



Stream Monitoring Information Exchange

Fall 2008 Report

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“Flattened Scraper Mayfly”
Epeorus sp. (Ephemeroptera: Heptageniidae)



“Net-spinning Caddisfly”
Arctopsyche grandis (Trichoptera: Hydropsychidae)

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EXECUTIVE SUMMARY

This report details the fall 2008 results of the Stream Monitoring Information Exchange (SMIE) volunteer water quality monitoring program in western North Carolina. The SMIE Program is a collaboration between various nonprofit organizations, educational institutions and local, state and federal agencies with an interest in water quality issues. The SMIE Program uses volunteers to collect benthic macroinvertebrate data to evaluate water quality. Volunteer stream monitoring data is being increasingly used by government agencies for planning and review purposes. The SMIE benthic macroinvertebrate protocol is designed to closely mimic NC Division of Water Quality (DWQ) collection techniques to facilitate more precise comparisons between those data. The data will be shared with DWQ to identify streams in the process of environmental degradation.

The fall 2008 sampling season marked the end of the SMIE Program's fourth year; there are now 27 active sites and many sites have been sampled all seven seasons (spring and fall). Two sites have been discontinued but one new site has been added in a new county, Yancey County.

Sixteen volunteers attended a training session in October, 2008. Monitoring was conducted at 27 sites in Buncombe, Haywood, Madison, Mitchell and Yancey Counties in streams ranging from third to fifth order. Sites were selected, when possible, as Volunteer Water Information Exchange (VWIN) sites or DWQ sampling sites (as identified from DWQ's French Broad Basinwide Assessment reports). Samples were collected using kick net, leaf pack and visual search methods.

Taxa richness ranged from eight to 20 taxa of 43 possible. Sites with greater taxa richness are considered to have better water quality. The EPT taxa (Ephemeroptera = mayflies, Plecoptera = stoneflies, and Trichoptera = caddisflies) richness ranged from two to 13 of 19 possible. It is generally considered that the EPT taxa are the most pollution sensitive, thus sites with greater number of EPT taxa are considered to have better water quality.

The Izaak Walton League (IWL) scores ranged from nine to 27; seven sites were considered excellent, 16 were good, three were fair, and one was poor. The Virginia Save Our Streams scores ranged from three to twelve, with 24 sites rated as "acceptable" and five as "unacceptable". Those sites with ecological ratios indicating environmental degradation suggest that invertebrates are influenced by organic pollution and limited habitat resources (particularly woody debris).

The efforts of SMIE Program volunteers appear to show that streams in Buncombe, Haywood, Madison, Mitchell, and Yancey Counties are impacted by multiple land use factors at different scales in space and time. These factors include human encroachment, replacement of native riparian buffer vegetation with impervious surfaces, exotic and invasive species, erosion that leads to sedimentation of stream substrates, and possibly residual affects from a drought in 2007 and 2008.

SMIE Program staff are working with DWQ's Biological Assessment Unit staff to understand the data and develop an effective evaluation tool to rate the sampling streams. The next steps in development of the SMIE Programs are to (1) continue building a volunteer base, (2) continue building a database that monitors changes in the benthic communities and strengthens data analysis, and (3) working with DWQ's Biological Assessment Unit to develop an index that is user-friendly for volunteers and accurately reflects water quality condition.

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1.0 INTRODUCTION

This report details the fall 2008 results of the Stream Monitoring Information Exchange (SMIE) volunteer water quality monitoring program in western North Carolina. Protocols were developed by Jason Robinson (Kanugalihi Biological Consulting), the NC Division of Water Quality (DWQ) and the SMIE Program, a collaboration between various nonprofit organizations, educational institutions and local, state and federal agencies with an interest in water quality issues. The SMIE, coordinated by Clean Water for North Carolina, seeks to increasing regional communication about water quality issues, and has assumed responsibility for designing and implementing a program to train volunteers to engage in standardized protocols for benthic macroinvertebrate monitoring in WNC.

Volunteer stream monitoring data is being increasingly used by government agencies for planning and review purposes. This protocol is specifically designed to closely mimic DWQ collection techniques to facilitate more precise comparisons between those data. The advanced level of identification (often to species) used by DWQ precludes anything but general comparisons with SMIE data, as the volunteer monitoring protocol identifies only to the family levels (at best). The volunteer monitoring dataset is being used to analyze the performance of the ecological metrics included in the SMIE protocols, and this information will be used to make decisions about data presentation in the future. The data will be shared with DWQ to identify streams in the process of environmental degradation. This information is valuable to researchers as well as other volunteer monitoring groups. It will be submitted for publishing in peer-reviewed journals and made available through an interactive web map so volunteers and others can access water quality information.

2.0 METHODS

2.1 Instruction and Training

Volunteers were solicited through participating SMIE organizations as well as through public outreach. Tim Forrest, professor at the University of North Carolina-Asheville, was instrumental in providing a place and classroom resources for hosting a basic training session on October 26, 2008. Sixteen volunteers attending the event to learn how to use the SMIE protocols. Volunteers were instructed in general stream ecology principles, the theory behind sampling streams for water quality, and the common groups of insects used in the protocol. Microscopes greatly facilitated this process, but the protocol is designed such that microscopic evaluation is not necessary for field identifications. Microsoft PowerPoint®, chalkboards and video microscopes all were valuable instructional tools. Volunteers received packets containing information on basic stream ecology (including a dichotomous key), the SMIE sampling protocol, and a laminated identification sheet.

The effectiveness of the training sessions was evaluated using several methods: (1) a brief five question pre- and post-survey of general knowledge of stream biology and sampling concepts; (2) after several hours of identification training, a 15-question quiz to test identification skills; and (3) an evaluation of the instructor methods and materials, as well as of individual performance and overall efficacy of the training.

2.2 Sampling

Monitoring was conducted in fall 2008 at 26 established SMIE sites and one new one (Table 1), including a site in a new county, Yancey County. All stream sampling and habitat descriptions followed the SMIE stream monitoring protocols (Robinson 2004). At least one group leader or the SMIE biologist was in charge of leading each group. Sites were selected, when possible, as Volunteer Water Information Exchange (VWIN) sites (a water quality monitoring program coordinated by the University of North Carolina –

Asheville, Environmental Quality Institute) or the DWQ sampling sites (as identified from DWQ's French Broad Basinwide Assessment reports). Samples were collected using kick net, leaf pack and visual search methods.

Riffles were the primary habitat for benthic macroinvertebrate collection. Riffles are loosely defined as areas greater than 15 ft² with relatively shallow water depth (5-40 cm) and visible current. Benthic macroinvertebrates were collected using a kick net (mesh size 500 µm). Sampling consisted of overturning stones (by feet or hands) for one minute within a 15 ft² area upstream of the net. All organisms were picked from the net, identified and recorded separately from the leaf pack and visual collections.

Leaf packs were collected at each site within riffle habitats. Volunteers collected about 600 to 700 cm³ of leaf material in a leaf pack sample. This material was washed and poured through a kick net several times to remove insects and reduce the volume of material to be searched. All organisms were picked from the net or leaf material, identified and recorded separately from the kick net and visual collections.

The visual survey is performed by someone with a working knowledge of different types of habitats and insects; in most instances this will be the group leader. Searchable habitats include pools, riffles, runs, aquatic macrophytes, submerged mosses, undercut banks, large logs and boulders and sand bars. This method often yields taxa not collected in the other two samples and provides a total estimate of taxa richness at a site. These organisms were identified and recorded separate from the riffle and leaf pack collections.

Several habitat characteristics are evaluated as part of each sampling event, including:

- What type of barriers to fish movement may be present (i.e., waterfalls, culverts);
- The location of leaf packs, which gives an indication of riparian buffer quality and quantity;
- What substrates are available for aquatic invertebrates to inhabit (i.e., bedrock, boulder, cobble, gravel, sand, clay, algae, woody debris);
- Water color to give an indication of such problems as sedimentation or nuisance algal blooms;
- The composition of streambank vegetation; a healthy riparian buffer of trees and shrubs provides good shade to keep water temperatures cool and a supply of leaf litter inputs that are important for the base of the food chain;
- If any litter or trash is observed; and
- The effort it took to sample the riffle habitat. If a lot of effort was made, this is an indication of the severe sedimentation. Substrates that are extremely embedded are poor habitat for aquatic organisms. Many organisms inhabit the underside of rocks for protection, searching for food, or predation. The undersides of rocks cannot be accessed if the spaces between the rocks are filled in with sediment. Excess sediment also inhibits fish and amphibian reproduction by covering the area where many of those organisms lay their eggs, or may smother the eggs themselves.

This habitat data helps interpret what natural or man-made factors are affecting the benthic macroinvertebrate community. The presence or absence of fish is also noted. A stream that supports a greater diversity of organisms is generally considered to be a healthier stream.

2.3 Information Output

Microsoft Excel[®] spreadsheet software was used to summarize and manage data. Several metrics were calculated, including an Izaak Walton League (IWL) rating, Virginia Save Our Streams (VASOS) multi-metric index, several taxa richness metrics, and ecological metrics calculated as ratios of trophic groups (identified at family level). The use of many of these metrics is widespread. The SMIE Program is working with the NC Division of Water Quality - Biological Assessment Unit to develop a biological index that includes those metrics that best explain DWQ's own evaluation of water quality. A summary of standard ecological metrics can be found in Hauer and Lamberti (2000) and Rosenberg and Resh (1996). It should be

noted that the SMIE protocol was designed to include VASOS and IWL collection strategies nested within the collection procedure, but slight deviations from those procedures are necessarily expected (e.g., the relaxing of the requirement that the kick net collect >200 organisms).

3.0 RESULTS and DISCUSSION

3.1 Training Sessions

The pre- and post-survey of the SMIE training found the majority of participants (72%) either maintained or improved (by at least one question) their comprehension of basic stream ecology and water quality assessment, and maintained or improved (92%) their basic invertebrate identification skills after completing the training session.

The average taxonomy score on the identification quiz was 10 out of 15 (67%). Participants typically have the most difficulty distinguishing between the two free-living caddisflies and between different categories of stoneflies.

Training participants completed an evaluation of the instructor methods and materials, as well as of individual performance and overall efficacy of the training. Evaluations showed that participants ranged from having little or no prior experience monitoring streams to college-level instruction, and all felt the SMIE training improved their monitoring skills/knowledge. All participants felt they had maintained or improved their knowledge of threats to water quality, and the majority of participants felt more empowered to address threats to water quality.

3.2 Stream Monitoring

Twenty-seven sites were sampled in Buncombe, Haywood, Madison, Mitchell, and Yancey Counties in streams generally ranging from third to fifth order. Relationships between the metrics calculated are being explored in an effort to determine which metrics best explain water quality and habitat quality at each site.

Tables 1 and 2 summarize the collection data. Taxa richness ranged from eight (Pigeon River downstream of Canton) to 20 species (East Fork Pigeon River) of 43 possible (Figure 1). Sites with greater taxa richness are considered to have better water quality (Rosenberg and Resh 1996). Even though the site with the highest diversity had less than half of the total possible, it should be noted that several species are rare and/or hard to find (i.e., roach shredder stoneflies, sand and stick cased caddisflies, sand snail case caddisflies, alderflies, predator beetles, fat-head craneflies, red midges, leeches, sowbugs, scuds, round right-facing snails, clams/mussels). Also, not finding tolerant taxa typical of only poorer water quality can be a sign of good water quality (i.e., oligochaetes, leeches, clams, some damselflies, blackflies, red midges, coiled left-facing snails).

The total number of organisms collected ranged from a high of 346 (California Creek) to three sites less than 100 (Bent Creek, Big Laurel Creek, Reed Creek; Table 1). Abundant organisms were also collected at many other sites. With good species diversity, high total numbers can indicate good water quality. If total numbers are high but species diversity low, the stream may be impaired and only those species that can tolerate the pollutant(s) are flourishing.

The IWL narrative score ranges are <11 “poor”; 11-16 “fair”; 17-22 “good,” and >22 “excellent”. There is no upper limit for the “excellent” range. The IWL scores ranged from 9 (Reed Creek) to 27 (Ashworth Creek; Table 1); seven sites were considered excellent, 16 were good, three were fair, and one was poor.

The VASOS method scores sites on a scale of 1 to 12. Sites either pass or fail, receiving narrative ratings of either “acceptable” or “unacceptable”. The VASOS scores ranged from three to twelve, with 22 sites rated as acceptable and five as unacceptable.

With some exceptions, the IWL and VASOS scores corresponded to each other. Sites that were in “excellent” condition tended to have the highest VASOS scores. It should be noted that IWL and VASOS don’t consider the same parameters when calculating the final number. For example, stoneflies, mayflies and caddisflies are separated in the IWL calculation but are lumped together for VASOS. In addition, both calculate their metrics using only the kick net data, so additional organisms collected in leaf packs or visually, particularly EPT taxa, are not included, which can explain discrepancies with other metrics.

Many sites had high EPT (Ephemeroptera = mayflies, Plecoptera = stoneflies, and Trichoptera = caddisflies) taxa richness (Figure 2). EPT richness ranged from two (Reed Creek, Pigeon River downstream of Canton) to 13 (East Fork Pigeon River) of 19 possible. It is generally considered that EPT taxa (mayflies, stoneflies and caddisflies) are the most pollution sensitive (Resh 1993), thus sites with greater number of EPT taxa are considered to have better water quality. It is important to note that many EPT taxa exhibit natural trends in their life cycle, such that many organisms observed in spring may not be observed in fall, and vice versa.

Ecological metrics showed several interesting trends. All but five sites were characterized as heterotrophic ($P/R < 0.75$; Table 2). This metric is calculated as the ratio of ‘scrapers’, which scrape algae off rocks, to ‘filterers’ and ‘collectors’, which filter organic matter floating in the water column. Heterotrophic sites may be receiving less nutrients (i.e., nitrogen or phosphorus from agricultural activities or leaking septic systems) than autotrophic sites, and thus could be “respiring” communities, meaning they are using up the available nutrients before they build up and cause nuisance plant and algae blooms. Collector-gatherers and filterers tend to be abundant in these cases. Nutrient pollution can lead to significant environmental degradation (Laws 1993) and conditions unsuitable for healthy benthic macroinvertebrate and fish communities, such as low dissolved oxygen, high temperature and lack of suitable substrate.

The leaf input metric evaluates the importance of woody vegetation inputs to stream food webs; it’s calculated as the ratio of ‘shredders’, which feed on decomposing leaves, to ‘filterers’ and ‘collectors’, which filter organic matter floating in the water column. The fall 2008 data suggests the riparian buffer zone at most sites has been disturbed and woody vegetation inputs are limited. Twenty-four of the 27 sites had leaf input metrics less than 0.5. Values less than 0.5 in winter and autumn (0.25 in spring and summer) are considered impaired. This can be a result of human encroachment in the riparian buffer (i.e., road and homes). Healthy streams have good supplies of woody vegetation inputs to support a healthy macroinvertebrate population. It could also be due to new-fall leaves not being conditioned enough for shredders to be able to feed on them. The highest value was found at the Bent Creek site (1.47), which has a largely forested drainage area.

The top-down (predator-prey) ratios were low at all sites and indicate the benthic community is influenced by bottom-up controls (i.e., the available food resources). However, this ratio was high (>0.5) at three sites (Bent Creek, Cane Creek #11, Jonathans Ck @ ups Moody Farm Bridge) and suggests predator abundance may infrequently influence the composition of macroinvertebrate assemblages. This metric is calculated as the ratio of predators to shredders, scrapers, collectors and filterers.

The Simpson’s Diversity and Taxa Density indices are designed to evaluate how the total numbers of organisms found in the sample are evenly distributed among the number of species collected. Polluted sites tend to have greater abundances among fewer taxa, thus these indices would be low. Low values suggest pollution or recent benthic macroinvertebrate colonization, such as after flooding. Simpson values ranged from 0.43 (California Creek) to 0.89 (Swannanoa River downstream of Beetree Creek). Most sites had values between 0.65 and 0.85. Taxa density numbers were low and ranged from 0.03 (Pigeon River downstream of Canton) to 0.16 (Shelton Laurel Creek).

3.3 Site descriptions and sampling summaries

The following section describes the location and habitat at each sample site. The SMIE and VWIN programs now use a revised site numbering system; both programs use the same number where sites overlap. Site numbers are listed next to the site name; corresponding DWQ site identifications are also listed, if available. A general description of the benthic macroinvertebrate data is also provided. References to the right and left side of the stream correspond to the right and left stream sides when facing downstream. Overall water quality patterns for many of the streams or their parent watersheds are described in the DWQ French Broad Basinwide Plan (2005; <http://h2o.enr.state.nc.us/basinwide/documents/Chapter4Subbasin04-03-04.pdf>).

Buncombe County

Asheworth Creek – SMIE Site #124

This site is located approximately 30 meters upstream of the confluence with Cane Creek #1 at the US 74 bridge. It corresponds with a VWIN site (old site 15B) and was first sampled in spring 2005. The riparian zone is mostly trees and shrubs but a road has disturbed the riparian zone on the right side of the stream. Substrates are comprised of gravel and cobblestones that are moderately embedded.

Seventeen taxa were collected at this site, seven of those were EPT taxa. The most abundant organisms collected were net-spinning caddisflies (30%), coiled right-facing snails (21%), and flattened scraper mayflies (12%), and there was good distribution of abundances among the species represented as indicated by one of the highest Simpson's Diversity values (0.84). IWL rated this site "excellent" (27) but it was "unacceptable" by VASOS (6) due to low EPT abundances, other than net-spinning caddisflies. The IWL score is the highest IWL score observed this sampling season.

Bent Creek - SMIE Site #119

This site is located in the Asheville Arboretum near the Hard Times trailhead parking lot. It was approximately 10 meters upstream of the trail bridge before a debris dam changed the habitat to a pool. It was moved approximately 100 yards upstream of the trail bridge. The original site corresponded to a VWIN site (old site 12A) and was first sampled in spring 2005. The SMIE Program typically holds its Group Leader and refresher courses here. The bottom habitat is gravel and cobblestones but is moderately embedded. The forest is relatively intact around the site which provides excellent riparian conditions.

Fourteen taxa were collected at this site. Eight of those were EPT taxa, including giant shredders, which are one of the most pollution intolerant groups among the SMIE taxa. The most abundant organisms in the sampler were quick crawling predator stoneflies (40%) and fragile detritivore stoneflies (22%). The IWL score is indicative of "good" water quality (19). The VASOS rating also considers this site "acceptable" (10). However, very few organisms were collected (92), which is below the number recommended for proper data analysis (200 individuals).

Big Ivy River - SMIE Site #101

This site is located in the Forks of Ivy area north of Asheville. It corresponds to a VWIN site (old site 1A) and DWQ site 2 and was first sampled in spring 2005. The riparian buffer zone is stable but has been disturbed by the construction of a road and several houses. It consists of mostly trees and shrubs. Gravel and cobble comprise the majority of the substrates but sand is also abundant, which has resulted in the substrates being moderately embedded.

Eighteen total taxa and seven EPT taxa were collected at this site. Net-spinning caddisflies dominated the sample (61%). Flattened scraper mayflies were also abundant (16%). This site was rated "good" by IWL (22), and "acceptable" by VASOS (7). However, shredders were very uncommon as indicated by the low leaf input metric (0.05). This can be a result of human encroachment in the riparian buffer (i.e., road and homes), or due to new-fall leaves not being conditioned enough for shredders to be able to feed on them.

Cane Creek - SMIE Site #123

This site is located approximately 50 meters upstream of the US 74 bridge. It corresponds with a VWIN site (old site 15A) and was first sampled in spring 2005. The riparian zone is mostly trees and shrubs but a parking lot and driveway have disturbed the riparian zones on both sides of the stream. Substrates are comprised of gravel and cobblestones that are moderately embedded by sand.

Thirteen taxa were collected at this site; seven of those were EPT taxa. Quick crawling predator stoneflies (52%) and net-spinning caddisflies (26%) comprised most of the sample. IWL rated this site “good” (22) and it was “acceptable” by VASOS (9). However, shredders were noticeably uncommon as indicated by the low leaf input metric (0.03). This can be a result of human encroachment in the riparian buffer (i.e., road and homes), or due to new-fall leaves not being conditioned enough for shredders to be able to feed on them.

Cane Creek - SMIE Site #182

This site is less than a mile upstream of the SMIE sites on Cane and Ashworth Creeks, near Cane Creek cemetery and Fairview School. The sample is collected off of US-74 near the bridge where Miller Road crosses Cane Creek (below where Ballard Creek comes in). The site is a DWQ monitoring site. The riparian zone is mostly trees and shrubs. Substrates are comprised of gravel and cobblestones that are moderately embedded by sediment.

Fourteen taxa were collected at this site, including eight EPT taxa. Net-spinning caddisflies dominated the sample (74%), which likely resulted in the low Simpsons Diversity value (0.44). Low Simpsons Diversity values suggest pollution or recent benthic macroinvertebrate colonization, such as after flooding. However, IWL rated this site “excellent” (23) and it was “acceptable” by VASOS (7).

Hominy Creek - SMIE Site #117

This site is located approximately 100 meters upstream of the confluence with South Hominy Creek. It corresponds to a VWIN site (old site 11A) and DWQ site 7. It was first sampled in spring 2005. The substrates at this site are gravel and cobblestone, but sand is also prevalent. Trees and shrubs were the most common plants in the riparian zone, but many grasses and exotic species are also present.

Eighteen species were collected at this site. Ten of those were EPT taxa, including roach shredders, which are one of the most pollution intolerant groups among the SMIE taxa. Net-spinning caddisflies dominated this sample where they comprised 55% of the sample. This site was considered in “excellent” condition by IWL (23) and “acceptable” (7) by VASOS.

Newfound Creek - SMIE Site #106

This site is located approximately 50 meters upstream of the Rymer Road bridge and corresponds to a VWIN site (old site 4). It was first sampled in fall 2005. The substrates at this sample site are bedrock and boulders, but gravel, cobblestones and sand/silt are also abundant. The prevalence of sand and silt has led to the substrates being moderately embedded. Beavers constructed a dam between the spring and fall sampling seasons, which will likely change the substrate composition in future sampling events. The riparian zone consists of mostly trees and shrubs but it has been disturbed by roads and homes.

Fifteen taxa, including four EPT taxa, were collected. Stoneflies were noticeably absent as they have been in previous years. The sample was dominated by net-spinning caddisflies (64%). The site was considered “good” (21) by IWL. However, it was “unacceptable” (5) by VASOS, most likely a result of the low number of EPT taxa combined with the high number of net-spinning caddisflies.

Reed Creek - SMIE Site #181

This site is located in the Botanical Gardens of Asheville near UNCA below the confluence with Glenn Creek. It corresponds to a VWIN site (old site 7A). Substrates are composed of mostly gravel and cobblestones with sand also abundant. Because it is in the Botanical Gardens, the riparian zone is comprised of trees and shrubs. However, it is surrounded by an urban setting and is a popular recreation area for nature hikes.

This site and the Pigeon River (downstream of Canton) site had the lowest total diversity (eight taxa) and EPT diversity (two taxa) in the fall 2008. This site also had the lowest number of organisms collected (95), which is low for the spring season when aquatic organisms are their most abundant compared to other seasons. Stoneflies were noticeably absent. This site was rated as “poor” (9) by IWL and unacceptable (6) by VASOS. The IWL score is the lowest found observed this sampling season. The most prevalent organisms collected were net-spinning caddisflies (48%), chironomid midges (20%), and water worms (19%), although very few organisms were collected. The low number is below the number recommended for proper data analysis (200 individuals).

Reems Creek - SMIE Site #180

This site is located just below the confluence of Reems and Ox Creeks in Weaverville (just behind the residence at 23 Ox Creek Rd.) and is just downstream of two VWIN sites (old sites 5A & 5B). Sampling started in the fall 2007 at this site. Substrates are composed of mostly gravel and cobblestones with abundant sand. The riparian zone is comprised of trees and shrubs.

There were 18 taxa collected at this site with good representation of EPT taxa (10), including giant shredders, a highly intolerant taxa. The most prevalent organisms collected were fragile detritivores (27%), net-spinning caddisflies (22%), and quick crawling predators (14%) but this site had one of the highest Simpsons Diversity indices (0.85). This site was rated “excellent” (23) by IZL; VASOS rated it “acceptable” (11).

Sandymush Creek - SMIE Site #105

This site is located approximately 50 meters downstream of the Willow Road bridge and corresponds to a VWIN site (old site 3B). It was first sampled in fall 2005. The substrate consists of boulders, gravel and cobblestones although sand is also prevalent that has resulted in the substrates being moderately embedded. The riparian zone consists of trees and shrub.

This site was rated “good” by IWL (18) and “acceptable” by VASOS (10). Fifteen taxa were collected, including eight EPT taxa. Net-spinning caddisflies comprised most of the sample (38%) followed by flattened scrapers (28%).

Swannanoa River near the confluence of Beetree Creek - SMIE Site #115

This site is located at Charles D. Owen Park below the confluence with Beetree Creek. It corresponds to a VWIN site (old site 9B) and was first sampled in spring 2005. The riparian zone is mostly trees and shrubs but it has been highly disturbed by a public park on the right side and residential areas on the left. The substrates are mostly gravel and cobblestones but sand is also abundant, which has resulted in moderately embedded substrates.

Sixteen taxa were collected at this site, including six EPT taxa. Net-spinning caddisflies were the dominant taxa collected and comprised 58% of the sample. This site was rated “good” (22) by IWL and “acceptable” by VASOS (7). However, shredders were noticeably uncommon as indicated by the low leaf input metric (0.03). This can be a result of human encroachment in the riparian buffer (i.e., road and homes), or due to new-fall leaves not being conditioned enough for shredders to be able to feed on them.

Swannanoa River near the confluence of Bull Creek - SMIE Site #149

This site is located at Old Farm School Road just above the confluence with Bull Creek. It corresponds to a VWIN site (old site 38) and was first sampled in spring 2005. The substrate is mostly gravel and cobblestones with sand moderately embedding it in place. The riparian zone consists of trees and shrubs.

Fifteen taxa were collected at this site; three of those were EPT taxa. Four taxa comprised most of the sample: oligochaetes (23%), net-spinning caddisflies (20%), round-headed swimmers (19%), and blackflies (16%). This site had the highest Simpsons Diversity indices (0.89). IWL scored this site as “good” (21), but VASOS considered this site “unacceptable” (5). The low VASOS score can be attributed to a number of factors; low EPT abundance but a high number of net-spinning caddisflies, the presence of lunged (left-facing) snails, and a high proportion of tolerant organisms. There were also no stoneflies collected.

Haywood County

Crabtree Creek - SMIE Site #526

This site is located approximately fifty meters below the first bridge on Upper Crabtree Creek Road, which is less than a mile upstream of where Crabtree Creek flows under Hwy 20. This site corresponds to a VWIN site (old site 26) and DWQ site F2 and was first sampled in spring 2005. The riparian zone for the most part consists of mostly trees and shrubs, but grasses, honeysuckle, multiflora rose and privet are also common upstream of the site. Bedrock, boulders, gravel and cobblestones are all abundant, as is sand which has led to the substrates being moderately embedded.

Fifteen taxa were collected at this site; ten were EPT taxa. The sample was dominated by flattened scrapers (63%). This site is considered “good” by IWL (19) and acceptable (10) by VASOS. However, the high P/R ratio (5.24) indicates this stream may have some level of organic enrichment.

East Fork of the Pigeon River - SMIE Site #502

This site is located approximately 100 meters upstream of the SR 276 bridge over the East Fork of the Pigeon River. This site corresponds to DWQ site 1A and was first sampled in fall 2005. The riparian zone at this site is comprised of mostly trees and shrubs. A road lies in close proximity to the stream. Gravel and cobblestones dominate the substrate but bedrock is prevalent. The abundance of sand has also led the substrates to being moderately embedded.

Twenty taxa were collected, which is the highest diversity collected among all the sites in the fall 2008 collection season. This included 13 EPT taxa, which is also the highest EPT diversity collected. This site was rated “good” by IWL (21) and “acceptable” by VASOS (10). Four taxa comprised most of the sample: spiny crawler mayflies (30%), net-spinning caddisflies (22%), flattened scraper mayflies (12%), and fragile detritivore stoneflies (12%).

Fines Creek - SMIE Site #507

This site is located near the Fines Creek (Lower Fines Creek) bridge on SR 1335 near the junction with SR 1338. It corresponds to a VWIN site (old site 7) and was first sampled in spring 2005. The riparian zone is mostly trees and shrubs on the right side of the stream, but the road lies close to left side of the stream and has limited that side to mostly grasses. Stream habitat is comprised of sand, gravel, and cobblestones, although more sediment loads have been observed in recent samples.

Seventeen taxa were found in the sample, eight of which were EPT taxa. Net-spinning caddisflies were the most abundant organism collected (42% of the sample) but fragile detritivore stoneflies (17%), flattened scraper mayflies (17%), and round-headed swimmer mayflies (16%) were also common. IWL rated this site “excellent” (25) and it was “acceptable” by VASOS (8).

Jonathans Creek (downstream of Coleman Mountain Road) - SMIE Site #512

This site is located approximately 50 meters downstream of the Coleman Mountain Rd. (SR 1364) bridge near the junction with SR 276. It corresponds with a VWIN site (old site 12) and is very close to DWQ sites 27 and 28. It was first sampled in spring 2005. The riparian zone has been highly disturbed and is in poor condition. Mobile homes and commercial properties border both sides of the stream and the riparian buffer consists of mostly grasses. Very few trees are present. Substrates are comprised of gravel and cobblestones but increasing amount of sand have been noticed at the site.

Seventeen taxa were collected at this site, including ten EPT. Net-spinning caddisflies (39%) and flattened scraper mayflies (26%) were the most abundant organisms collected. IWL rated this site “good” (22) and it was “acceptable” by VASOS (10).

Jonathans Creek (downstream of Moody Farm Road bridge) - SMIE Site #527

This site is located in Maggie Valley approximately 50 meters downstream of the first bridge on Moody Farm Road (SR 1307). This site is near the junction with SR 19 and across from the Maggie Valley Country Club golf course. It corresponds with VWIN site (old site 27) and DWQ site 26 and was first sampled in spring 2005. The riparian buffer consists of mostly trees and shrubs providing good shade, but the left buffer is paralleled by a road and the right by houses. The dominant substrates are gravel and cobblestones. Sand is also abundant but does not appear to be affecting substrate embeddedness.

Thirteen taxa were collected at this site, with eight of those from the EPT groups. The most abundant organisms were net-spinning caddisflies (29%), small head caddisflies (26%), quick crawling predator stoneflies (13%), and flattened scraper mayflies (12%). The IWL score indicated this site was in “good” condition (18) and it was “acceptable” by VASOS (9).

Pigeon River - SMIE Site #581

This site is located downstream of the Blue Ridge Paper Products Mill in Canton. It is very close to a VWIN site (old site 4) and was first sampled in the fall 2006. Bedrock is abundant. Gravel and cobble habitat is present but limited and moderately embedded. The riparian zone is mostly trees and shrubs but roads parallel both sides of the river. Water temperature is consistently warmer than normal for any season.

Only two EPT taxa and eight total taxa were collected. This site and Reed Creek both had the lowest total diversity and EPT diversity in the fall 2008. Shredders were noticeably absent in the sample. Of the 309 organisms collected, 180 were net-spinning caddisflies and 101 were coiled left-facing snails. Both of these groups are considered tolerant. The dominance of these organisms can explain the low diversity index scores (Simpson’s Diversity and taxa density). Low Simpsons Diversity values suggest pollution or recent benthic macroinvertebrate colonization, such as after flooding. The abundance of net-spinning caddisflies along with high FPOM/CPOM ratio are evidence of organic enrichment. The VASOS score supports this finding with the lowest “unacceptable” score among all sites (3). The IWL methods rated this site as “fair” (11).

Raccoon Creek - SMIE Site #525

This site is located in Waynesville downstream of the first bridge on Howell Mill Road at the intersection with Business 23 (Old Asheville Highway). It corresponds with a VWIN site (old site 25). The riparian buffer consists of mostly trees and shrubs but it has been highly disturbed the construction of commercial business and a private residence. There is abundant rip-rap and exotic species present. The dominant substrates are gravel and cobblestones in the riffles but sand is also abundant in the pool and run habitats.

Fourteen taxa were collected at this site; seven of those were from the EPT groups. Net-spinning caddisflies (46%) and flattened scraper mayflies (32%) dominated the sample. The IWL score indicated this site was in “good” condition (19) and it was “acceptable” by VASOS (8).

Richland Creek - SMIE Site #580

This site is located approximately 200 meters upstream of Hyatt Creek Road at Exit 98 on US 23/74. It corresponds to DWQ site 19 and was first sampled in spring 2005. The stream resembles a long straight channel with little riffle formation or bank heterogeneity. The riparian zone on the right side of the stream is mostly a parking lot with some large trees and shrubs. Upstream of the parking lot and all along the left side of the stream, the riparian zone has been highly disturbed by residential homes. The stream substrates consist of cobble and gravel with abundant sand also present.

Seventeen taxa were collected at this site, including eight EPT taxa. Flattened scraper mayflies dominated the sample (52%). IWL rated this site as “excellent” (23) and it is “acceptable” by VASOS methods (10). However, the high P/R ratio (2.89) indicates this stream may have some level of organic enrichment.

Madison County

Big Laurel Creek - SMIE Site #904

This site is located approximately 200 meters downstream of the bridge at the Hwy 25/70 and NC 208 junction. It corresponds to a VWIN site (old site 10) and was first sampled in fall 2005. This is a popular recreation area for the community. A trail follows the stream to its confluence with the French Broad River, and it is a popular kayaking/rafting and trout fishing destination. The riparian zone of the right side is disturbed by a small campground and a parking lot borders the left side of the stream upstream of the site. Even with these disturbances, there are abundant large trees and shrubs in the riparian zone. The stream substrates are mostly cobble and gravel, sand is becoming increasingly abundant.

The IWL score (14) is “fair” and the VASOS rating is “acceptable” (9). This is a significant change over previous seasons that found the site in “excellent” condition. This may be attributed to the very few organisms collected in the sample (91), which may be due to stream degradation or human error. The low number collected is below the number recommended for proper data analysis (200 individuals). Fourteen species were collected, including seven EPT taxa. Net-spinning caddisflies (41%) and round-headed swimmers (18%) were the most common organism collected.

California Creek - SMIE Site #413

This site is located approximately 50 meters upstream of the bridge at Radford Road, which is just downstream of US 19. It was first sampled in spring 2005. It corresponds with a VWIN site (old site 13). Road, pasture and residential areas have disturbed the natural condition of the riparian zone. Riparian vegetation is mostly trees and shrubs. Gravel and cobblestones comprise the majority of the stream bottom but sand is also abundant.

Sixteen taxa were collected at this site, including seven EPT taxa. Net-spinning caddisflies dominated the sample (75%). The high abundance of net-spinning caddisflies and high FPOM/CPOM ratio (11.91) are evidence of some organic enrichment. However, IWL rated this site as “excellent” (25); VASOS rated it as “acceptable” (7).

Little Ivy River - SMIE Site #102

This site is located in the Forks of Ivy area north of Asheville and was first sampled in spring 2005. It is approximately 100 meters upstream of the confluence with Big Ivy River and corresponds to a VWIN site (old site 1B) and DWQ site 4. The substrates at this site are mostly gravel and cobblestones but bedrock and sand are also abundant. The sand has led to extreme embeddedness of the substrates. Some trees are found in the riparian zone but it has been highly disturbed and grasses and vines dominate. A road closely parallels the stream on the left side.

Fourteen taxa were collected with five of those being EPT taxa. Net-spinning caddisflies (46%), round headed swimmer mayflies (19%), and flatted scraper mayflies (17%) comprised most of the sample. IWL scored this site as “fair” (16) and VASOS ranked it as “acceptable” (10).

Puncheon Fork Creek - SMIE Site #480

This site is located near Ebbs Chapel at the junction of Laurel Valley Road and Puncheon Fork Road. It is just upstream of the culvert under Laurel Valley Road and is a DWQ monitoring site. Substrates are mostly gravel and cobblestones and are not embedded; the riparian zone is mostly trees and shrubs.

There were seventeen taxa collected at this site; ten of those were EPT taxa. The most prevalent organisms were net spiny crawler mayflies (24%), net-spinning caddisflies (22%), and fragile detritivore stoneflies (16%) but this site had one of the highest Simpsons Diversity indices (0.84). This site is rated “good” (21) by IWL and “acceptable” (11) by VASOS.

Shelton Laurel Creek - SMIE Site #409

This site is located adjacent to the Bela Baptist Church parking lot on Guntertown Road. It was first sampled in spring 2006. The right riparian zone is bordered by a road and the left side by a church parking lot. Very little vegetation is present, although riparian conditions greatly improve upstream of the sample site as natural vegetation increases. Vegetation along the road bank consists of shrubs, grasses and herbs consistent with roadside habitat. Large trees and shrubs are present on the left bank and help to protect the stream bank from erosion. The stream habitat consists of gravel and cobblestones but sand is also abundant.

There were 18 taxa collected at this site; ten of those were EPT taxa. Diversity was well-distributed among the taxa collected (Simpson’s diversity index = 0.87), but the most common taxa were flattened scraper mayflies (25%), quick-crawling predator stoneflies (18%). This site is rated “good” (22) by IWL and “acceptable” (12) by VASOS, which is the highest VASOS score among all sites.

Mitchell County

Cane Creek - SMIE Site #1481

This sample is collected just upstream of South Mitchell Avenue bridge, near the intersection of Hwy. 226 (Crimson Laurel Way) and Mitchell Avenue. This corresponds to a VWIN site (old site T1). Substrates are composed of mostly gravel and cobblestones but sand is also abundant. The riparian zone is mostly trees and shrubs, and grasses, vines, and rip-rap are also present.

There were fifteen taxa collected at this site; six of those were EPT taxa. The most prevalent organisms collected were flattened scraper mayflies (41%). This site was rated “good” (18) by IWL and “acceptable” (11) by VASOS, but the high P/R ratio (1.65) indicates this stream has some level of organic enrichment.

Yancey County

Cane River - SMIE Site #1480

This sample is collected by the Mountain Heritage High School practice football field and corresponds to a VWIN site (old site T5). This is the first season this site was sampled. Sampling was cancelled in spring 2008 due to water quality concerns. SMIE volunteers and local residents noted a strange color and odor prior to sampling and helped push for state regulators to investigate the upstream Burnsville Waste Water Treatment Plant. Multiple toxic discharges (very low pH, high chlorine and very high bacteria counts) occurred killing endangered Appalachian Elktoe mussel and other organisms. The Yancey County Health Department eventually posted "no swimming" signs.

The stream bottom is mostly gravel and cobble. The riparian zone is mostly trees, with some clearing close to the left bank where river rocks are intermittently mined.

There were twelve taxa collected at this site; seven of those were EPT taxa. The most prevalent organisms collected were net-spinning caddisflies (57%) and flattened scraper mayflies (19%). The high abundance of net-spinning caddisflies and high FPOM/CPOM ratio (7.25) are evidence of some organic enrichment. This site was rated “good” (18) by IWL and “acceptable” (8) by VASOS.

4.0 SUMMARY

The SMIE Program is still in its development stages. The fall 2008 sampling season marked the end of the Program’s fourth year; there are now 27 active sites and many sites have been sampled all seven seasons (spring and fall). Two sites have been discontinued (Flat Creek and Christian Creek) but one new site was added, the Cane River in Yancey County. The sampling protocols are consistent with DWQ protocols but data analysis issues are still being resolved with help from the NC DWQ Biological Assessment Unit. SMIE Program staff are working with Assessment Unit staff to understand the data and develop an effective evaluation tool to rate the sampling streams. Assessment Unit staff are currently reviewing the data to develop a biotic index that reflects their evaluations of water quality at each site.

Overall, the efforts of SMIE Program volunteers appear to show that streams in Buncombe, Haywood, Madison, Mitchell, and Yancey Counties are impacted by land use. Volunteers collected samples from streams that have some of the best water quality in western North Carolina. However, they’re also collecting from some of the worst streams. One consistent trend is that most riparian zones are less than adequate for multiple reasons. Human encroachment leads to increased impervious surfaces and reduces naturally vegetated landscapes, which leads to increased stream flows and subsequent erosion and flooding downstream, as well as reduced inputs of leaves and woody debris that serve as the base of the food chain. Exotic and invasive species are present in almost every watershed and are an indicator of how disturbed the ecological processes are in these systems. Another consistent trend is the presence of excess sediment. Few sites had substrates that were loose and easily moved. Embedded substrates reduce the quantity and quality of benthic habitats, and provide evidence for leaf pack and woody debris removal by high flow events.

The fall 2008 sampling season may have been affected by another variable that impacted all streams across the region in 2007 and 2008, a drought. There’s little doubt aquatic organisms were affected by the drought and they may not have recovered by the fall season. Many folks witnessed dried up springs and wells, and many streams and rivers were at their lowest levels on record. The French Broad River saw its lowest recorded water levels since such monitoring began in the late 19th century! When water levels are low, more substrates become exposed, which means less habitat for fish and benthic macroinvertebrates. The lower flow also means less dissolved oxygen and warmer temperatures. The streams of western North Carolina support many organisms adapted to high dissolved oxygen levels and cold temperatures, such as stoneflies, darters, and trout. There has been a positive side to the drought, though. Less rain means less non-point source pollution washing into the stream, such as fertilizers, pesticides, oil and trash. It also means less erosion of streambanks and therefore less sedimentation.

The quality of the resources available to benthic macroinvertebrate communities is a function of riparian and basin level processes (such as changes in nutrient loading, flow, and temperature). Thus, there are multiple factors at different levels of space (i.e., stream order) and time (i.e., season) that affect the distribution and abundance of aquatic macroinvertebrates. Since the SMIE approach uses benthic macroinvertebrate data to evaluate ‘water quality’, it must include those factors in our evaluation. The next steps in development of the SMIE Programs are to (1) continue building a volunteer base, (2) continue building a database that monitors changes in the benthic communities and strengthens data analysis, and (3) working with DWQ’s Biological Assessment Unit to develop a user-friendly index that accurately reflects water quality condition.

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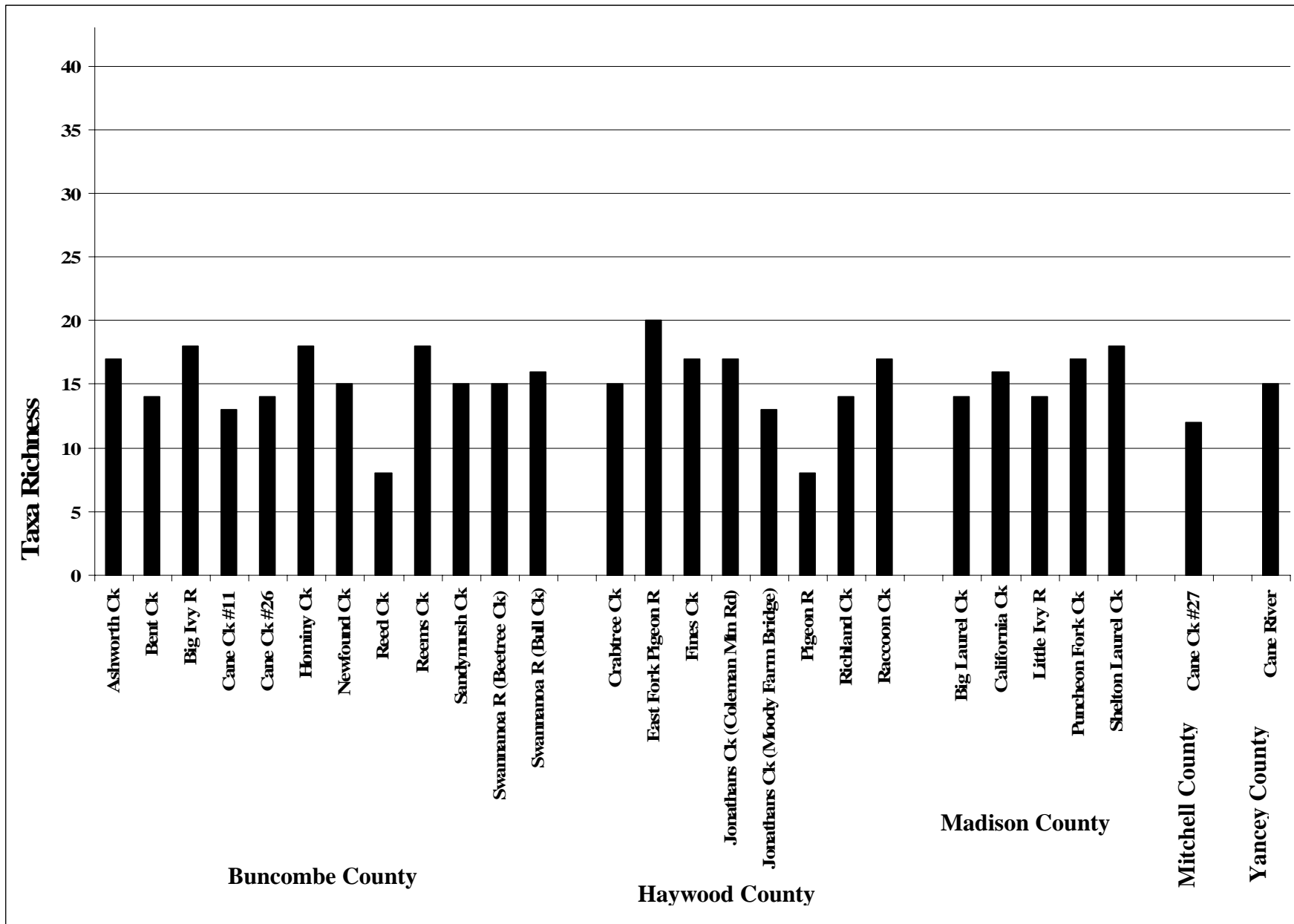


Figure 1. Taxa richness at all SMIE sample sites (43 taxa possible; Fall 2008).

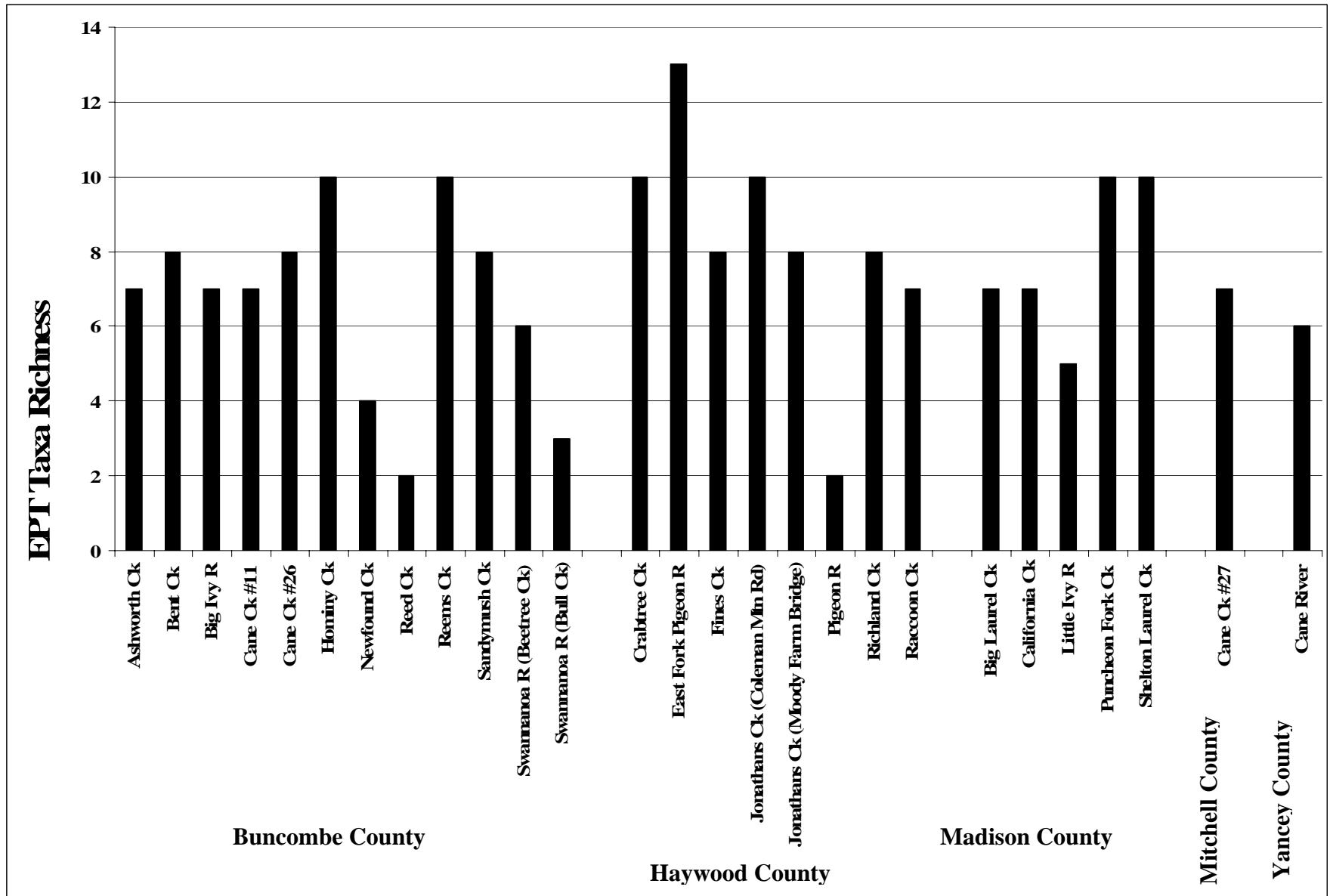


Figure 2. Number of EPT taxa at all SMIE sample sites (Ephemeroptera [mayflies], Plecoptera [stoneflies], Trichoptera [caddisflies]; 19 possible; Fall 2008).

Table 1. SMIE Program summary site data (Fall 2008; richness, abundance, VASOS and Izaak Walton League data)

Site #	Site	Taxa Richness	Total Number Collected	Number of EPT Taxa	VASOS	VASOS Rating	Izaak Walton League	Izaak Walton League Rating
<i>Buncombe County</i>								
101	Big Ivy River	18	261	7	7	Acceptable	22	Good
105	Sandymush Creek	15	198	8	8	Acceptable	18	Good
106	Newfound Creek	15	126	4	5	Unacceptable	21	Good
115	Swannanoa River @ dws Beetree Ck	16	123	6	7	Acceptable	22	Good
117	Hominy Creek	18	143	10	7	Acceptable	23	Excellent
119	Bent Creek @ Asheville Arboretum	14	92	8	10	Acceptable	19	Good
123	Cane Creek #11	13	210	7	9	Acceptable	22	Good
124	Asheworth Creek	17	164	7	6	Unacceptable	27	Excellent
149	Swannanoa River @ ups Bull Ck	15	168	3	5	Unacceptable	21	Good
180	Reems Creek	18	245	10	11	Acceptable	23	Excellent
181	Reed Creek	8	95	2	6	Unacceptable	9	Poor
182	Cane Creek #26	14	176	8	7	Acceptable	23	Excellent
<i>Haywood County</i>								
502	East Fk Pigeon River	20	145	13	10	Acceptable	21	Good
507	Fines Creek	17	157	8	8	Acceptable	25	Excellent
512	Jonathans Ck @ dws Coleman Mtn Rd	17	149	10	10	Acceptable	22	Good
525	Raccoon Creek	14	150	7	8	Acceptable	19	Good
526	Crabtree Creek	15	156	10	10	Acceptable	19	Good
527	Jonathans Ck @ ups Moody Farm Bridge	13	112	8	9	Acceptable	18	Good
580	Richland Creek @ ups Hyatt Ck Road	17	176	8	8	Acceptable	23	Excellent
581	Pigeon River @ dws Canton	8	309	2	3	Unacceptable	11	Fair

Table 1 (continued). SMIE Program summary site data (Fall 2008; richness, abundance, VASOS and Izaak Walton League data)

Site #	Site	Taxa Richness	Total Number Collected	Number of EPT Taxa	VASOS	VASOS Rating	Izaak Walton League	Izaak Walton League Rating
<i>Madison County</i>								
102	Little Ivy River	14	274	5	10	Acceptable	16	Fair
409	Shelton Laurel Creek	18	114	10	12	Acceptable	22	Good
413	California Creek	16	346	7	7	Acceptable	25	Excellent
480	Puncheon Fork Creek	17	269	10	11	Acceptable	21	Good
904	Big Laurel Creek	14	91	7	9	Acceptable	14	Fair
<i>Mitchell County</i>								
1481	Cane Creek #27	12	203	7	11	Acceptable	18	Good
<i>Yancey County</i>								
1480	Cane River	15	140	6	8	Acceptable	18	Good

EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)

VASOS = Virginia Save Our Streams Index

What do the scores mean?

- Total Taxa Richness = the higher the better
- EPT Taxa Richness = the higher the better
- VASOS Rating: Acceptable = 7-12; Unacceptable = 0-6
- Izaak Walton League Rating: Excellent > 22; Good = 17-22; Fair = 11-16; Poor <11

Table 2. SMIE Program summary site data (Fall 2008; ecological ratios, diversity and density data)

Site #	Site	P/R	Leaf Input	Top-Down	Simpsons Diversity	Taxa Density
<i>Buncombe County</i>						
101	Big Ivy River	0.24	0.05	0.10	0.59	0.07
105	Sandymush Creek	0.62	0.39	0.08	0.76	0.08
106	Newfound Creek	0.21	0.04	0.05	0.57	0.12
115	Swannanoa River @ dws Beetree Ck	0.22	0.03	0.18	0.63	0.13
117	Hominy Creek	0.16	0.10	0.14	0.68	0.13
119	Bent Creek @ Asheville Arboretum	0.60	1.47	0.96	0.77	0.15
123	Cane Creek #11	0.21	0.03	1.49	0.65	0.06
124	Asheworth Creek	0.89	0.23	0.08	0.84	0.10
149	Swannanoa River @ ups Bull Ck	0.11	0.06	0.02	0.89	0.09
180	Reems Creek	0.35	0.90	0.25	0.84	0.07
181	Reed Creek	0.10	0.01	0.02	0.71	0.11
182	Cane Creek #26	0.11	0.12	0.04	0.44	0.08
<i>Haywood County</i>						
502	East Fk Pigeon River	0.35	0.26	0.12	0.82	0.14
507	Fines Creek	0.39	0.26	0.07	0.74	0.11
512	Jonathans Ck @ dws Coleman Mtn Rd	0.70	0.11	0.12	0.76	0.11
525	Raccoon Creek	0.66	0.06	0.06	0.68	0.09
526	Crabtree Creek	5.24	1.05	0.20	0.57	0.10
527	Jonathans Ck @ ups Moody Farm Brdg	0.62	0.19	0.72	0.80	0.12
580	Richland Creek @ ups Hyatt Ck Rd	2.89	0.49	0.22	0.69	0.10
581	Pigeon River @ dws Canton	0.62	0.00	0.05	0.55	0.03

Table 2 (continued). SMIE Program summary site data (Fall 2008; ecological ratios, diversity and density data)

Site #	Site	P/R	Leaf Input	Top-Down	Simpsons Diversity	Taxa Density
<i>Madison County</i>						
102	Little Ivy River	0.38	0.05	0.03	0.71	0.05
409	Shelton Laurel Creek	0.78	0.16	0.38	0.87	0.16
413	California Creek	0.09	0.03	0.14	0.43	0.05
480	Puncheon Fork Creek	0.17	0.36	0.17	0.85	0.06
904	Big Laurel Creek	0.29	0.12	0.09	0.78	0.15
<i>Mitchell County</i>						
1481	Cane Creek #27	1.65	0.26	0.23	0.78	0.06
<i>Yancey County</i>						
1480	Cane River	0.31	0.02	0.11	0.63	0.11

Ecological Ratios

- P/R (Prod/Resp): > 0.75 indicates stream may be autotrophic or could have significant organic pollution; < 0.75 indicates stream may be heterotrophic
- Leaf Input: Heterotrophic streams >0.25 in spring and summer; > 0.5 in winter and autumn
- Top-Down: The lower the better, means more of the vegetable eating trophic groups are present
- Simpson's Diversity (1-D): the greater the value, the greater the sample diversity
- Taxa Density: the higher the better, lower numbers indicate large numbers of fewer taxa

Table 3. Cumulative SMIE Program data (Spring 2005 – Fall 2008)

Site #	Site	County	Date	Taxa Richness	EPT Taxa	VASOS Score	Izaak Walton League Score
101	Big Ivy	Madison	Spring 2005	17	7	9	11
			Fall 2005	17	7	7	26
			Spring 2006	14	8	9	22
			Fall 2006	8	3	12	16
			Spring 2007	13	6	12	11
			Fall 2007	18	8	6	17
			Spring 2008	15	7	9	23
			Fall 2008	18	7	7	22
102	Little Ivy	Buncombe	Spring 2005	13	5	9	10
			Fall 2005	11	5	7	18
			Spring 2006	16	8	12	21
			Fall 2006	13	4	10	17
			Spring 2007	12	5	11	17
			Fall 2007	15	6	7	24
			Spring 2008	13	6	9	17
			Fall 2008	14	5	10	16
105	Sandymush Ck	Buncombe	Fall 2005	12	6	6	19
			Spring 2006	14	6	7	12
			Fall 2006	13	7	8	16
			Fall 2007	15	8	6	18
			Spring 2008	15	7	10	16
			Fall 2008	15	8	8	18
106	Newfound Ck	Buncombe	Fall 2005	17	7	6	20
			Spring 2006	18	7	7	19
			Fall 2006	18	6	8	25
			Fall 2007	11	4	7	13
			Spring 2008	19	7	9	17
			Fall 2008	15	4	5	21
115	Swannanoa River @ dws of Beetree Ck	Buncombe	Spring 2005	11	6	9	5
			Fall 2005	10	6	8	15
			Spring 2006	17	9	8	15
			Fall 2006	12	4	5	18
			Spring 2007	13	8	10	14
			Fall 2007	12	2	6	14
			Spring 2008	17	8	9	25
			Fall 2008	16	6	7	22

Table 3 (continued). Cumulative SMIE Program data (Spring 2005 – Fall 2008)

Site #	Site	County	Date	Taxa Richness	EPT Taxa	VASOS Score	Izaak Walton League Score
117	Hominy Ck	Buncombe	Spring 2005	12	7	9	8
			Fall 2005	12	8	7	18
			Spring 2006	13	8	9	14
			Fall 2006	15	7	7	20
			Fall 2007	12	8	6	17
			Spring 2008	15	7	10	28
			Fall 2008	18	10	7	23
119	Bent Creek @ the Arboretum	Buncombe	Spring 2005	15	7	9	8
			Fall 2005	16	9	8	20
			Spring 2006	17	11	8	18
			Fall 2006	17	8	9	28
			Spring 2007	22	11	11	24
			Fall 2007	13	7	7	23
			Spring 2008	17	10	10	24
Fall 2008	14	8	10	19			
123	Cane Ck	Buncombe	Spring 2005	12	8	9	6
			Fall 2005	11	7	9	12
			Spring 2006	17	11	8	14
			Fall 2006	16	10	8	12
			Spring 2007	16	9	9	20
			Fall 2007	17	8	7	25
			Spring 2008	15	8	11	21
Fall 2008	13	7	9	22			
124	Ashworth Ck	Buncombe	Spring 2005	15	8	7	12
			Fall 2005	15	8	7	20
			Spring 2006	16	7	10	20
			Fall 2006	14	8	6	20
			Spring 2007	17	8	10	26
			Fall 2007	19	8	10	30
			Spring 2008	17	8	12	28
Fall 2008	17	7	6	27			
149	Swannanoa River @ ups of Bull Creek	Buncombe	Spring 2005	13	9	9	13
			Fall 2005	11	4	7	14
			Spring 2006	17	6	6	21
			Fall 2006	13	4	5	8
			Spring 2007	16	6	9	8
			Fall 2007	14	4	5	23
			Spring 2008	17	5	11	31
Fall 2008	15	3	5	21			

Table 3 (continued). Cumulative SMIE Program data (Spring 2005 – Fall 2008)

Site #	Site	County	Date	Taxa Richness	EPT Taxa	VASOS Score	Izaak Walton League Score
180	Reems Creek	Buncombe	Fall 2007	17	8	11	32
			Spring 2008	18	11	12	24
			Fall 2008	18	10	11	23
181	Reed Ck @ Asheville Botanical Gardens	Buncombe	Spring 2005	10	7	9	9
			Fall 2005	7	2	5	16
			Spring 2006	14	3	5	18
			Fall 2006	7	3	6	10
			Fall 2007	9	3	9	17
			Spring 2008	10	2	6	13
			Fall 2008	10	2	6	13
182	Cane Creek @ Miller Rd	Buncombe	Spring 2008	18	11	11	19
			Fall 2008	14	8	7	23
409	Shelton Laurel Ck	Madison	Spring 2006	24	13	11	15
			Fall 2006	19	11	9	30
			Spring 2007	19	9	12	23
			Fall 2007	20	10	11	23
			Spring 2008	22	12	10	31
			Fall 2008	18	10	12	22
413	California Ck	Madison	Spring 2005	13	6	8	7
			Fall 2005	16	8	7	22
			Spring 2006	16	6	10	22
			Fall 2006	12	5	9	20
			Fall 2007	11	6	8	11
			Spring 2008	17	8	11	24
			Fall 2008	16	7	7	25
480	Puncheon Fork Creek	Madison	Fall 2007	11	9	11	17
			Spring 2008	17	10	9	18
			Fall 2008	17	10	11	21
502	East Fk Pigeon River	Haywood	Fall 2005	21	13	9	20
			Spring 2006	13	8	9	15
			Fall 2006	16	8	12	20
			Spring 2007	21	12	10	22
			Fall 2007	14	6	11	20
			Spring 2008	17	12	10	19
Fall 2008	20	13	10	21			

Table 3 (continued). Cumulative SMIE Program data (Spring 2005 – Fall 2008)

Site #	Site	County	Date	Taxa Richness	EPT Taxa	VASOS Score	Izaak Walton League Score
507	Fines Ck	Haywood	Spring 2005	20	12	10	19
			Fall 2005	14	9	7	19
			Spring 2006	11	9	10	15
			Fall 2006	14	7	9	21
			Spring 2007	20	12	10	22
			Fall 2007	17	8	8	21
			Spring 2008	17	9	10	26
			Fall 2008	17	8	8	25
512	Jonathans Ck @ Coleman Mtn Rd	Haywood	Spring 2005	11	7	10	15
			Fall 2005	14	8	8	17
			Spring 2006	17	9	10	20
			Fall 2006	13	7	10	17
			Spring 2007	13	8	10	18
			Fall 2007	16	9	8	17
			Spring 2008	14	8	10	17
			Fall 2008	17	10	10	22
525	Raccoon Creek	Haywood	Spring 2008	11	5	9	15
			Fall 2008	14	7	8	19
526	Crabtree Ck	Haywood	Spring 2005	14	8	9	9
			Fall 2005	18	11	7	14
			Spring 2006	16	10	10	21
			Fall 2006	17	7	7	22
			Spring 2007	15	6	9	22
			Fall 2007	18	8	7	28
			Spring 2008	17	9	9	21
			Fall 2008	15	10	10	19
527	Jonathans Ck @ Moody Farm Bdge	Haywood	Spring 2005	12	9	9	11
			Fall 2005	13	7	7	19
			Spring 2006	17	10	10	16
			Fall 2006	16	9	11	18
			Spring 2007	16	10	10	15
			Fall 2007	16	9	9	20
			Spring 2008	15	10	10	12
			Fall 2008	13	8	9	18

Table 3 (continued). Cumulative SMIE Program data (Spring 2005 – Fall 2008)

Site #	Site	County	Date	Taxa Richness	EPT Taxa	VASOS Score	Izaak Walton League Score
580	Richland Ck @ ups Hyatt Ck Road	Haywood	Spring 2005	14	8	9	5
			Fall 2005	12	6	8	17
			Spring 2006	10	7	10	12
			Fall 2006	9	6	8	15
			Spring 2007	16	8	10	19
			Fall 2007	14	7	9	19
			Spring 2008	11	7	10	15
			Fall 2008	17	8	10	23
581	Pigeon River @ dws Canton	Haywood	Fall 2006	12	2	2	14
			Spring 2007	15	7	4	20
			Fall 2007	12	2	2	11
			Spring 2008	10	3	4	14
			Fall 2008	8	2	3	11
904	Big Laurel Ck	Madison	Fall 2005	18	11	8	25
			Spring 2006	18	10	12	25
			Fall 2006	16	9	11	19
			Spring 2007	17	9	12	16
			Fall 2007	15	10	11	20
			Spring 2008	17	19	11	28
			Fall 2008	14	7	9	14
1481	Cane Creek (Mitchell County)	Mitchell	Spring 2008	21	9	12	24
			Fall 2008	12	7	11	18
1480	Cane River	Yancey	Fall 2008	15	6	8	18
Discontinued sites							
9	Flat Ck	Buncombe	Spring 2005	12	9	8	5
24	Christian Creek	Buncombe	Fall 2007	11	4	7	23
What do the scores mean?							
Total Taxa Richness		= the higher the better					
EPT Taxa Richness		= the higher the better					
Izaak Walton Score		Excellent > 22					
		Good =17-22					
		Fair =11-16					
		Poor <11					
Note: IWL modified their index calculation; the SMIE Program used the revised methods in spring 2008, all previous years data were calculated using the old methods.							
VA SOS Rating		Acceptable		7-12			
		Unacceptable		0-6			

Appendix A

Taxa list for the Stream Monitoring Information Exchange Program

Organism ID Number	Group Name	Organism ID Number	Group Name
INSECTS		DIPTERANS	
	STONEFLIES	29	Watersnipe
1	Giant Shredder	30	Water-worm
2	Roach Shredder	31	Fat-head Cranefly
3	Quick Crawling Predator	32	Chironomid Midge
4	Fragile Detritivore	33	Red Midge
		34	Blackfly
	MAYFLIES	NON-INSECTS	
5	Flattened Scrapers	27	Oligochaete
6	Spiny Crawler	28	Leech
7	Round Headed Swimmer		
8	Burrowing Mayflies		
9	Spiny Turtle Mayfly		
10	Filter Mayfly		
	CADDISFLIES		CRUSTACEAN S
	Free Living	35	Crayfish
11	Net Spinner	36	Sowbug (Isopod)
12	Small Head Caddis	37	Scud (Amphipod)
	Vegetated Cases		
13	Stick Bait Caddis		SNAILS
14	Square Log Cabin Caddis	38	Coiled Left Face Snail
15	Sand and Stick Case Caddis	39	Coiled Right Face Snail
16	Vegetative Case Caddis	40	Rounded Right Face Snail
	Mineral Cases		
17	Gravel Coffin Case Caddis	41	Clams and Mussels
18	Sand Snail Case		
19	Sand or Mineral Case Caddis		
	BEEYLES		
20	Water Penny		
21	Predator Beetle		
22	Adult Riffle Beetle		
23	Larval Riffle Beetle		
	MEGALOPTERANS		
24	Hellgrammite		
25	Fishfly		
26	Alderfly		
	ODONATES		
42	Damselfly		
43	Dragonfly		