MACROINVERTEBRATE ASSESSMENT OF MAYO CREEK NEAR THE V. C. SUMMER NUCLEAR STATION OPERATED BY SOUTH CAROLINA ELECTRIC & GAS COMPANY, FAIRFIELD COUNTY, SOUTH CAROLINA

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TABLE OF CONTENTS

		Page
	LIST OF TABLES	ii
	LIST OF FIGURES	v
I	SUMMARY	1
II	INTRODUCTION	2
III	DESCRIPTION OF STUDY AREA	2
IV	METHODS	4
	A. Field Sampling	4
	B. Water Chemistry	4
	C. Sample Processing	4
	D. Data Analysis	4
V	RESULTS	7
	A. Physicochemical Analysis	7
	B. Macroinvertebrate Community Analysis (23 April 2009)	7
VI	DISCUSSION	12
VII	REFERENCES	13

LIST OF TABLES

Table		Page
1	Physicochemical data collected in conjunction with the macroinvertebrate assessment of Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.	7
2	Macroinvertebrates, their North Carolina biotic index tolerance values (TV), functional feeding groups (FG), and abundance collected from Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.	14
3	Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.	18
4	Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the VC Summer Nuclear Station, Fairfield County, South Carolina, 18 July 2008.	19
5	Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the VC Summer Nuclear Station, Fairfield County, South Carolina, 15 October 2008.	20
6	Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 29 January 2009.	21
7	Dominant taxa (>5% of the collection) for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.	22
8	Habitat assessment scores determined in conjunction with the macroinvertebrate assessment for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.	23
9	Physicochemical data collected in conjunction with the macroinvertebrate assessment of Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina.	24

LIST OF TABLES

Table		Page
10	Results of the two-factor ANOVA to detect differences in taxa richness through time and between sampling locations at Mayo Creek.	24
11	Averages of the $\log_{10}(x+1)$ transformed taxa richness data at Mayo Creek, listed in ascending order.	24
12	Results of the two-factor ANOVA to detect differences in taxa richness through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.	25
13	Results of the two-factor ANOVA to detect differences in total abundance through time and between sampling locations at Mayo Creek.	25
14	Results of the two-factor ANOVA to detect differences in percent of the dominant taxon through time and between sampling locations at Mayo Creek.	25
15	Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations at Mayo Creek.	25
16	Averages of the $\log_{10}(x+1)$ transformed EPT index data at Mayo Creek, listed in ascending order.	26
17	Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.	26
18	Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations of the 15 October 2008 and 18 July 2008 assessments at Mayo Creek.	26
19	Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations of the 29 Jan 2009 and 23 Apr 2009 assessments at Mayo Creek.	26
20	Results of the two-factor ANOVA to detect differences in EPT abundance through time and between sampling locations at Mayo Creek.	27
21	Averages of the $\log_{10}(x+1)$ transformed EPT abundance data at Mayo Creek, listed in ascending order.	27
22	Results of the two-factor ANOVA to detect differences in EPT abundance through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.	27
23	Results of the two-factor ANOVA to detect differences in NCBI through time and between sampling locations at Mayo Creek.	27

LIST OF TABLES

Table		Page
24	Averages of the $\log_{10}(x+1)$ transformed NCBI data at Mayo Creek, listed in ascending order.	28
25	Results of the two-factor ANOVA to detect differences in NCBI through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.	28
26	Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations at Mayo Creek.	28
27	Averages of the $\log_{10}(x+1)$ transformed SCDHEC bioclassification data at Mayo Creek, listed in ascending order.	28
28	Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.	29
29	Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations of the 15 October 2008 and 18 July 2008 assessments at Mayo Creek.	29
30	Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations of the 29 Jan 2009 and 23 Apr 2009 assessments at Mayo Creek.	29

LIST OF FIGURES

Figure		Page
1	Sampling locations for benthic macroinvertebrates collected from Mayo Creek near the V. C. Summer Nuclear Station, operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, Fairfield County, South Carolina.	3

I. SUMMARY

On April 23, 2009, CARNAGEY BIOLOGICAL SERVICES, LLC (SCDHEC Laboratory Certification Number 32572) conducted a benthic macroinvertebrate community assessment on Mayo Creek, near the V. C. Summer Nuclear Station, operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY. One objective of this assessment was to determine the condition of the stream's macroinvertebrate community at the time of sampling. A second objective was to compare the condition of the stream in four different seasons of the year.

Results of the benthic macroinvertebrate assessment conducted on Mayo Creek, April 23, 2009, indicated the creek's macroinvertebrate community was fully supported. All three stations had SCDHEC bioclassification scores of "good". The NCBI rating for of all three was "excellent". All three stations shared similar taxa richness, total abundance, EPT indices, and EPT abundance.

Through time the metrics indicated that the 18 July 2008 and the 15 October 2008 assessments were not significantly different from each other. The 29 January 2009 and 23 April 2009 assessments were significantly better than these two previous samples in SCDHEC bioclassification and EPT indices. Finally, the 23 April 2009 sample was significantly better than the 29 January 2009 assessment in NCBI, EPT abundance, and taxa richness.

The water chemistry data measured in conjunction with the 23 April 2009 macroinvertebrate assessment reflected similar pH, conductivity, and dissolved oxygen at all three stations. Temperature increased from 13.7 °C at Station 2 to 15.2 °C at Station 3. When compared across seasons, pH was similar in all seasons. Conductivity decreased with decreasing temperature. Dissolved oxygen increased with increasing temperature. All parameters monitored were within water quality standards for Class FW waters of the State of South Carolina (SCDHEC, 1998).

II. INTRODUCTION

On April 23, 2009, a benthic macroinvertebrate community assessment was conducted on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina. Three other assessments were conducted on 18 July 2008, 15 October 2008, and 29 Jan 2009

III. DESCRIPTION OF STUDY AREA

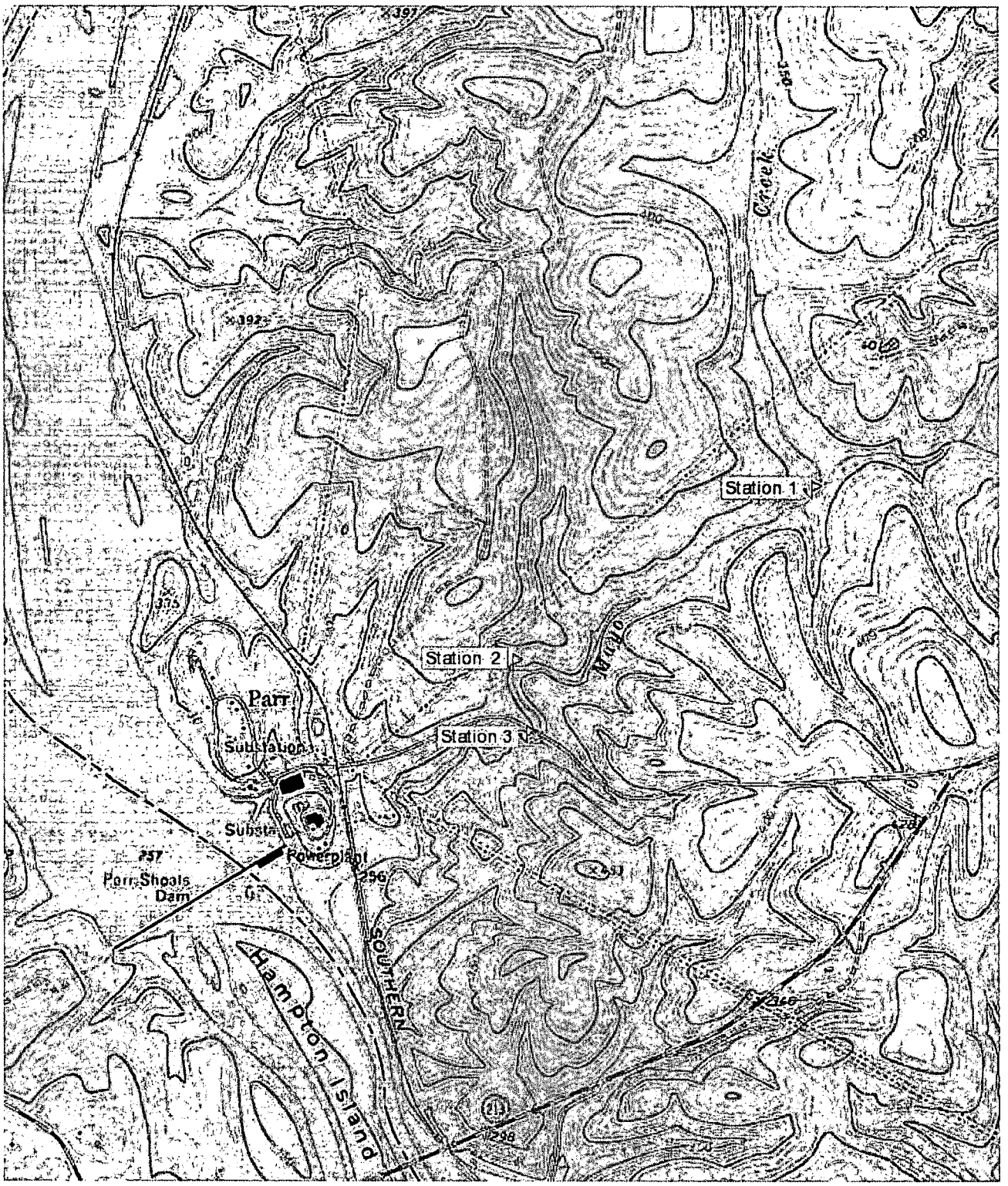
Collections of aquatic macroinvertebrates were made from three sampling locations in Mayo Creek near the V. C. Summer Nuclear Station (Figure 1).

Station 1 was located approximately 1.5 kilometers upstream of Parr Road below the confluence of a small unnamed tributary. The creek at this point was approximately 1.0 to 2.3 meters wide, and less than 0.1 to 0.2 meters deep. The substrate consisted mainly of sand with some gravel, cobble, and boulders, and the canopy provided approximately 30% cover.

Station 2 was located approximately 170 meters upstream of Parr Road. The creek at this point was 0.8 to 1.3 meters wide and less than 0.1 to 0.3 meters deep. The substrate consisted mainly of sand, with some cobble and exposed cobble and bedrock. This station had approximately 35% canopy cover.

Station 3 was established approximately 50 meters downstream of Parr Road. The creek at this point was 0.8 to 2.1 meters wide and less than 0.1 to 0.2 meters deep. The substrate consisted mainly of sand, with some gravel, cobble, and boulders. This station had approximately 50% canopy cover.

Figure 1. Sampling locations for macroinvertebrates collected from Mayo Creek near the V. C. Summer Nuclear Station, operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, Fairfield County, South Carolina.



IV. METHODS

A. Field Sampling

Qualitative collections of aquatic macroinvertebrates were made with a D-frame aquatic dip net, a U.S. Standard No. 30 sieve, and hand picking organisms from substrates with forceps. The multiple habitat approach, where specimens from all available habitats (stream margins, leaf packs, aquatic vegetation, water-soaked logs, and sand deposits) are pooled to form one aggregate sample was utilized as the sampling procedure. Samples were preserved in the field with 70% ethanol. Each sample represented 1.5 hours of sampling effort. Sampling procedures and habitat types were kept similar at each station to enable species and numerical population comparisons between stations. Habitat scores were determined using the *Habitat Assessment Field Data Sheet for Low Gradient Streams* (Barbour *et al.*, 1999).

B. Water Chemistry

Water chemistry parameters measured at each station in conjunction with the macroinvertebrate sampling included temperature, pH, conductivity, and dissolved oxygen.

C. Sample Processing

Upon return to the laboratory, macroinvertebrates were sorted from debris with the aid of a stereomicroscope. The macroinvertebrates were enumerated and identified to the lowest positive taxonomic level with the aide of appropriate microscopic techniques and taxonomic keys. All specimens will be maintained in CARNAGEY BIOLOGICAL SERVICES, LLC voucher collection for five years or placed into the permanent reference collection.

D. Data Analysis

Comparisons of the macroinvertebrate communities were based on the known tolerance levels and life history strategies of the organisms encountered and on taxonomic composition of each station. Comparisons of the macroinvertebrate communities were based on two-factor analysis of variance (ANOVA) to detect differences through time and between sampling locations of a number of the metrics listed below. Data were $\log_{10}(x+1)$ transformed prior to analysis. These metrics are outlined in Rapid Bioassessment Protocol III of the US EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Plafkin *et al.* 1989) and SCDHEC's *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC, 1999). They included the following:

1) Taxa richness - The number of different taxa found at a particular location is an indication of diversity. Reductions in community diversity have been positively associated with various forms of environmental pollution, including nutrient loading, toxic substances,

and sedimentation (Barbour *et al.*, 1996; Fore *et al.*, 1996; Rosenberg and Resh, 1993; Shackleford, 1988).

2) EPT Index - EPT Index is the number of taxa from the insect orders Ephemeroptera, Plecoptera and Trichoptera found at a station. These three insect orders are considered to be intolerant of adverse changes in water quality, especially temperature and dissolved oxygen, and therefore, a reduction in these taxa is indicative of reduced water quality (Barbour *et al.*, 1996; Lenat, 1988).

3) Chironomidae taxa and abundance - The Chironomidae are a taxonomically and ecologically diverse group with many taxa which are tolerant of various forms of pollution. The chironomids are often the dominant group encountered at impacted or stressed sites (Rosenberg and Resh, 1993).

4) Ratio of EPT and Chironomidae abundance - The relative abundance of these four indicator groups is a measure of community balance. When compared to a reference site, good biotic conditions are reflected in a fairly even distribution among these four groups (Plafkin *et al.*, 1989). The value of this ratio is reduced by impact due to the general reduction of the more sensitive EPT taxa and an increase in the more tolerant chironomid taxa.

5) Ratio of scraper/scraper and filtering collectors - When compared to a reference site, shifts in the dominance of a particular feeding type may indicate a community responding to an over-abundance of a particular food source or toxicants bound to a particular food source (Rosenberg and Resh, 1993).

6) Shredder/total number of specimens collected - When compared to a reference site, reductions in the relative abundance of shredders can indicate changes in the quality or quantity of riparian zone vegetation or the presence of toxic substances bound to organic carbon contained in the leaf and woody material which comprises their food source (Plafkin *et al.*, 1989).

7) Percent contribution of dominant taxon - This measures the redundancy and evenness of the community structure. It assumes a highly redundant community reflects an impaired community because as the more sensitive taxa are eliminated, there is often a significant increase in the remaining tolerant forms (Barbour *et al.*, 1996; Shackleford, 1988).

8) North Carolina biotic index (Table 1) - This index utilizes a pollution tolerance value developed over a wide range of conditions and pollution types to assess the amount of impact (North Carolina Department of Environment, Health and Natural Resources, 1997). The values range from 0-10, increasing as water quality decreases. Taxa are designated as

Rare (1-2 specimens), Common (3-9 specimens), or Abundant (≥10 specimens) and assigned a 1, 3, or 10 abundance code, respectively, for calculation of the NCBI.

9) SCDHEC bioclassification – Bioclassification is determined by averaging scores for the NCBI and EPT index at each station, then rating sites as "Excellent, Good, Good-Fair, Fair, or Poor" (SCDHEC, 1999).

V. RESULTS

A. Physicochemical Analysis

The water chemistry data measured in conjunction with the 23 April 2009 macroinvertebrate assessment are presented in Table 2. The data reflected similar pH, conductivity, and dissolved oxygen at all three stations. Temperature increased from 13.7 °C at Station 2 to 15.2 °C at Station 3. When compared across seasons, pH was similar in all seasons (Table 9). Conductivity decreased with decreasing temperature. Dissolved oxygen increased with increasing temperature.

Table 1. Physicochemical data collected in conjunction with the macroinvertebrate assessment of Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.

	Station		
Parameter	**1**	**2**	**3**
Water Temperature (°C)	13.6	13.7	15.2
pH (SU)	7.1	7.2	7.3
Conductivity (μmhos/cm)	82	110	111
Dissolved Oxygen (mg/l)	9.2	9.5	9.5

B. Macroinvertebrate Community Analysis (23 April 2009)

A total of 663 specimens representing 68 taxa were collected from Mayo Creek during the 23 April 2009 assessment. The taxa list, number of specimens, and relative abundance for each taxon are presented in Table 2. Bioassessment metrics for each sampling station are presented in Table 3. Table 7 lists the dominant taxa for each sampling station. Habitat assessment scores are presented in Table 8 for each station.

The sampling effort at Station 1, the upstream control, yielded 244 specimens representing 43 taxa. An EPT index of 21 was calculated for this station. The Chironomidae were represented by 4 taxa and contributed 7% of the total specimens collected. The NCBI value of 4.59 resulted in a water quality rating of "excellent" for this station. The SC Bioclassification score of 4.0 indicated a "good" rating for Station 1. The dominant functional feeding group was the collector-gatherers, which contributed 44% of the collection. The dominant taxon was *Acentrella* sp., which contributed 13% of the collection.

Station 2 yielded 204 specimens representing 38 taxa. An EPT index of 19 was calculated for this station. The Chironomidae were represented by 2 taxa and contributed 1% of the total specimens collected. The NCBI value of 4.19 results in a water quality rating of

"excellent" for this station. The SC Bioclassification score of 4.0 indicated a "good" rating for Station 2. The dominant functional feeding group was the collector-gatherers, which contributed 59% of the collection. The dominant taxon was *Caenis* sp., which contributed 31% of the specimens collected.

Station 3 yielded 215 specimens representing 34 taxa. An EPT index of 17 was calculated for this station. The Chironomidae were represented by 7 taxa and contributed a total of 8% of the specimens collected. The NCBI value of 4.36 results in a water quality rating of "excellent" for this station. The SC Bioclassification score of 3.8 indicated a "good" rating for Station 3. The dominant functional feeding group was the collector-gatherers, which contributed 52% of the collection. The dominant taxon was *Caenis* sp., which contributed 18% of the specimens collected.

The bioassessment metrics indicated a number of differences at Station 1 among the 18 July 2008, 15 October 2008, 29 January 2009, and the 23 April 2009 assessments. Taxa richness, EPT Indices and SCDHEC bioclassification values all increased from each previous assessment. NCBI values decreased from the previous assessments. Total abundance and EPT abundance showed a general increasing trend from the previous assessment.

At Station 2, the bioassessment metrics showed similar trends to those at Station 1. EPT Indices steadily increased from each previous assessment. NCBI values steadily decreased from each previous assessment.

At Station 3, taxa richness, total abundance, EPT indices, EPT abundance, and SCDHEC bioclassification values tended to increase from each previous assessment. With the exception of the 15 October 2008 assessment, NCBI values decreased from each previous assessment.

Results of a two-factor ANOVA to detect differences in taxa richness through time and between sampling locations at Mayo Creek are presented in Table 10. There was no significant difference (p-value = 0.37343) in taxa richness at Mayo Creek between sampling locations. There was a significant difference (p-value = 0.02431) in taxa richness through time at Mayo Creek.

In order to determine which assessment had significant differences in taxa richness, a multiple comparison procedure consisting of additional single-factor ANOVAs was

performed. The averages of the $\log_{10}(x+1)$ transformed taxa richness data are listed in ascending order in Table 11. Since the 23 April 2009 assessment had the highest average $\log_{10}(x+1)$ transformed taxa richness, an ANOVA was performed without that assessment's data. This ANOVA showed no significant difference between the 18 July 2008, 15 October 2008, and 29 January 2009 assessments (p-value = 0.48911, Table 12).

Results of a two-factor ANOVA to detect differences in total abundance through time and between sampling locations at Mayo Creek are presented in Table 13. There was no significant difference in total abundance at Mayo Creek between sampling locations (p-value = 0.33794) or through time (p-value = 0.34617).

Results of a two-factor ANOVA to detect differences in the percent of the dominant taxon through time and between sampling locations at Mayo Creek are presented in Table 14. There was no significant difference in the percent of the dominant taxon at Mayo Creek between sampling locations (p-value = 0.20708) or through time (p-value = 0.17786).

Results of a two-factor ANOVA to detect differences in EPT index through time and between sampling locations at Mayo Creek are presented in Table 15. There was no significant difference (p-value = 0.92780) in EPT index at Mayo Creek between sampling locations. There was a significant difference (p-value = 0.00069) in EPT index through time at Mayo Creek.

In order to determine which assessment had significant differences in EPT index, a multiple comparison procedure consisting of additional single-factor ANOVAs was performed. The averages of the $\log_{10}(x+1)$ transformed EPT index data are listed in ascending order in Table 16. Since the 23 April 2009 assessment had the highest average $\log_{10}(x+1)$ transformed EPT index, an ANOVA was performed without that assessment's data. This ANOVA showed a significant difference between the 18 July 2008, 15 October 2008, and 29 January 2009 assessments (p-value = 0.01657, Table 17). A third ANOVA showed no significant difference between the 18 July 2008 and 15 October 2008 assessments (p-value = 0.72443, Table 18). A fourth ANOVA showed no significant difference between the 29 January 2009 and 23 April 2009 assessments (p-value = 0.18402, Table 19).

Results of a two-factor ANOVA to detect differences in EPT abundance through time and between sampling locations at Mayo Creek are presented in Table 20. There was no significant difference (p-value = 0.58304) in EPT abundance at Mayo Creek between

sampling locations. There was a significant difference (p-value = 0.00107) in EPT abundance through time at Mayo Creek.

In order to determine which assessment had significant differences in EPT abundance, a multiple comparison procedure consisting of additional single-factor ANOVAs was performed. The averages of the $\log_{10}(x+1)$ transformed EPT abundance data are listed in ascending order in Table 21. Since the 23 April 2009 assessment had the highest average $\log_{10}(x+1)$ transformed EPT abundance, an ANOVA was performed without that assessment's data. This ANOVA showed no significant difference between the 18 July 2008, 15 October 2008, and 29 January 2009 assessments (p-value = 0.11894, Table 22).

Results of a two-factor ANOVA to detect differences in NCBI through time and between sampling locations at Mayo Creek are presented in Table 23. There was no significant difference (p-value = 0.37466) in NCBI at Mayo Creek between sampling locations. There was a significant difference (p-value = 0.00061) in NCBI through time at Mayo Creek.

In order to determine which assessment had significant differences in NCBI, a multiple comparison procedure consisting of additional single-factor ANOVAs was performed. The averages of the $\log_{10}(x+1)$ transformed NCBI data are listed in ascending order in Table 24. Since the 23 April 2009 assessment had the lowest average $\log_{10}(x+1)$ transformed NCBI, an ANOVA was performed without that assessment's data. This ANOVA showed no significant difference between the 18 July 2008, 15 October 2008, and 29 January 2009 assessments (p-value = 0.05262, Table 25).

Results of a two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations at Mayo Creek are presented in Table 26. There was no significant difference (p-value = 0.26502) in SCDHEC bioclassification at Mayo Creek between sampling locations. There was a significant difference (p-value = 0.00099) in SCDHEC bioclassification through time at Mayo Creek.

In order to determine which assessment had significant differences in SCDHEC bioclassification, a multiple comparison procedure consisting of additional single-factor ANOVAs was performed. The averages of the $\log_{10}(x+1)$ transformed SCDHEC bioclassification data are listed in ascending order in Table 27. Since the 23 April 2009 assessment had the highest average $\log_{10}(x+1)$ transformed SCDHEC bioclassification, an ANOVA was performed without that assessment's data. This ANOVA showed a significant

difference between the 18 July 2008, 15 October 2008, and 29 January 2009 assessments (p-value = 0.02854, Table 28). A third ANOVA showed no significant difference between the 18 July 2008 and 15 October 2008 assessments (p-value = 0.90248, Table 29). A fourth ANOVA showed no significant difference between the 29 January 2009 and 23 April 2009 assessments (p-value = 0.07128, Table 30).

VI. DISCUSSION

Results of the benthic macroinvertebrate assessment conducted on Mayo Creek, April 23, 2009, indicated the creek's macroinvertebrate community was fully supported. All three stations had SCDHEC bioclassification scores of "good". The NCBI rating for of all three was "excellent". All three stations shared similar taxa richness, total abundance, EPT indices, and EPT abundance.

Examination of the bioassessment metrics indicated that at all three stations, the overall quality of the stream increased from each previous assessment. This may be related to increased rainfall during the study.

Two-factor ANOVAs indicated that there were no significant differences between the three stations for any of the metrics tested.

Two factor ANOVA indicated that the 23 April 2009 assessment had significantly higher taxa richness, EPT abundance, and NCBI through time than the other three assessments. The 18 July 2008, 15 October 2008, and 29 January 2009 assessments did not vary significantly for the metrics. EPT indices and SCDHEC bioclassification were significantly greater through time for the 29 January 2009 and 23 April 2009 assessments than for the 18 July 2008 and 15 October 2008 assessments. The 29 January 2009 and 23 April 2009 assessments were not significantly different. Nor were the 18 July 2008 and 15 October 2008 assessments. Neither total abundance or the percentage of the dominant taxon was significant across time.

Thus, the highest quality was found in the 23 April 2009 assessment, followed by the 29 January 2009 assessment. There was no significant differences between the 18 July 2008 or 15 October 2008 assessments.

The water chemistry data measured in conjunction with the 23 April 2009 macroinvertebrate assessment reflected similar pH, conductivity, and dissolved oxygen at all three stations. Temperature increased from 13.7 °C at Station 2 to 15.2 °C at Station 3. When compared across seasons, pH was similar in all seasons. Conductivity decreased with decreasing temperature. Dissolved oxygen increased with increasing temperature. All parameters monitored were within water quality standards for Class FW waters of the State of South Carolina (SCDHEC, 1998).

VII. REFERENCES

Barbour, M.T.; J. Gerritsen; G.E. Griffith; R. Frydenborg; E. McCarron; J.S. White; and M.L. Bastian. 1996. A framework for biological criteria for Florida streams using benthic macroinvertebrates. J. N. Am. Benthol. Soc. 15:185-211.

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Breitenmoser-Würsten, C. and M. Satori. 1995. Distribution, diversity, life cycle and growth of a mayfly community in a prealpine stream (Insecta, Ephemeroptera). Hydrobiol. 308: 85-101.

Courtemanch, D.L. and S.P. Davies. 1987. A coefficient of community loss to assess detrimental change in aquatic communities. Water Research 21:217-222.

Fore, L.S.; J.R. Karr; and R.W. Wisseman. 1996 Assessing invertebrate responses to human activities: evaluation of alternative approaches. J. N. Am. Benthol. Soc. 15:212-232.

Jaccard, P. 1912. The distribution of flora in the alpine zone. New Phytologist 11: 37-50.

Lenat, D.R. 1988. Water quality assessment of streams using a qualitative collection method for benthic macroinvertebrates. J. N. Am. Benthol. Soc. 7: 222-233.

North Carolina Department of Environment, Health and Natural Resources. 1997. Standard operating procedures: biological monitoring. State of North Carolina. Division of Water Quality, North Carolina Department of Environment, Health and Natural Resources, Raleigh, NC, 65 pp.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and, R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers. US EPA Assessment and Watershed Protection Division, Washington, D.C. EPA/444/4-89/001.

Rosenberg, D.M. and V.H. Resh (eds.) 1993. Freshwater biomonitoring and benthic macroinvertebrates. Chapman and Hall, New York, New York. 488pp.

Shackleford, B. 1988. Rapid bioassessment of lotic macroinvertebrate communities: Biocriteria development. Biomonitoring Section, Arkansas Dept. Poll. Contl. And Ecol. Little Rock, Ark. 45pp.

South Carolina Department of Health and Environmental Control. 1998. Water classifications and standards (Regulation 61-68), Classified waters (Regulation 61-69). State of South Carolina. Office of Environmental Quality Control, SC DHEC, Columbia, SC.

South Carolina Department of Health and Environmental Control. 1999. Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling. Technical Report No. 004-98. Bureau of Water, Division of Water Monitoring, Assessment, and Protection, Aquatic Biology Section. SC DHEC, Columbia, SC. 18+ pp.

Table 2. Macroinvertebrates, their North Carolina biotic index tolerance values (TV), functional feeding groups (FG), and abundance collected from Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
Annelida									
Oligochaeta									
Lumbriculida									
Lumbriculidae									
1	Lumbriculus sp.	7.23	SC	1			0.00		
Tubificida									
Naididae									
2	Nais sp.	9.08	SC			1			0.00
3	Stylaria lacustris	9.58	SC	3			0.01		
4	Tubifex tubifex	10.20	SC		1			0.00	
Arthropoda									
Arachnoidea									
Acariformes									
Hydrachnidae									
5	Hydrachna sp.	5.73	P		2	2		0.01	0.01
Insecta									
Coleoptera									
Dryopidae									
6	Helichus fastigiatus	4.83	SC		2			0.01	
Dytiscidae									
7	Neoporus mixtus		P	1			0.00		
8	Neoporus sp.		P	1			0.00		
9	Neoporus striatopunctatus		P	1			0.00		
10	Neoporus vittatipennis		P	4			0.02		
Elmidae									
11	Dubiraphia quadrinotata	6.13	CG		1			0.00	
12	Dubiraphia vittata	6.13	OM		1			0.00	
13	Macronychus glabratus	4.78	CG	1	2	1	0.00	0.01	0.00
14	Microcylloepus pusillus	2.31	CG		2			0.01	
15	Stenelmis sp.	5.30	SC	8	3	1	0.03	0.01	0.00
Ptilodactylidae									
16	Anchytarsus bicolor	3.84	SH	1			0.00		
Staphylinidae									
17	Staphylinidae Genus species		P	1			0.00		

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 2. Continued.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
Diptera									
Ceratopogonidae									
18	Bezzia/Palpomyia sp.	7.06	P	1			0.00		
Chironomidae									
19	Ablabesmyia mallochi	7.39	P	1			0.00		
20	Brillia flavifrons	5.38	SH		1			0.00	
21	Cricotopus sp.	5.49	SH			2			0.01
22	Neozavrelia sp.		0			1			0.00
23	Orthocladius sp.	6.14	SH	7		5	0.03		0.02
24	Parametriocnemus sp.		CG			4			0.02
25	Polypedilum fallax gr.	6.59	SH	8			0.03		
26	Polypedilum flavum	5.98	SH	2		1	0.01		0.00
27	Thienemanniella xena	6.06	CG			1			0.00
28	Thienemannimyia gr.	8.62	P		1	4		0.00	0.02
Dixidae									
29	Dixella indiana		CG		1			0.00	
Simuliidae									
30	Prosimulium sp.	4.21	CF			3			0.01
31	Simulium sp.	4.20	CF		4	10		0.02	0.05
32	Simulium ubiquitum	4.20	CF		3	13		0.01	0.06
Tipulidae									
33	Hexatoma sp.	4.51	P	3			0.01		
34	Tipula sp.	7.53	SH	2			0.01		
Ephemeroptera									
Baetidae									
35	Acentrella sp.	4.20	CG	31	2	19	0.13	0.01	0.09
36	Baetis intercalaris	5.19	CG	5	4	25	0.02	0.02	0.12
37	Baetis pluto	4.48	CG	2	2	3	0.01	0.01	0.01
38	Centroptilum triangulifer	6.80	CG	3	3		0.01	0.01	
39	Pseudocloeon dardanum	4.22	CG	1	3	1	0.00	0.01	0.00
Caenidae									
40	Caenis sp.	7.61	CG	25	64	39	0.10	0.31	0.18

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 2. Continued.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
Ephemerellidae									
41	Dannella simplex	3.81	CG	3	4	6	0.01	0.02	0.03
42	Ephemerella sp.	2.24	CG	30	20	11	0.12	0.10	0.05
43	Eurylophella verisimilis	0.51	CG	2	1		0.01	0.00	
44	Telogonopsis deficiens	2.95	CG	4	11	1	0.02	0.05	0.00
Heptageniidae									
45	Maccaffertium modestum	5.70	SC	23	12	11	0.09	0.06	0.05
Isonychiidae									
46	Isonychia sp.	3.65	CF	7	12	12	0.03	0.06	0.06
Leptophlebiidae									
47	Paraleptophlebia sp.	1.14	CG			1			0.00
Heteroptera									
Belostomatidae									
48	Belostoma lutarium	10.00	P	1			0.00		
Veliidae									
49	Rhagovelia obesa		P		1			0.00	
Megaloptera									
Corydalidae									
50	Corydalus cornutus	5.36	P	2		1	0.01		0.00
Odonata									
Calopterygidae									
51	Calopteryx sp.	7.98	P	3	2		0.01	0.01	
Gomphidae									
52	Gomphus sp.	6.00	P		1			0.00	
53	Hagenius brevistylus	4.19	P		1			0.00	
54	Ophiogomphus sp.	5.74	P	2	1		0.01	0.00	
Plecoptera									
Chloroperlidae									
55	Haploperla brevis	1.18	SC		1			0.00	
Nemouridae									
56	Amphinemura sp.	3.53	SH	9	7	12	0.04	0.03	0.06
Perlidae									
57	Agnetina sp.	0.20	P	11	17	14	0.05	0.08	0.07
Perlodidae									
58	Isoperla sp.	1.70	P	14	3	2	0.06	0.01	0.01

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 2. Continued.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
Trichoptera									
Hydropsychidae									
59	Cheumatopsyche sp.	6.42	CF	8	3	4	0.03	0.01	0.02
60	Hydropsyche betteni	7.98	CF	3			0.01		
61	Hydropsychidae Genus spp.		CF	3			0.01		
Lepidostomatidae									
62	Lepidostoma sp.	1.10	SH			1			0.00
Leptoceridae									
63	Triaenodes ignitus	4.78	SH	1			0.00		
Limnephilidae									
64	Pycnopsyche luculenta \ sonso	2.70	SH	1	2		0.00	0.01	
Philopotamidae									
65	Chimarra sp.	2.96	CF	3	1	1	0.01	0.00	0.00
Malacostraca									
Decapoda									
Cambaridae									
66	Cambaridae Genus species	7.70	OM		2	1		0.01	0.00
Mollusca									
Bivalvia									
Unionoida									
Corbiculidae									
67	Corbicula fluminea	6.32	CF			1			0.00
Platyhelminthes									
Turbellaria									
Tricladida									
Planariidae									
68	Dugesia tigrina	7.43	OM	1			0.00		

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 3. Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.

	Station		
Metric	**1**	**2**	**3**
Taxa Richness	43	38	34
Number of Specimens	244	204	215
EPT Index	21	19	17
EPT Abundance	189	172	163
Chironomidae Taxa	4	2	7
Chironomidae Abundance	18	2	18
EPT/Chironomidae Abundance	10.50	86.00	9.06
North Carolina Biotic Index	4.59	4.19	4.36
SCDHEC Bioclassification	4.0	4.0	3.8
Percent Collector-Filterers	9.84	11.27	20.47
Percent Collector-Gatherers	43.85	58.82	52.09
Percent Omnivores	0.41	1.47	0.47
Percent Predators	18.85	14.22	10.70
Percent Scrapers	14.34	9.31	6.05
Percent Shredders	12.70	4.90	9.77
Scraper/Collector-Filterers	1.46	0.83	0.30
Shredders/Total	0.13	0.05	0.10
Percent Dominant Taxon	12.70	31.37	18.14
Number Of Dominant Taxa	5	6	9

Table 4. Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the VC Summer Nuclear Station, Fairfield County, South Carolina, 18 July 2008.

	Station		
Metric	**1**	**2**	**3**
Taxa Richness	26	33	26
Number of Specimens	151	149	129
EPT Index	8	9	9
EPT Abundance	97	97	92
Chironomidae Taxa	5	4	2
Chironomidae Abundance	24	5	3
EPT/Chironomidae Abundance	4.04	19.40	30.67
North Carolina Biotic Index	6.17	5.73	5.93
SCDHEC Bioclassification	2.3	2.8	2.3
Percent Collector-Filterers	21.19	27.52	10.08
Percent Collector-Gatherers	27.15	30.20	49.61
Percent Omnivores	0.66	2.68	0.00
Percent Predators	23.84	16.78	20.93
Percent Scrapers	23.18	16.11	14.73
Percent Shredders	3.97	6.71	4.65
Scraper/Collector-Filterers	1.09	0.59	1.46
Shredders/Total	0.04	0.07	0.05
Percent Dominant Taxon	23.84	22.15	41.86
Number Of Dominant Taxa	5	5	4

Table 5. Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the VC Summer Nuclear Station, Fairfield County, South Carolina, 15 October 2008.

	Station		
Metric	**1**	**2**	**3**
Taxa Richness	30	23	25
Number of Specimens	182	165	157
EPT Index	9	9	7
EPT Abundance	130	131	108
Chironomidae Taxa	1	3	2
Chironomidae Abundance	2	3	3
EPT/Chironomidae Abundance	65.00	43.67	36.00
North Carolina Biotic Index	5.52	5.81	6.26
SCDHEC Bioclassification	2.8	2.5	2.2
Percent Collector-Filterers	31.32	21.82	28.03
Percent Collector-Gatherers	26.92	47.88	43.31
Percent Omnivores	2.75	3.03	7.01
Percent Predators	20.88	13.33	13.38
Percent Scrapers	12.64	9.09	6.37
Percent Shredders	5.49	4.85	1.91
Scraper/Collector-Filterers	0.40	0.42	0.23
Shredders/Total	0.05	0.05	0.02
Percent Dominant Taxon	24.18	44.85	40.76
Number Of Dominant Taxa	4	4	6

Table 6. Rapid bioassessment metrics calculated for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 29 January 2009.

	Station		
Metric	**1**	**2**	**3**
Taxa Richness	31	29	29
Number of Specimens	150	143	146
EPT Index	14	13	17
EPT Abundance	106	93	118
Chironomidae Taxa	6	3	5
Chironomidae Abundance	19	5	17
EPT/Chironomidae Abundance	5.58	18.60	6.94
North Carolina Biotic Index	5.12	5.21	5.46
SCDHEC Bioclassification	3.7	3.2	3.3
Percent Collector-Filterers	26.00	25.17	19.18
Percent Collector-Gatherers	26.67	34.97	45.89
Percent Omnivores	3.33	2.80	0.00
Percent Predators	8.67	9.09	6.85
Percent Scrapers	22.67	20.28	15.75
Percent Shredders	12.67	7.69	12.33
Scraper/Collector-Filterers	0.87	0.81	0.82
Shredders/Total	0.13	0.08	0.12
Percent Dominant Taxon	20.67	17.48	27.40
Number Of Dominant Taxa	6	6	5

Table 7. Dominant taxa (>5% of the collection) for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.

Station 1			**Station 2**			**Station 3**		
Taxon	**No.**	**Rel. Abd.**	**Taxon**	**No.**	**Rel. Abd.**	**Taxon**	**No.**	**Rel. Abd.**
Acentrella sp.	31	12.70	Caenis sp.	64	31.37	Caenis sp.	39	18.14
Ephemerella sp.	30	12.30	Ephemerella sp.	20	9.80	Baetis intercalaris	25	11.63
Caenis sp.	25	10.25	Agnetina sp.	17	8.33	Acentrella sp.	19	8.84
Maccaffertium modestum	23	9.43	Maccaffertium modestum	12	5.88	Agnetina sp.	14	6.51
Isoperla sp.	14	5.74	Isonychia sp.	12	5.88	Simulium ubiquitum	13	6.05
			Telogonopsis deficiens	11	5.39	Isonychia sp.	12	5.58
						Amphinemura sp.	12	5.58
						Maccaffertium modestum	11	5.12
						Ephemerella sp.	11	5.12

Table 8. Habitat assessment scores determined in conjunction with the macroinvertebrate assessment for the three sampling stations on Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina, 23 April 2009.

Habitat Parameter	***Sta. 1***	***Sta. 2***	***Sta. 3***
1. Epifaunal Substrate/Available Cover	14	14	11
2. Pool Substrate Characterization	16	16	11
3. Pool Variability	7	11	9
4. Sediment Deposition	19	18	18
5. Channel Flow Status	17	20	19
6. Channel Alteration	20	20	18
7. Channel Sinuosity	15	16	12
8. Bank Stability (Left Bank (LB*))	10	10	8
Bank Stability (Right Bank (RB*))	10	10	10
9. Vegetative Protection (LB*)	10	9	10
Vegetative Protection (RB*)	10	7	10
10. Riparian Vegetative Zone (LB*)	10	10	10
Riparian Vegetative Zone (RB*)	10	10	10
Total Score	**168**	**171**	**156**

* Left or right bank is determined when facing downstream.

Table 9. Physicochemical data collected in conjunction with the macroinvertebrate assessment of Mayo Creek near the V. C. Summer Nuclear Station, Fairfield County, South Carolina.

Station	Date	Temperature (°C)	pH (SU)	Conductivity (µmho/cm)	Dissolved Oxygen (mg/L)
1	18 Jul 2008	22.6	7.2	122	6.5
	15 Oct 2008	17.1	7.4	101	12.3
	29 Jan 2009	8.9	7.3	89	11.5
	23 Apr 2009	13.6	7.1	82	9.2
2	18 Jul 2008	21.3	7.0	123	7.2
	15 Oct 2008	15.1	7.3	96	10.8
	29 Jan 2009	9.6	7.6	87	9.9
	23 Apr 2009	13.7	7.2	110	9.5
3	18 Jul 2008	20.9	7.0	126	6.8
	15 Oct 2008	14.9	7.3	106	8.9
	29 Jan 2009	9.4	7.5	88	11.7
	23 Apr 2009	15.2	7.3	111	9.5

Table 10. Results of the two-factor ANOVA to detect differences in taxa richness through time and between sampling locations at Mayo Creek.

ANOVA for Taxa Richness at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.04479	3	0.01493	6.68211	0.02431	4.75706
Location	0.00521	2	0.00261	1.16599	0.37343	5.14325
Error	0.01341	6	0.00223			
Total	0.06340	11				

Table 11. Averages of the $\log_{10}(x+1)$ transformed taxa richness data at Mayo Creek, listed in ascending order.

Average Log (Taxa Richness + 1) at Mayo Creek				
Date	15 Oct 2008	18 Jul 2008	29 Jan 2009	23 Apr 2009
Average	1.42885	1.46474	1.48646	1.59286

Table 12. Results of the two-factor ANOVA to detect differences in taxa richness through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.

ANOVA for Taxa Richness at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.00508	2	0.00254	0.85975	0.48911	6.94427
Location	0.00186	2	0.00093	0.31407	0.74698	6.94427
Error	0.01182	4	0.00295			
Total	0.01875	8				

Table 13. Results of the two-factor ANOVA to detect differences in total abundance through time and between sampling locations at Mayo Creek.

ANOVA for Total Abundance at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.21612	3	0.07204	1.34230	0.34617	4.75706
Location	0.14029	2	0.07014	1.30698	0.33794	5.14325
Error	0.32201	6	0.05367			
Total	0.67842	11				

Table 14. Results of the two-factor ANOVA to detect differences in percent of the dominant taxon through time and between sampling locations at Mayo Creek.

ANOVA for percent of the dominant taxon at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.11589	3	0.03863	2.29425	0.17786	4.75706
Location	0.06974	2	0.03487	2.07075	0.20708	5.14325
Error	0.10103	6	0.01684			
Total	0.28666	11				

Table 15. Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations at Mayo Creek.

ANOVA for EPT Index at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.23603	3	0.07868	27.16451	0.00069	4.75706
Location	0.00044	2	0.00022	0.07588	0.92780	5.14325
Error	0.01738	6	0.00290			
Total	0.25385	11				

Table 16. Averages of the $\log_{10}(x+1)$ transformed EPT index data at Mayo Creek, listed in ascending order.

Average Log (EPT Index + 1) at Mayo Creek				
Date	15 Oct 2008	18 Jul 2008	29 Jan 2009	23 Apr 2009
Average	0.96770	0.98475	1.19250	1.29958

Table 17. Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.

ANOVA for EPT Index at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.09399	2	0.04699	13.53756	0.01657	6.94427
Location	0.00013	2	0.00007	0.01896	0.98131	6.94427
Error	0.01389	4	0.00347			
Total	0.10800	8				

Table 18. Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations of the 15 October 2008 and 18 July 2008 assessments at Mayo Creek.

ANOVA for EPT Index at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.00044	1	0.00044	0.16436	0.72443	18.51282
Location	0.00235	2	0.00118	0.44291	0.69305	19.00000
Error	0.00531	2	0.00265			
Total	0.00809	5				

Table 19. Results of the two-factor ANOVA to detect differences in EPT index through time and between sampling locations of the 29 Jan 2009 and 23 Apr 2009 assessments at Mayo Creek.

ANOVA for EPT Index at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.01720	1	0.01720	3.98487	0.18402	18.51282
Location	0.00153	2	0.00076	0.17712	0.84953	19.00000
Error	0.00863	2	0.00432			
Total	0.02736	5				

Table 20. Results of the two-factor ANOVA to detect differences in EPT abundance through time and between sampling locations at Mayo Creek.

ANOVA for EPT Abundance at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.11710	3	0.03903	23.10550	0.00107	4.75706
Location	0.00200	2	0.00100	0.59106	0.58304	5.14325
Error	0.01014	6	0.00169			
Total	0.12923	11				

Table 21. Averages of the $\log_{10}(x+1)$ transformed EPT abundance data at Mayo Creek, listed in ascending order.

Average Log (EPT Abundance + 1) at Mayo Creek				
Date	18 Jul 2008	15 Oct 2008	29 Jan 2009	23 Apr 2009
Average	1.98365	2.09176	2.02602	2.24388

Table 22. Results of the two-factor ANOVA to detect differences in EPT abundance through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.

ANOVA for EPT Abundance at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.01781	2	0.00890	3.79919	0.11894	6.94427
Location	0.00067	2	0.00033	0.14225	0.87161	6.94427
Error	0.00937	4	0.00234			
Total	0.02785	8				

Table 23. Results of the two-factor ANOVA to detect differences in NCBI through time and between sampling locations at Mayo Creek.

ANOVA for NCBI at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.02353	3	0.00784	28.38382	0.00061	4.75706
Location	0.00064	2	0.00032	1.16144	0.37466	5.14325
Error	0.00166	6	0.00028			
Total	0.02583	11				

Table 24. Averages of the $\log_{10}(x+1)$ transformed NCBI data at Mayo Creek, listed in ascending order.

Average Log (NCBI + 1) at Mayo Creek				
Date	23 Apr 2009	29 Jan 2009	15 Oct 2008	18 Jul 2008
Average	0.73058	0.79669	0.83611	0.84142

Table 25. Results of the two-factor ANOVA to detect differences in NCBI through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.

ANOVA for NCBI at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.00358	2	0.00179	6.71879	0.05262	6.94427
Location	0.00071	2	0.00036	1.33266	0.36015	6.94427
Error	0.00107	4	0.00027			
Total	0.00536	8				

Table 26. Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations at Mayo Creek.

ANOVA for SCDHEC bioclassification at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.05220	3	0.01740	23.81045	0.00099	4.75706
Location	0.00244	2	0.00122	1.67051	0.26502	5.14325
Error	0.00438	6	0.00073			
Total	0.05903	11				

Table 27. Averages of the $\log_{10}(x+1)$ transformed SCDHEC bioclassification data at Mayo Creek, listed in ascending order.

Average Log (SCDHEC bioclassification + 1) at Mayo Creek				
Date	15 Oct 2008	18 Jul 2008	29 Jan 2009	23 Apr 2009
Average	0.53894	0.54300	0.64294	0.69306

Table 28. Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations of the 15 October 2008, 18 July 2008, and 29 January 2009 assessments at Mayo Creek.

ANOVA for SCDHEC bioclassification at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.02082	2	0.01041	9.83949	0.02854	6.94427
Location	0.00239	2	0.00119	1.12715	0.40904	6.94427
Error	0.00423	4	0.00106			
Total	0.02744	8				

Table 29. Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations of the 15 October 2008 and 18 July 2008 assessments at Mayo Creek.

ANOVA for SCDHEC bioclassification at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.00002	1	0.00002	0.01920	0.90248	18.51282
Location	0.00271	2	0.00136	1.05072	0.48763	19.00000
Error	0.00258	2	0.00129			
Total	0.00531	5				

Table 30. Results of the two-factor ANOVA to detect differences in SCDHEC bioclassification through time and between sampling locations of the 29 Jan 2009 and 23 Apr 2009 assessments at Mayo Creek.

ANOVA for SCDHEC bioclassification at Mayo Creek						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Time of Sampling	0.00377	1	0.00377	12.54670	0.07128	18.51282
Location	0.00094	2	0.00047	1.55901	0.39078	19.00000
Error	0.00060	2	0.00030			
Total	0.00531	5				