Bioassessment of Page Brook

Final Report

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Introduction and Literature Review

Page Brook in Clarke County, Virginia is the subject of a watershed restoration project to mitigate nonpoint source pollution impacts in an agricultural landscape. The water quality of Page Brook is of particular concern because it constitutes a major source of water for the Prospect Hill Spring, which supplies drinking water to 300 households. Fecal coliform bacteria have been detected in 40% of the wells sampled in Clarke County in the past 10 years, with beef cattle having been identified as the primary source (Hagedorn 1999). In addition to its importance in public water supply, Page Brook is also a major tributary to Spout Run, the county's only trout stream. To address these problems, from 1996-1998 the Clarke County Office of Natural Resources arranged for construction of fences alongside Page Brook from its origin to its confluence with Spout Run in order to exclude cattle and allow regrowth of riparian vegetation.

Excluding cattle from streams via the installation of fences along the stream reduces bank erosion and streambed disturbance which can hinder vegetative statility and increase sediment resuspension. However, there are questions as to the extent to which fencing allows for stream recovery and the time period over which any recovery will occur. In addition, fencing alone may not result in restoration of water quality and physical habitat if other Best Management Practices (BMPs), such as off-stream watering tanks, are not also utilized. There are also issues regarding the optimal characteristics of stream buffers, such as the distance between the fence and the stream bank and the type of vegetation (i.e. woody versus herbaceous) which should be present in the buffer zone between the stream and the fence. Given that stream fencing has significant costs, information on how to maximize its effectiveness in protecting water quality is valuable to natural resource managers in areas where animal grazing is an important land use.

Cattle with unrestricted access to streams may have deleterious or undesirable impacts on stream biota in several ways. Suspended sediment levels may be enhanced through erosion directly from the banks and/or from adjacent pasture. Suspended sediments may interfere with respiration and feeding of stream invertebrates (Lemly 1982) and fish (Gardner 1981). Deposited fine sediments may provide a poor substrate for many invertebrates and eliminate fish nesting areas. Enahanced levels of nutrients such as nitrogen and phosphous reach these streams from manure deposited directly in the stream and/or on the adjacent pasture. Although less important in flowing waters than in lakes and ponds, nitrogen and phosphorus can stimulate the growth of nuisance algae which can alter stream food webs. Manure can also be a source of ammonia, which can be toxic to fish and benthic macroinvertebrates at high pH. The grazing and trampling action of cattle prevents the establishment of woody vegetation, eliminating the shading effect of trees. As a result, water temperatures may increase. Temperature is a critical factor controlling the life cycles of many aquatic organisms, and elevated stream temperatures can result in the elimination of cold-water animals such as stonefly nymphs and trout (Vannote and Sweeney 1980).

Knowing the potential for livestock with unrestricted access to streams to impact freshwater organisms, it should not be surprising to find that many studies to date indicate substantial degradation of the fauna of streams in watersheds with substantial land used as cattle pasture. A study in the piedmont region of Maryland found that the lack of fencing around stream channels, along with a lack of other BMPs, resulted in sediment and nutrient pollution from dairy operations (Shirmohammadi and Magette, 1997).

This study was designed to use benthic invertebrates and physical stream habitat to assess stream conditions and monitor the response to riparian zone fencing. The overall objective of the study is to provide county resource managers with information on the effectiveness of fencing as a best management practice (BMP) in improving water quality in Clarke County.

Study Sites

Sites were selected to determine the status of Page Brook along is entire length and to ascertain the effectiveness of livestock fencing as a means for improving stream quality. Ideally, in a study attempting to determine the degree to which a stream or streams have been impacted by non-point source pollution, a reference station located in a relatively undisturbed watershed is selected in order to obtain information on the biological condition of a stream which is minimally impacted by human activities, but which shares the same natural influences as the study streams (e.g., stream order, climate, geology, etc.). An attempt was made to locate such a reference stream for this study, but examination of appropriate 7.5 minute scale topographic maps of the surrounding area did not reveal any such streams. Eight sites were sampled consistently during the years 1996-98. Table 1 indicates the names, location, and sampling dates at each station. In Fall 1996 two sites were sampled on the Meade property. This was reduced to one site on subsequent sampling dates.

Methods

A modification of EPA Rapid Bioassessment Protocol (RBP) II was used as the basic tool for macroinvertebrate bioassessment (Plafkin et al. 1989). RBP II utilizes semiquantitative field collections in riffle/run and leaf litter habitats to determine the values of eight metrics which characterize the status of the benthic macroinvertebrate community. The protocol allows for the modification of metrics and the use of alternative metrics depending on regional conditions. Previous work has indicated that the scrapers/filter collector metric was very variable and not particularly indicative of degraded conditions (Jones and Kelso 1994). Furthermore, the occurence of these two groups was sporadic in our samples. Thus, we deleted this metric. We used Sorensen's index for community similarity. The ratio shredders/total number could not be used as coarse particulate organic matter (CPOM) was not available at many sites. The seven metrics that we utilized in this study are shown in Table 2.

Macroinvertebrate communities were sampled at each site using a 44 cm x 22 cm kick net. The 0.5 mm mesh net was held to the bottom facing upstream and the substrate was disturbed for 1 m directly upstream from the net for one minute. Larger stones were also wiped clean manually when deemed necessary. Contents of the net were placed in a shallow pan. The net was inspected to remove adhering animals. Large stones and leaves were rinsed and discarded. Obvious animals were picked directly into the sample jar. The remaining sample was collected by pouring the contents of the pan through a 0.5 mm sieve. This material was also transferred to the sample jar. The sample was preserved with formalin. Samples were collected from two locations at each station, a rapidly flowing riffle and a less rapid run, and composited into a single jar.

In the lab samples were rinsed with tap water through a 0.5 mm sieve to remove formalin and placed into a 35 cm x 40 cm pan marked with 5 cm x 5 cm squares. The pan was then shaken to distribute the sample evenly over the entire surface of the pan. Using a random number table, squares were selected for organism removal until a target number of 200 organisms was achieved. All organisms were picked from the selected squares. The remaining sample was returned to the sample jar and represerved with alcohol/glycerine. Samples containing less than 100 animals were reported, but RBP metrics were not calculated. The selected organisms were sorted into ethanol-glycerine, identified to family and enumerated. Oligochaetes were not identified to family and were counted as a single taxon in all calculations. Taxonomic references included Merritt and Cummins (1996) and Pennak (1978).

Macroinvertebrate rating was calculated following the guidance of the EPA bioassessment manual. In order to determine the values of certain metrics, it was necessary to assign biotic index values to each family (Hilsenhoff 1982). Since an external reference site unimpacted by agricultural activity with similar natural watershed characteristics was not available for sampling, the sampling event (i.e. station/date combination) which most consistently had scores on each metric ranking at or near the top of all samples was selected as the reference sample. The raw scores of all samples were then expressed relative to the score of the reference sample. Metric scoring criteria used were those cited for RBP II (Fig. 6.3-4, Plafkin et al. 1989). EPT/Isopods was scored using the same criteria as EPT/Chironomids. Criteria for Sorenson's Index were: 0 for values less than 0.55, 3 for values between 0.55 and 0.75, and 6 for values greater than 0.75.

Relationships among sites were also explored using box plots created using SYSTAT for Windows. For a given category of samples a box plot depicts the spread of the middle half of the values as a box. A horizontal line within the box denotes the median. Whiskers (bracketed lines) extend to the edges of the data. Outliers are denoted by circles.

Habitat assessment was conducted using the methods outlined in the EPA bioassessment document (Plafkin et al. 1989). At each site the Physical Characterization/Water Quality data sheet was filled out, normally during the macroinvertebrate sampling. This information was used to construct a rating based on the criteria in the habitat assessment portion of the document.

Results

Macroinvertebrates

A total of 12,525 macrobenthic invertebrates were identified and enumerated in 35 samples. Isopods of the family Asellidae were the most abundant group comprising over 57% of all specimens. The midge family Chironomidae constituted the second most numerous at 14.6% followed by the caddisfly family Hydropsychidae with 5.8%. Other groups comprising over 1% of individuals were oligochaetes, the Ceratopogonidae (midges), the Simulidae (blackflies), the Baetidae (mayflies), and the Elmidae (riffle beetles). Number of individuals of each macroinvertebrate family found in each sample are contained in Appendix A. Relative abundance of each taxa is found in Appendix B. Since samples were picked to a constant number of individuals, relative abundance (percentage contribution to the total sample abundance) was more meaningful than absolute numbers and this will be used through the rest of the analysis.

Box plots were used to examine trends among sampling times by pooling data from all stations. The major noninsect taxa included isopods, pelecypods (bivalues), gastropods (snails), oligochaetes, and planaria (flatworms). Isopods were a substantially lower percentage of individuals in the 1996 samples than those collected during 1997 and 1998 (Figure 2). Of the samples collected in those two latter years, the spring 1998 sample had a lower median percentage of isopods. Pelecypods were somewhat higher in the spring 1998 samples than at other times. Oligochaetes showed a generally decreasing contribution throughout the period. Trichoptera and Diptera were the most abundant insect taxa. Trichoptera were slightly more abundant during spring 1998 (Figure 3). Diptera made a substantially greater contribution during 1996 and spring 1998 than at other times. Other insect taxa exhibited little change in relative abundance through time.

Trends along the stream gradient were also examined using box plots, this time pooling data from all sampling times. Isopods were heavy dominants at the three upper sites on the Dunning property, although there was evidence of a decreasing trend moving downstream (Figure 4). This trend accelerated at the next site on Meade property where isopod relative abundance decreased to below 50%. This trend was reversed at the next site located just across the boundary into the Upper Schutte property (Huntington) where isopods again were clearly in the majority. This high relative abundance was also found at the downstream Huntington site, but decreased at the next site downstream of the railroad crossing at Lower Schutte and these lower levels were maintained at the farthest downstream site at Rt. 617. Oligochaetes were not generally abundant at the Dunning sites, but were common at tht two Huntington sites. Molluscs were generally more abundant at Huntington and Lower Schutte sites. Planaria were sporadic in occurrence. Trichoptera, Ephemeroptera, and Coleoptera displayed a spatial pattern opposite that of the isopods with greatest relative abundance at Meade and Lower Schutte (Figure 5). Diptera were very variable at the Dunning sites, decreased to low values at Huntington, and increased again at the Lower Schutte sites. Odonates were observed only at the downstream sites. The patterns in taxa relative abundance and community diversity can be illustrated with stacked bar charts representing average relative abundance of major taxa (Figure 6). This clearly shows the enhanced diversity at the Meade and Lower Schutte site.

Patterns in the metrics were also investigated seasonally and longitudinally. Seasonal patterns in most of the metrics were not strong (Figure 7). In most cases the interquartile range bars overlapped extensively indicating little evidence of a clear seasonal or year-to-year change. This was also true of the summed Biological Condition Index (BCI) scores which are shown in units of total score and percent of reference.

Longitudinal changes were more marked and consistent (Figure 8). Taxa richness, EPT index, and Sorenson's index increased from the Spring House site through Meade, then fell off distinctly at the upstream Huntington site, recovering again at the Lower Schutte sites. Family biotic index and percent dominance exhibited a similar patter in the oppostie direction since these parameters are scaled opposite to taxa richness and EPT index. EPT/isopods was clearly higher at the Meade and Lower Schutte sites. The summed BCI scores reflected this clear spatial pattern. The low outlier at Meade was a 1996 sample that was located just below the Dunning property.

Results of the metric calculations and determination of Biological Condition are shown in Table 3. Sites located at Lower Schutte and all but one Meade Site were rated unimpaired or moderately impaired, while nearly half of those at Dunning and Huntington were highly impaired. All metrics appeared to discriminate fairly well among the three condition classes with the combined BCI score doing even better (Figure 9).

Habitat

Results of habitat analysis using the standard EPA habitat protocol are shown in Tables 4-7 for 1997 and 1998. Pasture was the dominant surrounding land use resulting in local erosion varying from light to moderate in most cases. Clear evidence of nonpoint sources was observed in the form of cattle activity in and along the stream (Table 4). Page Brook is a small stream varying in width from 1 to 3.5 m and in depth from 3-20 cm in riffles and 12-65 cm in pools. Maximum velocities were 0.1 to 0.2 m/sec. Canopy cover was lacking over much of the stream, the most consistent shading being found on the Meade property.

Water quality measurements indicated that Page Brook had high alkalinity, substantial conductivity, and above neutral pH as expected for a stream in the carbonate section of the Shenandoah Valley (Table 5). Dissolved oxygen was generally adequate to support aquatic life. However, it should be remembered that these spot readings may not be indicative of the full range of DO values experienced by the stream. Water odors and surface oils were generally lacking. Turbidity was observed at several locations along the stream and reached high levels in fall 1998 at Schutte Upstream.

Sediment odors were most common at Schutte Upstream where they were characterized as "sewage" and "anaerobic" during 1998 (Table 6). Organic sediment deposits were also observed at Schutte Upstream. Sediment deposits at Meade were characterized as "silt/sludge". Sediment oils were generally absent. Substrate size was generally supportive of macroinvertebrates with substantial proportions of riffle substrate consisting of boulder, cobble, and gravel.

The quantitative habitat assessment index was highest at the beginning and end of the stream reach and dropped to a minium at Schutte Upstream (Table 7, Figure 10). The low values at this site reflected high levels of embeddedness, poor substrate and cover conditions, and channel and bank erosion due to instream cattle activity. While these conditions were prevalent all along the upper portion of the stream they were most intense at Schutte Upstream.

Discussion

The Page Brook watershed is a landscape whose vegetative cover has been extensively modified for agriculture. Native deciduous forest cover is virtually absent having been displaced by pasture and selective row cropping. Nonetheless, the stream does show the ability to support a moderately diverse macrobenthic community when adequately protected.

The two factors which seemed most determinative of benthic community integrity in Page Brook were the quality of riparian vegetation and the intensity of cattle access to the stream. In the Dunning stretch, riparian vegetation was mainly restricted to grasses and other herbs and forbs. Thus, the occurrence of a lone tree could be used as a station landmark. Cattle had frequent and extensive access to the stream and further degraded riparian vegetative quality by trampling and burying the vegetation with their hooves. This also had the effect of enhancing erosion and sediment release. During the project fences were constructed along this stretch of the stream and conditions improved somewhat at times. However, our observations indicated that gates were often left open and cattle resumed their visits along the stream. Thus, recovery of this section was modest at best.

On most of the Meade property the intensity of cattle access seemed reduced and there was a tree cover over most of the stream reach. This resulted in a marked recovery of the benthic community. While still dominated by tolerant taxa, the benthic community became substantially more diverse and metrics increased.

At the lower end of the Meade property and at the upper end of Huntington, cattle activity in the stream increased sharply. For about a 30 m stretch around the property boundary, cattle congregated in and along the stream, the banks were worn down, and the sediments consisted of an odiferous mixture of silt and fine organic matter (presumable from manure). This area resulted in a major disruption of the benthic community at the upper Huntington site (Site SU). At least one other major cattle access point was similarly degraded on Huntington and the benthic community was degraded at the lower Huntington site (Site SD) as well. Fencing was installed on this property, but cattle continued to access the stream intensively at crossings.

Cattle access was again restricted at the lower Schutte property and riparian vegetation recovered. While the riparian tree cover was not as extensive as at Meade, the lack of cattle access allowed a lush community of grasses, herbs, and forbs to carpet the banks providing cover for organisms and stability for bank sediments. Furthermore, large boulders were placed in the stream at selected points providing additional cover and stability. The benthic community responded in kind by improving markedly at the upper end of this property (Site RR) and attaining its best condition as the stream flowed out of the study area at Route 617 (Site 617).

Data available from the USGS NAWQA study during 1993-95 shows that the Page Brook watershed was typical of Great Valley carbonate sites having a high percentage of land use devoted to agriculture (Table 8). The Page Brook data shown here were collected in 1993 at a site characterized as Boyce which presumably is near the lower end of the current study area. The USGS data indicate that Page Brook had a higher than normal proportion of two tolerant groups, chironomids and hydropsychids, suggesting a stream community somewhat more impaired than the average for other Great Valley carbonate streams. Interestingly, the high proportions of isopods observed in the current study were not observed in the USGS sample, although isopods were found in greater numbers than in the average for Great Valley streams. These data suggest that the biotic community of Page Brook should be better and could be improved with attention to habitat and water quality concerns.

Conclusions

The Page Brook watershed is a landscape whose vegetative cover has been extensively modified for agriculture. Native deciduous forest cover is virtually absent having been displaced by pasture and selected row cropping. The stream community is seriously degraded in areas where cattle continue to have access. Nonetheless, the stream does show the ability to support a moderately diverse macrobenthic community when adequately protected. Fencing has not been effective in some reaches due to inattention to keeping the gates closed. Only a short period of cattle access can be sufficient to significantly damage the stream and undo months, if not years, of vegetative stabilization. Assuming that the fences can be effectively utilized, we recommend resampling of the benthic community after 2-3 years to determine the state of stream recovery.

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Table 1.
Sample Locations
Page Brook Study

Sample ID	Location on Page Brook	Property Owner	Stream Mile	‘96	Fall ‘97	Spr’98	Fall’98
SH	Just downstream of spring house	Dunning	0	XX	X	X	X
Tree	At large isolated sycamore tree	Dunning	0.05		X	X	X
OB	At old barn foundation	Dunning	0.62	XX	X	X	X
M	100 m upstream of Meade/Hundington fence	Meade	0.89	XX	X	X	X
SU	At stone wall near upper end of Huntington	Schutte (U)	1.06	X	X	X	X
SD	Just below fence at lower end of Huntington	Schutte (U)	1.66	X	X	X	X
RR	Just downstream of RR culvert	Schutte (L)	1.91	X	X	X	X
617	At Rt. 617	Schutte (L)	2.00	X	X	X	X

Table 2.
Metrics Used in Page Brook Study

Taxa Richness (TR)	- a count of the number of taxa found in a given sample (high values indicate good water quality and habitat)
Family Biotic Index (FBI)	- the average tolerance value of individuals in a sample (low values indicate good water quality and habitat)
EPT/Chironomid abundance (ept/chir, e/c)	- the number of individuals belonging to the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) divided by the number of individuals belonging to the Dipteran family Chironomidae (midges) (high values indicate good water quality and habitat).
Percent dominance (% dom, %d)	- the percentage of total sample abundance represented by the most abundant taxon (low values indicate good water quality and habitat).
EPT Index (EPTI)	-the number of taxa (in this case families) found in the sample from the orders Ephemeroptera, Plecoptera, and Trichoptera (high values indicate good water quality and habitat).
EPT/Isopod abundance (ept/iso, e/i)	-the number of individuals belonging to the insect orders Ephemeroptera, Plecoptera, and Trichoptera divided by the number of individuals belonging to the crustacean order Isopoda (high values indicate good water quality and habitat).
Sorenson's Index of community similarity (Sor)	-a measure of how closely the family composition of a sample matches that of the reference sample (high values indicate good water quality and habitat).

Table 3. Metrics and Biological Condition Index Calculations

			Metric values							Metrics % of Reference							Metric Score							Total	% of	Impair-
Station	Date		TRich	FBI	ept/chir	%dom	EPTI	ept/iso	Sor	TR	FBI	e/c	%d	EPTI	e/i	Soren	TR	FBI	e/c	%d	EPTI	E/I	Sor	BCI	Ref	ment
PB@SH	July 96	1mUS	9	6.42	0.01	68.7	1	0.03	0.571	40.9	88.4	0.2	68.7	14.3	2.3	0.5714	3	6	0	0	0	0	3	12	31	MOD
PB@SH	May 96	3MDS	13	6.32	0.05	67.9	2	0.18	0.864	59.1	89.9	1.3	67.9	28.6	14.0	0.8644	3	6	0	0	0	0	6	15	38	MOD
PB@SH	Fall 97		9	7.95	0.00	85.9	0	0.00	0.690	40.9	71.4	0.0	85.9	0.0	0.0	0.6903	3	3	0	0	0	0	3	9	23	HIGH
PB@SH	Spr 98		8	7.93	1.67	89.5	2	0.02	0.696	36.4	71.7	38.9	89.5	28.6	1.2	0.6964	0	3	3	0	0	0	3	9	23	HIGH
PB@SH	Fall 98		12	7.84	1.00	91.0	1	0.01	0.628	54.5	72.4	23.4	91.0	14.3	0.9	0.6275	3	3	0	0	0	0	3	9	23	HIGH
PB@Tree	Fall 97		14	7.52	1.63	75.8	2	0.09	0.726	63.6	75.5	38.0	75.8	28.6	6.8	0.7257	3	3	3	0	0	0	3	12	31	MOD
PB@Tree	Spr 98		14	6.56	0.53	44.4	3	0.17	0.608	63.6	86.5	12.4	44.4	42.9	13.2	0.6078	3	6	0	3	0	0	3	15	38	MOD
PB@Tree	Fall 98		10	7.94	3.00	96.1	3	0.01	0.648	45.5	71.6	70.1	96.1	42.9	0.5	0.6481	3	3	3	0	0	0	3	12	31	MOD
PB@OB	May 96	3mDS	12	6.11	0.03	73.7	3	0.19	0.825	54.5	93.0	0.8	73.7	42.9	14.5	0.8254	3	6	0	0	0	0	6	15	38	MOD
PB@OB	May 96	10mU	9	6.57	0.01	54.7	2	0.02	0.611	40.9	86.4	0.3	54.9	28.6	1.8	0.6111	0	6	0	0	0	0	3	9	23	HIGH
PB@OB	Aug 97		10	7.45	0.50	72.1	2	0.04	0.685	45.5	76.2	11.7	72.1	28.6	2.8	0.6852	3	3	0	0	0	0	3	9	23	HIGH
PB@OB	Spr 98		15	7.44	3.67	74.5	2	0.07	0.724	68.2	76.3	85.7	74.5	28.6	5.6	0.7241	3	3	6	0	0	0	3	15	38	MOD
PB@OB	Fall 98		17	7.09	1.83	71.0	6	0.19	0.727	77.3	80.2	42.8	71.0	85.7	14.5	0.7273	3	3	3	0	3	0	3	15	38	MOD
PB@MD	Sep 96	10m fr	10	5.92	0.61	29.4	2	0.57	0.811	45.5	95.9	14.2	29.4	28.6	44.3	0.8108	3	6	0	6	0	3	6	24	62	MOD
PB@MU	Sep 96	10-15	13	6.75	0.52	53.0	2	0.19	0.727	59.1	84.1	12.2	53.0	28.6	14.5	0.7273	3	3	0	0	0	0	3	9	23	HIGH
PB@M	Fall 97		18	5.39	3.35	30.5	5	1.74	0.819	81.8	105.5	78.2	30.5	71.4	134.6	0.8189	6	6	6	3	3	6	6	36	92	NOT
PB@M	Spr 98		14	6.23	1.29	45.5	4	0.51	0.709	63.6	91.2	30.1	45.5	57.1	39.8	0.7091	3	6	3	3	0	3	3	21	54	MOD
PB@M	Fall 98		17	5.49	2.21	36.6	6	0.95	0.655	77.3	103.4	51.5	36.6	85.7	73.6	0.6549	3	6	3	3	3	3	3	24	62	MOD
PB@SU	Sep 96		9	6.55	0.16	42.2	1	0.06	0.544	40.9	86.7	3.7	42.2	14.3	4.4	0.5437	3	6	0	3	0	0	0	12	31	MOD
PB@SU	Fall 97		13	7.87	0.33	71.1	1	0.00	0.693	59.1	72.2	7.8	71.1	14.3	0.3	0.6931	3	3	0	0	0	0	3	9	23	HIGH
PB@SU	Spr 98		11	6.82	0.34	54.1	3	0.18	0.673	50.0	83.3	7.9	54.1	42.9	13.7	0.6731	3	3	0	0	0	0	3	9	23	HIGH
PB@SU	Fall 98		10	7.91	1.00	88.1	1	0.01	0.525	45.5	71.8	23.4	88.1	14.3	0.5	0.5253	3	3	0	0	0	0	0	6	15	HIGH
PB@SD	Sep 96		10	7.17	0.10	52.7	1	0.05	0.550	45.5	79.2	2.4	52.7	14.3	4.1	0.5495	3	3	0	0	0	0	0	6	15	HIGH
PB@SD	Fall 97		11	7.75	8.00	88.2	1	0.02	0.559	50.0	73.3	186.9	88.2	14.3	1.9	0.5591	3	3	6	0	0	0	3	15	38	MOD
PB@SD	Spr 98		15	7.22	0.88	60.8	2	0.15	0.495	68.2	78.6	20.4	60.8	28.6	12.0	0.4948	3	3	0	0	0	0	0	6	15	HIGH
PB@SD	Fall 98		13	7.70	1.14	72.3	3	0.04	0.690	59.1	73.8	26.7	72.3	42.9	2.9	0.6903	3	3	3	0	0	0	3	12	31	MOD
PB@RR	Jul 96		13	7.29	3.33	80.6	5	0.14	0.310	59.1	78.0	77.9	78.1	71.4	10.9	0.3095	3	3	6	0	3	0	0	15	38	MOD
PB@RR	Fall 97		19	6.13	1.31	41.8	4	0.32	0.836	86.4	92.6	30.5	41.8	57.1	24.9	0.8361	6	6	3	3	0	3	6	27	69	MOD
PB@RR	Spr 98		18	6.27	0.53	30.4	3	0.51	0.819	81.8	90.6	12.4	30.4	42.9	39.2	0.8189	6	6	0	3	0	3	6	24	62	MOD
PB@RR	Fall 98		16	6.43	0.76	48.1	4	0.28	0.667	72.7	88.3	17.8	48.1	57.1	21.8	0.6667	3	6	0	3	0	0	3	15	38	MOD
PB@617	Jul 96		18	6.25	2.03	46.9	7	0.53	0.790	81.8	90.9	47.3	46.9	100.0	40.9	0.79	3	6	3	3	3	3	6	27	69	MOD
PB@617	Fall 97		22	5.68	4.28	30.1	7	1.29	1.000	100.0	99.9	100.0	30.1	100.0	100.2	1	6	6	6	3	6	6	6	39	100	NOT
PB@617	Spr 98		15	6.01	0.68	35.7	5	0.93	0.678	68.2	94.5	15.8	35.7	71.4	72.2	0.678	3	6	0	3	3	3	3	21	54	MOD
PB@617	Fall 98		24	6.53	0.94	47.1	6	0.31	0.824	109.1	87.0	21.9	47.1	85.7	23.8	0.8244	6	6	0	3	3	0	6	24	62	MOD

Table 4. Habitat evaluation. General information.

STATION	Date	Land Use	Local Erosion	Local NPS	Stream Width (m)	Stream Depth (cm) Riffle	Run	Pool	High Water Mark (cm)	Max Velocity (m/sec)	Dam	Channelized	Canopy Cover
PB@SH	Fall 97	Pasture	Moderate	Some*	3.50	3.0	3.0	30.0	n/a	0.2	N	Y	MostlyOpen
PB@Tree	Fall 97	Pasture	Moderate	Some*	1.50	10.0	20.0	30.0	n/a	0.2	N	Probably	Open
PB@OB	Fall 97	Pasture	Moderate	Obvious*	3.00	10.0	20.0	30.0	n/a	0.2	N	Y	MostlyOpen
PB@M	9/23/97	Pasture	Moderate	Obvious*	3.00	5.0	10.0	20.0	n/a	0.1	N	N	MostlyShade
PB@SU	Fall 97	Pasture	Heavy	Obvious*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PB@SD	9/23/97	Pasture	Moderate	Obvious*	3.00	5.0	10.0	20.0	n/a	0.1	N	Y	MostlyOpen
PB@RR	9/3/97	Pasture	None	None	1.50	15.0	25.0	35.0	n/a	0.2	N	N	HalfOpen
PB@617	9/3/97	Pasture	Light	None	1.00	20.0	30.0	40.0	n/a	0.2	N	N	MostlyOpen
PB@SH	28-May-98	Pasture	None	None	1.00	n/a	23.0	26.0	35		Y	Y	MostlyShade
PB@Tree	28-May-98	Pasture	None	None	1.00	10.0	28.0	30.0	150		N	N	Open
PB@OB	19-Jun-98	Pasture	Moderate	Some*	1.80	11.0	14.0	30.0	180		Y	N	MostlyOpen
PB@M	22-Jun-98	Pasture	Moderate	Some*	2.30	8.0	15.0	19.0	60		N	N	MostlyShade
PB@SU	22-Jun-98	Pasture	Moderate	Some*	1.00	8.5	n/a	29.0			Y	N	Open
PB@SD	22-Jun-98	Pasture	Moderate	Some*	2.00	n/a	42.0	44.0			N	N	MostlyOpen
PB@RR	22-Jun-98	Pasture	Moderate	Some*	2.50	19.0	30.0	50.0			n/a	n/a	MostlyOpen
PB@617	22-Jun-98	Pasture	None	None	3.50	n/a	35.0	65.0					
PB@SH	18-Oct-98	Pasture	Moderate	Obvious*	1.30	8.0	10.0	16.5	n/a		N	N	n/a
PB@Tree	18-Oct-98	Pasture	Moderate	Some*	1.50	5.5	4.5	13.0	n/a		N	N	n/a
PB@OB	18-Oct-98	Pasture	Moderate	Obvious*	2.00	2.0	8.0	20.2	n/a		N	N	n/a
PB@M	16-Oct-98	Pasture	Moderate	Some*	3.10	4.5	n/a	18.0	90		N	N	MostlyShade
PB@SU	16-Oct-98	Pasture	Moderate	Obvious*	2.10	3.5	7.5	20.0	50		N	N	Open
PB@SD	02-Oct-98	Pasture	Moderate	Some*	1.90	7.0	13.5	12.0	80		N	N	Open
PB@RR	02-Oct-98	Pasture	None	None	2.20	7.5	17.5	46.0	90		N	N	MostlyOpen
PB@617	02-Oct-98	Pasture	None	None	3.10	19.0	28.0	49.0	90		n/a	n/a	MostlyOpen

Table 5. Habitat evaluation. Water quality.

STATION	Date	Temp (oC)	DO (mg/L)	DO (%sat)	pH	Alkalinity (mgCaCO3/L)	Cond (umho)	Cond25	Water Odors	Surface Oils	Turbidity	Color
PB@SH	Fall 97	18.7	7.08	76	n/a	n/a	850		None	None	Slight	n/a
PB@Tree	Fall 97	24.7	9.70	117	n/a	n/a	750		Normal	None	n/a	n/a
PB@OB	Fall 97	23.0	10.30	120	n/a	n/a	670		Normal	None	Moderate	n/a
PB@M	9/23/97	16.7	7.37	76	n/a	n/a	183		Normal	None	Turbid	n/a
PB@SU	Fall 97	19.8	6.23	68	n/a	n/a	393		Org/Manu	Sheen	Slight	n/a
PB@SD	9/23/97	16.0	5.94	60	n/a	n/a	n/a		None	None	Turbid	n/a
PB@RR	9/3/97	16.4	5.87	60	n/a	n/a	470		Normal	None	Slight	n/a
PB@617	9/3/97	17.3	5.74	60	n/a	n/a	475		None	None	Slight	n/a
PB@SH	28-May-98	14.7	6.18	61	n/a	n/a	415		Normal	Slick	Clear	n/a
PB@Tree	28-May-98	16.9	8.93	93	n/a	n/a	435		Normal	None	Clear	n/a
PB@OB	19-Jun-98	17.3	9.20	96	n/a	n/a	n/a		Normal	None	Clear	n/a
PB@M	22-Jun-98	n/a	n/a	n/a	n/a	n/a	n/a		Normal	None	Slight	n/a
PB@SU	22-Jun-98	n/a	n/a	n/a	n/a	n/a	n/a		None	None	Slight	n/a
PB@SD	22-Jun-98	n/a	n/a	n/a	n/a	n/a	n/a		Normal	Slick	Slight	n/a
PB@RR	22-Jun-98	17.7	9.50	100	n/a	n/a	n/a		Normal	None	Clear	n/a
PB@617	22-Jun-98	n/a	n/a	n/a	n/a	n/a	n/a		Normal	Sheen	Slight	n/a
PB@SH	18-Oct-98	14.7	7.03	70	7.20	180	417	520	None	None	Clear	n/a
PB@Tree	Fall 98	19.0	8.56	93	7.50	180	299	336	None	None	Slight	n/a
PB@OB	Fall 98	14.3	9.37	92	8.00	173	390	491	None	None	Clear	n/a
PB@M	16-Oct-98	10.1	12.54	112	n/a	160	337	471	n/a	None	Slight	n/a
PB@SU	16-Oct-98	9.5	9.39	82	n/a	160	338	480	Normal	None	Opaque	Mocha
PB@SD	02-Oct-98	16.7	6.35	66	n/a	n/a	431		Normal	None	Clear	n/a
PB@RR	02-Oct-98	14.6	6.04	60	n/a	n/a	430		Normal	None	Clear	n/a
PB@617	02-Oct-98	14.0	6.61	64	n/a	n/a	425		Normal	None	Slight	n/a

Table 6. Habitat evaluation. Substrate.

STATION	Date	Odor	Sediment Oils	Deposits	Black Stones	Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Clay
PB@SH	Fall 97	None	Absent	None		0	0	40	60	0	0	0
PB@Tree	Fall 97	Normal	Absent	Sand		0	0	40	20	40	0	0
PB@OB	Fall 97	Normal	Absent	Sand		n/a	n/a	n/a	n/a	n/a	n/a	n/a
PB@M	9/23/97	Manure	Slight	Silt		0	10	60	10	10	10	0
PB@SU	Fall 97	n/a	n/a	n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a
PB@SD	9/23/97	Normal	Absent	Sand		0	10	60	10	20	0	0
PB@RR	9/3/97	Normal	Absent	None		0	10	50	20	20	0	0
PB@617	9/3/97	Normal	Absent	None		0	30	50	20	0	0	0
PB@SH	28-May-98	Normal	Absent	Sand	Yes	5	5	25	35	30	0	0
PB@Tree	28-May-98	Normal	Absent	Sand	Yes	5	5	15	40	35	0	0
PB@OB	19-Jun-98	Normal	Absent	Sand	No	0	0	30	30	30	10	0
PB@M	22-Jun-98	Normal	Absent	Silt	No	0	6	32	28	28	6	0
PB@SU	22-Jun-98	H2S	Absent	Silt	No	0	35	10	15	10	30	0
PB@SD	22-Jun-98	Sewage	Absent	Silt	No	0	20	0	0	10	70	0
PB@RR	22-Jun-98	Normal	Absent	Sand	n/a	0	5	32	26	32	5	0
PB@617	22-Jun-98	Normal	Absent	Sand	Yes	0	45	0	0	50	5	0
PB@SH	18-Oct-98	None	None	Sand/Silt	No	5	0	40	40	10	5	0
PB@Tree	Fall 98	None	None	Sand/Silt	Yes	0	20	40	30	5	5	0
PB@OB	Fall 98	None	None	Sand/Silt	No	6	6	41	35	6	6	0
PB@M	16-Oct-98	None	Absent	Silt/Sludge	No	0	35	35	5	5	20	0
PB@SU	16-Oct-98	Anaerobic	Absent	Silt/Manure	n/a	0	5	30	20	5	40	0
PB@SD	02-Oct-98	Normal	Absent	Sand/Silt	Yes	0	5	0	15	65	15	0
PB@RR	02-Oct-98	Normal	Absent	Sand/Silt	Yes	0	5	0	20	50	25	0
PB@617	02-Oct-98	Normal	Absent	Sand	Yes	0	29	9	34	24	4	0

Table 7. Habitat evaluation. EPA Habitat Assessment Index.

STATION	Date	Substrate & Cover	Embeddedness	Flow	Channel alteration	Scour & Deposition	Pool/riffle	Bank Stability	Bank Vegetation	Stream Cover	Overall Score	% of possible
PB@SH	Fall 97	13	18		9.5	9.5		4	9.5	4	67.5	67.5
PB@Tree	Fall 97	13	13		9.5	9.5		5.5	8	4	62.5	62.5
PB@OB	Fall 97	8	8		9.5	5.5		4	8	4	47	47.0
PB@M	9/23/97	10.5	13		5.5	7.5		4	7	7	54.5	54.5
PB@SU	?/?/97	8	2.5		1.5	9.5		1	4	4	30.5	30.5
PB@SD	9/23/97	13	13		7.5	9.5		4	9.5	4	60.5	60.5
PB@RR	9/3/97	18	13		13.5	11.5		8	9.5	5.5	79	79.0
PB@617	9/3/97	18	18		9.5	13.5		8	9.5	4	80.5	80.5
PB@SH	28-May-98	16	18	15	11	15	8	10	10	5	108	80.0
PB@Tree	28-May-98	17	20	18	15	15	13	8	10	4	120	88.9
PB@OB	19-Jun-98	12	17	16	12	13	9	8	10	5	102	75.6
PB@M	22-Jun-98	13	11	16	7	8	8	7	9	6	85	63.0
PB@SU	22-Jun-98	7	5	16	8	8	7	8	9	4	72	53.3
PB@SD	22-Jun-98	2	2	11	3	3	5	7	9	3	45	33.3
PB@RR	22-Jun-98	19	18	16	14	13	11	8	10	5	114	84.4
PB@617	22-Jun-98	10	14	14	13	14	9	9	9	5	97	71.9
PB@SH	18-Oct-98	17	17	12	13	13	8	8	6	3	97	71.9
PB@Tree	Fall 98	16	16	12	14	14	8	6	9	3	98	72.6
PB@OB	Fall 98	16	16	11	13	14	7	8	9	6	100	73.7
PB@M	16-Oct-98	9	5	7	7	17	16	15	12	11	99	73.3
PB@SU	16-Oct-98	15	10	13	4	4	5	2	5	3	61	45.2
PB@SD	02-Oct-98	12	14	11	11	11	8	8	10	5	90	66.7
PB@RR	02-Oct-98	17	17	12	14	11	11	10	10	5	107	79.3
PB@617	02-Oct-98	18	16	15	14	11	13	10	10	5	112	83.0

Table 8.
Results from USGS NAWQA Sampling
Great Valley Carbonate Sites

	Average	Page Brook
Watershed area (mi2)	10.7	4.9
Land Use (%)		
Agriculture	71.7	76.8
Forest	11.6	23.0
Urban	16.5	0.3
Macroinvertebrate Composition (% of total abundance)		
Chironomidae	29.4	40.9
Hydropsychidae	15.9	27.8
Other Trichoptera	0.9	0
Asellidae	4.6	7.5
Elmidae	13.3	14.4
Simulidae	8.6	0.4
Ephermeroptera	8.3	2.3

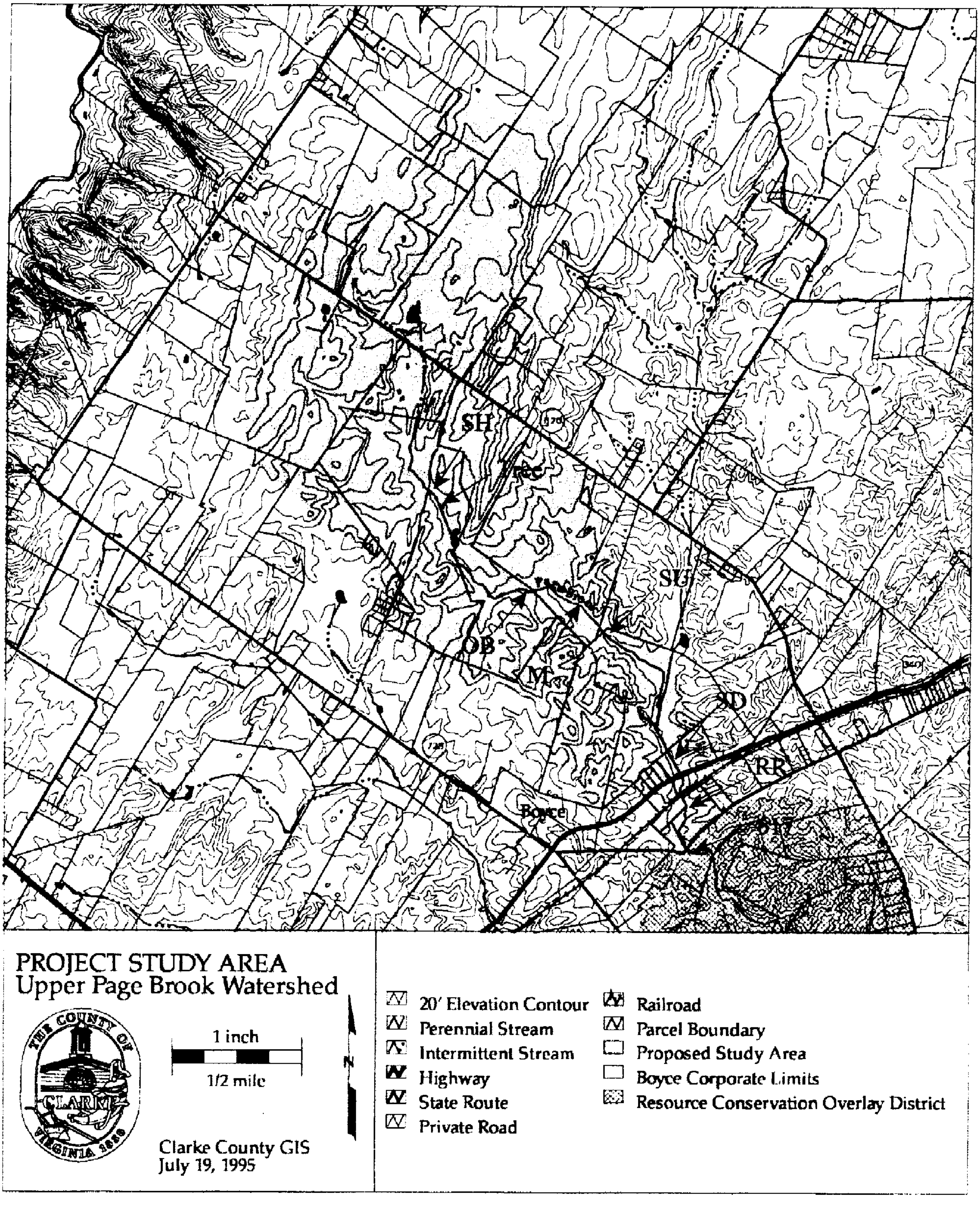

Figure 1. Map of the Study Area showing sampling sites.

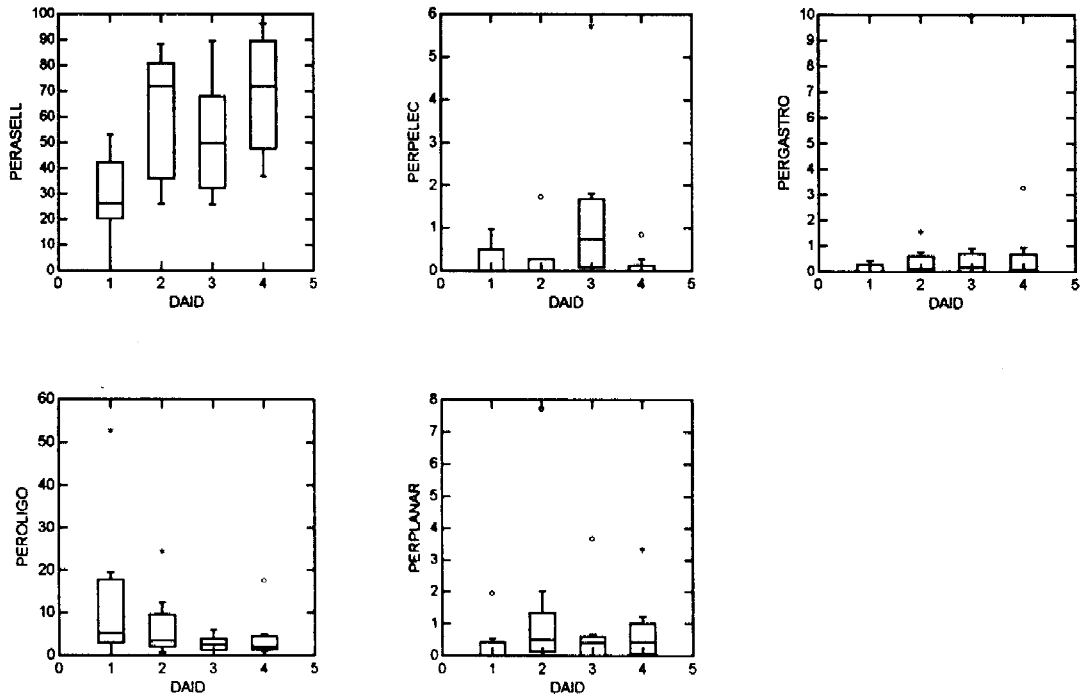

Figure 2. Major non-insect taxa as percentage of total individuals. Trends by sampling time. Average over all stations. Taxa abbreviations: PERASELL: Isopod Aselluidae, PERPELEC: Pelecypoda (bivalves), PERGASTRO: Gastropoda (snails), PEROLIGO: Oligochaeta, PERPLANAR: Planaria (flatworms). Sampling time abbreviations: 1: 1996, 2:Fall 1997, 3: Spring 1998, 4: Fall 1998.

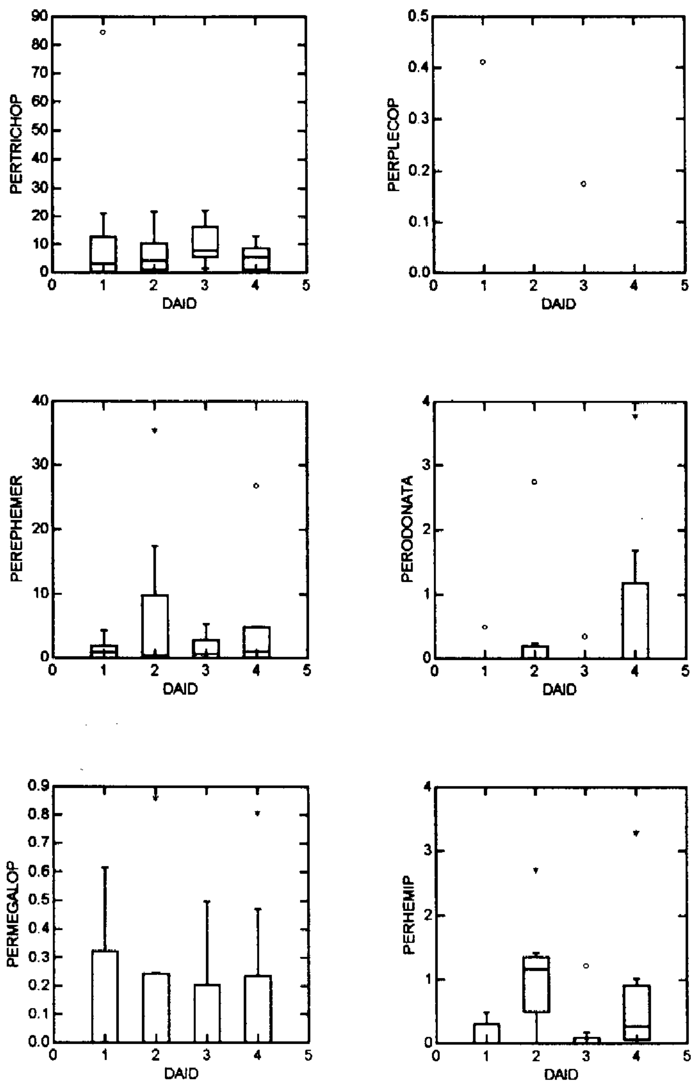

Figure 3. Major insect taxa as percentage of total individuals. Trends by sampling time. Average over all stations. Taxa abbreviations: PERTRICHOP: Trichoptera (caddisflies), PERPLECOP: Plecoptera (stoneflies), PERDIPTERA: Diptera (two-winged flies), PERODONATA: Odonata (dragonflies), PERCOLEOP: Coleoptera (beetles), PERMEGALOP: Megaloptera (dobsonflies), PERHEMIP: Hemiptera (true bugs). Sampling time abbreviations: 1: 1996, 2:Fall 1997, 3: Spring 1998, 4: Fall 1998.

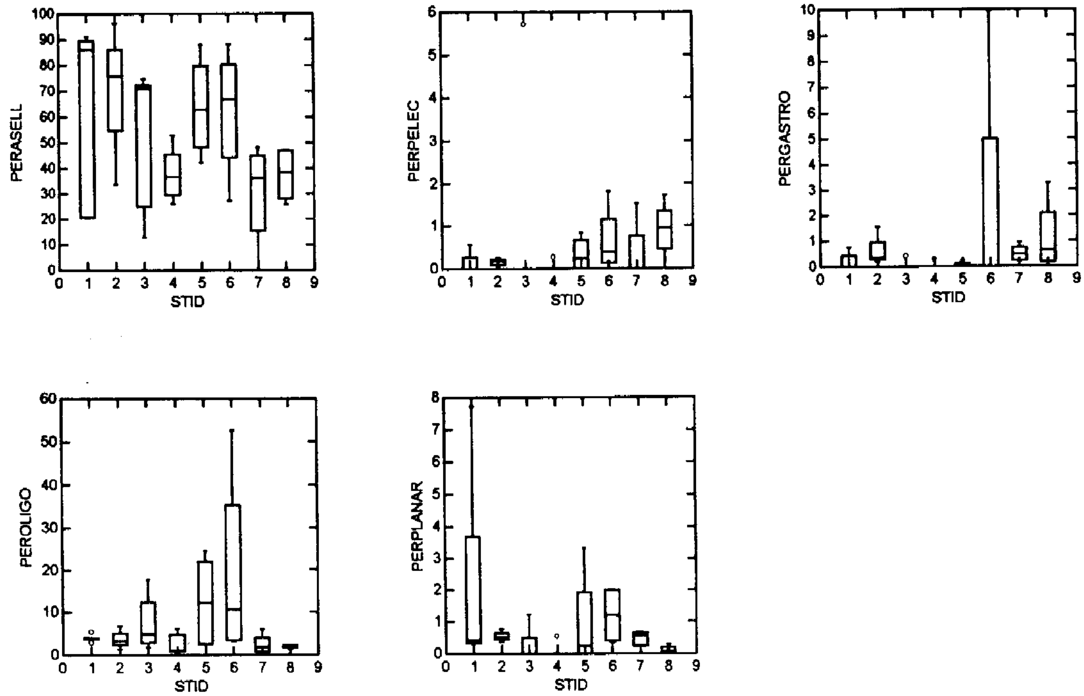

Figure 4. Major non-insect taxa. Trends by station arranged from upstream to downstream. Average over all sampling times. Taxa abbreviations: PERASELL: Isopod Aselluidae, PERPELEC: Pelecypoda (bivalves), PERGASTRO: Gastropoda (snails), PEROLIGO: Oligochaeta, PERPLANAR: Planaria (flatworms). Sampling site abbreviations: 1: SH, 2:Tree, 3:OB, 4:M, 5:SU, 6:SD, 7:RR, 8:617.

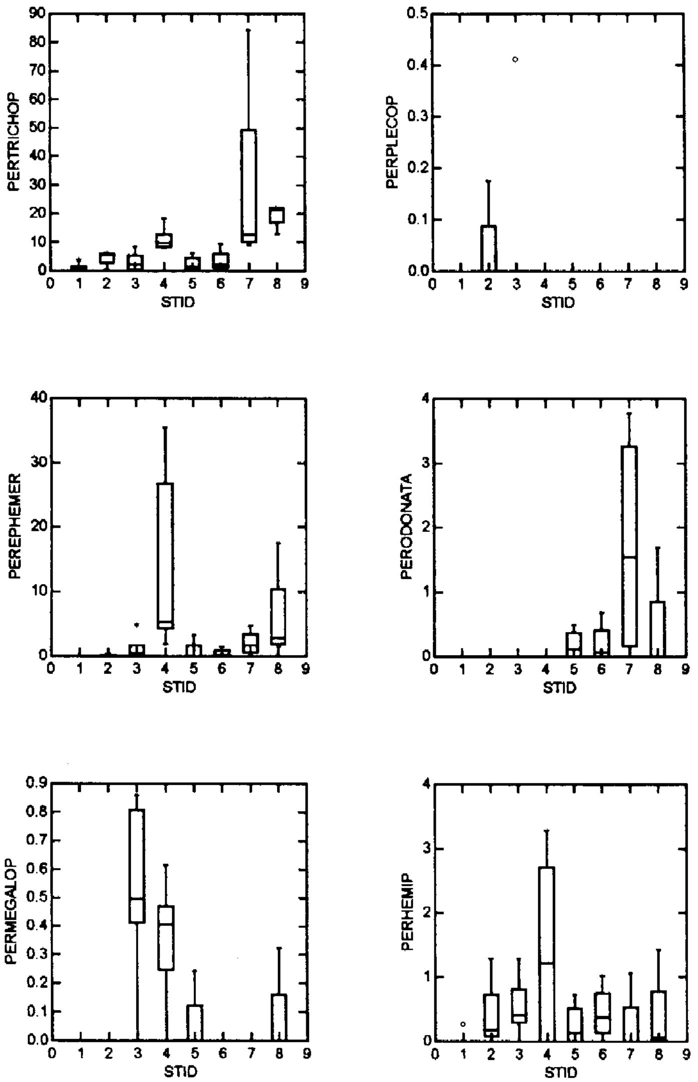

Figure 5. Major insect taxa. Trends by station arranged from upstream to downstream. Average over all sampling times. Taxa abbreviations: PERTRICHOP: Trichoptera (caddisflies), PERPLECOP: Plecoptera (stoneflies), PERDIPTERA: Diptera (two-winged flies), PERODONATA: Odonata (dragonflies), PERCOLEOP: Coleoptera (beetles), PERMEGALOP: Megaloptera (dobsonflies), PERHEMIP: Hemiptera (true bugs). Sampling site abbreviations: 1: SH, 2:Tree, 3:OB, 4:M, 5:SU, 6:SD, 7:RR, 8:617.

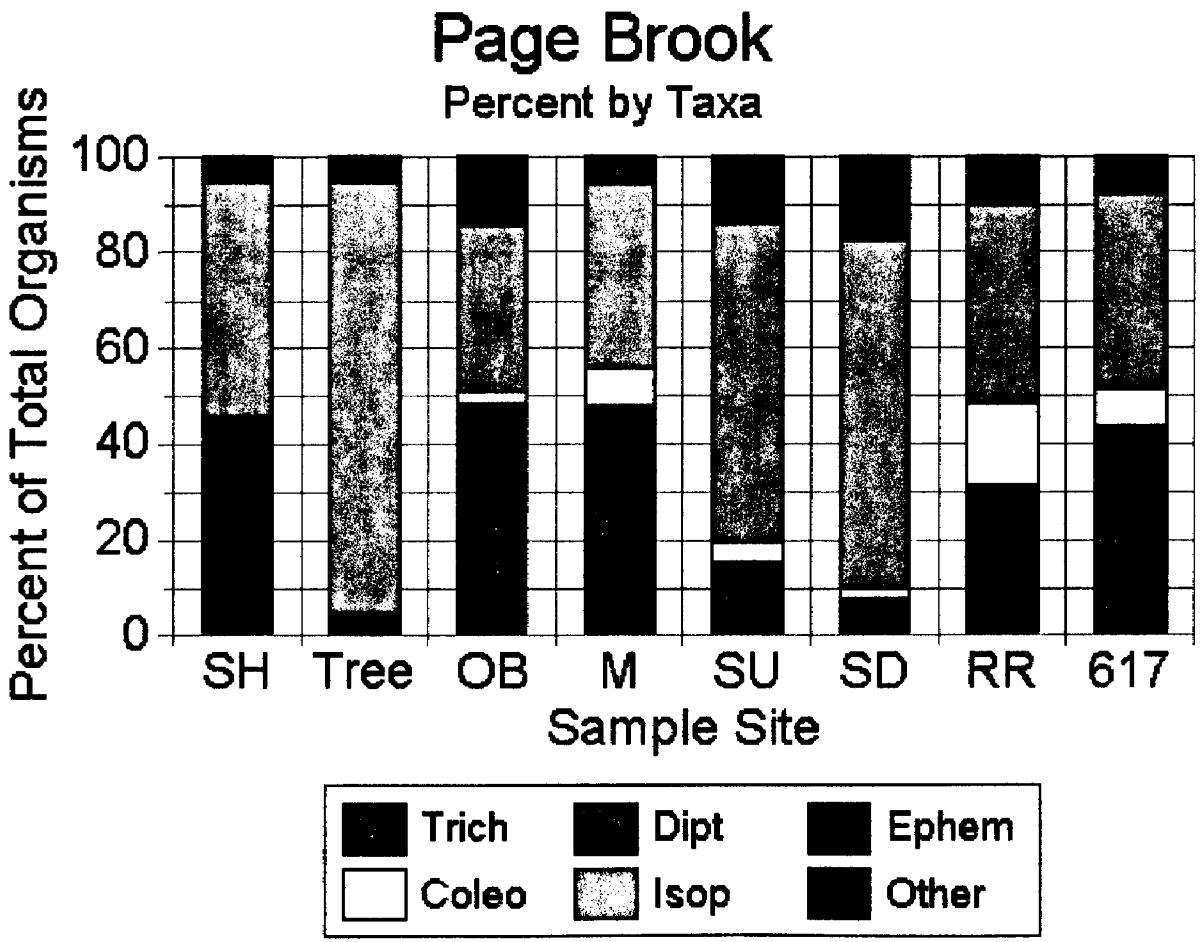

Figure 6. Relative abundance by major taxa with sample sites arranged from upstream to downstream. Average over all sampling times.

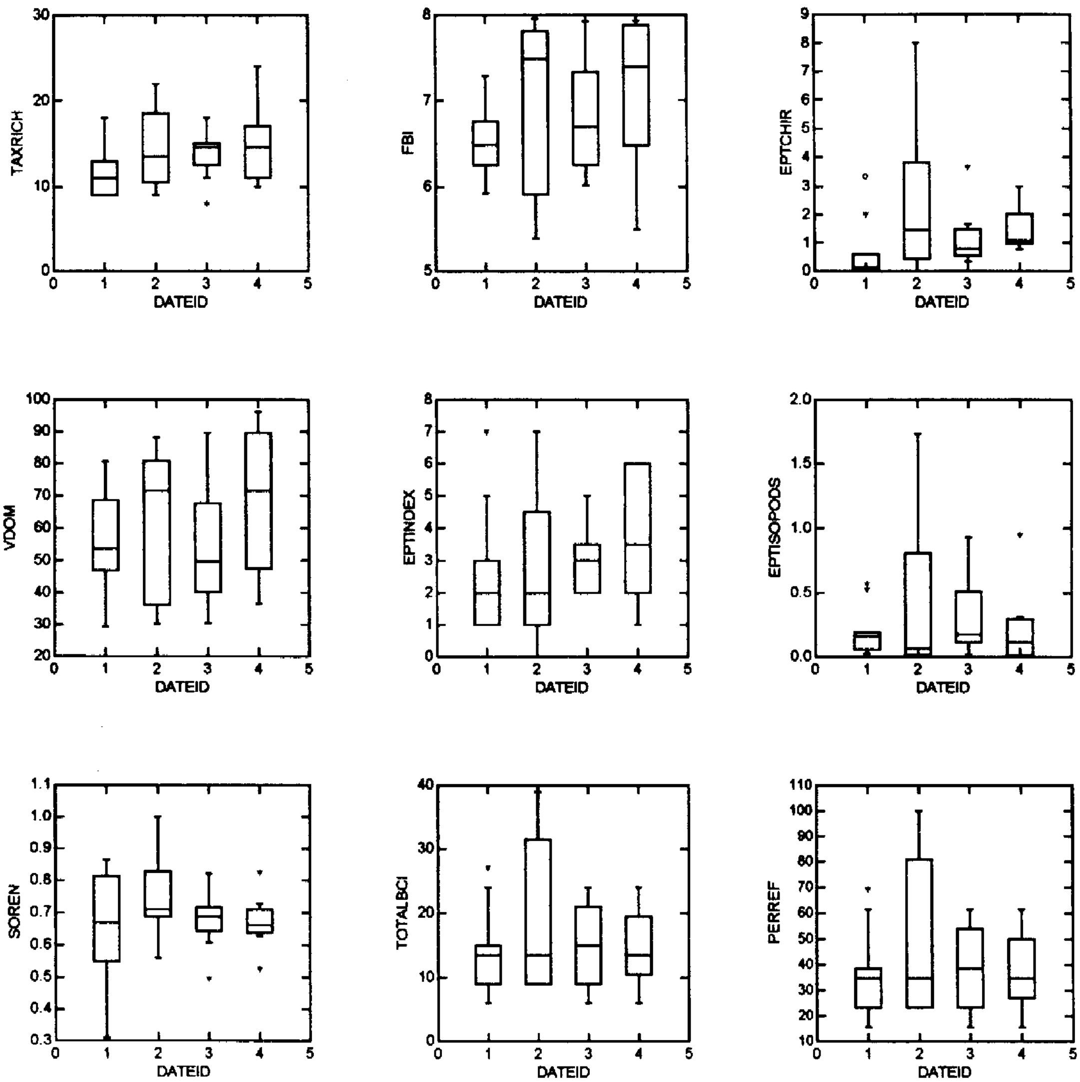

Figure 7. Metric values. Trends by sampling time. Average over all stations. Metric abbreviations: TAXRICH: Taxa richness, FBI: Family biotic index, EPTCHIR: EPT/Chironomid abundance, VDOM: percent dominance, EPTINDEX: EPT index, EPTISOPODS: EPT/Isopod abundance, SOREN: Sorenson's index of community similarity, TOTALBCI: Biological Condition Index Score, PERREF: BCI as a percent of reference BCI. Sampling time abbreviations: 1: 1996, 2:Fall 1997, 3: Spring 1998, 4: Fall 1998.

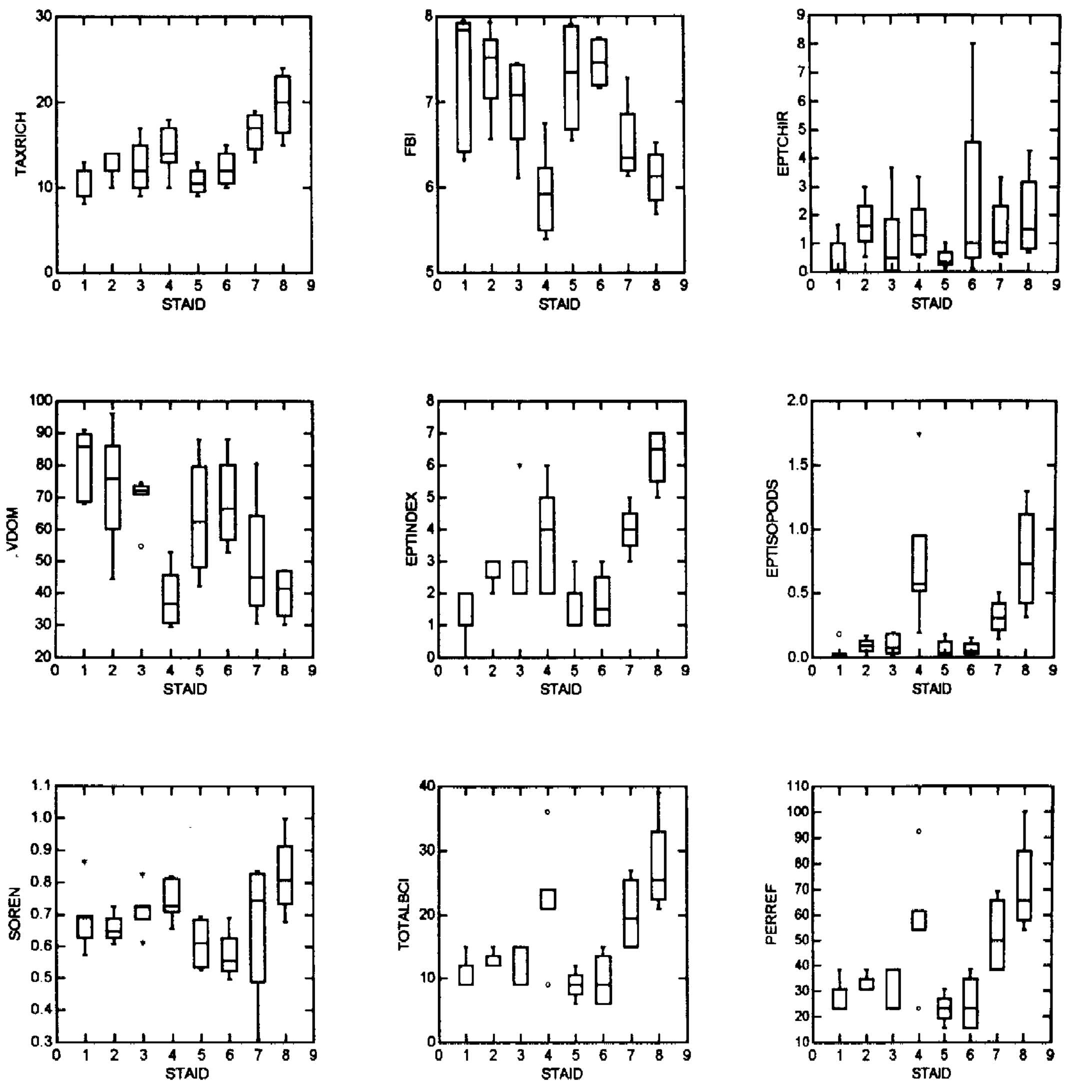

Figure 8. Metric values. Trends by station arranged from upstream to downstream. Average over all sampling times. Figure 7. Metric values. Trends by sampling time. Average over all stations. Metric abbreviations: TAXRICH: Taxa richness, FBI: Family biotic index, EPTCHIR: EPT/Chironomid abundance, VDOM: percent dominance, EPTINDEX: EPT index, EPTISOPODS: EPT/Isopod abundance, SOREN: Sorenson's index of community similarity, TOTALBCI: Biological Condition Index Score, PERREF: BCI as a percent of reference BCI. Sampling site abbreviations: 1: SH, 2:Tree, 3:OB, 4:M, 5:SU, 6:SD, 7:RR, 8:617.

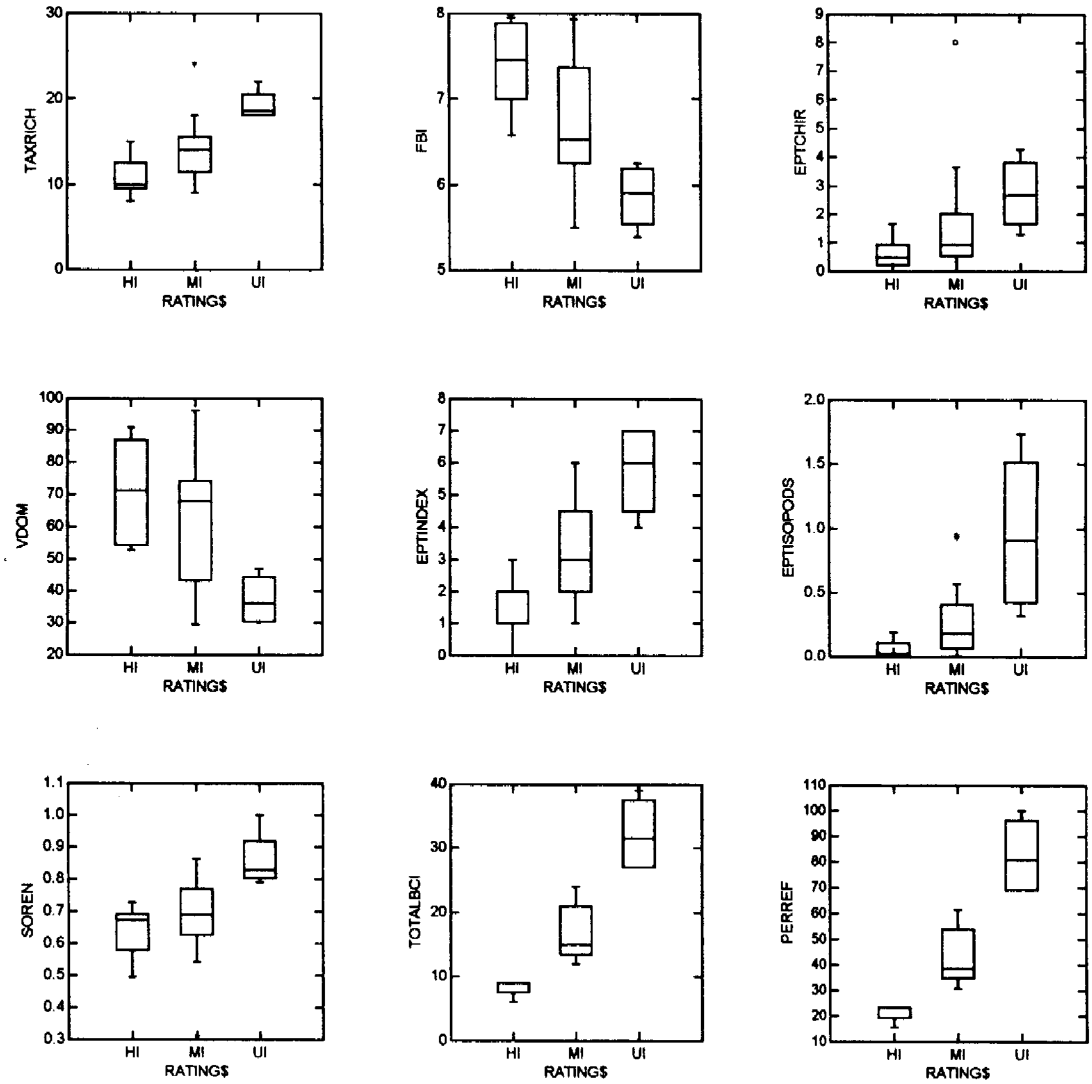

Figure 9. Metric values. Trends by condition class. Average over all sampling times and stations. Metric abbreviations: TAXRICH: Taxa richness, FBI: Family biotic index, EPTCHIR: EPT/Chironomid abundance, VDOM: percent dominance, EPTINDEX: EPT index, EPTISOPODS: EPT/Isopod abundance, SOREN: Sorenson's index of community similarity, TOTALBCI: Biological Condition Index Score, PERREF: BCI as a percent of reference BCI. Condition class abbreviations: HI: highly impaired, MI: moderately impaired, UI, unimpaired.

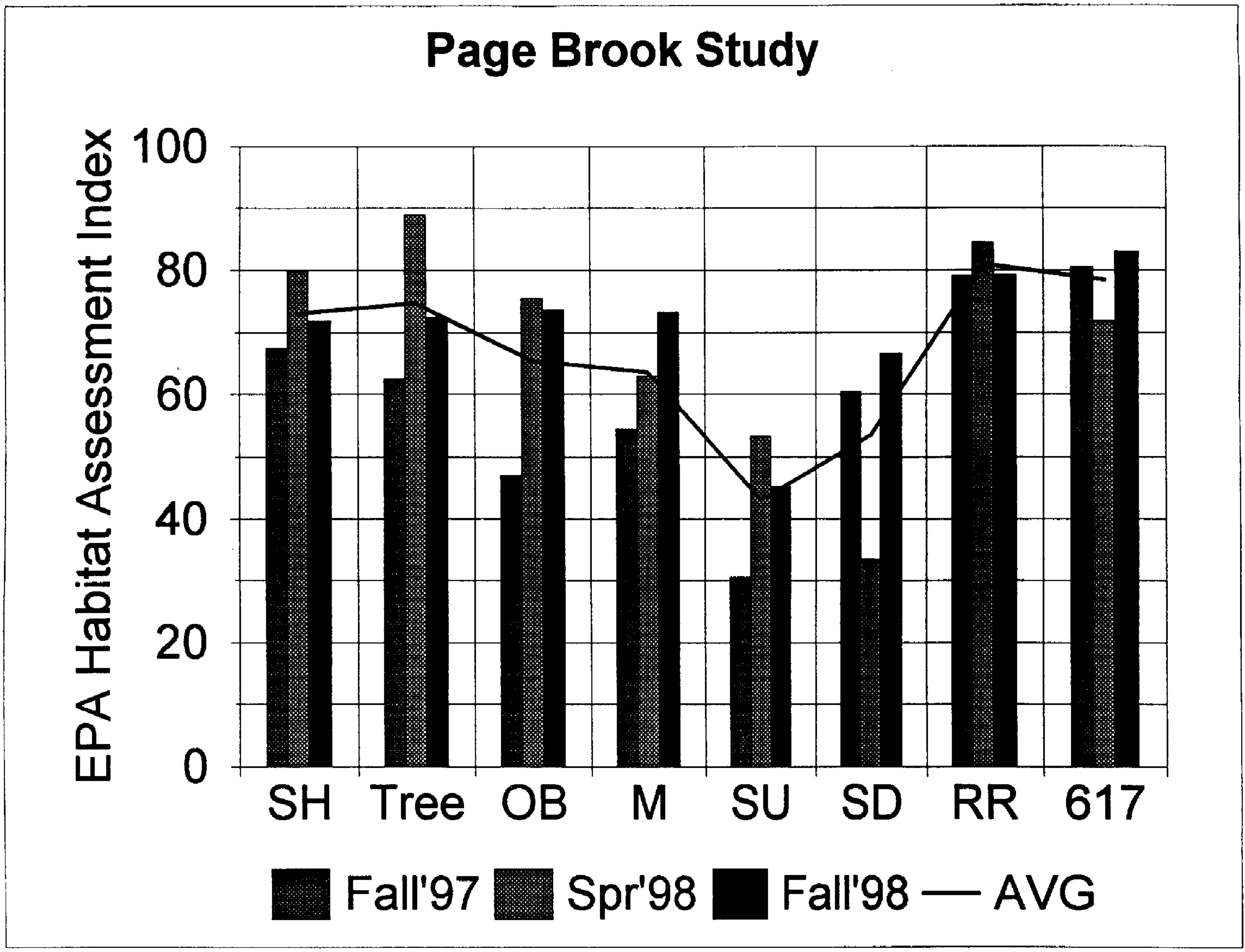

Figure 10. EPA Habitat Assessment Index. Percent of possible.

Appendix A: Page Brook Macroinvertebrate Data - Raw Counts

Station	Date	Hydropsyc	Psychomy	Polycentro	Philopotan	Limnephili	Hydroptilid	Perlidae	Ceratopog	Simulidae	Chironomi	Tipulidae
PB@SH	96	0	0	0	0	0	2	0	0	6	219	0
PB@SH	96	2	0	0	0	0	7	0	1	4	165	0
PB@SH	Fall97	0	0	0	0	0	0	0	0	0	2	0
PB@SH	Spr98	3	0	0	0	0	2	0	0	0	2	0
PB@SH	Fall98	4	0	0	0	0	0	0	0	1	3	2
PB@Tree	Fall97	25	0	0	0	0	0	0	0	0	15	0
PB@Tree	Spr98	31	0	0	0	0	1	1	254	0	61	0
PB@Tree	Fall98	2	0	0	2	0	0	0	1	0	1	0
PB@OB	96	0	0	0	0	0	1	1	2	3	179	0
PB@OB	96	0	0	0	0	0	0	0	1	1	185	0
PB@OB	Fall97	5	0	0	0	0	0	0	0	1	11	0
PB@OB	Spr98	12	0	0	0	0	10	0	24	2	5	0
PB@OB	Fall98	16	0	0	5	0	0	0	0		17	3
PB@MD	96	21	0	0	0	0	0	0	0	6	45	0
PB@MU	96	30	0	0	0	0	0	0	0	19	70	3
PB@M	Fall97	40	0	0	0	0	0	0	0	2	54	3
PB@M	Spr98	44	0	0	1	0	0	0	0	2	44	0
PB@M	Fall98	5	1	0	12	0	0	0	0	0	33	3
PB@SU	96	5	0	0	0	0	0	0	0	5	31	0
PB@SU	Fall97	1	0	0	0	0	0	0	0	0	2	1
PB@SU	Spr98	20	0	0	0	0	3	0	0	11	102	0
PB@SU	Fall98	2	0	0	0	0	0	0	0	0	1	0
PB@SD	96	0	0	0	0	0	0	0	0	1	28	0
PB@SD	Fall97	16	0	0	0	0	0	0	0	0	1	0
PB@SD	Spr98	12	0	0	0	0	9	0	0	2	23	0
PB@SD	Fall98	6	0	0	1	0	0	0	0	0	6	0
PB@RR	96	25	0	0	0	1	1	0	0	2	0	2
PB@RR	Fall97	52	0	0	0	0	2	0	0	7	48	2
PB@RR	Spr98	63	0	0	0	0	21	0	0	64	170	0
PB@RR	Fall98	19	0	0	0	0	0	0	0	0	37	2
PB@617	96	55	0	0	0	1	9	0	0	0	37	5
PB@617	Fall97	73	0	0	1	0	2	0	0	9	31	3
PB@617	Spr98	35	0	0	0	0	14	0	0	16	79	1
PB@617	Fall98	100	3	4	1	0	0	0	0	9	127	2

Appendix A: Page Brook Macroinvertebrate Data - Raw Counts

Station	Date	Empididae	Stratiomyi	Tabanidae	Ephemeric	Amelidae	UK/IM EPI	Baetidae	Ephemere	Heptagenii	Siphloneur	Leptophlet
PB@SH	96	0	0	0	0	0	0	0	0	0	0	0
PB@SH	96	1	0	0	0	0	0	0	0	0	0	0
PB@SH	Fall97	0	0	0	0	0	0	0	0	0	0	0
PB@SH	Spr98	0	0	0	0	0	0	0	0	0	0	0
PB@SH	Fall98	0	0	0	0	0	0	0	0	0	0	0
PB@Tree	Fall97	0	0	1	0	0	0	1	0	0	0	0
PB@Tree	Spr98	0	0	0	0	0	0	0	0	0	0	0
PB@Tree	Fall98	0	0	0	0	0	0	2	0	0	0	0
PB@OB	96	0	0	0	0	0	0	4	0	0	0	0
PB@OB	96	0	0	0	0	0	0	1	0	0	0	0
PB@OB	Fall97	0	0	0	0	0	0	0	0	1	0	0
PB@OB	Spr98	0	0	1	0	0	0	0	0	0	0	0
PB@OB	Fall98	0	0	0	0	1	0	9	0	1	0	1
PB@MD	96	2	0	0	0	0	0	7	0	0	0	0
PB@MU	96	0	0	0	0	0	0	7	0	0	0	0
PB@M	Fall97	3	0	0	0	1	8	124	0	4	0	7
PB@M	Spr98	0	0	0	0	0	0	12	0	0	0	1
PB@M	Fall98	1	0	0	0	0	0	26	0	3	0	28
PB@SU	96	0	0	0	0	0	0	0	0	0	0	0
PB@SU	Fall97	0	0	0	0	0	0	0	0	0	0	0
PB@SU	Spr98	5	0	0	0	0	1	11	0	0	0	0
PB@SU	Fall98	0	0	0	0	0	0	0	0	0	0	0
PB@SD	96	0	0	0	0	0	0	3	0	0	0	0
PB@SD	Fall97	0	0	0	0	0	0	0	0	0	0	0
PB@SD	Spr98	0	0	0	0	0	0	0	0	0	0	0
PB@SD	Fall98	0	0	0	0	0	0	1	0	0	0	0
PB@RR	96	1	0	0	0	0	0	0	0	0	0	0
PB@RR	Fall97	2	0	0	0	0	0	3	0	7	0	0
PB@RR	Spr98	1	0	0	0	0	2	5	0	0	0	0
PB@RR	Fall98	1	0	0	0	0	0	1	0	8	0	1
PB@617	96	2	0	0	0	0	0	8	0	2	0	0
PB@617	Fall97	5	0	0	0	0	0	15	0	31	14	1
PB@617	Spr98	5	0	0	0	0	2	1	1	1	0	0
PB@617	Fall98	22	2	0	1	0	1	4	0	7	0	0

Appendix A: Page Brook Macroinvertebrate Data - Raw Counts

Station	Date	Calipterygi	Corduliida(	Aeshnidae	Elmidae	Hydrophili(	Psephenid	Dytiscidae	Haliplidae	Corydalida	Sialidae	Veliidae
PB@SH	96	0	0	0	1	0	0	1	0	0	0	0
PB@SH	96	0	0	0	2	0	0	2	0	0	0	0
PB@SH	Fall97	0	0	0	2	0	0	0	0	0	0	0
PB@SH	Spr98	0	0	0	0	1	0	0	0	0	0	0
PB@SH	Fall98	0	0	0	1	0	0	0	0	0	0	0
PB@Tree	Fall97	0	0	0	4	0	0	0	0	0	0	0
PB@Tree	Spr98	0	0	0	3	0	0	0	0	0	0	0
PB@Tree	Fall98	0	0	0	9	0	0	0	0	0	0	0
PB@OB	96	0	0	0	7	0	0	0	0	1	0	0
PB@OB	96	0	0	0	4	0	0	0	0	0	0	0
PB@OB	Fall97	0	0	0	10	0	0	0	0	2	0	3
PB@OB	Spr98	0	0	0	8	0	0	0	3	2	0	0
PB@OB	Fall98	0	0	0	3	0	0	0	0	2	0	1
PB@MD	96	0	0	0	19	0	4	0	0	1	0	0
PB@MU	96	0	0	0	16	0	6	0	0	0	0	0
PB@M	Fall97	0	0	0	31	0	2	0	0	1	0	10
PB@M	Spr98	0	0	0	19	0	2	0	0	1	0	3
PB@M	Fall98	0	0	0	9	0	2	0	0	1	0	7
PB@SU	96	1	0	0	34	0	2	0	0	0	0	0
PB@SU	Fall97	0	1	0	3	0	0	1	0	1	0	0
PB@SU	Spr98	0	0	0	11	0	1	0	0	0	0	0
PB@SU	Fall98	0	0	0	4	0	0	0	1	0	0	1
PB@SD	96	0	0	0	1	0	0	0	0	0	0	1
PB@SD	Fall97	1	0	0	22	0	0	0	0	0	0	2
PB@SD	Spr98	0	0	0	2	0	0	0	2	0	0	0
PB@SD	Fall98	2	0	0	3	0	0	0	5	0	0	1
PB@RR	96	0	0	0	0	0	0	0	0	0	0	0
PB@RR	Fall97	13	0	0	95	0	0	0	0	0	0	5
PB@RR	Spr98	0	0	2	14	0	0	0	8	0	0	0
PB@RR	Fall98	7	0	1	21	0	0	0	6	0	0	0
PB@617	96	0	0	0	19	0	0	0	7	0	1	0
PB@617	Fall97	0	0	0	34	0	0	0	0	0	0	2
PB@617	Spr98	0	0	0	1	0	0	0	0	0	0	0
PB@617	Fall98	10	0	4	33	0	0	0	40	0	0	1

Appendix A: Page Brook Macroinvertebrate Data - Raw Counts

Station	Date	Gerridae	Corixidae	Belastoma	Isotomidae	Asellidae	Cambarida	Hydracarin	Pelecypod	Gastropod	Oligochaet	Hirundinea
PB@SH	96	0	0	0	0	65	0	0	0	0	17	0
PB@SH	96	0	0	0	0	49	0	1	0	1	7	0
PB@SH	Fall97	0	0	0	0	456	5	0	0	4	20	1
PB@SH	Spr98	0	0	0	0	317	0	0	2	0	14	0
PB@SH	Fall98	1	0	0	0	343	1	4	1	0	15	1
PB@Tree	Fall97	1	4	0	0	294	7	0	1	6	26	1
PB@Tree	Spr98	0	0	1	0	193	2	1	1	2	19	0
PB@Tree	Fall98	0	0	0	0	1011	0	0	0	2	14	0
PB@OB	96	0	1	0	0	31	0	1	0	0	12	0
PB@OB	96	0	1	0	0	84	0	0	0	0	60	0
PB@OB	Fall97	0	0	0	0	168	3	0	0	0	29	0
PB@OB	Spr98	0	0	0	0	301	3	0	23	0	7	0
PB@OB	Fall98	0	1	0	0	176	1	0	0	1	7	0
PB@MD	96	0	0	0	0	48	0	0	0	0	10	0
PB@MU	96	0	0	0	0	197	0	2	1	1	18	0
PB@M	Fall97	0	1	0	0	105	7	0	0	0	3	0
PB@M	Spr98	0	0	0	0	112	2	1	0	0	2	0
PB@M	Fall98	0	0	0	1	78	0	1	0	0	2	0
PB@SU	96	0	0	0	0	87	0	0	1	0	40	0
PB@SU	Fall97	0	3	0	0	293	2	0	0	1	101	0
PB@SU	Spr98	0	0	0	0	197	0	2	0	0	0	0
PB@SU	Fall98	0	0	0	0	317	0	1	3	0	18	0
PB@SD	96	0	0	0	0	56	0	0	1	0	108	2
PB@SD	Fall97	0	0	0	0	656	4	2	2	0	23	0
PB@SD	Spr98	0	0	0	0	135	0	0	4	22	8	0
PB@SD	Fall98	0	2	0	0	214	0	2	0	0	52	0
PB@RR	96	0	0	0	0	0	0	0	0	0	0	0
PB@RR	Fall97	0	0	0	1	198	22	0	0	2	10	0
PB@RR	Spr98	0	0	0	0	179	6	2	9	3	35	0
PB@RR	Fall98	0	0	0	0	102	0	0	0	2	3	0
PB@617	96	0	0	0	0	145	0	6	3	1	7	0
PB@617	Fall97	0	3	0	1	105	3	1	6	0	7	0
PB@617	Spr98	0	0	0	0	57	0	0	2	2	4	0
PB@617	Fall98	0	0	0	1	390	0	27	0	27	11	0

Appendix A: Page Brook Macroinvertebrate Data - Raw Counts

Station	Date	Planariida‹	Nematoda	Ostracoda	Poduridae	Spongillid‹	Copepoda	Total
PB@SH	96	1	0	0	0	0	7	319
PB@SH	96	1	0	0	0	0	0	243
PB@SH	Fall97	41	0	0	0	0	0	531
PB@SH	Spr98	13	0	0	0	0	0	354
PB@SH	Fall98	0	0	0	0	0	0	377
PB@Tree	Fall97	2	0	0	0	0	0	388
PB@Tree	Spr98	2	0	0	0	0	0	572
PB@Tree	Fall98	8	0	0	0	0	0	1052
PB@OB	96	0	0	0	0	0	0	243
PB@OB	96	0	0	0	0	0	0	337
PB@OB	Fall97	0	0	0	0	0	0	233
PB@OB	Spr98	2	0	0	0	0	0	403
PB@OB	Fall98	3	0	0	0	0	0	248
PB@MD	96	0	0	0	0	0	0	163
PB@MU	96	2	0	0	0	0	0	372
PB@M	Fall97	0	0	0	0	0	0	406
PB@M	Spr98	0	0	0	0	0	0	246
PB@M	Fall98	0	0	0	0	0	0	213
PB@SU	96	0	0	0	0	0	0	206
PB@SU	Fall97	2	0	0	0	0	0	412
PB@SU	Spr98	0	0	0	0	0	0	364
PB@SU	Fall98	12	0	0	0	0	0	360
PB@SD	96	4	0	0	0	0	0	205
PB@SD	Fall97	15	0	0	0	0	0	744
PB@SD	Spr98	1	0	0	0	1	0	221
PB@SD	Fall98	1	0	0	0	0	0	296
PB@RR	96	0	0	0	0	0	0	32
PB@RR	Fall97	3	1	0	1	0	0	474
PB@RR	Spr98	4	0	0	0	0	0	588
PB@RR	Fall98	1	0	0	0	0	0	212
PB@617	96	0	0	1	0	0	0	309
PB@617	Fall97	1	1	0	0	0	0	349
PB@617	Spr98	0	0	0	0	0	0	221
PB@617	Fall98	1	0	0	0	0	0	828

Appendix B: Page Brook Macroinvertebrate Data - Relative Abundance

Station	Date	Hydropsyc	Psychomy	Polycentro	Philopotan	Limnephili	Hydroptilid	Perlidae	Ceratopog	Simulidae	Chironomi	Tipulidae
PB@SH	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.63%	0.00%	0.00%	1.88%	68.65%	0.00%
PB@SH	96	0.82%	0.00%	0.00%	0.00%	0.00%	2.88%	0.00%	0.41%	1.65%	67.90%	0.00%
PB@SH	Fall97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.38%	0.00%
PB@SH	Spr98	0.85%	0.00%	0.00%	0.00%	0.00%	0.56%	0.00%	0.00%	0.00%	0.56%	0.00%
PB@SH	Fall98	1.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.27%	0.80%	0.53%
PB@Tree	Fall97	6.44%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.87%	0.00%
PB@Tree	Spr98	5.42%	0.00%	0.00%	0.00%	0.00%	0.17%	0.17%	44.41%	0.00%	10.66%	0.00%
PB@Tree	Fall98	0.19%	0.00%	0.00%	0.19%	0.00%	0.00%	0.00%	0.10%	0.00%	0.10%	0.00%
PB@OB	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.41%	0.41%	0.82%	1.23%	73.66%	0.00%
PB@OB	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.30%	0.30%	54.90%	0.00%
PB@OB	Fall97	2.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.43%	4.72%	0.00%
PB@OB	Spr98	2.98%	0.00%	0.00%	0.00%	0.00%	2.48%	0.00%	5.96%	0.50%	1.24%	0.00%
PB@OB	Fall98	6.45%	0.00%	0.00%	2.02%	0.00%	0.00%	0.00%	0.00%	0.00%	6.85%	1.21%
PB@MD	96	12.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.68%	27.61%	0.00%
PB@MU	96	8.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.11%	18.82%	0.81%
PB@M	Fall97	9.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.49%	13.30%	0.74%
PB@M	Spr98	17.89%	0.00%	0.00%	0.41%	0.00%	0.00%	0.00%	0.00%	0.81%	17.89%	0.00%
PB@M	Fall98	2.35%	0.47%	0.00%	5.63%	0.00%	0.00%	0.00%	0.00%	0.00%	15.49%	1.41%
PB@SU	96	2.43%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.43%	15.05%	0.00%
PB@SU	Fall97	0.24%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.49%	0.24%
PB@SU	Spr98	5.49%	0.00%	0.00%	0.00%	0.00%	0.82%	0.00%	0.00%	3.02%	28.02%	0.00%
PB@SU	Fall98	0.56%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.28%	0.00%
PB@SD	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.49%	13.66%	0.00%
PB@SD	Fall97	2.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%
PB@SD	Spr98	5.43%	0.00%	0.00%	0.00%	0.00%	4.07%	0.00%	0.00%	0.90%	10.41%	0.00%
PB@SD	Fall98	2.03%	0.00%	0.00%	0.34%	0.00%	0.00%	0.00%	0.00%	0.00%	2.03%	0.00%
PB@RR	96	78.13%	0.00%	0.00%	0.00%	3.13%	3.13%	0.00%	0.00%	6.25%	0.00%	6.25%
PB@RR	Fall97	10.97%	0.00%	0.00%	0.00%	0.00%	0.42%	0.00%	0.00%	1.48%	10.13%	0.42%
PB@RR	Spr98	10.71%	0.00%	0.00%	0.00%	0.00%	3.57%	0.00%	0.00%	10.88%	28.91%	0.00%
PB@RR	Fall98	8.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	17.45%	0.94%
PB@617	96	17.80%	0.00%	0.00%	0.00%	0.32%	2.91%	0.00%	0.00%	0.00%	11.97%	1.62%
PB@617	Fall97	20.92%	0.00%	0.00%	0.29%	0.00%	0.57%	0.00%	0.00%	2.58%	8.88%	0.86%
PB@617	Spr98	15.84%	0.00%	0.00%	0.00%	0.00%	6.33%	0.00%	0.00%	7.24%	35.75%	0.45%
PB@617	Fall98	12.08%	0.36%	0.48%	0.12%	0.00%	0.00%	0.00%	0.00%	1.09%	15.34%	0.24%

Appendix B: Page Brook Macroinvertebrate Data - Relative Abundance

Station	Date	Empididae	Stratiomyi	Tabanidae	Ephemeric	Amelidae	UK/IM EPI	Baetidae	Ephemere	Heptagenii	Siphloneur	Leptophlet
PB@SH	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SH	96	0.41%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SH	Fall97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SH	Spr98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SH	Fall98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@Tree	Fall97	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	0.00%
PB@Tree	Spr98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@Tree	Fall98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%	0.00%	0.00%	0.00%	0.00%
PB@OB	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.65%	0.00%	0.00%	0.00%	0.00%
PB@OB	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.30%	0.00%	0.00%	0.00%	0.00%
PB@OB	Fall97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.43%	0.00%	0.00%
PB@OB	Spr98	0.00%	0.00%	0.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@OB	Fall98	0.00%	0.00%	0.00%	0.00%	0.40%	0.00%	3.63%	0.00%	0.40%	0.00%	0.40%
PB@MD	96	1.23%	0.00%	0.00%	0.00%	0.00%	0.00%	4.29%	0.00%	0.00%	0.00%	0.00%
PB@MU	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.88%	0.00%	0.00%	0.00%	0.00%
PB@M	Fall97	0.74%	0.00%	0.00%	0.00%	0.25%	1.97%	30.54%	0.00%	0.99%	0.00%	1.72%
PB@M	Spr98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.88%	0.00%	0.00%	0.00%	0.41%
PB@M	Fall98	0.47%	0.00%	0.00%	0.00%	0.00%	0.00%	12.21%	0.00%	1.41%	0.00%	13.15%
PB@SU	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SU	Fall97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SU	Spr98	1.37%	0.00%	0.00%	0.00%	0.00%	0.27%	3.02%	0.00%	0.00%	0.00%	0.00%
PB@SU	Fall98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SD	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.46%	0.00%	0.00%	0.00%	0.00%
PB@SD	Fall97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SD	Spr98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SD	Fall98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.34%	0.00%	0.00%	0.00%	0.00%
PB@RR	96	3.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@RR	Fall97	0.42%	0.00%	0.00%	0.00%	0.00%	0.00%	0.63%	0.00%	1.48%	0.00%	0.00%
PB@RR	Spr98	0.17%	0.00%	0.00%	0.00%	0.00%	0.34%	0.85%	0.00%	0.00%	0.00%	0.00%
PB@RR	Fall98	0.47%	0.00%	0.00%	0.00%	0.00%	0.00%	0.47%	0.00%	3.77%	0.00%	0.47%
PB@617	96	0.65%	0.00%	0.00%	0.00%	0.00%	0.00%	2.59%	0.00%	0.65%	0.00%	0.00%
PB@617	Fall97	1.43%	0.00%	0.00%	0.00%	0.00%	0.00%	4.30%	0.00%	8.88%	4.01%	0.29%
PB@617	Spr98	2.26%	0.00%	0.00%	0.00%	0.00%	0.90%	0.45%	0.45%	0.45%	0.00%	0.00%
PB@617	Fall98	2.66%	0.24%	0.00%	0.12%	0.00%	0.12%	0.48%	0.00%	0.85%	0.00%	0.00%

Appendix B: Page Brook Macroinvertebrate Data - Relative Abundance

Station	Date	Calipterygi	Corduliida	Aeshnidae	Elmidae	Hydrophilic	Psephenid	Dytiscidae	Haliplidae	Corydalida	Sialidae	Veliidae
PB@SH	96	0.00%	0.00%	0.00%	0.31%	0.00%	0.00%	0.31%	0.00%	0.00%	0.00%	0.00%
PB@SH	96	0.00%	0.00%	0.00%	0.82%	0.00%	0.00%	0.82%	0.00%	0.00%	0.00%	0.00%
PB@SH	Fall97	0.00%	0.00%	0.00%	0.38%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SH	Spr98	0.00%	0.00%	0.00%	0.00%	0.28%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SH	Fall98	0.00%	0.00%	0.00%	0.27%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@Tree	Fall97	0.00%	0.00%	0.00%	1.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@Tree	Spr98	0.00%	0.00%	0.00%	0.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@Tree	Fall98	0.00%	0.00%	0.00%	0.86%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@OB	96	0.00%	0.00%	0.00%	2.88%	0.00%	0.00%	0.00%	0.00%	0.41%	0.00%	0.00%
PB@OB	96	0.00%	0.00%	0.00%	1.19%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@OB	Fall97	0.00%	0.00%	0.00%	4.29%	0.00%	0.00%	0.00%	0.00%	0.86%	0.00%	1.29%
PB@OB	Spr98	0.00%	0.00%	0.00%	1.99%	0.00%	0.00%	0.00%	0.74%	0.50%	0.00%	0.00%
PB@OB	Fall98	0.00%	0.00%	0.00%	1.21%	0.00%	0.00%	0.00%	0.00%	0.81%	0.00%	0.40%
PB@MD	96	0.00%	0.00%	0.00%	11.66%	0.00%	2.45%	0.00%	0.00%	0.61%	0.00%	0.00%
PB@MU	96	0.00%	0.00%	0.00%	4.30%	0.00%	1.61%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@M	Fall97	0.00%	0.00%	0.00%	7.64%	0.00%	0.49%	0.00%	0.00%	0.25%	0.00%	2.46%
PB@M	Spr98	0.00%	0.00%	0.00%	7.72%	0.00%	0.81%	0.00%	0.00%	0.41%	0.00%	1.22%
PB@M	Fall98	0.00%	0.00%	0.00%	4.23%	0.00%	0.94%	0.00%	0.00%	0.47%	0.00%	3.29%
PB@SU	96	0.49%	0.00%	0.00%	16.50%	0.00%	0.97%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SU	Fall97	0.00%	0.24%	0.00%	0.73%	0.00%	0.00%	0.24%	0.00%	0.24%	0.00%	0.00%
PB@SU	Spr98	0.00%	0.00%	0.00%	3.02%	0.00%	0.27%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@SU	Fall98	0.00%	0.00%	0.00%	1.11%	0.00%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%
PB@SD	96	0.00%	0.00%	0.00%	0.49%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.49%
PB@SD	Fall97	0.13%	0.00%	0.00%	2.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.27%
PB@SD	Spr98	0.00%	0.00%	0.00%	0.90%	0.00%	0.00%	0.00%	0.90%	0.00%	0.00%	0.00%
PB@SD	Fall98	0.68%	0.00%	0.00%	1.01%	0.00%	0.00%	0.00%	1.69%	0.00%	0.00%	0.34%
PB@RR	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@RR	Fall97	2.74%	0.00%	0.00%	20.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.05%
PB@RR	Spr98	0.00%	0.00%	0.34%	2.38%	0.00%	0.00%	0.00%	1.36%	0.00%	0.00%	0.00%
PB@RR	Fall98	3.30%	0.00%	0.47%	9.91%	0.00%	0.00%	0.00%	2.83%	0.00%	0.00%	0.00%
PB@617	96	0.00%	0.00%	0.00%	6.15%	0.00%	0.00%	0.00%	2.27%	0.00%	0.32%	0.00%
PB@617	Fall97	0.00%	0.00%	0.00%	9.74%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.57%
PB@617	Spr98	0.00%	0.00%	0.00%	0.45%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@617	Fall98	1.21%	0.00%	0.48%	3.99%	0.00%	0.00%	0.00%	4.83%	0.00%	0.00%	0.12%

Appendix B: Page Brook Macroinvertebrate Data - Relative Abundance

Station	Date	Gerridae	Corixidae	Belastoma	Isotomidae	Asellidae	Cambarida	Hydracarin	Pelecypod	Gastropod	Oligochaet	Hirundinea
PB@SH	96	0.00%	0.00%	0.00%	0.00%	20.38%	0.00%	0.00%	0.00%	0.00%	5.33%	0.00%
PB@SH	96	0.00%	0.00%	0.00%	0.00%	20.16%	0.00%	0.41%	0.00%	0.41%	2.88%	0.00%
PB@SH	Fall97	0.00%	0.00%	0.00%	0.00%	85.88%	0.94%	0.00%	0.00%	0.75%	3.77%	0.19%
PB@SH	Spr98	0.00%	0.00%	0.00%	0.00%	89.55%	0.00%	0.00%	0.56%	0.00%	3.95%	0.00%
PB@SH	Fall98	0.27%	0.00%	0.00%	0.00%	90.98%	0.27%	1.06%	0.27%	0.00%	3.98%	0.27%
PB@Tree	Fall97	0.26%	1.03%	0.00%	0.00%	75.77%	1.80%	0.00%	0.26%	1.55%	6.70%	0.26%
PB@Tree	Spr98	0.00%	0.00%	0.17%	0.00%	33.74%	0.35%	0.17%	0.17%	0.35%	3.32%	0.00%
PB@Tree	Fall98	0.00%	0.00%	0.00%	0.00%	96.10%	0.00%	0.00%	0.00%	0.19%	1.33%	0.00%
PB@OB	96	0.00%	0.41%	0.00%	0.00%	12.76%	0.00%	0.41%	0.00%	0.00%	4.94%	0.00%
PB@OB	96	0.00%	0.30%	0.00%	0.00%	24.93%	0.00%	0.00%	0.00%	0.00%	17.80%	0.00%
PB@OB	Fall97	0.00%	0.00%	0.00%	0.00%	72.10%	1.29%	0.00%	0.00%	0.00%	12.45%	0.00%
PB@OB	Spr98	0.00%	0.00%	0.00%	0.00%	74.69%	0.74%	0.00%	5.71%	0.00%	1.74%	0.00%
PB@OB	Fall98	0.00%	0.40%	0.00%	0.00%	70.97%	0.40%	0.00%	0.00%	0.40%	2.82%	0.00%
PB@MD	96	0.00%	0.00%	0.00%	0.00%	29.45%	0.00%	0.00%	0.00%	0.00%	6.13%	0.00%
PB@MU	96	0.00%	0.00%	0.00%	0.00%	52.96%	0.00%	0.54%	0.27%	0.27%	4.84%	0.00%
PB@M	Fall97	0.00%	0.25%	0.00%	0.00%	25.86%	1.72%	0.00%	0.00%	0.00%	0.74%	0.00%
PB@M	Spr98	0.00%	0.00%	0.00%	0.00%	45.53%	0.81%	0.41%	0.00%	0.00%	0.81%	0.00%
PB@M	Fall98	0.00%	0.00%	0.00%	0.47%	36.62%	0.00%	0.47%	0.00%	0.00%	0.94%	0.00%
PB@SU	96	0.00%	0.00%	0.00%	0.00%	42.23%	0.00%	0.00%	0.49%	0.00%	19.42%	0.00%
PB@SU	Fall97	0.00%	0.73%	0.00%	0.00%	71.12%	0.49%	0.00%	0.00%	0.24%	24.51%	0.00%
PB@SU	Spr98	0.00%	0.00%	0.00%	0.00%	54.12%	0.00%	0.55%	0.00%	0.00%	0.00%	0.00%
PB@SU	Fall98	0.00%	0.00%	0.00%	0.00%	88.06%	0.00%	0.28%	0.83%	0.00%	5.00%	0.00%
PB@SD	96	0.00%	0.00%	0.00%	0.00%	27.32%	0.00%	0.00%	0.49%	0.00%	52.68%	0.98%
PB@SD	Fall97	0.00%	0.00%	0.00%	0.00%	88.17%	0.54%	0.27%	0.27%	0.00%	3.09%	0.00%
PB@SD	Spr98	0.00%	0.00%	0.00%	0.00%	61.09%	0.00%	0.00%	1.81%	9.95%	3.62%	0.00%
PB@SD	Fall98	0.00%	0.68%	0.00%	0.00%	72.30%	0.00%	0.68%	0.00%	0.00%	17.57%	0.00%
PB@RR	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PB@RR	Fall97	0.00%	0.00%	0.00%	0.21%	41.77%	4.64%	0.00%	0.00%	0.42%	2.11%	0.00%
PB@RR	Spr98	0.00%	0.00%	0.00%	0.00%	30.44%	1.02%	0.34%	1.53%	0.51%	5.95%	0.00%
PB@RR	Fall98	0.00%	0.00%	0.00%	0.00%	48.11%	0.00%	0.00%	0.00%	0.94%	1.42%	0.00%
PB@617	96	0.00%	0.00%	0.00%	0.00%	46.93%	0.00%	1.94%	0.97%	0.32%	2.27%	0.00%
PB@617	Fall97	0.00%	0.86%	0.00%	0.29%	30.09%	0.86%	0.29%	1.72%	0.00%	2.01%	0.00%
PB@617	Spr98	0.00%	0.00%	0.00%	0.00%	25.79%	0.00%	0.00%	0.90%	0.90%	1.81%	0.00%
PB@617	Fall98	0.00%	0.00%	0.00%	0.12%	47.10%	0.00%	3.26%	0.00%	3.26%	1.33%	0.00%

Appendix B: Page Brook Macroinvertebrate Data - Relative Abundance

Station	Date	Planariidae	Nematoda	Ostracoda	Poduridae	Spongillida	Copepoda	Total
PB@SH	96	0.31%	0.00%	0.00%	0.00%	0.00%	2.19%	100.00%
PB@SH	96	0.41%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SH	Fall97	7.72%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SH	Spr98	3.67%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SH	Fall98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@Tree	Fall97	0.52%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@Tree	Spr98	0.35%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@Tree	Fall98	0.76%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@OB	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@OB	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@OB	Fall97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@OB	Spr98	0.50%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@OB	Fall98	1.21%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@MD	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@MU	96	0.54%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@M	Fall97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@M	Spr98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@M	Fall98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SU	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SU	Fall97	0.49%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SU	Spr98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SU	Fall98	3.33%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SD	96	1.95%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SD	Fall97	2.02%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@SD	Spr98	0.45%	0.00%	0.00%	0.00%	0.45%	0.00%	100.00%
PB@SD	Fall98	0.34%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@RR	96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@RR	Fall97	0.63%	0.21%	0.00%	0.21%	0.00%	0.00%	100.00%
PB@RR	Spr98	0.68%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@RR	Fall98	0.47%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@617	96	0.00%	0.00%	0.32%	0.00%	0.00%	0.00%	100.00%
PB@617	Fall97	0.29%	0.29%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@617	Spr98	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
PB@617	Fall98	0.12%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%