rich mountain watersheds) comprised 56% of the total collection. **2002 - 2007** -- consistent NCIBI metric scores and ratings in two consecutive samples; this rural watershed continues to be influenced by non-point nutrient and sediment loading from agricultural practices.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BIG PINE CR	**off SR 1151**	**06/19/07**	**EF73**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MADISON	4	06010105	35.8384563	-82.7724754	6-108	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	15.8	1700	7	0.3	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	20 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	21.5
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	58
pH (s.u.)	6.7

Water Clarity	Very slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	**83**

Site Photograph

Substrate cobble, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/19/07	2007-87	9	---	Not Rated

Most Abundant Species River Chub

Exotic Species Brown Trout

Species Change Since Last Cycle N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a tributary to the French Broad River located about one and a half miles above its confluence; drains part of west-central Madison County. Although largely forested, much of the stream runs parallel with the road corridor and is vegetated with the exotic Japanese knotweed (*Polygonum cuspidatum*); many residential lawns and gardens also exist along the stream. **Habitat** -- high gradient mountain stream with chutes, riffles, runs, and a few good pools; several sunlit areas (road and stream-side residences) and a moderately elevated conductivity are contributing to the slick periphyton found on the rocky substrates. **2007** -- a highly abundant (n = 1749) yet low diversity fish community was collected; River Chubs and herbivorous Central Stonerollers (n = 592 or 34%, and n = 515 or 29%, respectively) comprised more than half of the fish collected. Several species were anticipated but absent including Mountain Brook Lamprey, Greenfin Darter, Swannanoa Darter, Mottled Sculpin, and Rainbow Trout. Based on NCIBI metric scores at this site, the rating would be Poor; since the fish community in this mountain watershed has been substantially altered by loca

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Big Laurel Cr	**SR 1503**	**EB184**	**09/18/06**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	355436	823238	6-112	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	5	2,677	4	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	40	10	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	18.7
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	45
pH (s.u.)	6.1
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph

Substrate Rubble, gravel, sand, silt, and boulder.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/18/06	10088	---	44	---	2.72	Excellent
07/08/02	8843	---	45	---	2.30	Excellent
07/08/97	7341	---	33	---	2.30	Good

Taxonomic Analysis

EPT taxa richness has remained essentially unchanged between the 2002 and 2006 sampling events. Intolerant taxa common or abundant from both the 2002 and 2006 collections include the mayflies *Epeorus rubidus* , *Ephemera* sp., the stoneflies *Acroneuria abnormis* , *Paragnetina immarginata* , *Tallaperla* sp., and the caddisflies *Dolophilodes* sp., *Glossosoma* sp., and *Rhyacophila fuscula* . The slight increase in EPTBI measured from the 2006 sample was the result of a corresponding increase in abundances of several facultative taxa such as the mayflies *Baetis pluto* , *Plauditus dubius* , *Maccaffertium modestum* , *Maccaffertium pudicum* and the caddisflies *Cheumatopsyche* sp., and *Ceratopsyche bronta* .

Data Analysis

Since the initial 1997 Good bioclassification, this site has improved to Excellent although the EPTBI did increase slightly in 2007 relative to the earlier samples. However, the 2007 sample also produced the highest EPT abundance (204) relative to the 2002 sample (196) and the 1997 sample (147). In general, the improvement seen in 2002 from the 1997 sample has been maintained through 2006 and indicates that water quality in this catchment remains stable. Indeed, conductivity values were nearly identical from 2002 (47µS/cm) and 2006 (45 µS/cm)

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Big Laurel Cr	**NC 208**	**EB181**	**09/21/06**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	355522	824505	6-112	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	67.5	1,640	20	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10-Residential

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	14.6
Dissolved Oxygen (mg/L)	9.49
Specific Conductance (µS/cm)	78
pH (s.u.)	7
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	3
Riffle Habitat (16)	12
Left Bank Stability (7)	7
Right Bank Stability (7)	6
Light Penetration (10)	6
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	69

Site Photograph

Substrate Rubble, sand, gravel, boulder and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/21/06	10074	---	47	---	3.37	Excellent
05/30/02	8767	90	46	4.60	3.50	Good
07/08/97	7340	---	36	---	2.70	Excellent
08/19/92	6004	---	38	---	3.00	Excellent

Taxonomic Analysis

Since 1997, overall EPT diversity has increased at this station. However, the 2002 Full-Scale sample produced the highest EPTBI recorded and was the result of first-time occurrence of several facultative mayfly taxa: *Plauditus dubius* , *Centrotilum* sp., *Pseudocloeon frondale* , and *Hexagenia* sp. The occurrence of these taxa contributed to the lowered bioclassification observed in 2002. These aforementioned taxa were not collected in 2006 and as a result the EPTBI lowered.

Data Analysis

Although the 2002 sample received a Good bioclassification, it was on the borderline of receiving an Excellent bioclassification. While the EPTBI has increased since 1997, there has also been an increase in EPT abundance as it was 149 in 1992, 131 in 1997, 200 in 2002, and 262 in 2006. Overall, water quality at this location has remained generally stable since sampling commenced in 1992.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Puncheon Fk	**SR 1503**	**EB217**	**08/01/07**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	355435	823239	6-112-5	Southern Crystaline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	7.3	2,998	5	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	20	30	10 (Commercial)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	23.3
Dissolved Oxygen (mg/L)	7.2
Specific Conductance (µS/cm)	41.4
pH (s.u.)	6.4
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	14
Pool Variety (10)	4
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	74

Site Photograph

Substrate Boulder, rubble, gravel, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/01/07	10265	40	40	2.48	2.48	Excellent
07/08/02	8770	40	40	2.80	2.80	Excellent
07/08/97	7342	31	31	2.20	2.20	Good

Taxonomic Analysis

This site has shown improved community metrics since the first sample in 1997. EPT taxa present in 2002 and 2007 but absent in 1997 included the mayflies *Acentrella* sp., *Serratella carolina* , the stonefly *Malirekus hastatus* , and the caddisflies *Lepidostoma* sp., *Polycentropus* sp., and *Pycnopsyche* sp. Moreover, there were several EPT taxa collected here for the first time and included the mayflies *Diphetor hageni, Ephemerella subvaria* , and the caddisflies *Diplectrona modesta, Leucotrichia pictipes, Lype diversa, Neophylax consimilis, and Neophylax mitchelli* .

Data Analysis

Since 1997, the EPT taxa richness and EPT abundance have been trending higher. In fact, the 2007 sample had the highest EPT abundance (252) yet measured here and has increased steadily from 174 in 1997 and 219 in 2002. In addition to these three samples, a 2006 sample was taken about 1.5 miles upstream off SR 1502 as part of a High Quality Waters/Outstanding Resource Waters reclassification study which was requested prior to the installation of a large subdivision and WWTP which will discharge to Puncheon Fork. This sample also resulted in an Excellent bioclassification. These data currently suggest favorable water quality at this location.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Shelton Laurel Cr	**NC 208**	**EB219**	**09/19/06**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	355607	824435	6-112-26	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	54.8	1,712	10	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	0	0	20-Residential

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Madison Co., Boe/Laurel Elementary School	NC0034207001	0.005

Water Quality Parameters

Temperature (°C)	17.9
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	49
pH (s.u.)	5.9
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	15
Pool Variety (10)	5
Riffle Habitat (16)	14
Left Bank Stability (7)	5
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	3
Total Habitat Score (100)	78

Site Photograph

Substrate Rubble, boulder, gravel, sand, bedrock, with a trace of silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/19/06	10101	---	44	---	3.40	Excellent
06/27/02	8841	---	32	---	3.60	Good
07/08/97	7339	---	31	---	3.10	Good
08/19/92	6003	---	32	---	2.90	Good
05/16/90	5267	---	44	---	2.50	Excellent

Taxonomic Analysis

The 2006 sample resulted in several EPT taxa collected at this location for the first time and included the mayfly *Maccaffertium pudicum* , the stoneflies *Eccoptura xanthenes* , *Paragnetina immarginata* , *Pteronarcys proteus* , and the caddislifes *Leucotrichia pictipes* , and *Paranyctiophylax moestus* . The addition of the long-lived and intolerant stoneflies *Paragnetina immarginata* and *Pteronarcys proteus* are particularly significant and suggest improved conditions at this location in 2006. In addition, the 2006 sample resulted in the most EPT specimens (203) ever collected here and represents a substantial increase from earlier samples: 142 in 1990, 144 in 1992, 163 in 1997, and 150 in 2002.

Data Analysis

Although the EPTBI had been steadily increasing from the initial 1990 Excellent sample, this trend was reversed in 2006 as the EPTBI decreased slightly from the 2002 sample. In addition, the combination of the highest EPT abundance yet measured at this location, the highest EPT diversity measured sine 1990, and the first time presence of two long-lived and intolerant stoneflies suggest improved water quality along this reach of SHelton Laurel Creek. Although not conclusive, the limited conductivity data available here are supportive of this assertion as the conductivity was lower in 2006 (49 µS/cm) versus the 2002 measurement (56 µS/cm).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Spring Cr	**SR 1172**	**EB222**	**11/01/06**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Madison	4	06010105	354800	825110	6-118-(1)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	30.8	2,437	6	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	0	30	20-road

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	10.6
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	63
pH (s.u.)	7.4
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	2
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	2
Riffle Habitat (16)	16
Left Bank Stability (7)	2
Right Bank Stability (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	57

Site Photograph

Substrate Rubble, boulder, gravel, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
11/01/06	10119	---	41	---	3.06	Excellent
06/27/02	8842	---	37	---	3.30	Excellent
07/08/97	7338	---	31	---	3.00	Good
08/19/92	6002	---	26	---	2.70	Good-Fair

Taxonomic Analysis

This site at SR 1172 is well upstream of the historic basinsite at NC 209. Although it is further upstream, and the sample was collected outside of the normal summer window, there were several non-seasonal intolerant EPT taxa collected from Spring Creek for the first time and included the mayflies *Baetisca carolina* and *Rhithrogena uhari*, the stoneflies *Agnetina capitata* and *Tallapera* sp, and the caddisflies *Diplectrona modesta*, and *Rhyacophila carolina*.

Data Analysis

Based on the 2002 sample collected further downstream at NC 209, the 2006 sample obtained at SR 1172 provides further evidnece that water quality continues to improve throughout the Spring Creek watershed over levels measured in the early 1990's when biomonitoring initiated. Since 1992, EPT taxa richness and EPT abundnace have generally been on the increase. Sampling at the historic basinsite at NC 209 will resume in 2012.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MEADOW FK	**NC 209**	**06/19/07**	**EF72**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MADISON	4	06010105	35.8309149	-82.8620598	6-118-19	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	22.7	1900	7	0.4	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	98	2 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.8
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	41
pH (s.u.)	6.2

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	9
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**99**

Site Photograph

Substrate cobble, boulder, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/19/07	2007-86	11	48	Good

Most Abundant Species Longnose Dace

Exotic Species Rainbow Trout and Brown Trout

Species Change Since Last Cycle N/A

Data Analysis

This is the first fish community sample collected here. **Watershed** -- a forested tributary to Spring Creek and ultimately the French Broad River; this site location is just above the Spring Creek confluence; drains the westernmost tip of Madison County, including some Pisgah National Forest lands; Hatchery Supported Trout Waters. **Habitat** -- very high quality instream habitats including high gradient riffles and runs, and fast plunge pools; the stream is braided in several sections of the 600' sample reach and has extensive forested riparian zones; this site earned the highest habitat score among all sites sampled in the basin in 2007. **2007** -- an abundant (n = 421) assemblage of cool and cold water fish species was collected; the fish community had low to moderate species richness (typical for high gradient mountain streams) and included 2 reproducing species of trout; there appears to be no water quality issues in this high gradient mountain watershed.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Pigeon R	**I-40 at Brown's Bridge**	**EB250**	**08/08/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Cocke Co., Tenn.	5	6010106	354707	830647	5-(7)f	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	535	2,048	40	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	22.6
Dissolved Oxygen (mg/L)	N/A
Specific Conductance (µS/cm)	220
pH (s.u.)	6.4
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	5
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	70

Site Photograph

Substrate Boulder, rubble, gravel, and sand with a trace of bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10302	84	34	4.90	3.70	Good
07/23/02	8885	76	38	5.00	3.92	Good
07/24/97	7365	81	40	4.77	3.13	Good
08/03/94	6632	58	27	4.37	3.61	Good
07/25/90	5400	57	22	4.67	3.78	Good-Fair

Taxonomic Analysis

Including the 2007 sample, this location has been sampled on 12 occasions with five samples resulting in Good bioclassifications, six Good-Fair ratings, and one Fair bioclassification in 1985. This site showed an improvement in bioclassification starting with the 1994 sample and this trend has continued (particularly as it pertains to the EPT community). Indeed, since the improvement noted in 1994, numerous EPT taxa have been present each year since 1994 and include the mayflies *Baetis intercalaris* , *Maccaffertium ithaca* , *M. modestum* , the stoneflies *Acroneuria abnormis* , *Leuctra* sp., *Paragnetina immarginata* , and the caddisflies *Cheumatopsyche* sp., *Hydropsyche venularis* , *Lepidostoma* sp., *Polycentropus* sp., *Ceratopsyche*

Data Analysis

With the exception of the 1985 sample, this site has always been either Good-Fair or Good and has been consistently been Good since 1994. Although there are large diurnal swings in discharge in this segment of the Pigeon River below Lake Waterville, it does not appear that this is an overwhelmingly negative influence on the invertebrate community as a whole. However, there may be some issues with low dissolved oxygen levels as the low dissolved oxygen indicating gastropod *Physella* sp has been common in the last three collections (previously *Physella* sp had only been collected once and was rare between 1989, 1990, and 1994).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
W Fk Pigeon R	**SR 1216**	**EB273**	**08/08/07**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	352346	825617	0	Southern Crystaline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; Tr	28	2,998	15	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (SR 1216)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	22.3
Dissolved Oxygen (mg/L)	10.9
Specific Conductance (µS/cm)	6
pH (s.u.)	6.3
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	17
Bottom Substrate (15)	15
Pool Variety (10)	5
Riffle Habitat (16)	15
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	82

Site Photograph

Substrate Rubble, boulder, gravel, sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10306	---	46	---	1.93	Excellent
11/29/04	9528	69	42	2.50	2.00	Good
07/25/02	8896	---	37	---	2.40	Excellent
07/22/97	7358	---	50	---	1.50	Excellent
01/12/93	6044	81	47	2.50	1.70	Excellent

Taxonomic Analysis

The upstream portion of the West Fork Pigeon River watershed is completely protected with only very minimal impacts from SR 1216 present. As would be expected from an undisturbed catchment such as this, all but one sample taken here has been Excellent. Several of the same pollution intolerant EPT taxa have been present at this station from every summer sample and include the mayflies *Acentrella* sp., *Drunella cornutella* , and *Rhithrogena exilis* , the stoneflies *Acroneuria abnormis* , *Leuctra* sp. and *Pteronarcys proteus* , and the caddisflies *Ceratopsyche alhedra* , *Dolophilodes* sp., *Glossosoma* sp., *Lepidostoma* sp., *Pycnopsyche* sp., and *Ceratopsyche sparna* .

Data Analysis

With the exception of the post Hurricane Ivan, Francis, and Jeanne sampling conducted in 2004, every sample taken at this location using NCDWQ collection methodology (six samples since 1990) has resulted in an Excellent bioclassification. With the exception of the 2004 post Hurricane sampling, and the 2002 sample (which was conducted during a torrential downpour) EPT community metrics have been remarkably consistent at this location over time and reflects the highly protected nature of the West Fork Pigeon River catchment.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Richland Cr	**Business, US 23**	**EB262**	**08/07/07**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	352752	830040	5-16-(11.5)b	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr	11	2,759	5	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	10	90	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	27.9
Dissolved Oxygen (mg/L)	6.6
Specific Conductance (µS/cm)	24.5
pH (s.u.)	6.8
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	14
Bottom Substrate (15)	14
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	2
Right Riparian Score (5)	1
Total Habitat Score (100)	73

Site Photograph

Substrate Rubble, gravel, sand, and boulder.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/07/07	10297	---	27	---	2.85	Good-Fair
07/29/02	8894	---	31	---	2.90	Good
07/25/97	7370	---	23	---	2.70	Good-Fair
08/18/92	5997	---	17	---	3.50	Fair

Taxonomic Analysis

Although the 2007 sample declined in bioclassification from the 2002 (Good) sample, the 2007 collection was just one EPT short of receiving a Good rating and the EPTBI was essentially identical between years. These data suggest that there has been no significant change in water quality at this location since 2002. In terms of EPT species richness, the 2007 and 2002 sample were both superior to the 1997 and 1992 samples. Intolerant EPT taxa collected either in 2002 and or 2007 but absent from the 1992 and 1997 samples include the mayflies *Drunella cornutella* , *Epeorus dispar* , *Habrophlebiodes* sp., *Stenacron pallidum* , the stoneflies *Isoperla holochlora* , *Malirekus hastatus* , *Pteronarcys* sp., and *Suwallia* sp., and the caddisflies *Brachycentrus spinae* , *Dolophilodes* sp.,

Data Analysis

The large increase in EPT species richness noted in 2002 and 2007 (relative to the 1992 and 1997 samples) is likely related to the decreased nonpoint runoff which is prevalent in this watershed as both of these samples were taken during droughts. The large increase in EPT taxa richness from the 1992 and 1997 samples noted in 2002 and 2007 was mostly concentrated in stonefly diversity. In 1992 and 1997 only one taxon of stonefly was collected. In 2002 four stonefly taxa were collected and in 2007 three taxa were present. In general, stoneflies are widely considered the most intolerant of all the aquatic insect orders and combined with the other improved metrics these data continue to suggest improved conditions in this segment of Richland Creek.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
RICHLAND CR	**Boyd Ave**	**06/15/07**	**EF44**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HAYWOOD	5	06010106	35.48916667	-82.99916667	5-16-(11.5)a	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
B;Tr	42.9	2665	12	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	25	75 (residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.6
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	50
pH (s.u.)	6.9

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	**83**

Site Photograph

Substrate Cobble and boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/15/07	2007-82	7	---	Not Rated
07/17/01	2001-78	11	28	Poor

Most Abundant Species Longnose Dace

Exotic Species Rainbow Trout, Brown Trout, and Green Sunfish

Species Change Since Last Cycle

Gains -- Western Blacknose Dace. **Losses** -- Whitetail Shiner, White Sucker, Brown Bullhead, Redbreast Sunfish, and Black Crappie.

Data Analysis

Watershed -- a tributary to the Pigeon River; drains southwestern Haywood County, including the upper portion of the City of Waynesville and the US 23/74 corridor. **Habitat** -- fast, shallow riffles and runs; undercuts and snags; very clean substrate; open canopy near the bridge, then shaded; residences within the riparian zones. **2007** -- conductivity slightly elevated; more than twice as many fish were collected in 2007 than in 2001 (n = 410 vs. 200); only seven species were present, no darters, lampreys, or sculpins were present; excellent wild Rainbow Trout and Brown Trout populations; Rainbow Trout (n = 90) were 125-250 mm TL and Brown Trout (n = 11) were 150-270 mm TL; fish community is Not Rated because the community has characteristics of a trout stream which it did not have in 2001. **2001 & 2007** -- 12 species are known from the site, but no darters, sculpins, or lampreys; percentage of tolerant fish decreased from 13.5% in 2001 to 0.5% in 2007; dominant species have been the Northern Hogsucker and Longnose Dace; although Not Rated; community has greatly improved since 2001; sampled in 2001 as part of the Richland Creek Use Attainability Reclassification study (BAU Memorandum F-2001020906).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Richland Cr	**SR 1184**	**EB260**	**08/07/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	353031	825819	0	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	47.7	2,586	10	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	N/A
Dissolved Oxygen (mg/L)	N/A
Specific Conductance (µS/cm)	N/A
pH (s.u.)	7.2
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	14
Pool Variety (10)	3
Riffle Habitat (16)	15
Left Bank Stability (7)	6
Right Bank Stability (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	77

Site Photograph

Substrate Rubble, gravel,sand, and boulder.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/07/07	10299	---	29	---	3.41	Good
07/24/02	8891	---	19	---	4.30	Good-Fair
07/24/97	7373	---	24	---	3.20	Good-Fair
08/18/92	5998	---	26	---	3.30	Good-Fair
08/10/88	4692	42	11	6.20	5.30	Fair

Taxonomic Analysis

In addition to the six samples noted above, this location has also been sampled twice earlier (1985 and 1983) with both of these samples producing Poor bioclassifications. This segment of Richland Creek has been improving in bioclassification since 1983 and the 2007 sample set record high EPT species richness and abundance values. Notably intolerant EPT collected for the first time at this location included the mayflies *Serratella carolina* , *S. deficiens* , the stonefly *Malirekus hastatus* , and the caddisflies *Diplectrona modesta* , *Dolophilodes* sp., *Lepidostoma* sp., *Leucotrichia pictipes* , *Oecetis* sp., and *Triaenodes ignitus* .

Data Analysis

The continued trend of improving EPT community metrics and bioclassification at this location since 1983 is primarily the result of the removal of the two upstream dischargers (Lee and Dayco) in 1998. Moreover, recent work (2006 and 2007) undertaken by Regional Office staff have resulted in the identification and subsequent repair of numerous sewer leaks and overflows upstream of this location (on Richland Creek proper as well as on several tributaries including Hyatt Creek and Shelton Branch). The record high EPT richness and EPT abundance measured in 2007 is likely related to a subsequent reduction in these inputs as well as a reduction in overall nonpoint runoff from Waynesville.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
RICHLAND CR	**SR 1184**	**06/15/07**	**EF47**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HAYWOOD	5	06010106	35.50833333	-82.97194444	5-16-(11.5)c	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
B;Tr	48	2590	9	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	5 (residential)	0	25 (industrial)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.5
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	56
pH (s.u.)	6.2

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	4
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	**85**

Site Photograph

Substrate Cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/15/07	2007-81	12	36	Fair
07/17/01	2001-77	9	28	Poor

Most Abundant Species Central Stoneroller

Exotic Species Rainbow Trout, Brown Trout, Redbreast Sunfish, and Green Sunfish

Species Change Since Last Cycle **Gains** -- Longnose Dace, Western Blacknose Dace, Smallmouth Bass, and Largemouth Bass. **Losses** -- Bluegill.

Data Analysis

Watershed -- a tributary to the Pigeon River; drains southwestern Haywood County, including the Waynesville metropolitan area; Hatchery Supported Trout Waters; site is ~ 1.3 miles above Lake Junaluska. **Habitat** -- riffles, chutes, and runs; deep pool in middle of the reach; residence along the right bank. **2007** -- conductivity slightly elevated; more than 15 times as many fish were collected in 2007 than in 2001 (n = 603 vs. 41); increases especially noted in the number of Central Stoneroller, Longnose Dace, and Northern Hogsucker; only 12 species were collected; percentage of tolerant fish (Redbreast Sunfish and Green Sunfish) was high, but decreased from 46% in 2001 to 11% in 2007; percentage of omnivores+herbivores was also high; wild Rainbow Trout and Brown Trout present, some stocked trout collected, including one Brook Trout 323 mm TL. **2001 & 2007** -- 13 species known from the site, but no darters, sculpins, or lampreys; although community was rated Fair in 2007, there was a dramatic improvement since 2001 in the abundance and diversity metrics; dominant species is the Central Stoneroller; sampled in 2001 as part of the Richland Creek Use Attainability Reclassification study (BAU Memorandum F-2001020906).

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
RICHLAND CR	**Walnut Trail Rd**	**06/14/07**	**EF48**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HAYWOOD	5	06010106	35.53777778	-82.95638889	5-16-(16)a	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	64.7	2510	13	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	55	15 (rural residential)	25	5 (NC 209)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.7
Dissolved Oxygen (mg/L)	6.4
Specific Conductance (µS/cm)	60
pH (s.u.)	5.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	12
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	**79**

Site Photograph

Substrate Cobble, boulder, and gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/14/07	2007-80	10	40	Good-Fair
09/24/02	2002-83	12	32	Poor
10/22/97	97-91	12	38	Fair

Most Abundant Species Central Stoneroller **Exotic Species** Redbreast Sunfish

Species Change Since Last Cycle **Gains** -- Tuckasegee Darter. **Losses** -- Brown Bullhead and Green Sunfish.

Data Analysis

Watershed -- a tributary to the Pigeon River; drains southwestern Haywood County, including the City of Waynesville metropolitan area; site is ~ 1.5 miles above the creek's confluence and ~ 1 mile below Lake Junaluska. **Habitat** -- riffles, chutes, and runs with a variety of pool sizes; exposed gravel bars. **2007** -- water clear and warmer than expected, conductivity slightly elevated, dissolved oxygen saturation at 74%; twice as many fish were collected in 2007 than in 2002 (n = 224 vs. 116), but the diversity metrics and abundance were still lower than expected for a stream of this size; only 10 species present, including just 2 species of cyprinids; percentage of tolerant fish (Redbreast Sunfish) decreased from 44% to 4% between 2002 and 2007; percentage of species with multiple age classes increased form 64% to 80%; first time a species of darter has been collected; large specimens of Northern Hogsucker and Rock Bass. **1997 - 2007** -- total habitat scores have ranged from 73 to 79; conductivity has ranged from 60 to 81 µS/cm; 15 species are known from the site, including 6 species of sunfish and 4 species of cyprinids, but no sculpins or lampreys; dominant species have been the Central Stoneroller and Northern Hogsucker.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Richland Cr	**SR 1519**	**EB261**	**08/07/07**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	353252	825645	0	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	67.7	2,493	9	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	30	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	N/A
Dissolved Oxygen (mg/L)	N/A
Specific Conductance (µS/cm)	N/A
pH (s.u.)	6.6
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	76

Site Photograph

Substrate Rubble, sand, gravel, boulder and bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/07/07	10300	---	16	---	4.46	Fair
07/25/02	8893	45	20	5.40	4.40	Good-Fair
07/25/97	7372	---	15	---	4.40	Fair
08/18/92	5999	---	14	---	4.40	Fair

Taxonomic Analysis

With the exception of the 2002 collection, this site has always maintained a Fair bioclassification. The 2007 sample lacked, for the first time ever, the flow dependent Heptageniid mayflies *Maccaffertium ithaca* , and *M. modestum* as well as the edge-dependent caddisflies *Triaenodes ignitus* and *Nectopsyche exquisita* . The lack of these taxa are likely related to the 2007 drought and corresponding decreased discharge from Lake Junaluska which would both reduce flow as well as available edge habitat.

Data Analysis

This site is approximately 2.3 miles below Lake Junaluska. It is possible that the severe 2007 drought has resulted in reduced discharge from the lake. This hypothesis is supported by the absence (for the first time) of all Heptagennid mayflies and by a lack of several edge-dependent taxa. While the next closest upstream site (approximately 3.2 miles) on Richland Creek (SR 1184) improved drastically in 2007 due to reduced non-point pollution input, these effects were likely attenuated by the effects of the lake. Indeed, relative to the SR 1184 site, this location has always had much lower EPT diversity and is likely related to physical and chemical effects of Lake Junaluska.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Johnathans Cr	**SR 1306**	**EB239**	**08/07/07**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	353107	830607	0	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; Tr, CA	13.8	2,974	6	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	30	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	N/A
Dissolved Oxygen (mg/L)	N/A
Specific Conductance (µS/cm)	N/A
pH (s.u.)	N/A
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	0
Right Riparian Score (5)	3
Total Habitat Score (100)	73

Site Photograph

Substrate Boulder, rubble, gravel, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/07/07	10301	---	38	---	1.73	Excellent
07/24/02	8890	---	37	---	1.50	Excellent
07/24/97	7368	---	46	---	1.60	Excellent
08/18/92	5996	---	41	---	2.00	Excellent

Taxonomic Analysis

Although some of the watershed upstream of this location includes residential and commercial impacts, the majority of this catchment is still forested. As such, the EPT community here has largely been stable through time. However, the 2002 and 2007 samples both lacked several caddisfly taxa that had been collected here in 1992 and 1997. These taxa were *Goera* sp., *Neophylax mitchelli* , *Rhyacophila nigrita* , and *Ceratopsyche slossonae* . It is unclear why these highly pollution intolerant taxa were absent in 2002 and 2007 but present in 1992 and 1997.

Data Analysis

With the exception of the four aforementioned intolerant caddisfly taxa absent in 2007 and 2002 but collected in 1997 and 1992, the EPTBI (and EPT taxa richness) has been largely stable at this location. However, the EPT abundance has continued a slightly downward trend with 193, 272, 150, and 191 EPT specimens being tallied from the 1992, 1997, 2002, and 2007 samples respectively. Conductivity was very low (24 µS/cm) from the 2002 sample generally indicating favorable water chemistry here but meters were malfunctioning in 2007 so no measurements were made.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Johnathans Cr	**SR 1322**	**EB240**	**08/08/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	353433	830107	0	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	50.9	2,564	11	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	50	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Maggie Valley WWTP	NC0056561001	1.0

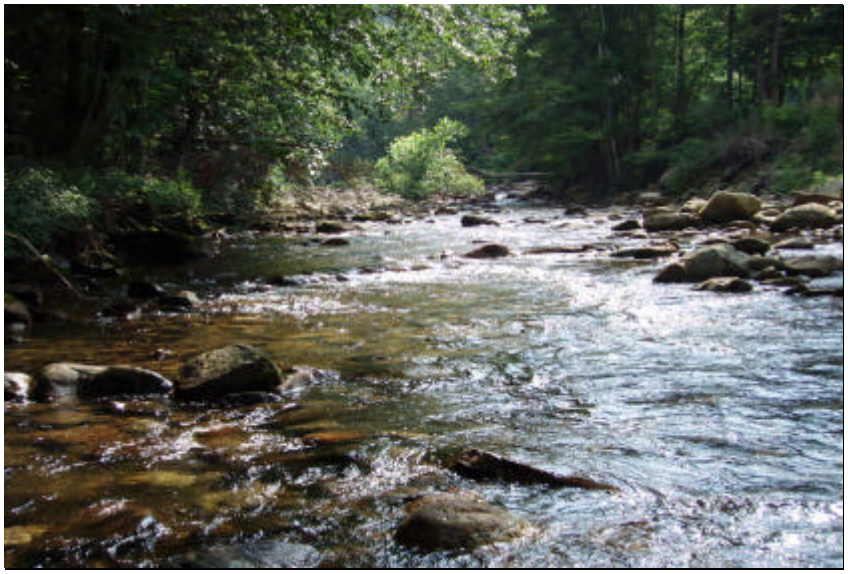
Water Quality Parameters

Temperature (°C)	21.2
Dissolved Oxygen (mg/L)	N/A
Specific Conductance (µS/cm)	N/A
pH (s.u.)	6
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	3
Riffle Habitat (16)	15
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	72

Site Photograph



Substrate Boulder, rubble, gravel, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10305	---	35	---	2.95	Good
07/25/02	8892	---	40	---	3.60	Excellent
07/24/97	7364	---	41	---	2.60	Excellent
08/18/92	5995	---	33	---	3.30	Good

Taxonomic Analysis

There were several EPT taxa that were present from the 1997 and 2002 samples that were absent for the first time in 2007 and included the mayflies *Baetis flavistriga* , *Heptagenia marginalis* , *Isonychia* sp., the stonefly, *Perlesta* sp., and the caddisfly *Pycnopsyche* sp. The decrease in EPT taxa for 2007 may be the result of less dilution of the upstream discharger due to the severe 2007 drought. Although 2002 was also a drought year that event was much less severe than the 2007 drought and may have provided more dilution and thereby explaining the 2002 Excellent rating.

Data Analysis

This site is downstream from Maggie Valley and landuse is a mix of urban, forest and agriculture. This site is also approximately two miles downstream from the Maggie Valley WWTP (NC0056561001; 1.0 MGD). Streams that are downstream of large point dischargers often experience an increase in the instream waste concentration (IWC) during times of drought due to lessened dilution. This was likely the case in 2007 and the drop in EPT taxa measured in 2007 supports this conclusion. Unfortunately, water chemistry meters were not in operation at the time of sampling so a conductivity measurement was not possible. The one previous conductivity measurement made in 2002 (34 µS/cm) was still quite low despite the upstream discharger.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Johnathans Cr	**SR 1349**	**EB241**	**08/08/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	353717	830018	0	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	65.4	2,410	17	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	10	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	21.9
Dissolved Oxygen (mg/L)	N/A
Specific Conductance (µS/cm)	N/A
pH (s.u.)	7.3
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	4
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	3
Total Habitat Score (100)	74

Site Photograph

Substrate Rubble, gravel, sand, boulder, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10304	---	33	---	2.95	Good
09/09/02	8986	---	34	---	3.80	Good
07/24/97	7367	---	39	---	3.10	Excellent
08/18/92	5994	---	23	---	3.70	Good-Fair

Taxonomic Analysis

EPT richness at this location continues a slight downward trend since the only Excellent sample was recorded here in 1997. EPT present in 1997 but absent in the drought years of 2002 and 2007 included the mayflies *Baetis tricaudatus* , *Caenis* sp., *Dannella simplex* , *Drunella conestee* , *Ephemerella catawba* , *Rhithrogena* sp., *Mccaffertium modestum* , *Serratella serratoides* , the stonefly *Perlesta* sp., and the caddisfly *Micrasema wataga* .

Data Analysis

Declines in EPT taxa richness in 2002 and 2007 are likely attributed to the concentration of effluent from the upstream Maggie Valley WWTP discharge. The record high EPT richness noted in 1997 coincided with a year that had more rainfall than either the last two samples and this improvement in the EPT community was likely the result of dilution effects. Water chemistry meters were malfunctioning at the time of sampling so no conductivity measurements were available.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CRABTREE CR	**NC 209**	**06/14/07**	**EF21**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HAYWOOD	5	06010106	35.59805556	-82.93388889	5-22	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	19.1	2520	8	0.3	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	25	0	65 (pasture)	10 (old school)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.1
Dissolved Oxygen (mg/L)	8.7
Specific Conductance (µS/cm)	65
pH (s.u.)	7.6

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	4
Right Bank Stability (7)	4
Light Penetration (10)	5
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	**68**

Site Photograph

Substrate Sand, cobble, boulder, and bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/14/07	2007-79	13	44	Good-Fair
09/24/02	2002-82	11	40	Good-Fair
06/03/97	97-52	8	28	Poor

Most Abundant Species Central Stoneroller

Exotic Species Brown Trout and Redbreast Sunfish

Species Change Since Last Cycle **Gains** -- River Chub, Fathead Minnow, and Western Blacknose Dace. **Losses** -- Largemouth Bass.

Data Analysis

Watershed -- a tributary to the Pigeon River; drains northeastern Haywood County; no municipalities in the rural watershed. **Habitat** -- riffles, chutes, runs, and plunge pools; a fairly open canopy with breaks in the riparian zones; eroded areas, especially at the end of the reach on the left bank; cattle continued to have access to the stream; water very easily silted. **2007** -- conductivity elevated; a very abundant community with a lot of biomass of most species; diversity lower than expected, no species of darters present; dominance by the Central Stoneroller and the very high percentage of omnivores+herbivores were indicative of nutrient enrichment; River Chub collected for the very first time. **1997 - 2007** -- conductivity has ranged from 57 to 75 µS/cm; total habitat scores have ranged from 64 to 68; 14 species are known from the site, but no species of darters, sculpins, or lampreys ever collected at the site; species diversity and NCIBI scores and ratings have steadily increased over time, but nutrients and bank erosion are still chronic problems at the site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Fines Cr	**SR 1355**	**EB231**	**08/08/07**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	354007	825938	0	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	25.6	2,295	7	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	10	10	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	21.8
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	52.8
pH (s.u.)	7.3
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	15
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	87

Site Photograph

Substrate Boulder, rubble, gravel, sand, silt, and bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10303	---	29	---	3.13	Good
07/24/02	8889	---	25	---	3.50	Good-Fair
07/23/97	7362	---	27	---	2.60	Good-Fair
08/17/92	5991	---	19	---	3.70	Good-Fair

Taxonomic Analysis

The 2007 sample produced both the highest EPT species richness and the highest EPT abundance (132) ever measured at this location. Intolerant EPT taxa collected for the first time here included the mayflies *Acentrella* sp., *Baetisca* sp., the stoneflies *Malirekus hastatus* , *Perlesta* sp., and the caddisfly *Lepidostoma* sp.

Data Analysis

The Fines Creek watershed is a mixture of residential, agricultural, and forest uses. As would be expected in a catchment where non-point pollution is the primary pollutant source, reduced pollution runoff due to the 2007 drought is likely the reason for the improvement in metrics and bioclassification seen this year.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
FINES CR	**off SR 1355**	**06/14/07**	**EF76**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HAYWOOD	5	06010106	35.6669444	-82.991111	5-32	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	25.7	2293	12	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.0
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	71
pH (s.u.)	6.8

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	**89**

Site Photograph

Substrate cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/14/07	2007-78	16	40	Good-Fair
09/24/02	2002-85	13	38	Fair
10/22/97	97-93	11	34	Fair

Most Abundant Species Central Stoneroller

Exotic Species Redbreast Sunfish, Swamp Darter, Rainbow Trout, and Brown Trout

Species Change Since Last Cycle

Gains -- Swamp Darter, Smallmouth Bass, Largemouth Bass, Black Redhorse, and Western Blacknose Dace.
Losses -- Whitetail Shiner and Green Sunfish.

Data Analysis

Watershed -- the last tributary to join the Pigeon River above Walters Lake; located about 200 meters above its confluence; drains part of northeast Haywood County; much of the lower valleys in this watershed are used for dairy production, and most tributaries are paralleled by roads; a use attainability study was conducted in 2006, which qualified this watershed for supplemental Tr reclassification (BAU Memo 20060906). **Habitat** -- high gradient mountain stream habitats with plunge pools, abundant riffles, and some large woody debris from storm events. **2007** -- a fairly diverse and abundant (n = 754) fish community was collected, half of which consisted of the herbivorous Central Stonerollers (n = 376); the slight improvement in rating is largely due to additional species and the increase in abundance since the 2002 sample; one introduced Swamp Darter was collected. **1997 - 2007** -- nonpoint agricultural runoff continues to impact the water quality in this catchment. However, species richness and abundance of the fish community has steadily increased over 3 samples.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Cataloochee Cr	**SR 1395**	**EB227**	**08/08/07**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Haywood	5	06010106	354002	830422	0	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr, ORW	49.1	2,499	18	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/A

Water Quality Parameters

Temperature (°C)	N/A
Dissolved Oxygen (mg/L)	N/A
Specific Conductance (µS/cm)	N/A
pH (s.u.)	N/A
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	8
Riffle Habitat (16)	15
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	92

Site Photograph

Substrate Boulder, rubble, gravel, sand, silt, and bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10310	120	59	3.33	2.10	Excellent
07/24/02	8888	---	42	---	1.50	Excellent
07/23/97	7363	102	50	2.70	1.60	Excellent
08/17/92	5992	84	42	2.90	1.80	Excellent
07/11/91	5660	80	48	2.70	2.00	Excellent

Taxonomic Analysis

Including the 2007 sample, this segment of Cataloochee Creek has been sampled on 14 occasions with all collections resulting in Excellent bioclassifications. The 2007 sample resulted in the highest EPT species richness ever measured here with several taxa collected for the first time including the mayfly *Ephemera blanda*, the stoneflies *Helopicus* sp., and *Suwallia* sp., and the caddisflies *Goera calcarata*, and *Oligostomis pardalis*. This entire catchment is contained within Great Smokies National Park. This is reflected in the invertebrate community as many of the same highly intolerant taxa have been collected here during each summer sample and include the mayflies *Drunella conestee*, *D. cornutella*, the stoneflies *Isoperla holochlora*, *Malirekus hastatus*, and *Tallaperla* sp., and the caddisflies *Dolophilodes* sp., *Glossosoma* sp., and *Lepidostoma*

Data Analysis

Although water chemistry meters were not functioning in 2007, previous water chemistry measurements reflect the highly protected nature of this catchment as measurements in 2002 and 1997 were 16µS/cm and 10 µS/cm respectively which are among the lowest conductivities measured in North Carolina. Predictably, this site has among the highest EPT species richness ever recorded by Division of Water Quality Biologists and ranks 6th overall from more than 6,500 samples. In addition, this location also ranks 2nd overall in terms of total EPT abundance with 356 EPT specimens collected.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NOLICHUCKY R	**NC 197 (SR1321)**	**EB289**	**08/14/07**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Mitchell	6	06010108	360429	822041	7	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	593	1960	30	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	20	0	20

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	---
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	106
pH (s.u.)	8.5
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	7
Riffle Habitat (16)	15
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	82

Site Photograph

Substrate cobble, boulder, gravel, and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10247	88	37	4.5	3.5	Good
07/09/02	8846	89	43	4.4	3.6	Good
07/09/97	7345	71	37	4.0	3.6	Good
07/21/92	5926	87	41	4.2	3.4	Good

Taxonomic Analysis

EPT richness in the Nolichucky River fell to 37 as 3 fewer mayfly taxa, 2 caddisfly taxa, and one stonefly taxon were collected than in 2002, which had the highest richness ever recorded for a basinwide sample at this site. The EPT community was dominated by moderately intolerant taxa like *Isonychia* sp, *Tricorythodes* sp., *Neureclipsis* sp. and *Oecetis persimilis*. Abundant intolerant taxa that occurred included *Acroneuria abnormis*, *Paragnetina ichusa*, and *Ceratopsyche morosa*. Previously collected taxa that were not found in 2007 included the intolerant species, *Mystacides sepulchralis*, *Goera* sp., *Glossosama* sp., *Anthopotamus distinctus*, *Leucrocuta* sp. and *Perlesta* sp.

Data Analysis

This river integrates water from the Cane River and the North Toe River (Excellent and Good, respectively) and has no NPDES dischargers. This site has consistantly rated Good for the last 15 years. The biotic index has increased since 1997, suggesting slightly more tolerant benthic community which is supported by an increase in midges and oligochaetes. A relatively high specific conductance indicates dischargers upstream (mostly in the North Toe River) but seems to have little impact on the biota. The water quality, overall, remains good and appears to be relatively stable.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
N TOE R	**SR 1121**	**06/22/07**	**EF36**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
AVERY	6	06010108	36.06583333	-82.00027778	7-2-(0.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-V;Tr	29.5	3262	14	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	30 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	14.0
Dissolved Oxygen (mg/L)	9.3
Specific Conductance (µS/cm)	64
pH (s.u.)	7.0

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	4
Light Penetration (10)	4
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	**82**

Site Photograph

Substrate cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/22/07	2007-93	15	44	Good-Fair
06/23/97	97-61	18	46	Good-Fair

Most Abundant Species Mottled Sculpin

Exotic Species Green Sunfish, Rainbow Trout, and Brown Trout

Species Change Since Last Cycle

Gains -- Green Sunfish. **Losses** -- Mountain Brook Lamprey, Redbreast Sunfish, Western Blacknose Dace, and Brook Trout.

Data Analysis

Watershed -- the headwaters of the North Toe River located in west-central Avery County; the North Toe River eventually joins the Cane River to form the Nolichucky River in Yancey County before flowing into Tennessee; land use in this upper part of the watershed is a mix of forest, agriculture and urban (Newland and part of Sugar Mountain); Hatchery Supported Trout Waters. **Habitat** -- primarily riffles and runs with some boulder pools; the macrophyte *Podostemum* was thriving among the riffle habitats. **2007** -- an extremely abundant (n = 1242), and moderately diverse fish community was collected including several large wild specimens of Brown and Rainbow Trout; Mottled Sculpin represented 35% (n = 435) of the sample population. **1997 - 2007** -- relatively stable NCIBI metrics between sample years; although the rating did not change, the small drop in NCIBI score comes from 3 fewer species in the 2007 sample, including the intolerant Brook Trout. This watershed continues to receive non-point nutrient loading from agricultural practices.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N TOE R	**US 19E**	**EB288**	**08/13/07**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Avery	6	06010108	355852	820058	7-2-(21.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; Tr, CA	74	2800	25	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	40	0	20 (campground)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	22.6
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	58
pH (s.u.)	7.7
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	14
Left Bank Stability (7)	5
Right Bank Stability (7)	6
Light Penetration (10)	4
Left Riparian Score (5)	2
Right Riparian Score (5)	4
Total Habitat Score (100)	74

Site Photograph

Substrate cobble, boulder, and gravel; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/07	10243	95	42	4.1	3.4	Good
07/10/02	8805	89	39	4.9	3.8	Good
07/10/97	7351	72	42	4.0	3.4	Excellent
07/21/92	5923	99	41	4.3	3.2	Good

Taxonomic Analysis

The North Toe River at US 19E has maintained a fairly stable EPT community since 1992. Additionally, the biotic index has dropped after a somewhat significant rise was observed in 2002. This drop can be attributed to a more intolerant EPT community and fewer oligochaete worms collected in 2007. The intolerant EPT community had 3 abundant stonefly taxa (*Acroneuria abnormis*, *Leuctra* sp., and *Paragnetina immarginata*), 2 abundant caddisfly taxa (*Brachycentrus spina*e and *Neophylax oligius*) and one abundant mayfly species (*Epeorus vitreus*). Other taxa included the intolerant but not abundant *Micrasema bennetti*, *M. wataga*, *Pteronarcys* sp., *Tallaperla* sp., *Baetisca* sp., *Brachycercus* sp., and *Serratella serrata.*

Data Analysis

This segment of the North Toe River is well developed along its length with small communities and active agricultural fields. Some small tributaries are undeveloped and drain portions of Pisgah National Forest in Avery County. This site was very silty, a symptom of agriculture and residential development. However, this stream rated Good but was borderline with Excellent. A slightly lower biotic index or 2 more EPT taxa would have given this site an Excellent bioclassification rating. As in 2002, there was a high abundance of diatomeceous growth on the rocks which may indicate nutrient enrichment. No serious habitat problems were noted.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N TOE R	**SR 1162**	**EB286**	**06/21/06**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Mitchell	6	06010108	355545	820655	7-2-(27.7)b	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	145	2473	30	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	75	25	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Uninem Corp - Quartz operation / Uninem Corp - Schoolhouse Quarz facility	NC0000175 / NC000061	3.6 / 2.16
Feldspar Corp. - Spruce Pine Facility / Spruce Pine WWTP	NC0000353 / NC0021423	3.5 / 2.0
K-T Feldspar Corp. - Spruce Pine Facility	NC0000400	3.5

Water Quality Parameters

Temperature (°C)	24.3
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	98
pH (s.u.)	6.9
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	83

Site Photograph

Substrate boulder, cobble, gravel and sand; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/21/06	9965	116	49	4.9	3.7	Good
07/10/02	8806	60	22	5.9	4.2	Fair
07/09/97	7348	70	34	4.7	3.7	Good
07/20/92	5922	78	23	5.2	3.1	Good-Fair

Taxonomic Analysis

EPT richness more than doubled since 2002 to achieve the highest number ever recorded at this site. Stoneflies, completely absent in 2002, have recovered with 7 taxa present of which 2 were abundant (*Acroneuria abnormis* and *Perlesta* sp.). The most caddisfly taxa ever collected were collected in 2006, almost 3 times the number of caddisfly taxa collected in 1997 (the last Good rating). However, abundant midge taxa and many oligochaete taxa kept the biotic index relatively high at 4.9. The number of abundant EPT taxa increased overall, but was evenly split between intolerant and tolerant groups. Never before collected taxa included *Rhyacophila formosa* , *Micrasema wataga* , *Brachycentrus nigrosoma* , *Anthopotamus distinctus* and *Eurylophella aestiva* (23rd state record).

Data Analysis

Data from 2006 was used in lieu of sampling in 2007. Downstream of 5 major NPDES dischargers (four mining facilities and the town of Spruce Pine WWTP), the North Toe River has historically varied in bioclassification ratings. The Fair rating in 2002 occurred after a 1500 gallon petroleum spill which was remediated by the EPA. Since that event, the biota has recovered and surpassed prior levels to receive a Good bioclassification rating for 2007. Petroleum odors were noted during the 2006 sampling.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N TOE R	**SR 1314**	**EB287**	**08/27/07**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Yancey	6	06010108	360018	821146	7-2-(58.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr	322	2278	35	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	20	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none (below N Toe R @ SR1162 dischargers)	---	---

Water Quality Parameters

Temperature (°C)	27.3
Dissolved Oxygen (mg/L)	8.0
Specific Conductance (µS/cm)	101
pH (s.u.)	8.1
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	11
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	6
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	1
Right Riparian Score (5)	3
Total Habitat Score (100)	75

Site Photograph

Substrate bedrock, gravel, and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/27/07	10336	73	35	5.3	4.6	Good
07/09/02	8802	75	36	4.9	3.8	Good
07/09/97	7347	74	40	4.7	4.2	Good
07/21/92	5924	94	42	4.8	4.1	Good

Taxonomic Analysis

EPT richness continues to decline, although at a slow rate. The biota is dominated by semi-intolerant taxa such as *Neureclipsis* sp., *Tricorythodes* sp. and *Isonychia* sp. and by tolerant taxa such as *Baetis intercalaris*, *B. flavistriga*, *Caenis* sp. and *Cheumatopsyche* sp. Only one sensitve taxon, *Ceratopsyche morosa*, was abundant in 2007. Even though a few previously collected taxa were not found (*Eurylophella funeralis*, *Ephoron leukon*, *Serratella deficiens*, *S. serratoides*, *Nyctiophylax celta*, *Setodes* sp. and *Triaenodes ignitus*), some taxa were collected for the first time including the stonefly *Pteronarcys comstocki* (4th state record), *Oecetis nocturna*, *O. morsei*, and *Anthopotamus distinctus*. The stonefly *Perlesta* sp. was also missing, probably because of emergence.

Data Analysis

Over 14 miles downstream of the last major NPDES discharger and 7 miles downstream from the confluence with the South Toe River, this site passes through agricultural and industrial (mining) areas. This site has maintained a Good rating since 1992. However, it appears that the macroinvertebrate community is becoming more tolerant as evidenced by an increasing biotic index. One caveat, however is that EPT richness in 2007 may be affected by seasonal emergence of some insects from the stream as this site was sampled late in August. The appalachian elktoe (*Alasmidonta raveneliana*), a federally endagered mussel, was found near this site in 2002.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BIG CRABTREE CR	**SR 1002**	**06/18/07**	**EF7**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MITCHELL	6	06010108	35.8875	-82.14638889	7-2-48	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; Tr	12.3	2590	9	0.3	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.5
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	32
pH (s.u.)	6.1

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	15
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**92**

Site Photograph

Substrate cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/18/07	2007-83	20	58	Excellent
12/01/04	2004-141	17	58	Excellent
05/04/99	99-30	18	58	Excellent
09/30/98	98-77	17	58	Excellent
06/24/97	97-62	18	58	Excellent

Most Abundant Species Mottled Sculpin

Exotic Species Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Rosyside Dace, Greenside Darter, Black Redhorse, Gilt Darter, and Creek Chub. **Losses** -- White Sucker and Whitetail Shiner.

Data Analysis

Watershed -- a tributary to the North Toe River located about 5.5 miles upstream of its confluence; drains the southernmost tip of Mitchell County and small part of southeastern Yancey County. **Habitat** -- high quality instream habitats including runs with fast chutes, cobble riffles, and boulder pools; low flow; good forested riparian zone widths. **2007** -- an abundant community of fish (n = 474) with good species richness (including 4 intolerant species) and good reproductive function; all species collected were represented by multiple age classes; a 7.5 inch Eastern Hellbender (a NC species of Special Concern and indicative of low siltation) was also collected and released. **1997 - 2007** -- a total of 22 species are known from this watershed including 10 species of minnows, 3 species of suckers, and 4 species of darters. This regional reference site has maintained the same NCIBI score and Excellent rating over a 10 year period and would qualify for HQW or ORW status if petitioned.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BIG CRABTREE CR	**US 19 E**	**EB274**	**08/15/07**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Mitchell	6	06010108	355409	820851	7-2-48	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	17	2600	7	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	18.3
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	42
pH (s.u.)	6.7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	4
Total Habitat Score (100)	86

Site Photograph

Substrate cobble with boulder and gravel, some sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10293	---	37	---	2.9	Excellent
07/11/02	8809	---	37	---	3.0	Excellent
07/10/97	7350	---	40	---	2.2	Excellent

Taxonomic Analysis

EPT diversity in Big Crabtree Creek has remained stable relative to other sampling years. However, abundant intolerants in 2007 decreased by a factor of 2 from previous years. Six taxa in 2002 were abundant while only 3 were abundant in 2007 (the mayfly *Epeorus vitreus* and the stoneflies *Leuctra* sp. and *Tallaperla* sp.). Only one baetid mayflly (*Baetis intercalaris*) was collected in 2007 in contrast to 4 in 2002 and 5 in 1997. Also, 2 species of the caddisfly *Rhyacophila (R. amicus* and *R. fuscula),* present in previous years, were not collected. Collected taxa of note include the mayflies *Paraleptophlebia* sp. and *Serratella serratoides*; the stoneflies *Pteronarcys* sp. and *Paragnetina immarginata*; and the caddisflies *Brachycentrus spinae, Dolophilodes* sp., and *Mystacides sepulchralis*.

Data Analysis

The catchment of Big Crabtree Creek is primarily forested with sparse pockets of residential development throughout and agricultural fields near US 19E. With no dischargers and low potential non-point source runoff (particularly during drought conditions), Big Crabtree Creek has few stressors on the macroinvertebrate community. This conclusion is supported by an Excellent rating for the last 3 basinwide cycles.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
S TOE R	**SR 1167**	**EB294**	**08/13/07**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Yancey	6	06010108	354952	821104	7-2-52-(1)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr, ORW	43	2800	12	0.25

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	30	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

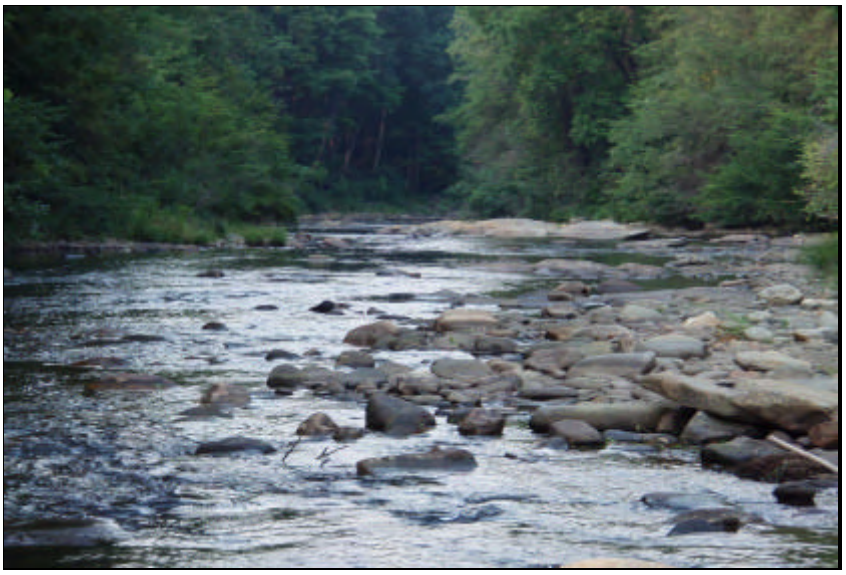
Water Quality Parameters

Temperature (°C)	25.2
Dissolved Oxygen (mg/L)	6.7
Specific Conductance (µS/cm)	21
pH (s.u.)	6.6
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	15
Pool Variety (10)	8
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	82

Site Photograph



Substrate cobble, boulder, and bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/07	10244	110	51	3.8	3.0	Excellent
07/11/02	8810	100	50	3.5	2.6	Excellent
07/10/97	7349	82	40	3.2	2.5	Excellent
07/20/92	5921	102	48	3.6	2.6	Excellent

Taxonomic Analysis

Very little change occurred in EPT richness from 2002 to 2007. Abundant taxa were mostly intolerant taxa such as *Neoephemera purpurea*, *Paragnetina immarginata*, *Leuctra* sp., *Brachycentrus spinae*, *B. appalachia*, *Dolophilodes* sp., and *Mystacides sepulchralis*. The increase in the biotic index can be partially attributed to a higher diverstiy of midges as well as an overall more tolerant EPT community. *Agnetina flavescens*, a perlid stonefly, was collected for only the 27th time in the entire state. Also, a hellbender (*Cryptobranchus alleganiensis*), a species of special concern in NC, was noted (and photographed).

Data Analysis

Classified as Outstanding Resource Waters (ORW), the South Toe River drains a portion of Pisgah National Forest in Southeastern Yancy County. With no NPDES dischargers, the agricultural and residential development that exists along the river corridor in the lower watershed has little to no impact on the stream in low flow years such as 2002 and 2007. At SR 1167, South Toe River has consistantly rated Excellent. Even though the biotic index has increased during the last 2 cycles, suggesting a more tolerant community, it is still well within the excellent range. Of particular note, rootmats were out of the water reducing habitat for some groups of benthic insects although the instream habitat was very good.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CANE CR	**SR 1211**	**06/21/07**	**EF14**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MITCHELL	6	06010108	36.01166667	-82.1475	7-2-59	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	16.3	2512	8	0.3	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	55	10 (rural residential)	30	5 (city park)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	14.7
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	68
pH (s.u.)	6.9

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	12
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	**70**

Site Photograph

Substrate cobble, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/21/07	2007-90	13	36	Fair
06/24/97	97-63	12	34	Fair

Most Abundant Species Bluehead Chub

Exotic Species Redbreast Sunfish, Bluehead Chub, and Brown Trout

Species Change Since Last Cycle **Gains** -- Rock Bass. **Losses** -- none

Data Analysis

Watershed -- a tributary to the North Toe River located about 4 miles above its confluence; drains central Mitchell County, just east of Bakersville; land use in this rural catchment is primarily agricultural; Hatchery Supported Trout Waters. **Habitat** -- cobble riffles, chutes, and one long shallow silty pool; thin but intact riparian zone widths on both sides of the sample reach; cattle have been fenced out of the stream. **2007** -- a moderately diverse, yet extremely abundant fish community (n = 1516) was collected; the non-indigenous Bluehead Chub (n = 636, 42%) and Central Stoneroller (n = 435, 29%) represented the majority; no darters were collected; only one intolerant species (Rock Bass) was collected. **1997 - 2007** -- there are 13 known species from this site including 8 species of minnows, 2 species of sunfish, 2 species of suckers, and 1 trout species. The NCIBI metrics have remained stable between sample cycles. However, this watershed continues to experience non-point runoff from rural agricultural practices, which is consistent with the high percentage of omnivores + herbivores collected in both samples.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BIG ROCK CR	**NC 226**	**06/20/07**	**EF10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MITCHELL	6	06010108	36.05027778	-82.21861111	7-2-64	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	33.3	2375	12	0.4	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	0	30	10

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.2
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	65
pH (s.u.)	6.9

Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	7
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	**87**

Site Photograph

Substrate cobble, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/20/07	2007-89	15	50	Good
09/30/98	98-78	14	50	Good

Most Abundant Species Mottled Sculpin

Exotic Species Brown Trout

Species Change Since Last Cycle **Gains** -- Bluegill and Smallmouth Bass. **Losses** -- Whitetail Shiner and Rainbow Trout.

Data Analysis

Watershed -- a tributary to the North Toe River located just over 5 miles above its confluence; drains a large portion of northern Mitchell County including some Pisgah National Forest lands within the outskirts of the catchment; Hatchery Supported Trout Waters. **Habitat** -- cobble and bedrock shelf riffles, boulder runs, and 1 long fast chute; thin riparian corridors that are flanked by pasture fields; slightly elevated conductivity. **2007** - a fairly diverse and abundant (n = 708) fish community was collected at this regional reference site; one very old Eastern Hellbender (NC Species of Special Concern and indicative of low siltation) measuring 21.5" long was also collected and released. **1998 - 2007** -- very stable NCIBI metric scores over the 9 year span between samples; this watershed is supporting a total of 17 known species including 8 species of minnows, 2 species of suckers, and 2 species of darters. Notwithstanding some non-point nutrient loading from agriculture, there appears to be no obvious water quality issues here.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BIG ROCK CR	**NC 197**	**EB275**	**08/14/07**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Mitchell	6	06010108	360128	821511	7-2-64	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	63	2135	9	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	20	60	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	25.5
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	66
pH (s.u.)	8.6
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	15
Left Bank Stability (7)	7
Right Bank Stability (7)	6
Light Penetration (10)	3
Left Riparian Score (5)	2
Right Riparian Score (5)	1
Total Habitat Score (100)	73

Site Photograph

Substrate sand with equal amounts of boulder, cobble and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10292	---	38	---	3.3	Excellent
07/09/02	8801	---	36	---	3.0	Excellent
07/09/97	7346	---	34	---	2.4	Good
07/21/92	5925	---	43	---	2.7	Excellent

Taxonomic Analysis

After a historically low EPT richness in 1997 (34), Big Rock Creek regained 2 EPT each basinwide cycle. Only 4 intolerant taxa were abundant; two stoneflies, *Acroneuria abnormis* and *Paragnetina immarginata,* as well as 2 caddisflies, *Brachycentrus spinae* and *Ceratopsyche morosa*. Other intolerant taxa were the mayflies *Epeorus vitreus*, *Heterocloeon anoka*, *Neoephemera purpurea* and *Anthopotamus distinctus* (1st collection at this site); and the caddisflies *Micrasema wataga* and *Setodes* sp. The caddisfly *Brachycentrus appalachia*, collected in previous years, was not found in 2007.

Data Analysis

Big Rock Creek drains a portion of Pisgah National Forest and the Pisgah Gamelands. However, the river corridor in the lower watershed is well developed both residentially and agriculturally. Although this stream only rated Good in 1997, two more taxa would have resulted in an Excellent rating. This stream appears to have no water quality issues as evidenced by a stable and diverse macroinvertebrate community.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
PIGEONROOST CR	**SR 1349/NC 197**	**06/20/07**	**EF39**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MITCHELL	6	06010108	36.04583333	-82.29916667	7-2-69	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	14.1	2130	9	0.4	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	93	5 (rural residential)	0	2 (fire station)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.4
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	39
pH (s.u.)	6.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	8
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	**92**

Site Photograph

Substrate cobble, boulder, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/20/07	2007-88	22	56	Good
06/21/02	2002-79	23	58	Excellent
10/20/97	97-87	21	60	Excellent

Most Abundant Species Mottled Sculpin

Exotic Species Redbreast Sunfish and Brown Trout

Species Change Since Last Cycle

Gains -- Redbreast Sunfish, Fatlips Minnow, and Creek Chub. **Losses** -- Rock Bass, Smallmouth Bass, Rainbow Trout, and Brook Trout.

Data Analysis

Watershed -- one of the last tributaries to the North Toe River before the North Toe joins the Cane River to form the Nolichucky River; drains part of the northwest corner of Mitchell County including portions of the Pisgah National Forest. **Habitat** -- high gradient forested mountain stream with abundant riffles, fast chutes, and boulder shelves. **2007** -- a very abundant fish population (n = 1553) with good species richness, including three intolerant species (Telescope Shiner, Greenfin Darter, and Gilt Darter); with the addition of just one more bass or trout species (see Losses), this site would have received its third consecutive rating of Excellent. **1997 - 2007** -- this site is supporting an incredibly abundant fishery of 27 known species including 13 species of minnows, 5 species of Darters, 3 species of trout, 2 species of bass, and 1 species of sucker. With stable NCIBI metrics, two Excellent ratings, and one Good rating, this watershed might qualify for reclassification to HQW or ORW if returns to Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CANE R	**US 19W**	**EB302**	**08/14/07**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Yancey	7	06010108	360000	822126	7-3-(13.7)a	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	145	2100	25	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	80	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	24.7
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	68
pH (s.u.)	8.7
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	74

Site Photograph

Substrate cobble, boulder, and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10246	99	45	4.4	3.5	Excellent
07/09/02	8845	91	46	4.4	3.6	Excellent
07/09/97	7344	84	46	4.4	3.5	Excellent
07/21/92	5927	93	48	4.4	3.5	Excellent

Taxonomic Analysis

The EPT richness, as well as the biotic index, have remained stable over the last four basinwide cycles. Of note is that more intolerant taxa were abundant (10) than moderately intolerant (6) and tolerant taxa (2) combined. Three intolerant caddisfly taxa, *Goera* sp., *Mystacides sepulchralis* , and *Nyctiophylax celta* were not previously collected. Other taxa included the mayflies *Ephoron leukon* , *Anthopotamus distinctus* , *Serratella deficiens* ; the stonefly *Acroneuria abnormis;* and the caddisflies *Micrasema wataga* and *Neureclipsis* sp. *Heterocloeon petersi* , *Perlesta* sp., *Psychomia flavida,* and *Triaenodes perna* , all found in 2002, were not collected in 2007.

Data Analysis

Originating in Pisgah National Forest, the Cane River passes through many small communities and rural developments. Additionally, the river is closely followed by US 19 for much of its length eliminating riparian and adding potential road runoff. Despite this, the Cane River has consistently rated Excellent since 1992 indicating no water quality or serious habitat deficiencies, based upon the macroinvertebrate community. The addition of high quality waters from many of the Cane River tributatries is likely partially responsible for maintainig the excellent water of the Cane River.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BALD MTN CR	**SR 1408**	**EB299**	**08/14/07**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Yancey	7	06010108	355902	822432	7-3-32	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	15	2380	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	70	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	17.1
Dissolved Oxygen (mg/L)	---
Specific Conductance (µS/cm)	44
pH (s.u.)	6.7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	0
Total Habitat Score (100)	77

Site Photograph

Substrate Mostly cobble with gravel. Some boulder and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10245	---	41	---	2.4	Excellent
07/09/02	8844	---	40	---	2.8	Excellent
07/08/97	7343	---	32	---	2.5	Good
07/21/92	5928	---	26	---	3.4	Good-Fair

Taxonomic Analysis

EPT richness was similar to 2002 levels but has increased substantially over the years prior to 2002. Abundant intolerant taxa dominate the fauna of Bald Mountain Creek. These taxa include the mayflies *Drunella conestee* , *Epeorus vitreus* , *Rithrogena* sp., and *Serratella carolina* ; the stoneflies *Leuctra* sp., *Paragnetina immarginata* , and *Pteronarcys* sp. ; and the caddisflies *Glossosoma* sp. and *Neophylax oligius* . Interestingly, previously abundant taxa such as the ubiquitous tolerant caddisfly *Cheumatopsyche* sp. and the moderately intolerant stonefly *Perlesta* sp. were not collected in 2007.

Data Analysis

SR 1408 closely follows Bald Mountain Creek completely eliminating the riparian on one side of the stream. Additionally, the river corridor is moderately developed both residentially and agriculturally, although, overall, the watershed drains mostly forested land. Despite this, Bald Mountain Creek water quality has steadily improved to Excellent from its lowest rating of Good-Fair garnered in 1992. However, the potential non-point source impacts from agriculture and residential development is high. As 2007 (as well as 2002) was a severe drought year, little non-point source runoff entered the stream to impact the benthic fauna.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BIG CR	**SR 1444**	**06/21/07**	**EF75**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
YANCEY	7	06010108	36.0154299	-82.3515462	7-3-40-(2.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	8.1	2230	5	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	10 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.8
Dissolved Oxygen (mg/L)	8.4
Specific Conductance (µS/cm)	40
pH (s.u.)	6.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	15
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	**86**

Site Photograph

Substrate cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/21/07	2007-92	19	56	Good

Most Abundant Species Mottled Sculpin

Exotic Species Rainbow Trout and Brown Trout

Species Change Since Last Cycle N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a tributary to the Cane River (and ultimately the Nolichucky River) located just above its confluence; drains part of the northern tip of Yancey County. The upper 1/2 of this highlands watershed lies within Pisgah National Forest lands. **Habitat** -- typical instream habitats for a high gradient mountain stream; 100% riffle-runs with chutes; open canopy and full sunlight for part of the sample reach, which flows through a residential property. **2007** -- a diverse and abundant (n = 767) population of fish were collected including 6 intolerant species, 9 minnow species, 3 darter species, and all 3 trout species; with one more darter species collected, this site would have rated Excellent. There are no apparent water quality issues in this watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
HOLLOW POPLAR CR	**NC 197**	**06/21/07**	**EF74**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MITCHELL	6	06010108	36.0875132	-82.3369141	7-10	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	6	2290	4	0.3	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	75	25 (rural residential)	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.1
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	41
pH (s.u.)	6.9

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	15
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	**86**

Site Photograph

Substrate cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/21/07	2007-91	2	---	Not Rated

Most Abundant Species	Rainbow Trout	**Exotic Species**	Rainbow Trout

Species Change Since Last Cycle N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a tributary to the Nolichucky River located about one mile above its confluence; drains a small headwater catchment in the western corner of Mitchell County bordering Tennessee; the highest elevations of this watershed lie within Pisgah National Forest lands. **Habitat** -- a highlands trout stream with 100% riffle-run habitats; an open canopy exists in sections of the stream along the road (see picture). **2007** -- only two species were collected (Rainbow Trout and Western Blacknose Dace), which is typical for the upper reaches of a high gradient Blue Ridge trout stream; this system probably used to support a reproducing population of Brook Trout, which were replaced with Rainbow Trout. Several dozen young-of-year wild Rainbow Trout were collected and or observed. No apparent water quality issues exist in this rural mountain watershed.