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A Seasonality Study of the West Virginia Stream Condition Index

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A SEASONALITY STUDY OF THE WEST VIRGINIA STREAM CONDITION INDEX

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Abstract

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The West Virginia Stream Condition Index (WVSCI) has not been rigorously tested for the effects of seasonal data collection. Scientific literature regarding seasonal impacts on biological indices is surprisingly limited. But most literature does agree that seasonal signals are small in comparison to variation between all possible biological conditions. Recently stream data have been collected from a full range of seasons by both West Virginia Department of Environmental Protection and myself. In this study habitat, benthic macroinvertebrate data, and WVSCI values were analyzed for seasonality. For this reason multiple independent data sets were utilized. The analyses covered in this report include the use of box-and-whisker plots, correlation analysis and ANOVAs. Preliminary results indicate that seasonality does impact certain metrics under some seasonal conditions. Among the six metrics that make up the WVSCI, some seasonal signal was detected for EPT Taxa, % Chironomidae, Hilsenhoff Biotic Index, Total Taxa and the WVSCI Index scores. These signals were very inconsistent across multiple, independent data sets. Presently, there are no suggestions for any alterations of the WVSCI that would reduce seasonal signals.

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CHAPTER 1

Introduction

The total number of aquatic insect species is estimated at over 40,000. Two patterns of life history are; those in which all stages are passed in water (e.g. Hemiptera, Coleoptera) number about 9000, while those in which the adult emerges as a terrestrial or aerial being number over 30,000 species, mostly in the Diptera (Hutchinson, G. E. 1993). There are numerous reasons why macroinvertebrates make such good indicator communities. First macroinvertebrates are fairly ubiquitous and extremely easy to collect (Cummins 1975) and, also are ideal due to there sedentary nature (Resh and Jackson 1993). In addition Resenberg and Resh (1993) state that large numbers of species exhibit a wide spectrum of responses to a number of different environmental stressors. Finally, macroinvertebrates are long lived creatures which allow us to see changes overtime and not just get a quick glimpse of what may have occurred (Rosenberg, D.M. 1998). Benthic macroinvertebrate assemblages have long been used to assess and monitor water quality. Today benthic macroinvertebrates are used in 90% of the state water quality assessment programs (Southerland and Stribling 1995).

So it is very obvious that these organisms would be ideal to monitor as an indicator of possible disruption in a given system. Though there are some factors that can restrict the use of these organisms as a consistent indicator. In 1982 M.J. Suess stated in *The Exmination of Water for Pollution Control* that seasonal variation in the organism's natural life cycle can complicate the comparison of samples from different seasons. Another confounding factor is the natural variability in species and large drifts of macroinvertebrates that can take place during high water events that tend to flush a great deal of the organisms into areas that they do not normally occur. Considering all this, though, benthic macroinvertebrates are still the most reliable indicators of stressors in our systems. Thus biomonitoring began to develop to uncover what these disruptions in the system could be linked to.

Biomonitoring's roots can be traced back to the early 20th century when R. Kolkwitz and M. Marsson began using macroinvertebrates to assess water quality. These two men developed the idea of saprobity (the degree of pollution) in rivers as a measure of the extent of the contamination by sewage, which results in decreased amounts of dissolved oxygen (Merrit and Cummins 1996). Scientists conducted numerous investigations and went on to make observations about the presence and absence of certain taxa in different environmental conditions, which led to the identification of indicator species.

Biomonitoring is the systematic use of living organisms or their responses to determine the quality of the environment. Water pollution is essentially a biological problem and is better understood through the study of the resident organisms. Chemical measurements are like taking snapshots of the ecosystem, whereas biological measurements are like making a videotape (Rosenberg, D.M 1998). However, the use of indicator species may provide too narrow a focus and that indicator communities may give us a better definition of the anomalies occurring in the system. Prior to the 1970's the North American biomonitoring programs were similar to the European's programs which involved a qualitative approach to monitoring. After the 1970's the North

American programs broke with this ideal and developed a quantitative approach, which involved hypothesis testing that needed replicate sample units and detailed statistical analysis (Resh and Jackson 1993).

There are many different levels of biomonitoring cited by Merrit and Cummins (1996) in *An Introduction to the Aquatic Insects of North America* that could be utilized to identify changes within the system being monitored. The biochemical and physiological level quantifies the subcellular levels of the organism, such as enzyme activity and respiratory metabolism (Merrit and Cummins 1996). This form of monitoring is somewhat limited because there is little knowledge of many of the subcellular processes of macroinvertebrates. Most likely the use of this level of biomonitoring will be utilized more in the future when a better understanding is gained. Another level of biomonitoring would be the individual level where monitoring being conducted is characterized by analyses at intermediate spatial and temporal scales (Merrit and Cummins 1996). This individual level is more focused on looking at deviations of normal behavior based on contaminants contained within the system. This is due to the fact that these creatures are bottom dwellers that live in area where the levels of contaminats are much higher than in the water column. The life-history of benthic organisms relates things like reproduction, growth, and survival to contaminants.

The population and species assemblage level looks at relatively the same spatial and temporal scales but is used more frequently to assess water quality. Biotic indices, such as the one being studied in this paper, use this level of monitoring to look at the effects of different contaminats on certain taxa. This level also deals with a univariate approach to the analysis on which biotic indices are based. Multivariate analysis is used when organisms in the environment are affected by more than one environmental variable (Norris and George 1993). The biotic index approach has been selected in this work to evaluateaspects of the West Virginia Stream Condition Index (WVSCI) developed in 2000 by Tetra Tech Inc. The WVSCI is a multimetric, invertebrate index of biological integrity developed specifically for West Virginia and its bio-regions. Tetra Tech utilized a set of the West Virginia Department of Environmental Protection's Watershed Assessment Program data to identify metrics, set standardization values, and finalize an index. Many state and federal regulatory agencies have been concerned about the impacts of ecoregional diversity and the seasonal trends that occur in benthic macroinvertebrate data. Some indices have had to make either metric or standardization corrections for both issues (Arnwine & Denton, 2001). Aware of these concerns, Tetra Tech investigated that role of both issues on the WVSCI. Ecoregional diversity was investigated using U.S. EPA EMAP data for the region. These data do not exhibit significant ecoregional variation in the final index score. Seasonal effects were tested using a set of WV DEP data. Some seasonal trends were noted, but the narrow time frame that the samples were collected (late spring to early fall), restricted their interpretations on this issue.

The WVSCI is made up of many different metrics, or biological measurements, that change in some predictable way with increased human influence (Barbour et al., 1996). They include specific measures of diversity, composition, and functional feeding group representation and include ecological information on tolerance to pollution. Multimetric indices, such as the IBI, incorporate multiple biological community characteristics and measure the overall response of the community to environmental stressors (Karr et al., 1986). West Virginia was determined to set up an index that would be used to determine the biological integrity of three different eco-regions in the state: Ridge and Valley, Western Alleghany Plateau, and the Central Appalachians. To accomplish this mission West Virginia's DEP was given the task of sampling 720 sites to determine reference conditions in these different eco-regions. Out of these 720 sites sixty-seven of them were classified as meeting reference conditions.

Tetra Tech determined that these sixty-seven sites would not be a reliable data set alone due to the clustering of the sites. Therefore, Tetra Tech decided to use data collected by EPA's Environmental Monitoring and Assessment Program. By using the same criteria that they had ordered WVDEP to utilize, they were able to gain an additional seventy-nine sites that could be used in calculating an index for the state. The issue of seasonal differences in the benthic macroinvertebrate assemblage might require grouping the data by narrower date ranges for classification (Tetra Tech, 2000). The following conclusions were made by Tetra Tech in light of temporal differences: ordination of the benthic data by ecoregion indicated that a spatial classification was not distinct and therefore would not play a role in significantly influencing index scores.

The ordination of the West Virginia benthic data by date was not distinct enough to partition into separate sampling periods such as winter, spring, summer, and fall. The classification into eco-regions did not explain differences among sites (0% difference explained) for EMAP data, and only a weak explanation (6.5% difference explained) for the West Virginia data. By grouping the benthic data into individual months, classification was improved over eco-regions (9.7% difference explained), but still not significant to explaining variability. Comparisons of the frequencies and relative abundance of taxa did not reveal distinct differences among sites in the three eco-regions. Also, correlation of various biological attributes or metrics with day-of-the-year sampled illustrated a weak relationship only with abundance of Chironomids while Box-and-whisker plots performed on various benthic attributes illustrated only weak distinction among eco-regions and sampling periods (Tetra Tech). From this information it was concluded that a sampling period from early spring to late summer would lower the variability in the overall scores, so the index was calibrated for a sampling period from April through October to offset this variability.

This calibration, though, doe not facilitate real world standards which require year round sampling, so it is essential that a more detailed look at the effects of seasonality be examined to see if there is a specific and noticeable difference in the winter sampling period and if there is a specific significance in impaired streams. This report will try to identify if a disparity in the winter sample does in fact exist and how this might affect the West Virginia Stream Condition Index. In the Early spring of 2002 I received a dataset from WV DEP personnel. These data were collected from eighteen reference sites spread across fourteen counties. Macroinvertebrate samples were collected following WV SCI protocols. Habitat and water quality data were also collected at each site on each visit. Three distinct seasons were sampled, winter (Dec./Jan), spring (March/April), and summer (July). By sampling high quality streams the effects of water chemistry and habitat quality were reduced. The proposed study will begin by comparing water chemistry and habitat values between the sites using box-and-whisker plots. Any data values greater then two standard deviations will be considered outliers. By utilizing habitat as an independent variable to determine any possible outliers, we will reduce to role of circular reasoning within the analysis of the benthic data. If sites are not included in an analysis a rational will be provided. Analyses of the benthic data will begin will box-and-whisker plots and proceed to ordination. Each metric score as well as index scores will be examined. Family taxonomy will be utilized for trend analysis in the benthic samples.

Another step in testing the WV SCI for seasonal effects would be to collect data from several streams known to be impaired. These sites would not be as constrained by competitive interactions as strongly as reference streams would be. Reference streams are high quality year round and would have a more complex community structure that would reduce the possibility of large niche shifts occurring. Impaired streams on the other hand have more variable water quality and give rise to niches not present in different seasons. An example would be lower temperatures in the winter may that may drive up dissolved oxygen levels giving winter-adapted taxa access to a large resource that is open for utilization (Stark *et al*, 1998). This has been noticed in acid mine streams in West Virginia where a significant number of winter stoneflies were collected from Laurel Creek (Upshur County) of Tygart Valley River. The presence of these EPT taxa artificially elevated the WVSCI scores well above those same site scores during summer data collection. Tennessee Department of Environment and Conservation also noted this trend in their assessment data when creating their state index (Arwine & Denton, 2001).

This study will make a collection of impaired sites around the state. The streams sampled will be scattered throughout the same ecoregions as the reference streams sampled and will consist of AMD, nutrient, and sediment impairment. Also three alternate data sets; WVDEP Reference data, WVDEP Repeat Data, and Stony River data, will be a comparison set by which to observe the changes in the study sites. The data will be compared by box and whisker polts, Julian Day graph comparisons, a variety of descriptive statiscs, and ANOVAs.

CHAPTER 2

Field Methods

Rapid Bioassessment Protocols

The Rapid Bioassessment Protocols in Streams and Wadeable Rivers (USEPA) was used to assess the habitat for this project. It advocates an integrated assessment, comparing habitat (e.g., physical structure, flow regime) and, biological measures with empirically defined reference conditions (actual reference sites, historical data, and some modeling). Reference conditions are best established through systematic monitoring of actual sites that represent the natural range of variation in "minimally" disturbed water chemistry, habitat, and biological conditions (Gibson et al. 1996). Of these 3 components of ecological integrity, ambient water chemistry may be the most difficult to characterize because of the complex array of possible constituents (natural and otherwise) that affect it. The implementation framework is enhanced by the development of an empirical relationship between habitat quality and biological condition that is refined for a given region. Once the relationship between habitat and biological potential is understood, water quality impacts can be objectively discriminated from habitat effects, and control and rehabilitation efforts can be focused on the most important source of impairment. Physical characterization includes documentation of general land use, description of the stream origin and type, summary of the riparian vegetation features, and measurements of in-stream parameters such as width, depth, flow, and substrate. Also, there are ten parameters that are combined to give a habitat score between zero and two hundred. The following are descriptions of physical characters described in this report, the first section being the parameters for habitat scoring and the last for the description of the physical characters of the collection point.

Habitat Scoring Parameters

1. EPIFAUNAL SUBSTRATE/AVAILABLE COVER: This includes the relative quantity and variety of natural structures in the stream. A wide variety and/or abundance of submerged structures in the stream provides macroinvertebrates and fish with a large number of niches, thus increasing habitat diversity.

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

EMBEDDEDNESS: Refers to the extent to which rocks (gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom. Embeddedness is a result of large-scale sediment movement and deposition, and is a parameter evaluated in the riffles and runs of high-gradient streams. (Image on following page)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
2.Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

VELOCITY/DEPTH COMBINATIONS: Patterns of velocity and depth are included for high-gradient streams under this parameter as an important feature of habitat diversity. The best streams in most high-gradient regions will have all 4 patterns present: (1) slow-deep, (2) slow-shallow, (3) fast-deep, and (4) fast-shallow.

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
3.Velocity/ Depth Regimes	All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (slow is <0.3 m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

SEDIMENT DEPOSITION: Measures the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition. Deposition occurs from large-scale movement of sediment. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms. (Image on following page)

	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

CHANNEL FLOW STATUS: The degree to which the channel is filled with water. The flow status will change as the channel enlarges (e.g., aggrading stream beds with actively widening channels) or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the amount of suitable substrate for aquatic organisms is limited.

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

CHANNEL ALTERATION: A measure of large-scale changes in the shape of the stream channel. Channel alteration is present when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. (Image on following page)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

FREQUENCY OF RIFFLES (OR BENDS): This measures the sequence of riffles and thus the heterogeneity occurring in a stream. Riffles are a source of high-quality habitat and diverse fauna, therefore, an increased frequency of occurrence greatly enhances the diversity of the stream community.

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

BANK STABILITY: Measures whether the stream banks are eroded (or have the potential for erosion). Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams. (Image on following page)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream**	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

BANK VEGETATIVE PROTECTION: Measures the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone. This parameter supplies information on the ability of the bank to resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap. (Image on following page)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
9. Vegetative Protection (score each bank) **Note: determine left or right side by facing downstream**	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

RIPARIAN VEGETATIVE ZONE WIDTH: Measures the width of natural vegetation from the edge of the stream bank out through the riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and nutrient input into the stream.

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Physical Site Descriptions

Predominant Surrounding Land Use Type: Document the prevalent land-use type in the catchment of the station (noting any other land uses in the area which, although not predominant, may potentially affect water quality). Land use maps should be consulted to accurately document this information.

Proportion of Reach Represented by Stream Morphological Types: The proportion represented by riffles, runs, and pools should be noted to describe the morphological heterogeneity of the reach.

Channelized: Indicate whether or not the area around the sampling reach or station is channelized (e.g., straightening of stream, bridge abutments and road crossings, diversions, etc.).

Aquatic Vegetation: The general type and relative dominance of aquatic plants are documented in this section. Only an estimation of the extent of aquatic vegetation is made. Besides being an ecological assemblage that responds to perturbation, aquatic vegetation provides a refuge and food for aquatic fauna.

Water Odors: Note those odors described (or include any other odors not listed) that are associated with the water in the sampling area.

Water Surface Oils: Note the term that best describes the relative amount of any oils present on the water surface.

Turbidity: If turbidity is not measured directly, note the term which, based upon visual observation, best describes the amount of material suspended in the water column.

Sediment Odors: Disturb sediment in pool or other depositional areas and note any odors described (or include any other odors not listed) which are associated with sediment in the sampling reach.

Sediment Oils: Note the term which best describes the relative amount of any sediment oils observed in the sampling area.

Sediment Deposits: Note those deposits described (or include any other deposits not listed) that are present in the sampling reach.

Inorganic Substrate Components: Visually estimate the relative proportion of each of the 7 substrate/particle types listed that are present over the sampling reach: Bedrock, Boulder, Cobble, Gravel, Sand, Silt, and Clay.

Macro-inveretebrate assessment

The Rapid bioassessment protocols for use in streams and wadeable rivers were followed in the collection of the benthic macroinvertebrates. At each collection point macroinvertbrates were collected with a 0.25 m^2 D-Frame kick net with a 500-µm mesh sized net. Four kick net samples were taken within a one hundred meter reach and composited into a single sample and placed in a zip-lock baggy with 75% ethanol. Samples were then taken back to the lab and picked to a two hundred bug sub-sample to give an estimation of the overall community. This measurement of the natural aquatic ecosystem and its biological communities can help to determine the condition of naturally occurring biological integrity. Several key attributes are measured to yield indications of the quality of the aquatic resources at a particular time. Biological sampling establish the attributes or measures used to summarize several community characteristics, such as taxa richness, number of individuals, sensitive or insensitive species, and the presence or absence of critical habitat consituents.

Biological measurements, called metrics, represent elements of the structure and function of the bottom-dwelling macroinvertebrate assemblage. Metrics change in some predictable way with increased human influence (Barbour et al. 1997). They include specific measures of diversity, composition, and functional feeding group representation and include ecological information on tolerance to pollution. Multimetric indices, such as the IBI, incorporate multiple biological community characteristics and measure the overall response of the community to environmental stressors (Karr et al. 1987, Barbour et al. 1995). Such a measure of the structure and function of the biota (using a regionally-calibrated multimetric index) is an appropriate indicator of ecological quality, reflecting biological responses to changes in physical habitat quality, the integrity of soil and water chemistry, geologic processes, and land use changes (to the degree that they affect the sampled habitat). Multimetric, macroinvertebrate indices of biotic integrity, variously called RBP (Rapid Bioassessment Protocol; Plafkin et al. 1989), and SCI (Barbour, M.T., J.M. Diamond, C.O. Yoder. 1996a) have been developed for many regions of North America and are generally accepted for biological assessment of aquatic resource quality (e.g., Southerland and Stribling 1995). The following is a description of the six metrics that are calculated to form the WVSCI, once the metrics are described they are then recalculated to a one hundred point scale to calculate the overall WVSCI score.

Total Taxa: Measures the total number of macroinvertebrate taxa collected in the sample. Total taxa usually decrease with an increase in stream degradation. Out of a two hundred organism sub-sample a stream can contain over fifteen taxa at the family level.

EPT Taxa: Measures the total number of specific taxa within pollution sensitive groups Ephemeroptera (Mayflies), Plecoptera (Stoneflies), and Trichoptera (Caddisflies). Again with the decrease of stream quality also follows in the decrease in EPT taxa. Most healthy streams will contain anywhere from nine to twelve EPT taxa at the family level.

%EPT: Measures the relative abundance of EPT individuals to the total number of organisms in the 200 organism sub-sample. Because of the sensitive nature of EPT taxa, this metric usually increases with increasing stream and water quality. In a high quality stream seventy to ninety percent of the organisms will fall within these sensitive families.

%Chironomidae: Measures the total number of chironomids to the total number of individuals in the two hundred organism sub-sample. Since chironomids are usually extremely pollution tolerant this metric usually increase with the decrease in water quality. A healthy stream will contain on average less than 10% of chironomids as compared to the other organisms.

%Top 2 Dominant Taxa: Measures the relative abundance of the two most dominant taxa at the family level. This metric will increase as the stream quality is degraded because the individuals end up being fewer in the number of taxa with the remaining taxa being pollution tolerant.

Family HBI: The Hilsenhoff Biotic Index summarizes the overall tolerance of the taxa collected to organic pollution. This index has been used to detect nutrient enrichment, high sediment loads, low dissolved oxygen, and thermal impacts. The tolerance values are assigned to each taxon on a scale from zero to ten, zero being the most sensitive and ten being the least sensitive. As water quality in the stream decreases the HBI should increase.

CHAPTER 3

Individual Site Descriptions

The following table (Table 1) details the collections for each site and is then followed by a description for each site. Each site description contains habitat information and a WVSCI score along with any other comments that were needed based on a site to site basis. All information for the habitat scores can be found in Appendix F and all WVSCI information can be found in Appendix H.

Table1. Site Samples

Name	Winter	Spring	Summer
Big Horse Creek			X
Cane Fork			X
Church Run	X	X	
Condon Run		X	X
Cross Creek	X	X	X
Deakin Run	X	X	X
Emory Creek		X	X
Grave Creek	X	X	X
Howard Creek	X	X	X
Hurricane Creek			X
Lindy Run		X	X
Little Buffalo Creek	X	X	X
Little River/East Fork		X	X
Lunice Creek	X	X	X
Meadow Creek	X	X	X
Mill Creek	X	X	X
Poplar Fork			X
Saltlick Creek	X	X	
Shock Run	X	X	X
Stonecoal Creek	X	X	X
Thorny Creek	X	X	X
Toney Fork			X
Tuscarora Creek	X	X	X

*Note: Graphs for all individual sites can be found in Appendix A

Big Horse Creek

Located in Boone County, Big Horse Creek in mainly a sediment impaired coldwater perennial stream. The predominant surrounding landuse is mainly forest with residential areas somewhat close to the sample area. The canopy was partly open. A total of 0% of the reach was covered by aquatic vegetation. There were no unusual odors or oil slicks observed within the reach. The stream morphology was 20% riffle, 40% run, and 40% pool. The substrate was composed of 10% silt, 30% sand, 40% gravel, and 20% cobble. Due to extremely high water during both the winter and spring sample period, this site was sampled only during the summer period. The habitat score was 139 and the WVSCI score was 68.

Cane Fork

Located in Kanawha County, Cane Fork is an acid mine drainage impaired coldwater perennial stream. The predominant surrounding landuse is a mixture of forest and field/pasture. The canopy cover was partly open with the riparian zone on the left bank being greater than 18 meters, but the right bank riparian zone was of lesser quality being in between 12 to 18 meters. A total of 0% of aquatic vegetation was covering the sample reach. There were no unusual odors or oil slicks observed in the sample reach though there was definite armoring of the substrate. The stream morphology was 40% riffle, and 60% run. The substrate was composed of 10% sand, 60% gravel, and 30% cobble. The average habitat score was 132. There were two samples, spring and summer, taken for Cane Fork, the summer received a WVSCI score of 44 and the spring sample failed to score due to an insufficient number of total organisms.

Church Run

Located in Preston County, Church run is an acid mine drainage impaired coldwater perennial stream. The predominant surrounding landuse is mixture of forest and industrial. The canopy cover was completely open and there was little riparian vegetation. The sample reach had 0% aquatic vegetation. There were no unusual odors or oil slicks in the reach but the substrate was noticeably armored by AMD and extremely difficult to penetrate. The stream morphology was 45% riffle, 25% run, and 30% pool. The substrate was composed of 10% sand, 60% gravel, 20% cobble, and 10% boulder. The average habitat score was 88. There was no mean WVSCI score for this site due to the fact that it was unable to be sampled during the summer due to extremely low flow. This stream scored a WVSCI score of 18 in the winter sample and a 29 in the spring sample.

Condon Run

Located in Randolph County, Condon run is an acid deposition impaired coldwater perennial stream. The predominant surrounding landuse is forest. The canopy cover was mostly shaded with the riparian zone being greater than 18 meters on both banks. There was 0% of aquatic vegetation covering the sample reach. There were no unusual odors in or oil slicks in the stream. The stream morphology was 45% riffle, 50% run and 5% pool. The substrate was composed of 5% sand, 15% gravel, 60% cobble, and 20% boulder. The average habitat score is 180. Condon run was unable to be sampled in the winter period due to high snows and inaccessibility. The WVSCI score for the spring is an 88 and an 84 in the summer.

Cross Creek

Located in Brooke County, Cross Creek is a nutrient impaired coldwater perennial stream. The predominant surrounding landuse at the sample point was a mixture of residential, forest, and commercial. The canopy cover was partly shaded with a decent riparian zone of about 10m on the right bank and 12m to 15m on the left bank. The sample reach was about 40% covered with attached algae and rooted submergent plants. There were no unusual odors or oil slicks seen anywhere within the sample reach. The stream morphology was 60% riffle and 40% pool. The substrate was composed of 30% sand, 40% gravel, 20% cobble, and 10% boulder. The average habitat score was 130. The mean WVSCI score for this site was 57.84; this site score highest in the winter sample and lowest in the spring sample.

Deakin Run

Located in Grant County, Deakin Run is an acid mine drainage impaired coldwater perennial stream. The predominant surrounding landuse is forest and roadway. The canopy cover is mostly open with riparian zones mostly comprised of small shrubs and grasses. The sample reach contained no aquatic plant life and there were no unusual odors or oil slicks, although the underside of the rocks were solid black and there were deposits of sludge on the stream banks. The stream morphology was 40% riffle, 45% run, and 15% pool. The substrate was composed of 20% sand, 45% gravel, 20% cobble, and 15% boulder. The average habitat score was 112. The mean WVSCI score was 77.83; this site scored highest in the winter sample and lowest in the spring sample.

Emory Creek

Located in Mineral County, Emory Creek is an acid mine drainage impaired coldwater perennial stream. The predominant surrounding landuse is a mixture of forest and industrial. The canopy cover was partly open with a large number of trees and a fairly large riparian zone of >50m on the right bank and 10m to 15m on the left bank. There were no unusual odors or oil slicks that were noticeable; there was slight armoring of the substrate due to AMD. The stream morphology was 40% riffle, 30% run, and 30% pool. The substrate is composed of 10% sand, 30% gravel, 20% cobble, and 40% boulder. The average habitat score was 124. There was no mean WVSCI score for this site because the winter sample did not contain any biological data (only very few chironomids were recovered). The stream scored a 30.69 in the spring sample and a 61.51 in the summer sample.

Grave Creek

Located in Marshall County, Grave Creek is a nutrient impaired coldwater perennial stream. The predominant surrounding landuse is a mixture of field/pasture and commercial. The canopy cover was partly shaded. There was a very limited riparian zone of 5m on the right bank and only 1m to 2m on the left bank. The sample reach was 10% covered with rooted submergent plants. There were no unusual odors or oil slicks seen within the sample reach although the water was turbid. The stream morphology was 20% riffle, 60% run, and 20% pool. The substrate was composed of 10% sand, 40% gravel, 40% cobble, and 10% boulder. The average habitat score was 108. The mean

WVSCI score was 56; this site scored highest during the summer sample period and lowest in the spring sample.

Howard Creek

Located in Greenbrier County, Howard Creek is a nutrient and sediment impaired coldwater perennial stream. The predominant surrounding landuse is forest and residential. The canopy cover was partly open. The riparian zone was >10 meters on both banks and mostly composed of small shrubs and grasses. A total of 0% of the sample reach was covered by aquatic vegetation. There were no unusual odors or oil slicks observed within the sample reach. The stream morphology was 70% riffle, and 30% run. The substrate was composed of 5% silt, 15% sand, 40% gravel, 30% cobble, and 10% boulder. The average habitat score is 134. The mean WVSCI score was a 75; this site scored highest in the summer sample and lowest in the winter sample.

Hurricane Creek

Located in Putnam County, Hurricane Creek is a nutrient and sediment impaired coldwater perennial stream. The predominant surrounding landuse is agriculture and field/pasture. The canopy was partly shaded. Approximately 45% of the sample reach was covered by aquatic algae. There were no unusual odors or oil slicks associated with this sample reach. The stream morphology was 5% riffle, 75% run, and 20% pool. The substrate was composed of 20% silt, 40% sand, 30% gravel, and 10% cobble. Due to extremely high water in the winter and spring sampling period only the summer sample was able to be obtained. The site had a habitat score of 80 and a WCSI score of 44 for the summer sample.

Lindy Run

Located in Tucker County, Lindy run is an acid deposition impaired coldwater perennial stream. The predominant surrounding landuse is forest. The canopy cover was partly open with the riparian zone being greater than 20 meters on both sides, mostly comprised of large trees and rhododendron. Approximately 0% of the reach was covered by aquatic vegetation. There were no unusual odors or oil slicks observed within the reach. The stream morphology was 5% sand, 30% gravel, 40% cobble, and 25% boulder. The average habitat score is 182. Lindy run was unable to be sampled in the winter due to high snowfall and inaccessibility to the area. The spring WVSCI score is a 78 and the summer score is a 75

Little Buffalo Creek

Located in Grant County, Little Buffalo Creek is an acid mine drainage impacted coldwater perennial stream. The predominant surrounding landuse is a mixture of forest and industrial. The canopy cover is partly shaded and there is a very small riparian zone. The sample reach contained 0% aquatic vegetation. There were no unusual odors or oil slicks but the substrate was somewhat armored by AMD and difficult to penetrate. The stream morphology was 30% riffle, 55% run, and 15% pool. The substrate was composed of 10% sand, 35% gravel, 35% cobble, and 20% boulder. The overall habitat score was 126. The mean WVSCI score is 57.6; this site scored highest in the summer sample and lowest in the winter sample.

Little River/East Fork

Located in Pocahontas County, Little River/East Fork is a cold water perennial stream with unknown sources of impact. The predominant surrounding landuse is forest. The canopy was partly open with a riparian zone greater than 20 meters on the left bank and less than 10 meters on the right bank due to a park area. The sample reach contained 15 % attached algae. There were no unusual odors or oil slicks seen in the sample reach. The stream morphology was 65% riffle 30% run and 5% pool. The substrate was composed of 10% sand, 40% gravel, 40% cobble, and 10% boulder. The average habitat score was 173. There was no mean score because a winter sample was not able to be obtained due to extremely low temperatures which had frozen the stream over. The WVSCI score for the spring is 88 and the summer sample is 91.93.

Lunice Creek

Located in Grant County, Lunice Creek is a nutrient and sediment impacted coldwater perennial stream. The predominant surrounding landuse is mostly field/pasture. The canopy cover was shaded with a riparian zone of about 10m to 15m on both banks. The reach was about 45% covered by a mixture of rooted emergent, rooted submergent, and attached algae. There were no unusual odors or oil slick seen in the sample reach. The stream morphology was 40% riffle, 40% run, and 20% pool. The substrate was composed of 15% silt, 15% sand, 50% gravel, and 20% cobble. The overall habitat score was 130. The mean WVSCI score was 81.43; this site scored highest in the spring sample and lowest in the winter sample.

Meadow Creek

Located in Greenbrier County, Meadow Creek is a nutrients and sediment impaired coldwater perennial stream. The predominant surrounding landuse is a mixture of forest and field/pasture. The canopy cover was partly open with the riparian zone on the bank being >20 meters while the left bank it was limited to about 5 meters due to is close proximity to a road. Approximately 20% of the sample reach covered by attached algae. There were no unusual odors or oil slicks observed in the sample reach. The stream morphology was 55% riffle, 25% run, and 20% pool. The substrate was composed of 5% silt, 15% sand, 30% gravel, 45% cobble, and 5% boulder. The average habitat score was 145. The mean WVSCI score was 86.81; this site scored highest in the winter sample and lowest in the spring sample.

Mill Creek

Located in Berkeley County, Mill Creek is a nutrient impaired coldwater perennial stream. The predominant surrounding landuse is forest and residential. The canopy cover is partly shaded with the riparian zone on the right bank had been a full forest during the winter sample, but had been cut and logged when we returned for later samples leaving the riparian zone at about 10m to 15m on the right bank and the left bank remained a consistent 5m to 10m zone. About 40% of the sample reach was covered by rooted submergents, and attached algae. There were no unusual odors, there were some oils seen coming out of the substrate when disturbed, and the water was noticeably turbid. The stream morphology was 15% riffle, 45% run, and 40% pool. The substrate was composed of 20% silt, 40% sand, 20% gravel, and 20% cobble. The average habitat score was 110. The mean WVSCI score was 70.86; this site scored highest in the winter sample and lowest in the summer sample.

Poplar Fork

Located in Putnam County, Poplar Fork is a nutrient and sediment impaired coldwater perennial stream. The predominant surrounding landuse is agricultural and field/pasture. The canopy was partly open. About 65% of the reach was covered by attached algae. There were no unusual odors or oil slicks observed in this sample reach but the water was slightly turbid. The stream morphology was 5% riffle, 85% run, and 10% pool. The substrate was composed of 20% silt, 40% sand, 30% gravel, and 10% cobble. Due to extremely high water winter and spring samples were unable to be obtained. The habitat score for the summer was 96 and the WVSCI score was 74.

Saltlick Creek

Located in Braxton County, Saltlick Creek is a sediment impaired coldwater perennial stream. The predominant surrounding landuse is residential; I-79 also intersects a section of the portion of the creek upstream of the sample site. The canopy cover was partly open and there were roads on either side of the creek that limited riparian zones. Approximately 80% of the sample reach was rooted emergents, rooted submergents, and attached algae. . There were no unusual odors or oil slicks seen, although the creek was very turbid during every sampling period. The stream morphology was 30% riffle, 30% run, and 40% pool. The substrate composition was 70% sand, 15% gravel, 15% cobble. The total habitat score was 109. There was no mean score for this site due to high water during the summer sampling period. The stream scored a 79.02 in the winter sample and a 64.40 in the spring sample.

Shock Run

Located in Pocahontas County, Shock Run is a nutrient and sediment impaired coldwater perennial stream. The predominant surrounding landuse is agriculture. The canopy cover was heavily shaded and the riparian zones were both about 15 to 20 meters wide and thick with trees and shrubs. Attached algae covered about 15% of the sample reach. There were no unusual odors or oil slick noticeable in the reach. The stream morphology was 40% riffle, 40% run, and 20% pool. The substrate is composed of 5% silt, 10% sand, 30% gravel, and 55% cobble. The average habitat score was 144. The mean WVSCI score was 83.71; this site scored highest in the spring sample and lowest in the winter sample.

Stonecoal Creek

Located in Lewis County, Stonecoal Creek is an impoundment impaired coldwater perennial stream. The predominant surrounding landuse is a mixture of commercial and residential. The canopy cover was partly shaded while the riparian zone was limited on the right bank by a large parking lot and some channelization, the riparian zone on the left bank was >20 meters. Approximately 0% of the reach covered by aquatic vegetation. There were no unusual odors or oil slicks present in the substrate or on the surface. The stream morphology was 60% riffle, 20% run, 20% pool. The substrate was composed of 10% silt, 30% sand, 15% gravel, and 45% cobble. The average habitat score was 105. The mean WVSCI score was 54.41; this site scored highest in the spring sample and lowest in the winter sample.

Thorny Creek

Located in Pocahontas, Thorny Creek is a nutrient and sediment impaired coldwater perennial stream. The predominant surrounding landuse is a mixture of agricultural and field/pasture. The canopy cover was partly shaded with the riparian zones covering approximately 5 to 10 meters on both banks. A total of 60% of the sample reach covered by rooted emergents, rooted submergents, and attached algae. There were no unusual odors or oil slicks present in the sample reach. The stream morphology was 60% riffle, 25% run, and 15% pool. The substrate was composed of 10% silt, 25% sand, 45% gravel, and 20% cobble. The average habitat score was 121. The mean WVSCI score was 73.82; this site scored highest in the winter sample and lowest in the summer sample.

Toney Fork

Located in Raleigh County, Toney Fork is a nutrient and sediment impaired coldwater perennial stream. The predominant surrounding landuse is mostly forest with a small amount of residential. The canopy cover was partly shaded with the left bank of the riparian zone being greater than 18 meters, while the right bank was of lesser quality and only 12 to 18 meters wide. Attached algae covering 25% of the sample reach. There was sewage smell coming from both the water and the substrate and sludge deposits along the banks. The stream morphology was 80% riffle, and 20% run. The substrate was composed of 5% silt, 15% sand, 40% gravel, 30% cobble, and 10%

boulder. The average habitat score was 139. There was no mean due to the inability to sample in the winter due to snow. The site scored a 38.78 in the spring sample and a 73.69 in the summer sample.

Tuscarora Creek

Located in Berkeley County, Tuscarora Creek is a nutrient impaired coldwater perennial stream. The predominant surrounding landuse is a mixture of field/pasture and residential. The canopy cover is partly shaded while there was a very small riparian zone on either bank of about 5m. About 30% of the sample reach was covered by rooted submergents and attached algae. There was the smell of sewage both around the water and when the substrate was disturbed. The stream morphology was 40% riffle and 60% run. The substrate was composed of 25% sand, 40% gravel, and 35% cobble. The average habitat score was 96. The mean WVSCI score was 62.91; this site scored highest in the winter sample and lowest in the summer sample.

CHAPTER 4

Discussion of Results

To determine the role of seasonality in the WVSCI descriptive statistics were employed, such as Julian Day regressions and box and whisker plots to give a visual representation of the data. ANOVAS were also utilized to show significance and correlation of the data. The discussion will begin with the a review of a box and whisker plot of each metric from six groups: All Impacted Sites, Sub groups of All Impacted Sites (Nutrient/Sediment Impacted Sites, AMD Impacted Sites), WVDEP Reference sites, WVDEP Repeat Data, and Stony River data. All results for these groups are broken down into the specific metrics and then winter, spring, and summer for each metric. Then we will discuss the ANOVAs for each group. Unfortunately, out of the twenty-three sites we wanted to sample on impacted areas, only twelve were able to be obtained for all three seasons due to unusually high water and poor weather. The following information for the All Impacted Sites and its subgroups are based on those twelve sites, the actual plots for which can be found in Appendix C of this report.

BOX AND WHISKER DISCUSSION

All Impacts

*All plots for this section are found in Appendix C.

WVSCI

This plot exhibits a slight trend upward from the winter to summer sample period. Because there being a great deal of overlap in the data and the medians do not varying to any great degree, the trend is most likely not significant. All the impacts together do not seem to

Total Taxa

This metric shows a continual trend upward from winter through summer, showing a higher median of taxa in the summer months. The highest number of taxa came in the summer sample period at Howards Creek with twenty-two total taxa.

EPT Taxa

This metric shows a peak in the spring sample with a median of eight taxa. Both winter and summer have a median of six taxa with the winter actually containing an outlier of thirteen taxa, while the largest value in the summer was ten taxa.

EPT%

The median for all three seasons of this metric was about forty-two percent. The season with the highest outlier was winter having an overall higher percentage of EPT taxa per sample. No seasonal trends were apparent in this plot

Chironomidae%

This metric show another peak trend in the spring and has a median of forty percent. The summer sample contained the lowest median of the family Chironomidae at just below twenty percent.

%Dominant Two Taxa

This metric is consistent for all three seasons at just over sixty percent. The summer season contained the most variable data with both the highest outlier at eighty-six percent and the lowest at thirty-three percent. No seasonal trends were observed in this plot.

Hilsenhoff Biotic Index

This metric is fairly consistent with a median score at just around 4.5. The winter sample contained the lowest outlier with a score of 2.88 at Mill Creek. No seasonal trends were observed in this plot.

Nutrient and Sediment Impacts

WVSCI

This plot show a slight upward trend from the winter sample to the summer sample. The medians of the plots were very similar, suggesting that the trend is probably not that significant.

Total Taxa

This plot shows a peak in the spring sample period with a median of approximately fifteen taxa. The summer sample contained the most variable data with a low of ten taxa and a high of twenty-two taxa.

EPT Taxa

This metric again shows a peak in the spring sample period with a median score of eight taxa. The medians for the winter, spring, and summer sample period are fairly close, though the individual scores drop off much more in the summer.

EPT%

This metrics' median is fairly consistent for all three sampling periods at or just over forty percent. The winter sample contained the highest score at ninety-one percent while the summer contained the lowest score of zero percent. No seasonal trends were observed in this plot.

Chironomidae%

This metric stays consistent through the winter and spring sample with a median score of twenty-two and twenty-four percent respectively. The summer median then dips to approximately 15 percent.

%Dominant Two Taxa

This metric exhibits a slight downward trend from winter to summer. The summer is the most variable of the samples showing a high of eight-six percent and a low of thirty-three percent.

Hilsenfoff Biotic Index

This metric exhibits a downward peak in the spring sample with a median score of approximately 4.3. The winter sample contained the most variable data having a HBI score of 2.82.

AMD Impacts*

*Note: Two sample locations were able to be obtained for all three seasons for the following category.

WVSCI

This plot shows an upward trend from the winter sample to the summer sample. The medians of these two samples steadily increase from sixty in the winter sample to just fewer than eight in the summer sample.

Total Taxa

This metric shows an upward trend in the number of taxa from the winter to summer sample. The summer sample had the highest median at sixteen total taxa.

EPT Taxa

This metric shows a peak trend in the spring sample. The median for the winter and summer samples are approximately seven while the spring sample has a median of approximately nine.

EPT%

This metric shows an upward trend from winter to summer sample. The median percentage in the winter is approximately forty-two percent, the spring sample percentage is approximately forty-four percent and the summer samle contained a median percentage of sixty-one percent.

Chironomidae%

This plot shows a sharp decrease in the chironomidae percentage in the summer sample. Both winter and spring medians are just above forty percent while the summer sample median is approximately eighteen percent.

%Dominant Two Taxa

This plot shows a slight downward peak in the spring sample. Both the winter and summer sample medians were approximately sixty-four percent while the spring median was slightly lower at fifty-six percent.

Hilsenhoff Biotic Index

This plot shows that all the sample periods had fairly similar medians of approximately four and half. No seasonal trends were apparent in this plot.

Reference Data

WVSCI

This plot shows a downward trend from the winter sample to the summer sample. There is a good deal of overlap within the data showing that the downward trend is not an extreme transition. The reference conditions show opposite effects of the impacted site results.

Total Taxa

This plot shows an overall downward trend as the year progresses to the summer. This would be expected due to natural life cycles of the benthic organisms. The winter sample contained the most taxa with a median of twenty-four.

EPT Taxa

There is a dramatic downward trend from winter to summer within this plot. This is to be expected in healthy streams that contain large varieties of EPT taxa due to significant hatch offs occurring in the spring and summer. The winter sample has a median of approximately sixteen EPT taxa while the summer has a median of just fewer than ten EPT taxa.

EPT%

This plot show somewhat of a downward trend from the winter to spring and summer sample, which would be expected due to decreased numbers of these taxa because of natural life cycles. The winter sample has a median of approximately eighty percent and then dips in the spring and summer sample to approximately sixty percent.

% Chironomidae

This plot shows no significant trends, with data overlapping for each season. The median for the winter sample was approximately twelve percent and increased to around sixteen percent in the spring and summer samples. No seasonal trends were observed in this plot.

% Dominant Two Taxa

This plot exhibits a slight upward trend in the spring sample where the median rises to approximately fifty percent while the winter and summer samples medians are right around forty-five percent. No seasonal trends were observed in this plot.

Hilsenhoff Biotic Index

This plot shows a slight upward peak in the spring sample period. The winter median is approximately three and a half, the spring median reaches four and then the summer drops back down to three and three quarters. No seasonal trends were apparent in this plot.

WVDEP Repeat Data

WVSCI

This plot shows a insignificant downward trend from the winter sample to the summer sample. No significant seasonal trends were observed in this plot. The median for the winter sample was approximately eighty-five while the summer median was just above eighty.

Total Taxa

This plot shows somewhat of a downward peak in the spring sample, although there is a significant amount of overlap between samples showing that there is actually very little variation between seasons. No seasonal trends were observed in this plot.

EPT Taxa

This plot exhibits a significant downward trend from the winter sample to the summer sample. This is expected due to benthic hatches and natural life cycles. The winter median is approximately sixteen EPT taxa, while the summer median is approximately nine taxa.

%EPT

This plot shows some downward movement of the metric scores from the winter to summer sample. Overall, though, this plot shows a great deal of overlap and no apparent seasonal trends.

% Chironomidae

This plot shows no real observed seasonal trends. There is a great deal of overlap in the data that remains fairly consistent over all the sample periods.

% Dominant Two Taxa

This plot shows a slight peak in the spring sample with a median of approximately fifty percent. The winter and summer samples have medians of approximately forty-five percent. No seasonal trends were observed in this plot.

Hilsenhoff Biotic Index

This plot show a slight peak in the spring sample with the summer sample median falling back down to rest between the winter and spring sample. No seasonal trends were observed in this plot.

Stony River Data

*Note: These data contains information for two winter samples, one spring sample, and one summer sample.

WVSCI

This plot remains consistent through the first winter and spring samples, drops off in the summer sample slightly and then rises again in the following winter sample to almost mirror the previous winter sample.

Total Taxa

This plot shows a small amount of movement in the total taxa. The winter sample has a median of approximately twelve taxa, then raises in the spring sample to approximately fourteen taxa, drops off in the summer with a median of ten taxa and then raises once again in the following winter sample to a median of approximately twelve taxa. No seasonal trends were apparent in this plot.

EPT Taxa

This plot shows a small amount of movement in the total taxa. The winter sample has a median of approximately seven taxa, then rises in the spring sample to a median of nine taxa, drops off in the summer with a median of five taxa and then raises once again in the following winter sample to a median of six taxa. No seasonal trends were apparent in this plot.

%EPT

This plot shows a slight downward trend in the spring sample. The winter median being approximately eighty-five percent, and then dropping to a median of approximately sixty-five percent in the spring sample. The plot then shows a slight increase in the summer sample to approximately seventy percent, and then another raise in the following winter sample to just under eighty percent.

%Chironomidae

This plot shows an upward peak in the spring sample and then a decline again through the summer sample into the next winter sample. This plot show an apparent difference in chironomidae percentages in the spring sample compared to the rest of the samples.

%Dominant Two Taxa

This metric remains fairly consistent throughout all sample periods. The winter and spring samples have medians of approximately sixty percent and the summer and following winter samples having medians of just below seventy percent. No seasonal trends were apparent in this plot.

Hilsenhoff Biotic Index

This metric remains fairly consistent throughout all sample periods. All medians fall within a range of four point two and four point five. No seasonal trends were apparent in this plot.

ANOVA AND KRUSKAL-WALLIS DISCUSSION

The significance of difference between seasons for reference data, repeat reference data, Stony River data, and impaired river data were tested using One Way Analysis of Data for parametric data and Kruskal-Wallis One Way Analysis of Variance on Ranks for non-parametric data. All tests were conducted using SigmaStat 2.03. A One Way Analysis of Variance is a test of significance of difference between means that are independent relative to the parameter that is being tested. The Kruskal-Wallis test is a non-parametric test that calculates the significance of difference between medians of three or more samples. The statement of null for all statistical tests was that seasonality did not affect distribution of benthic species regardless of index or taxa used as a data source. The following are the results for the metrics of the groups discussed earlier: All Impacted Sites, WVDEP Reference sites, WVDEP Repeat Data, and Stony River data. All results for these groups are broken down into the specific metrics and winter, spring, and summer for each metric. Each description contains a small analysis of the significance of the group and the p-value for the comparison of the seasons.

All Impacts

%EPT

The degrees of freedom are 2 and the F-value is .16 (Table 10). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference ($P = 0.853$).

EPT Taxa

The degrees of freedom are 2 and the F-value is .993 (Table 11). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference ($P = 0.381$).

%Chironomidae

The degrees of freedom are 2 and the F-value is 1.371 (Table 12). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference ($P = 0.268$).

%Dominant Two Taxa

The degrees of freedom are 2 and the F-value is .213 (Table 13). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference ($P = 0.809$).

Hilsenhoff Biotic Index

The degrees of freedom are 2 and the F-value is .0735 (Table 14). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference ($P = 0.929$).

Total Taxa

The degrees of freedom are 2 and the F-value is 1.851 (Table 15). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.173).

WVSCI

The degrees of freedom are 2 and the F-value is .545 (Table 16). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.585).

WVDEP Reference Data

%Dominant Two Taxa

The degrees of freedom are 2 and the F-value is .412 (Table 17). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.665).

% Chironomidae

The degrees of freedom are 2 and the F-value is .523 (Table 18). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.596).

% EPT

The degrees of freedom are 2 and the F-value is 2.628 (Table 19). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.084).

EPT Taxa

The degrees of freedom are 2 and the F-value is 19.906 (Table 21). The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
Winter vs. Summer	5.625	3	8.922	<0.001	Yes
Winter vs. Spring	2.746	3	4.285	0.011	Yes
Spring vs. Summer	2.879	3	4.493	0.008	Yes

Hilsenhoff Biotic Index

The degrees of freedom are 2 and the F-value is 4.157 (Table 20). The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.022).

Power of performed test with alpha = 0.050: 0.571

The power of the performed test (0.571) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
Spring vs. Winter	0.623	3	3.992	0.019	Yes
Spring vs. Summer	0.210	3	1.345	0.611	No
Summer vs. Winter	0.413	3	2.690	0.150	No

<u>Total Taxa</u>

The degrees of freedom are 2 and the F-value is 6.643 (Table 22). The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.003).

Power of performed test with alpha = 0.050: 0.846

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
Winter vs. Summer	4.688	3	4.929	0.003	Yes
Winter vs. Spring	3.613	3	3.737	0.030	Yes
Spring vs. Summer	1.075	3	1.112	0.713	No

<u>WVSCI</u>

The degrees of freedom are 2 and the F-value is 4.823 (Table 23). The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.013).

Power of performed test with alpha = 0.050: 0.664

The power of the performed test (0.664) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
Winter vs. Summer	8.461	3	4.142	0.015	Yes
Winter vs. Spring	6.873	3	3.310	0.061	No
Spring vs. Summer	1.588	3	0.765	0.852	No

WVDEP Repeat Data

<u>% Dominant Two Taxa</u>

The degrees of freedom are 2 and the F-value is 1.914 (Table 24). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.162).

<u>% Chironomidae</u>

The degrees of freedom are 2 and the F-value is .0915 (Table 25). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.913).

<u>% EPT</u>

The degrees of freedom are 2 and the F-value is 2.438 (Table 26). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.102).

EPT Taxa

The degrees of freedom are 2 and the F-value is 12.286 (Table 28). The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.993

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
Winter vs. Summer	5.385	3	6.986	<0.001	Yes
Winter vs. Spring	3.077	3	3.992	0.021	Yes
Spring vs. Summer	2.308	3	2.994	0.101	No

Hilsenhoff Biotic Index

The degrees of freedom are 2 and the F-value is 1.803 (Table 27). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.179).

Total Taxa

The degrees of freedom are 2 and the F-value is 3.130 (Table 29). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.056).

WVSCI

The degrees of freedom are 2 and the F-value is 3.164 (Table 30). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.054).

Stony River Data

*Note: The following data set contains two winter data sets along with a spring and summer data set. The second winter sample is designated as Winter2.

% Dominant Two Taxa

The degrees of freedom are 3 and the F-value is 1.001 (Table 31). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.398).

% Chironomidae

Normality Test: Failed (P = <0.001)
Kruskal-Wallis One Way Analysis of Variance on Ranks
H = 27.186 with 3 degrees of freedom. (P = <0.001) (Table 32)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison Diff of Ranks Q P<0.05

Spring vs Winter	30.294	4.533	Yes
Spring vs Winter2	27.199	4.007	Yes
Spring vs Summer	10.412	1.558	No
Summer vs Winter	19.882	2.975	Yes
Summer vs Winter2	16.787	2.473	No
Winter vs Winter2	23.096	0.456	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

<u>%EPT</u>

H = 7.294 with 3 degrees of freedom (Table 33). The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.063)

<u>EPT Taxa</u>

The degrees of freedom are 3 and the F-value is 2.367 (Table 35). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.079).

<u>Hilsenhoff Biotic Index</u>

H = 1.652 with 3 degrees of freedom (Table 34). The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.648)

Total Taxa

The degrees of freedom are 3 and the F-value is 3.227 (Table 36). The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.028).

Power of performed test with alpha = 0.050: 0.532

The power of the performed test (0.532) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

All Pairwise Multiple Comparison Procedures (Tukey Test):
Comparisons for factor:

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
Spring vs. Summer	4.235	4	4.320	0.017	Yes
Spring vs. Winter	2.765	4	2.820	0.201	No
Spring vs. Winter2	2.618	4	2.629	0.256	Do Not Test
Winter vs. Summer	1.618	4	1.625	0.661	No
Winter vs. Winter2	0.147	4	0.148	1.000	Do Not Test
Winter2 vs. Summer	1.471	4	1.500	0.715	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

WVSCI

The degrees of freedom are 3 and the F-value is 1.250 (Table 37). The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.299).

Table 2. Significance of Metrics and WVSCI ANOVAS

Data Set	EPT%	EPT Taxa	%Chironomidae	%Dominant 2 Taxa	HBI	Total Taxa	**WVSCI**
All Impacts							
WVDEP Reference Data		**X**			**X**	**X**	**X**
WVDEP Repeat Data		**X**					
Stony River Data			**X**			**X**	

***Note: X = Finding of significance.**

JULIAN DAY DESCRIPTION AND DISCUSSION

Julian day graphs are set up by making January 1st day one and December 31st as day three-hundred and sixty-four/five. This gives a visual reference for discerning trends in the data. The following discussion will list the six metrics that form the WVSCI along with the WVSCI score itself, and will attempt to describe the trends associated with impacted and non-impacted sites. By adding a trend line we are able to see changes that would not appear significant in normal statistics. Though it should be noted that the sites ranged a great deal in their scores, be it reference or impacted sites, and interpretation should also be limited. All Julian day plots can be located in Appendix B.

Hilsenhoff Biotic Index

All the data sets show the same trend of a rise in the summer (Graphs 13 ands 23). Though the impacted sites had a higher overall average of HBI score the trend followed that of the reference, repeat, and stony river data set. It must be said though that the trend is very slight and the r-value associated with the trend line was well below one.

% Chironomidae

This plot shows a large difference in the impacted sites from the rest of the data sets (Graphs 14 and 21). The reference, repeat, and stony river data sets all have a much lower percentage overall and exhibit a slight rise from the winter sample to the summer sample. The impacted site data, though, exhibits a large drop off from the winter sample to the summer sample.

% Dominant Two Taxa

The impacted sites actually follow the same trend as the reference and repeat data which is a very slight decline from the winter to summer sample (Graphs 15 and 20). The stony river data set actually exhibits the opposite effect having a slight upward trend from winter to summer. It must be stated though that for all the data sets the sites were extremely variable and did not exhibit strong trends.

%EPT

This plot shows agreement between all the data sets with a downward trend in the percent EPT taxa from the winter sample to the summer sample (Graphs 16 and 22). This would appear normal due to the natural life cycles of these organisms which tend to hatch out in the spring and summer months, thereby reducing their overall numbers.

EPT Taxa

The impacted sites show a slight trend downward from the winter to summer, but nothing to the degree of the rest of the data sets which all exhibit a large drop off in EPT taxa from the winter sample to the summer sample (Graphs 17 and 24). This could be explained because of the high numbers of these types of taxa associated with quality streams and then a loss of diversity due to natural life cycles such as hatch-offs and diapause stages in certain EPT taxa. Impacted sites would begin with a low number of the more tolerant EPT taxa and therefore would show less of a trend in this category.

Total Taxa

This plot shows an opposite trend in the impacted sites to that of the rest of the data sets (Graphs 18 and 25). The impacted sites seems to show an upward trend from the winter sample to the summer sample, while the rest of the data sets show a trend of losing taxa from the winter sample to the summer sample. The stony river decline in total taxa was not as extreme as the reference and repeat data but still exhibited the normal behavior that would be expected. It is possible that the impacted sites contain a great deal of tolerant taxa such as dipterans and tolerant forms of EPT which would colonize the impacted sites to possibly take advantage of large nutrient sources that are present year round.

WVSCI

This plot shows the reference, repeat data, and stony river data with a downward trend from the winter to summer sample, while the impacted sites exhibit a slight upward trend (Graphs 19 and 26). It's difficult to say why the trend for the impacted sites was to increase, it seems that the impacted sites seem to act very differently from that of a stream with a certain degree of quality in all but a few of the metrics.

MEAN DIFFERENCE RESULTS

The mean differences were calculated by taking the three different seasonal sample period scores for each metric and then finding the mean. This mean was then subtracted from each individual sample period score for each metric to try to determine if there were any trends related to seasonal changes. *Note: All Metric Mean Difference data can be located in Appendix D

Total Taxa

When looking at the AMD streams sampled both Deakin Run and Buffalo Creek act the same in the winter sample having a count falling under the average calculated for each site (Table 3). Then in the spring and summer months they act the opposite with Deakin Run having and above average count in the spring sample and falling back under the average for the summer sample, while Buffalo Creek remains under its calculated average in the spring and rises above it in the summer. As for the nutrient/sediment impacted streams six of the ten streams fall below their calculate average in the winter sample, four of ten were below the average in the spring sample, and five of ten in the summer sample.Half of the samples either met or were above their average for two of the three samples, and conversely the other five fell below their average for two of the three samples.

EPT Taxa

Both Deakin Run and Buffalo Creek follows the same pattern as that of Total Taxa described above (Table 4). The nutrient/sediment sites, though, differ slightly from that of the Total Taxa. Only three of the ten fell below their calculated average in the winter sample, four out of ten fell below their average for the spring sample, and six out of ten samples fell below the average for the summer sample. Of the ten samples four fell bellow their average for two of the three sample periods while the remaining six either met or were above their average for two of the three sample periods.

EPT %

Deakin Run and Buffalo Creek do not follow the same pattern as that of the EPT Taxa (Table 5). This time both fall below their calculated average only once, with Buffalo Creek doing so in the winter sample and Deakin Run in the spring. The nutrient/sediment streams differed slightly from the pattern in the EPT Taxa with five of the ten winter samples falling below their calculated average, six of ten in the spring falling below their average, and four of the ten below their average in the summer. Half of the samples fall below their average on two out of three samples, and the other five are above average for two of the three sample periods.

Chironomidae %

The AMD streams are the same in that they both fall below their average for two out of the three samples and both fall bellow their calculated average in the summer, but they differ in their winter and spring samples where Buffalo Creek falls below its average in the spring and Deakin Run falls below its average in the spring (Table 6). Four of the ten nutrient/sediment impacted streams fell below their average in the winter sample, four out of the ten fell below the average in the spring, and six of the ten fell below their average in the summer sample. Of the ten streams, six were above their average for two out of the three sample periods.

<u>% Dominant Two Taxa</u>

In the AMD streams Buffalo Creek fell below its average for two of the three seasons, spring and summer (Table 7). Deakin run was only below its average in the winter sample. Four of the ten streams impacted by nutrients and sediment fell below their average in the winter sample, while the same is true for the spring sample with four of the ten falling below their average. The summer sample contains six of ten streams that fall below their calculated average. Only four of the ten streams fell below their average for two out of the three sample periods.

<u>HBI</u>

Both of the AMD streams fall bellow their average for the HBI only once out of the three sample periods (Table 8). Deakin Run fell below in the winter sample and Buffalo Creek fell below in the spring sample. In the nutrient/sediment streams four of the ten fell below their average in the inter sample, five of the ten fell below in the spring sample, and only three of ten fell below in the summer sample. Only two of those samples fell below their average in two of the three sample periods.

WVSCI

Deakin Run was the only AMD stream to fall below its averge WVSCI score for two out of the three sample periods, spring and summer (Table 9). Buffalo Creek fell below only once and it was in the winter sample. Six of the ten nutrient/sediment streams fell below their calculated average during the winter sample, five of the ten fell below their average for the spring sample period, and five fell below their averages in the summer saple period. Six of the ten streams fell below their average for two out of the three sample periods.

CHAPTER 5

Conclusions

Taking this vast amount of data into account, there is still little evidence of a significant effect on the WVSCI caused by seasonality. The impacted sites as a whole act somewhat different from the reference streams which would be expected. The impacted sites EPT patterns don't trend downward as much as the reference sites but they also have far less taxa to lose as the year progresses from winter through summer making it seem as if seasonalty plays a role more on reference streams than on that of impacted streams. This is evident even more so as Total Taxa actually increases from winter to summer in the impacted site analysis, whereas the reference sites have a sharp decline of taxa from winter to summer months. The same is true if the WVSCI data is considered, but not to the degree in which the Total Taxa differs between the two groups of data, where the reference sites have a downward trend from the winter samples to the summer samples and the impacted sites act almost the opposite having generally a slight upward trend from winter to summer months. Data gathered at the Stony River generally mimics that of the reference data which is not suprising because the stony river is comparable to reference conditions, only being thermally impacted and not suffering the armoring effects of AMD or the siltation effects of nutrient or sediment impacted streams. By looking soley at the data collected at a variety of individually impacted sites found in **Appendix A** there is no evidence of any truly significant trends, each site acts differently from any other. This most likely indicates that a much more detailed study is needed to see if there is an actual influence on the WVSCI (more so on impacted sites than that of reference streams). It would appear that one can determine that the impacted sites will most likely be the more variable of the two groups and that there can be (and are) instances of direct impacts to the benthic communities in theses sites when surges of pollutants pass through the system. This alone would significantly alter scores, but there is usually no way of knowing whats coming down the stream and when or even if it will impact the scoring of a site.

Through the comparison of reference sites, duplicates of DEP reference data, Stony River Data, and my own data collected at sites impacted by AMD, nutrients, and sediments there is no clear finding of significance. It does not appear that seasonality greatly alters the WVSCI score to a point of being a confounding factor to benthic monitoring either in reference conditions or in impacted sitiuations. Impacted sites appear more stable in the scoring based on the limited number of taxa, usually tolerant, found in altered sytems. A good example of this is to consider the mean difference data. Even though as stated earlier a more in depth study involving the comparison of water quality data to benthic monitoring may offer better explanations to questions related to the way impacted streams tend to behave.

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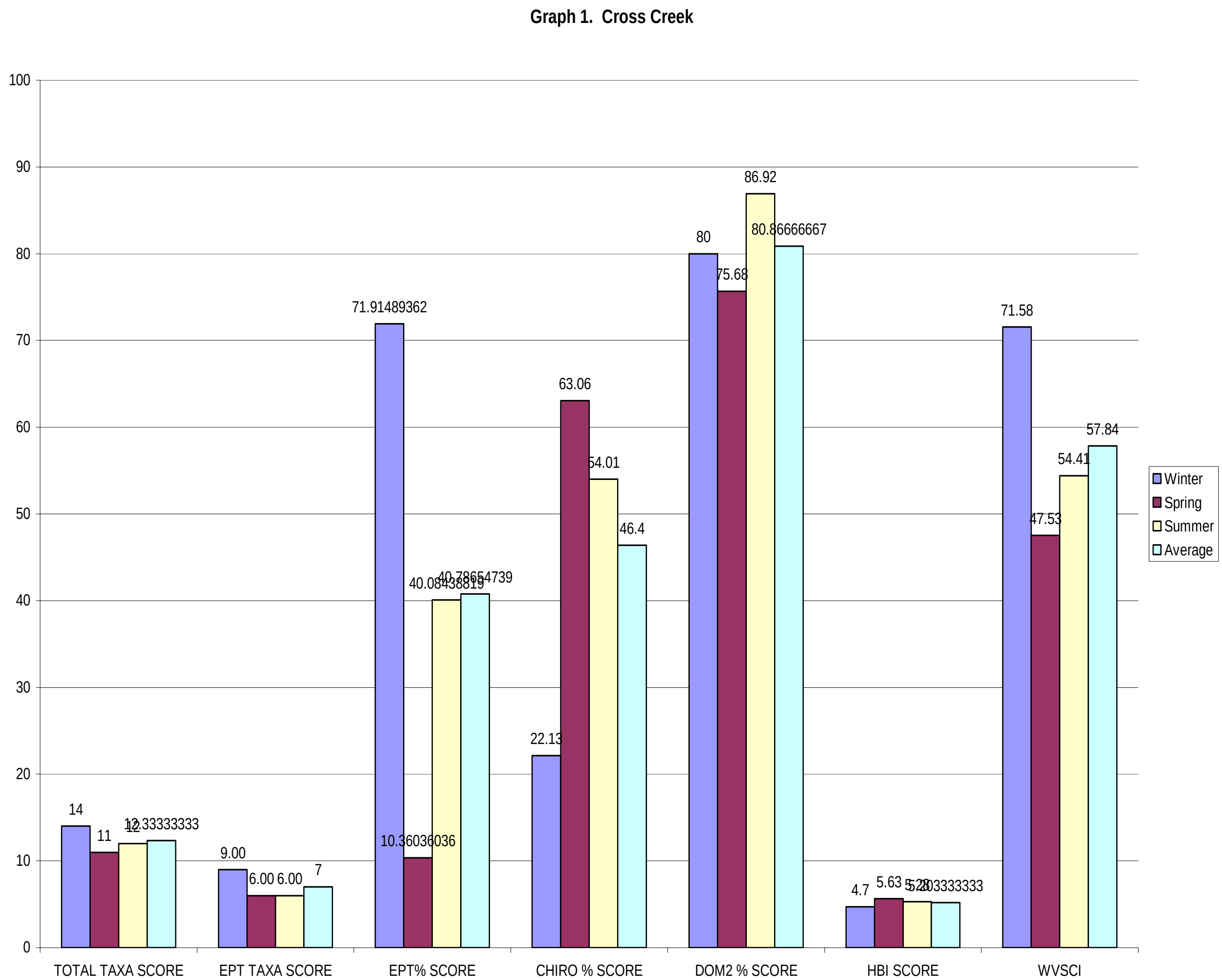
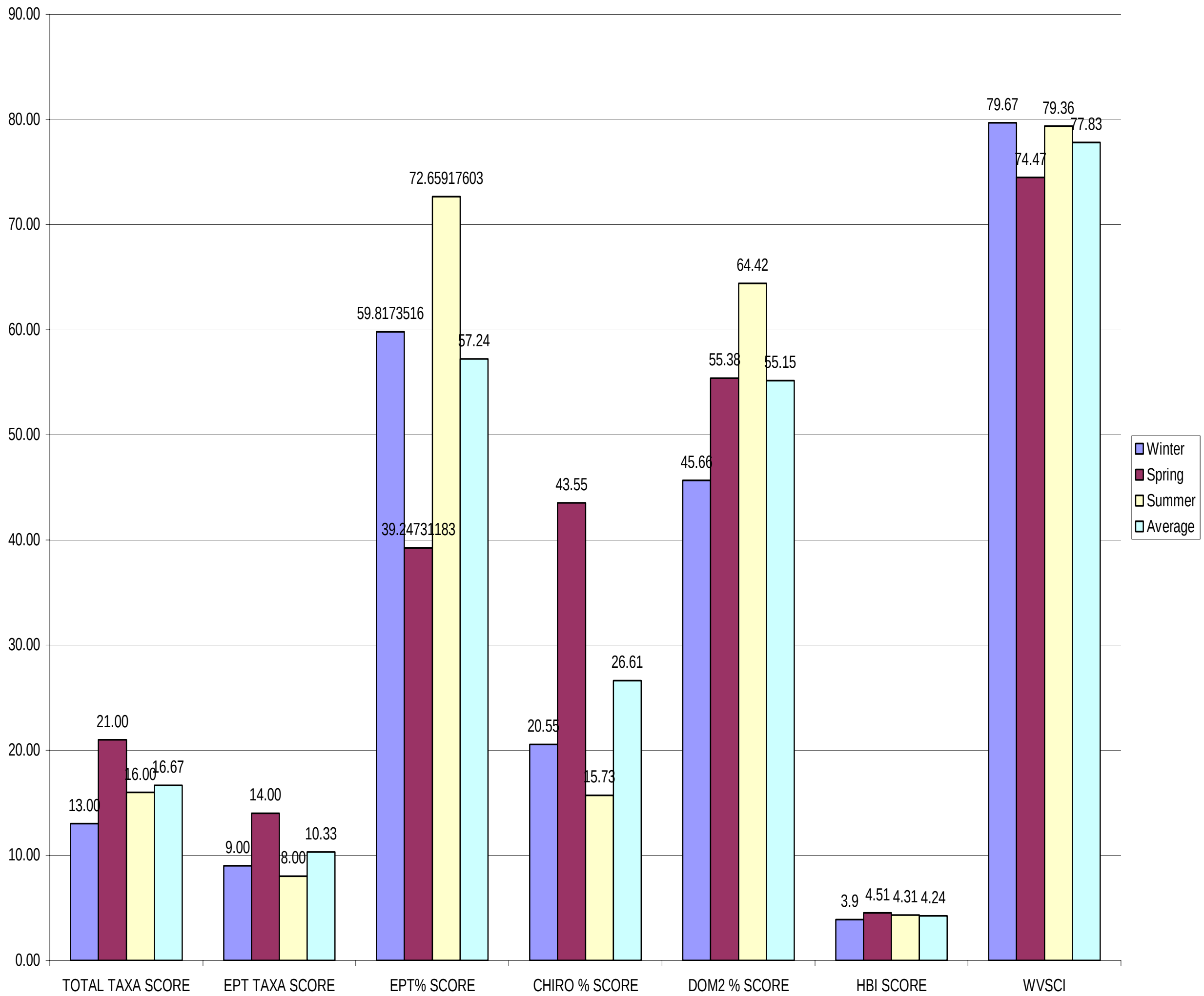
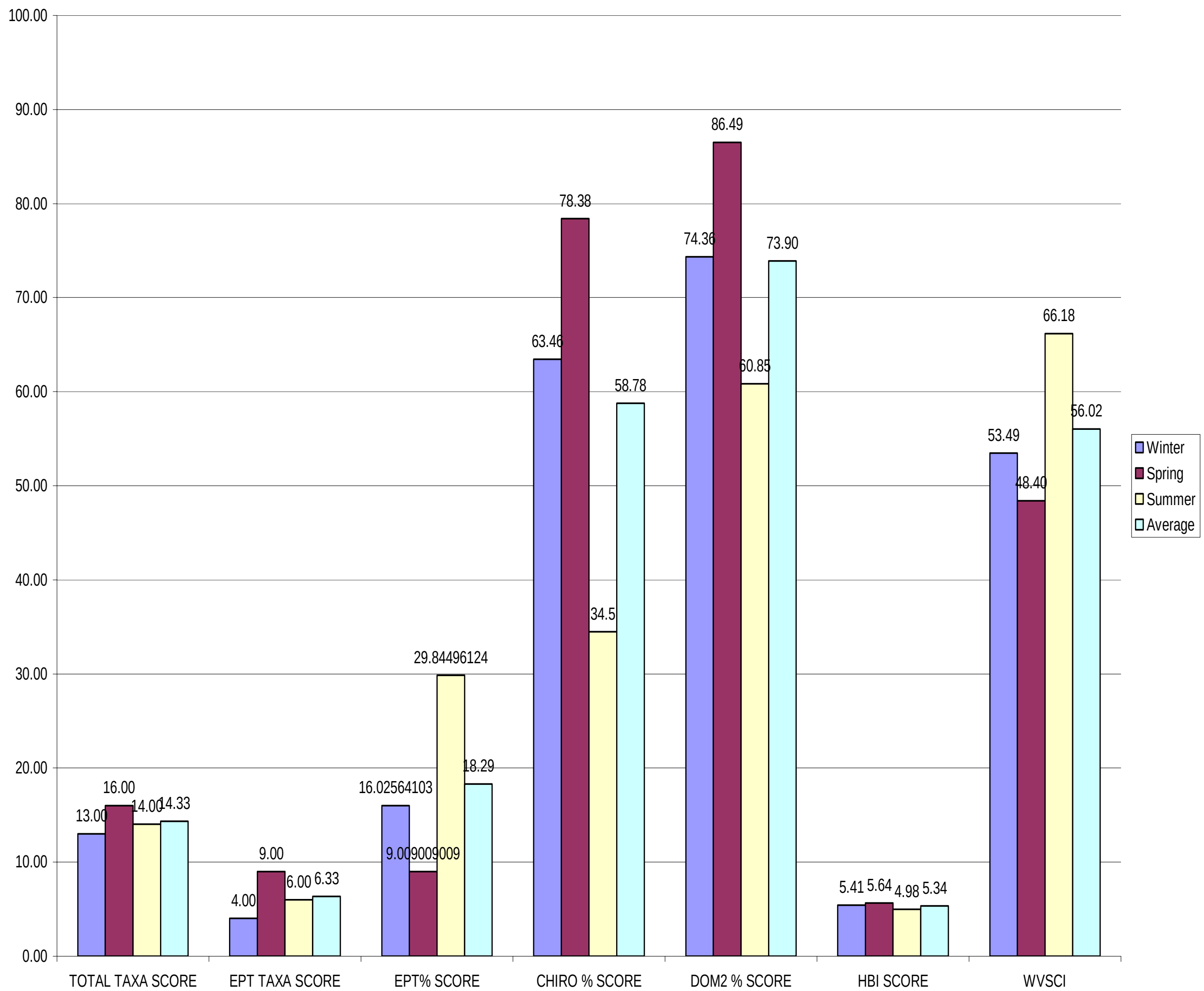
Appendix A: All Impacts Individual Site Comparisons



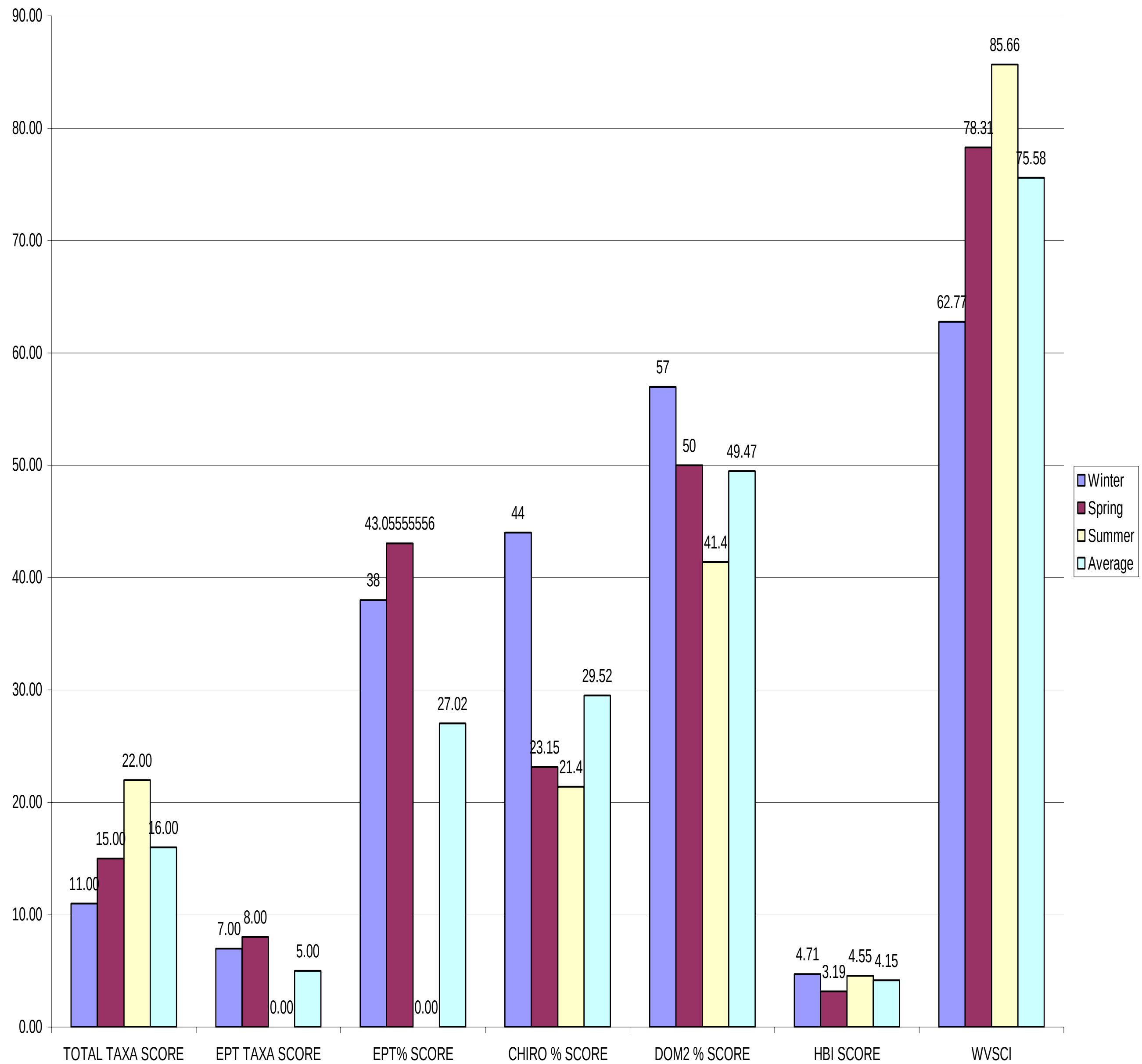
Graph 2. Deakin Run



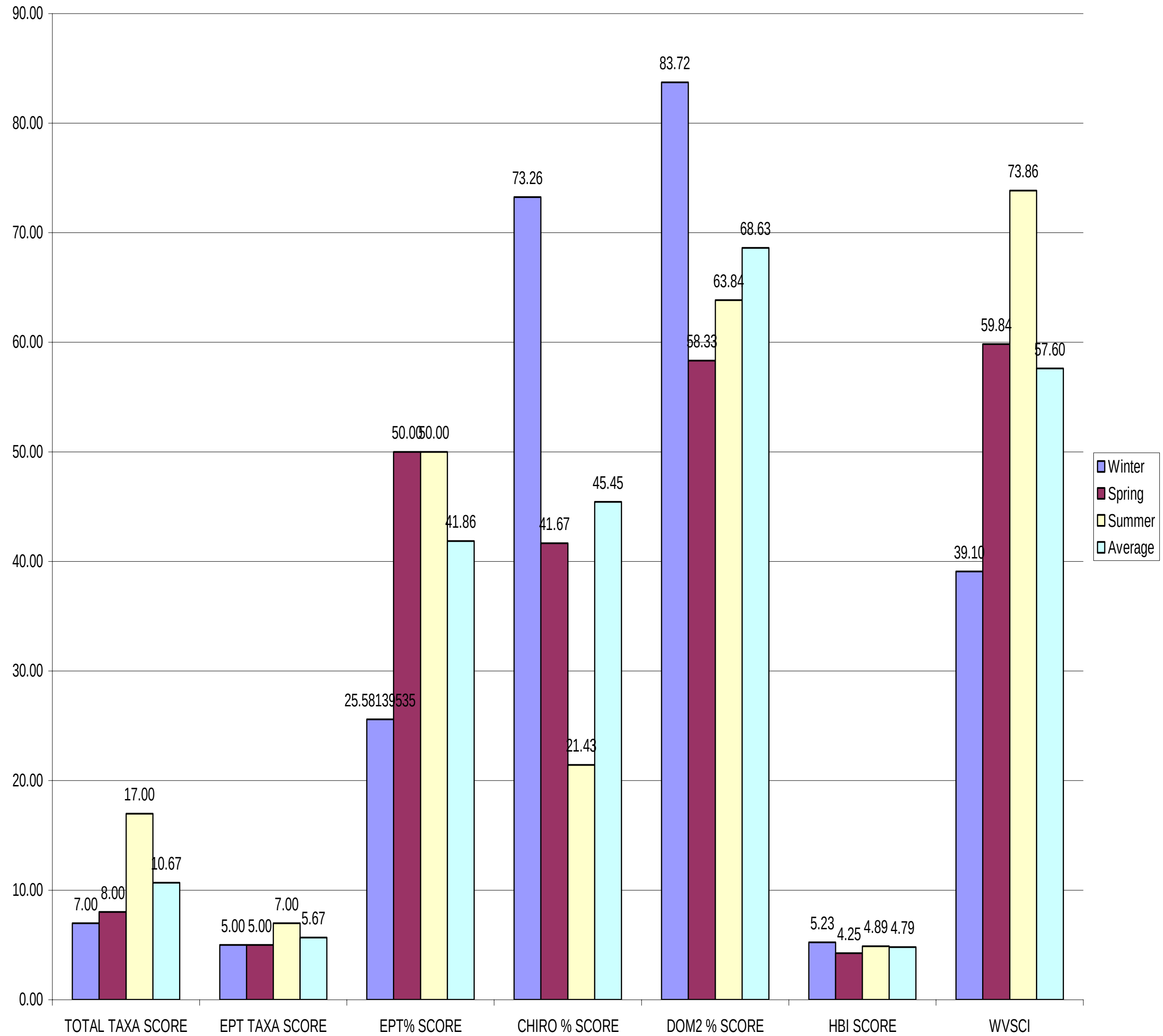
Graph 3. Grave Creek



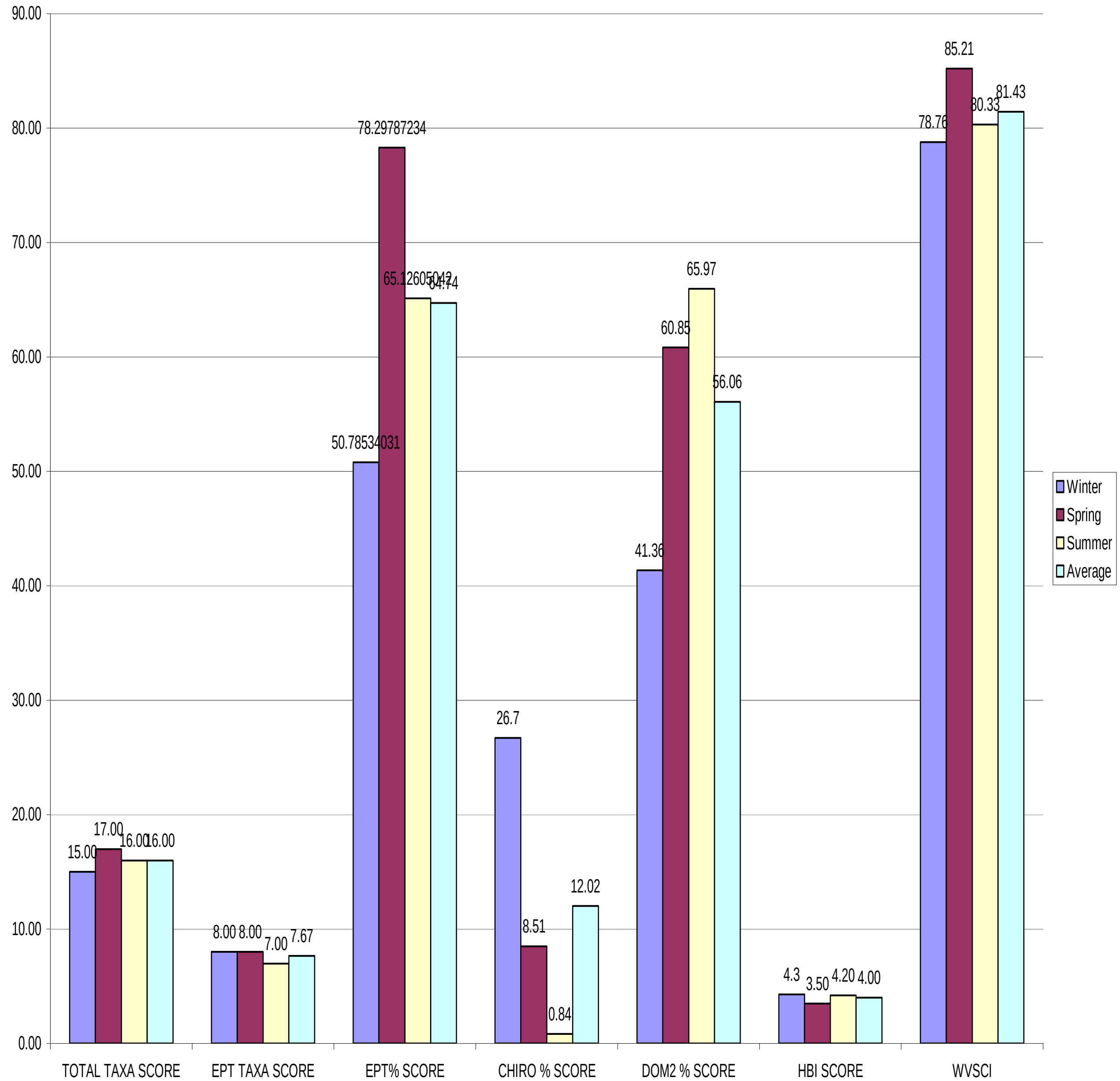
Graph 4. Howard Creek



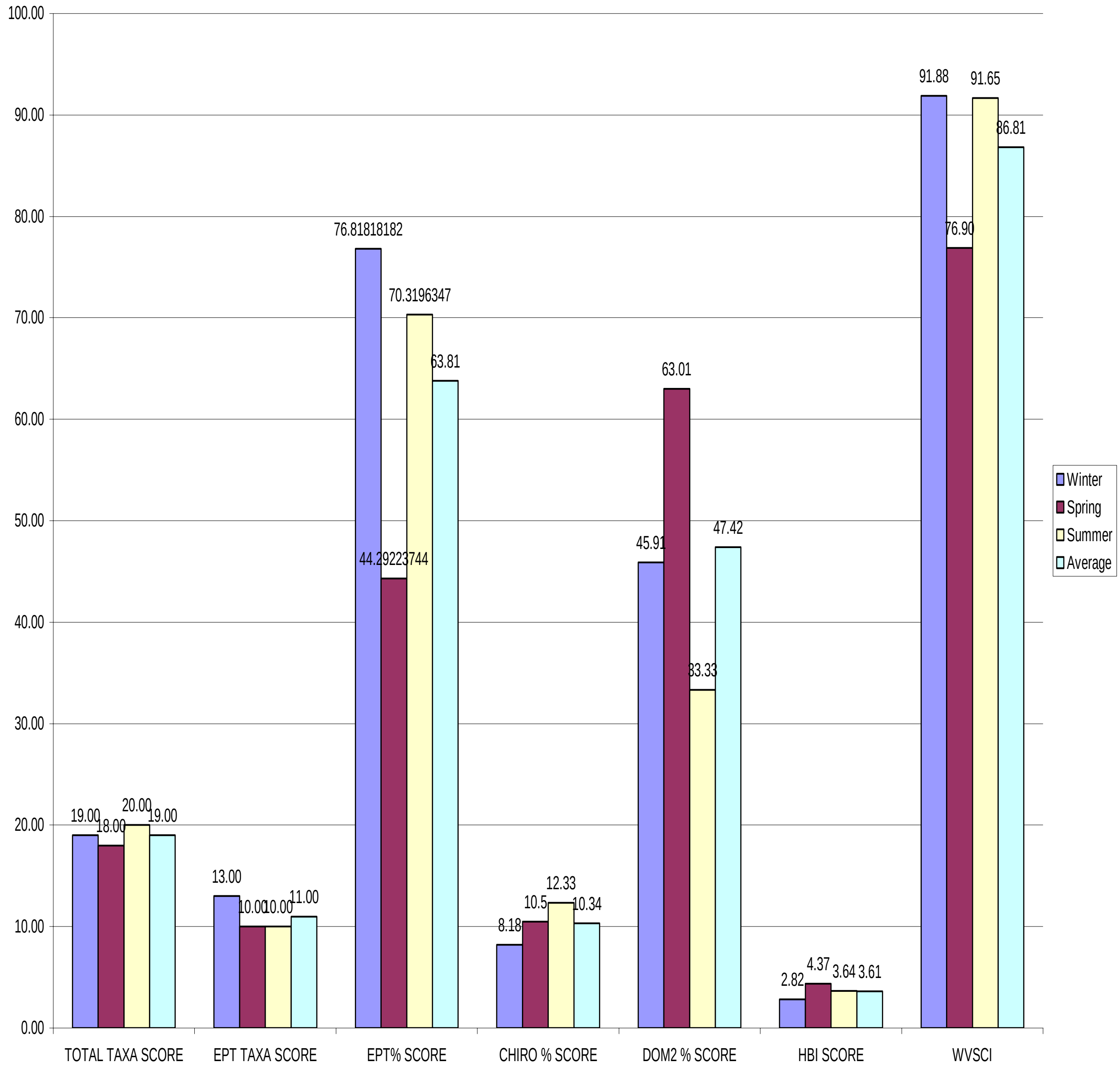
Graph 5. Little Buffalo Creek



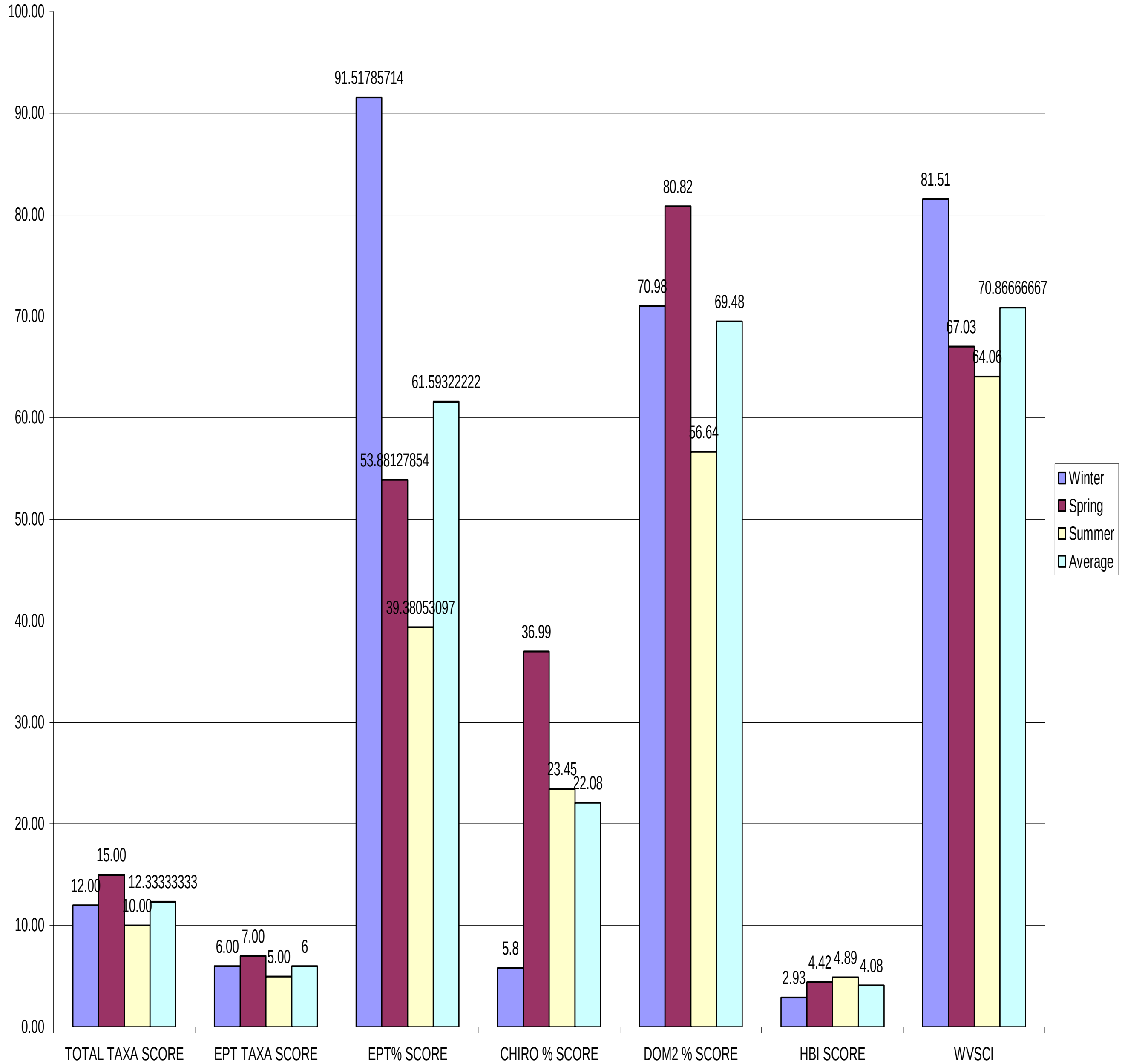
Graph 6. Lunice Creek



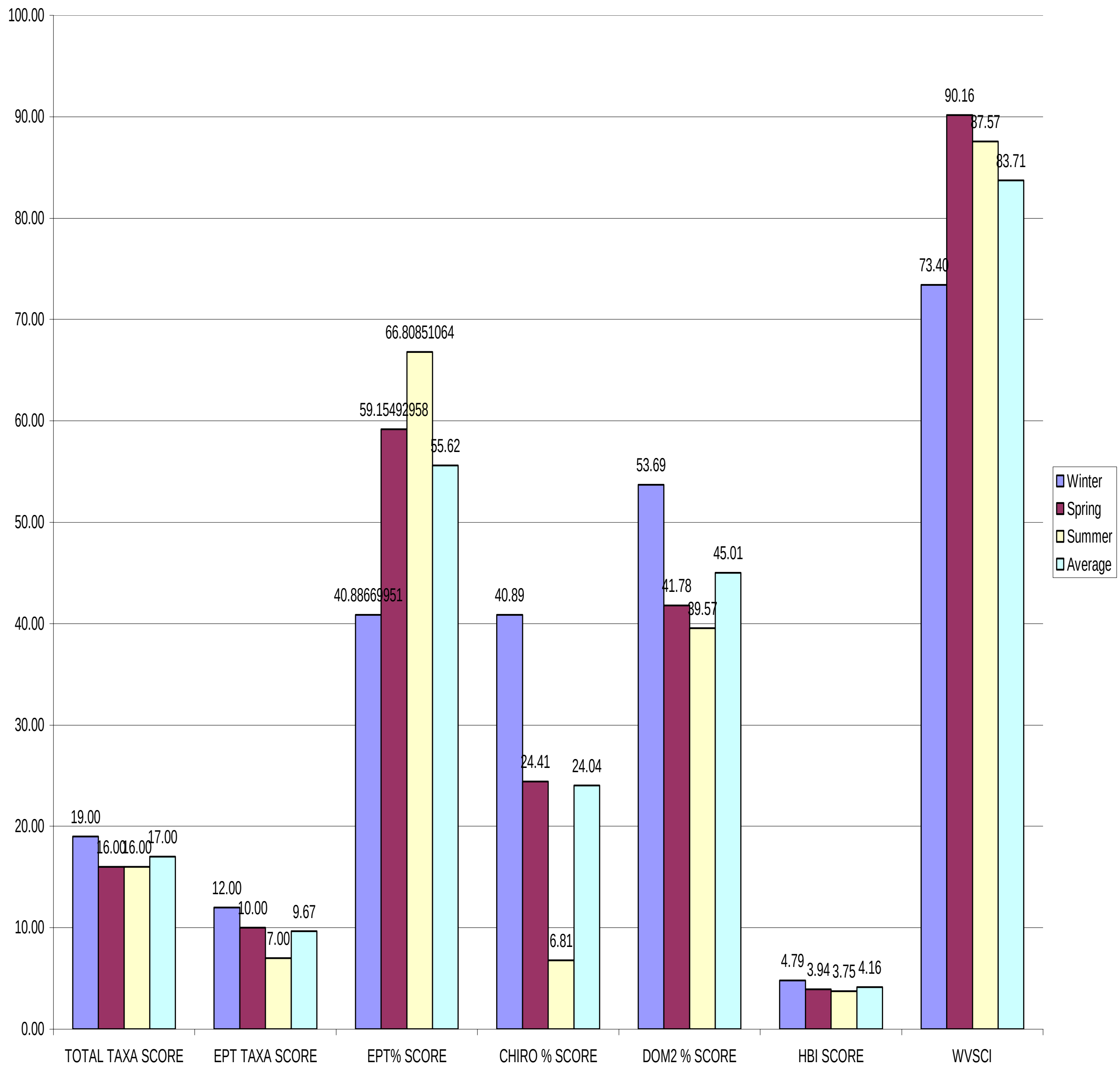
Graph 7. Meadow Creek



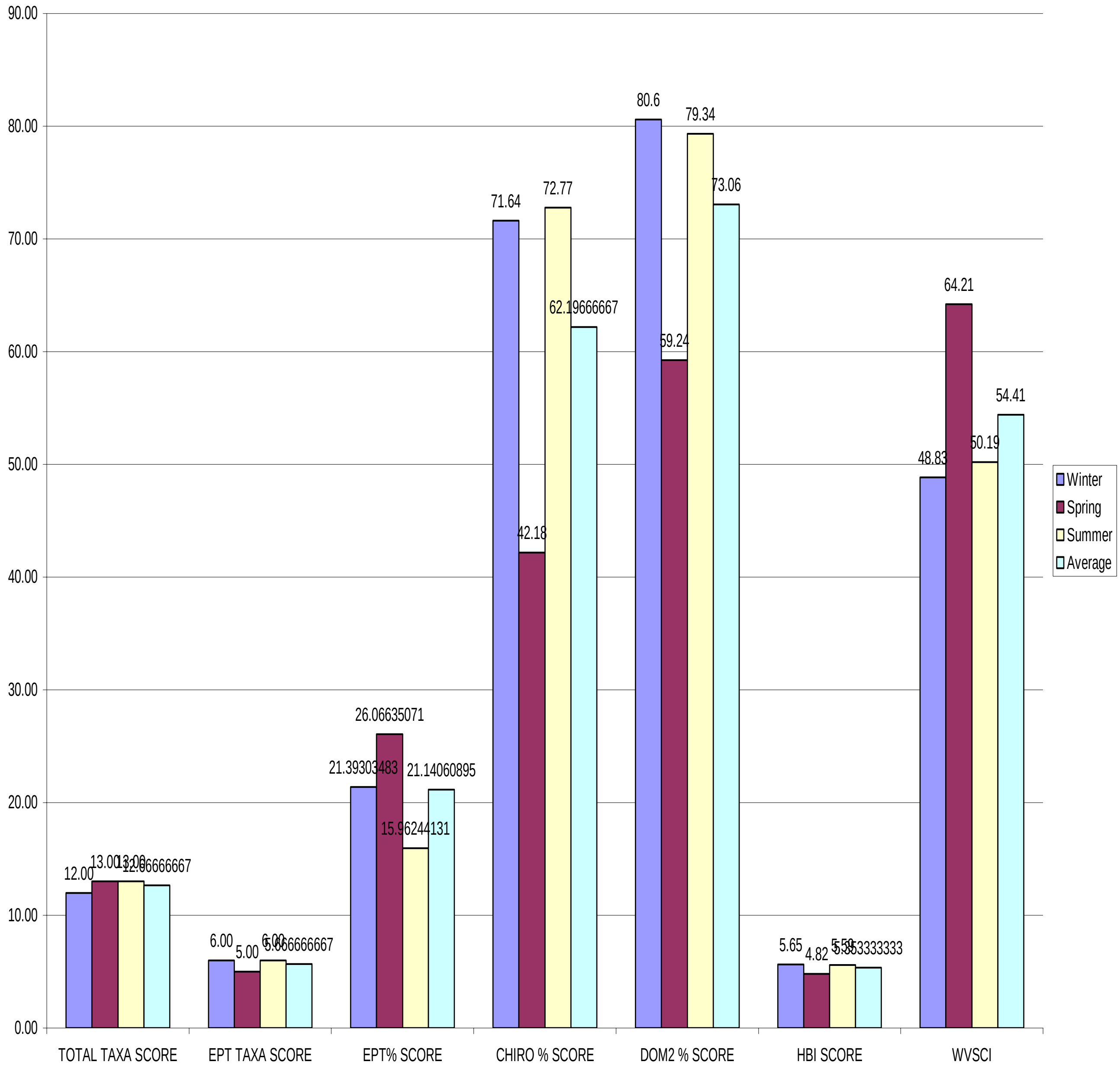
Graph 8. Mill Creek



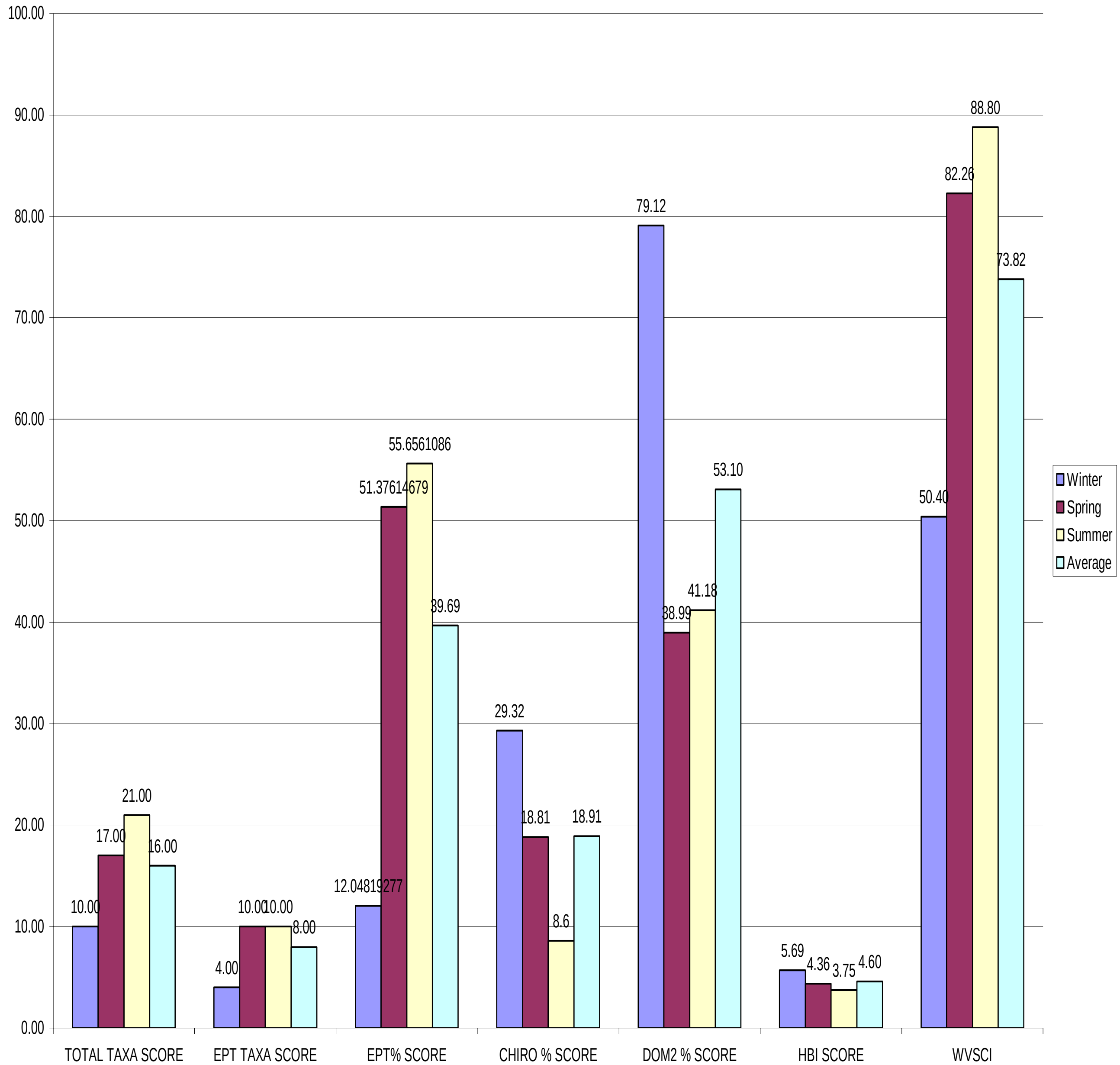
Graph 9. Shock Run



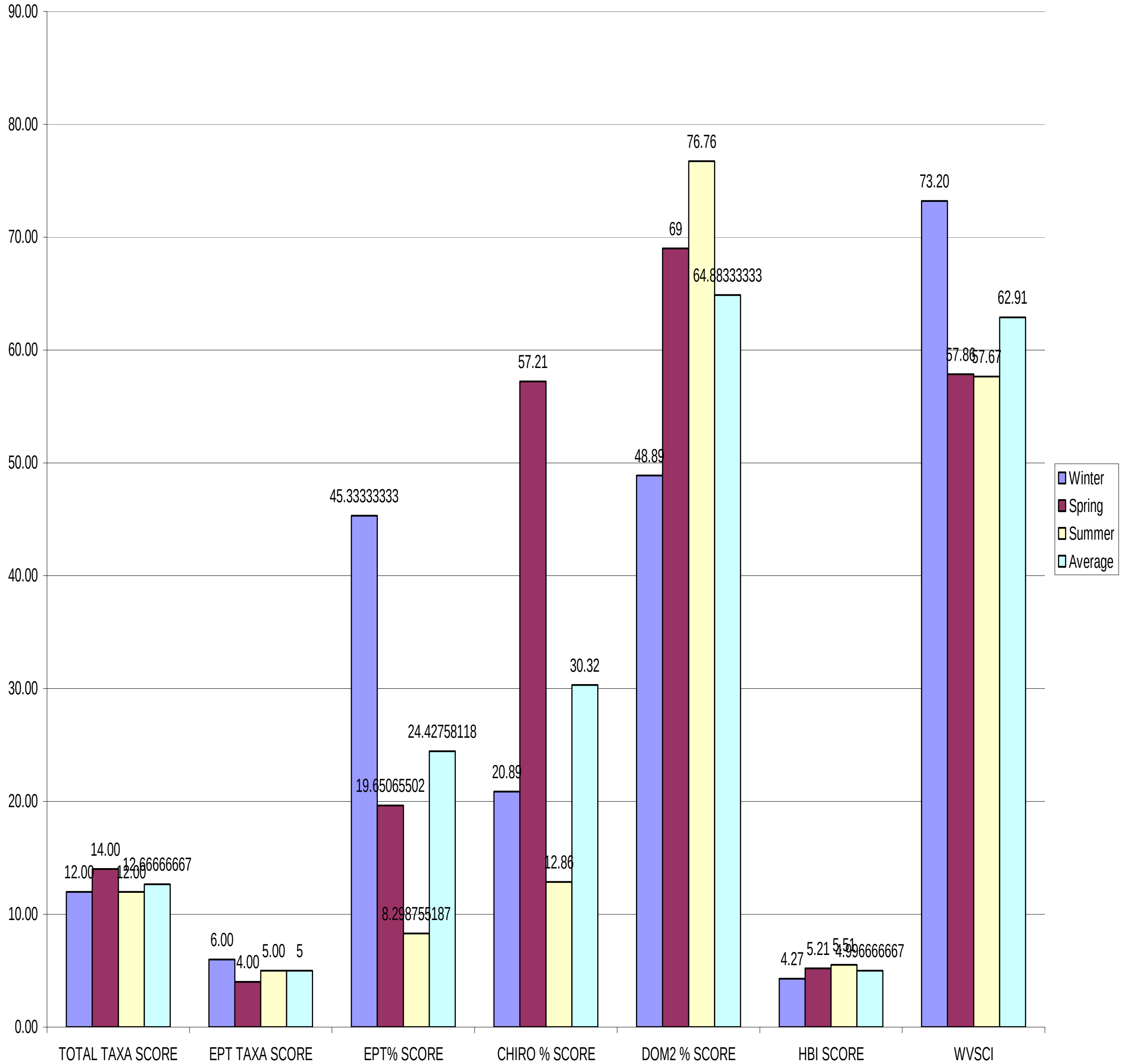
Graph 10. Stonecoal Creek



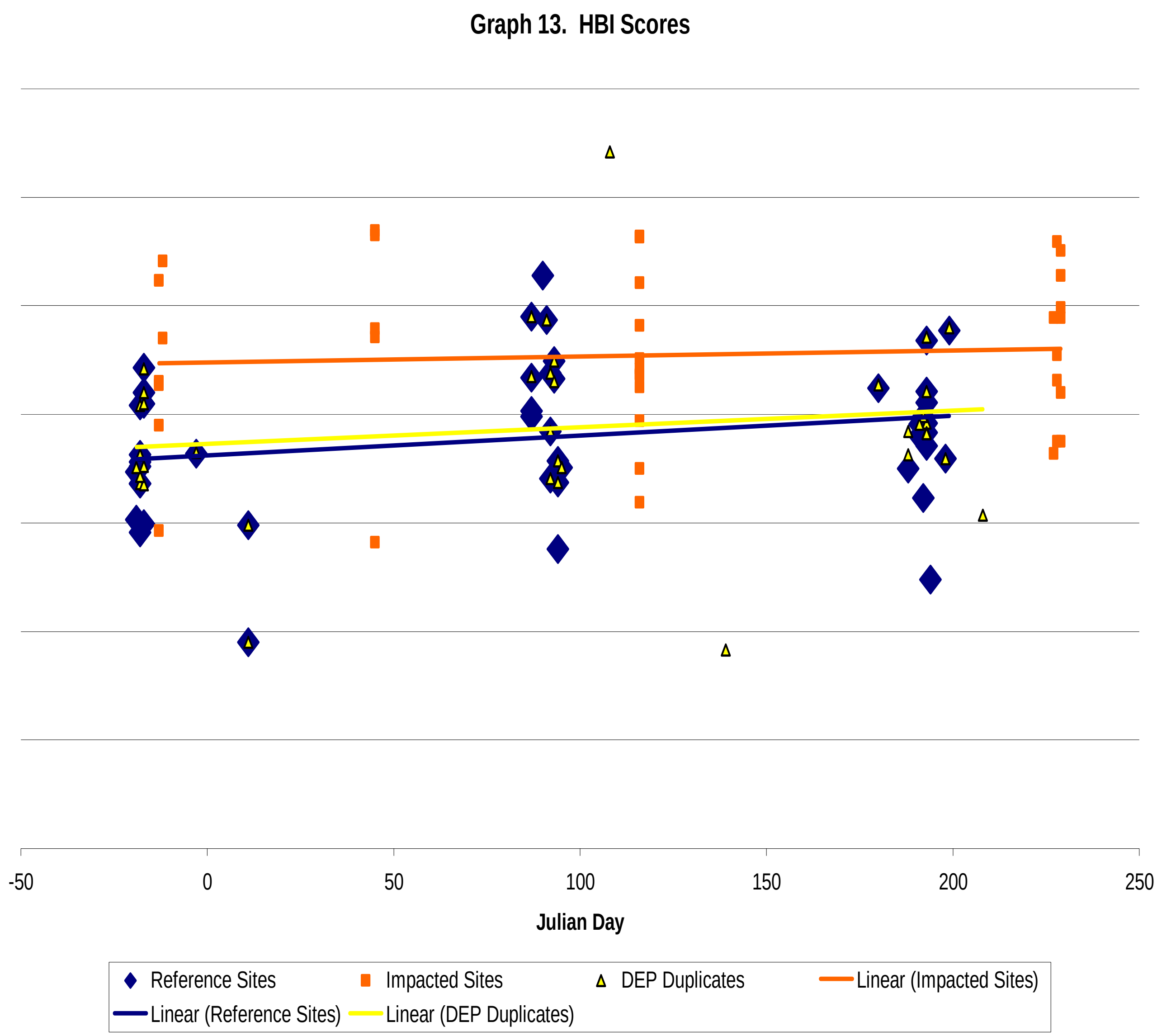
Graph 11. Thorny Creek



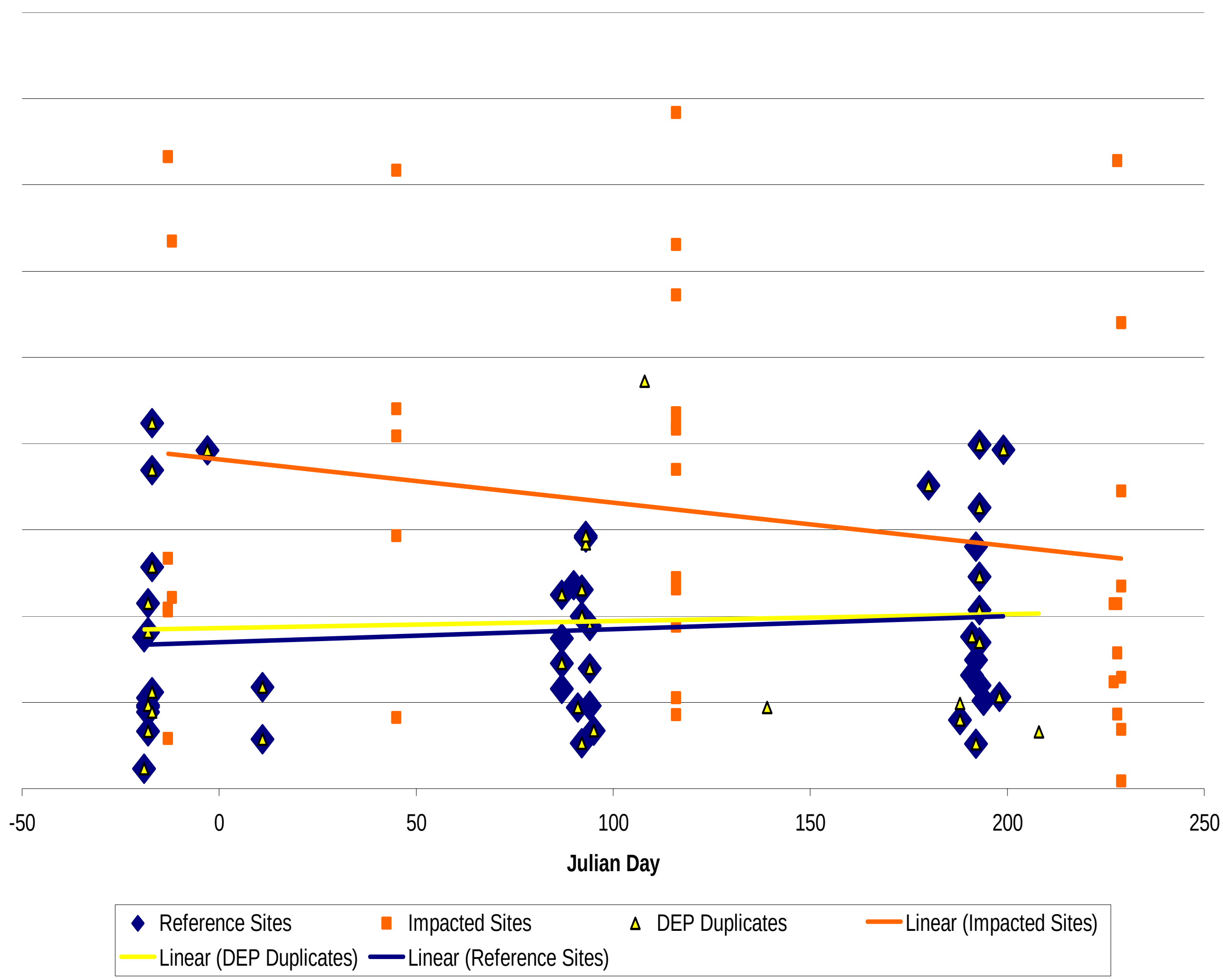
Graph 12. Tuscarora Creek

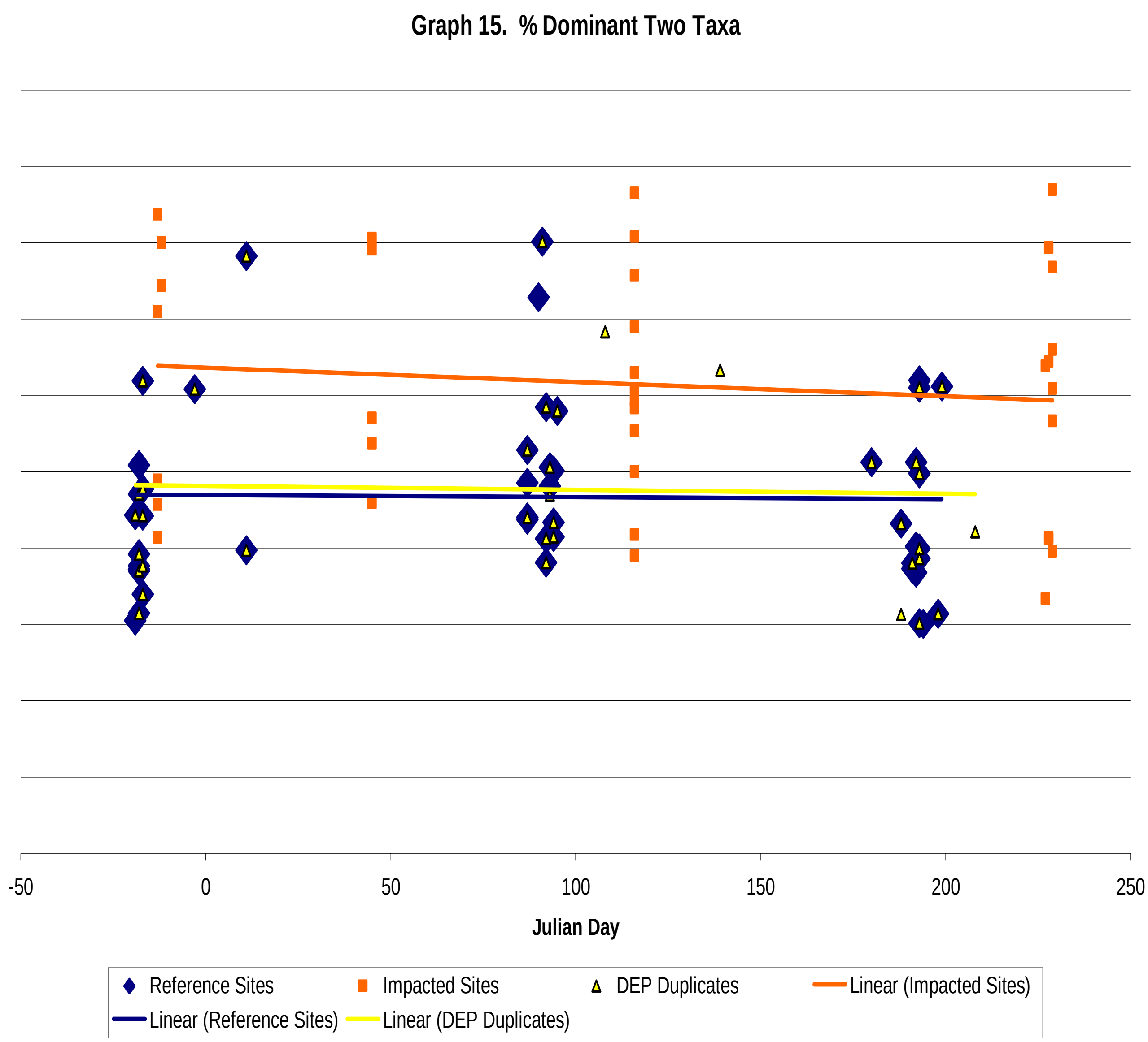


Appendix B: Julian Day Regressions

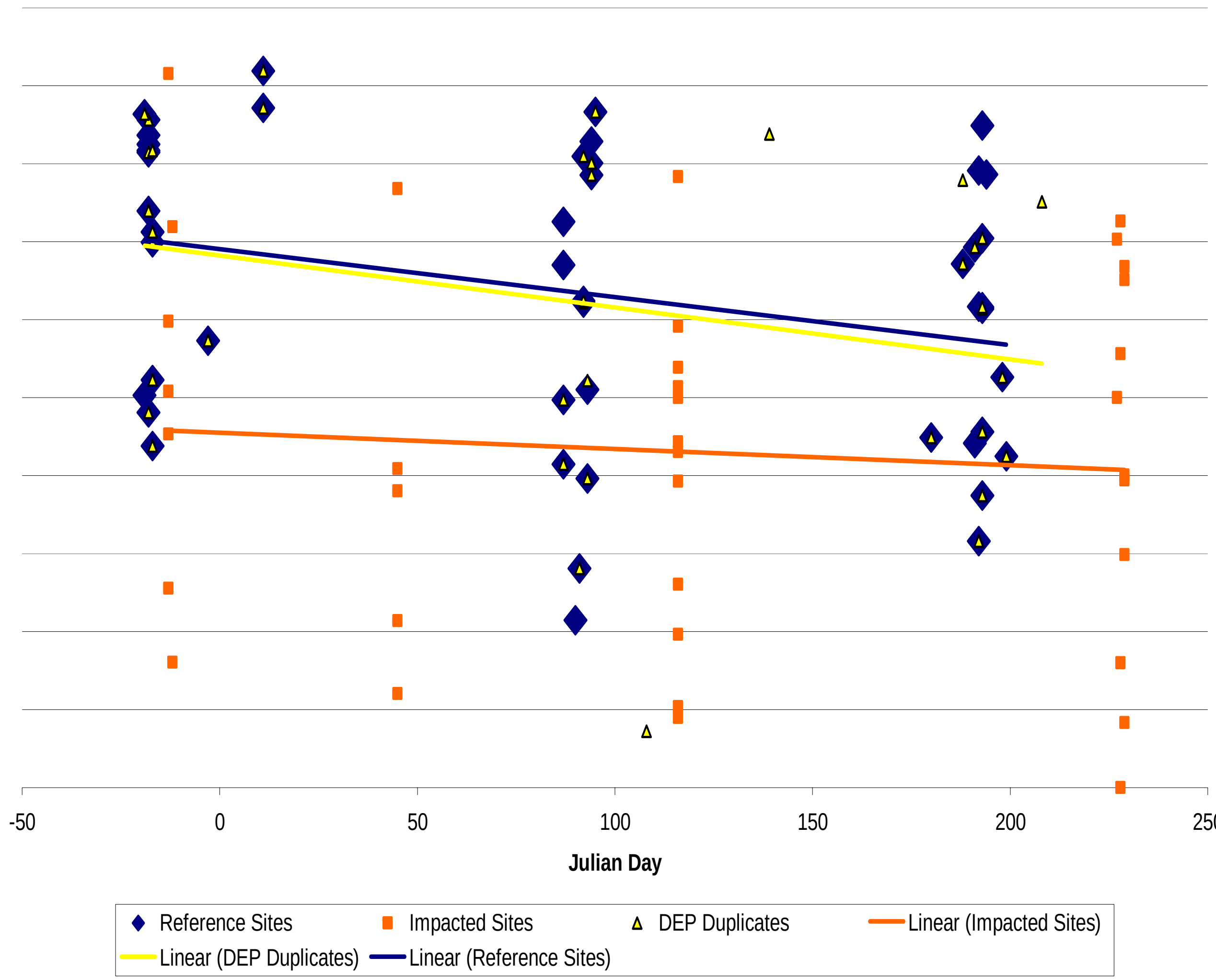


Graph 14. % Chironomidae



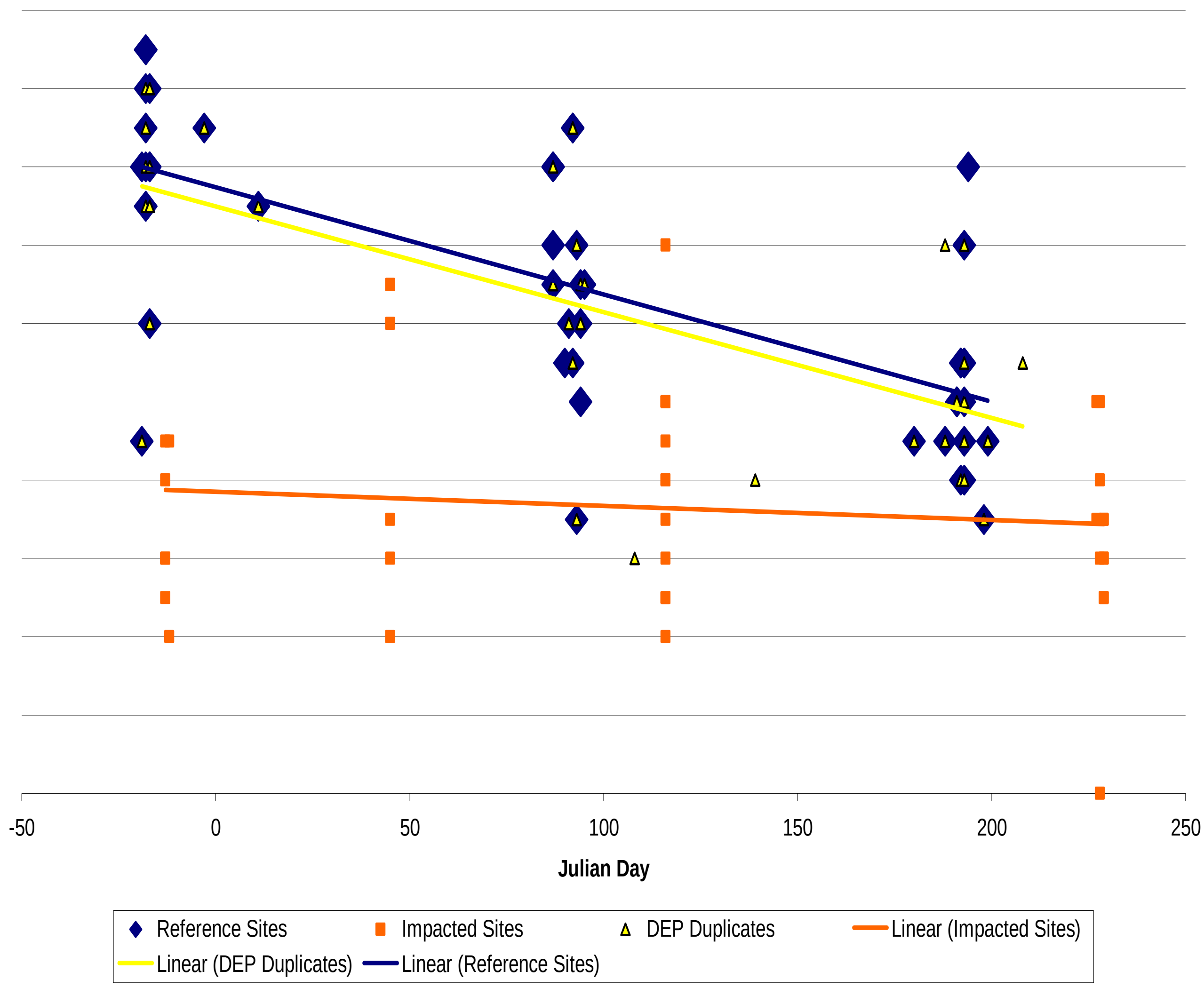

Graph 15. % Dominant Two Taxa
-50
0
50
100
150
200
250
Julian Day
Reference Sites
Impacted Sites
DEP Duplicates
Linear (Impacted Sites)
Linear (Reference Sites)
Linear (DEP Duplicates)

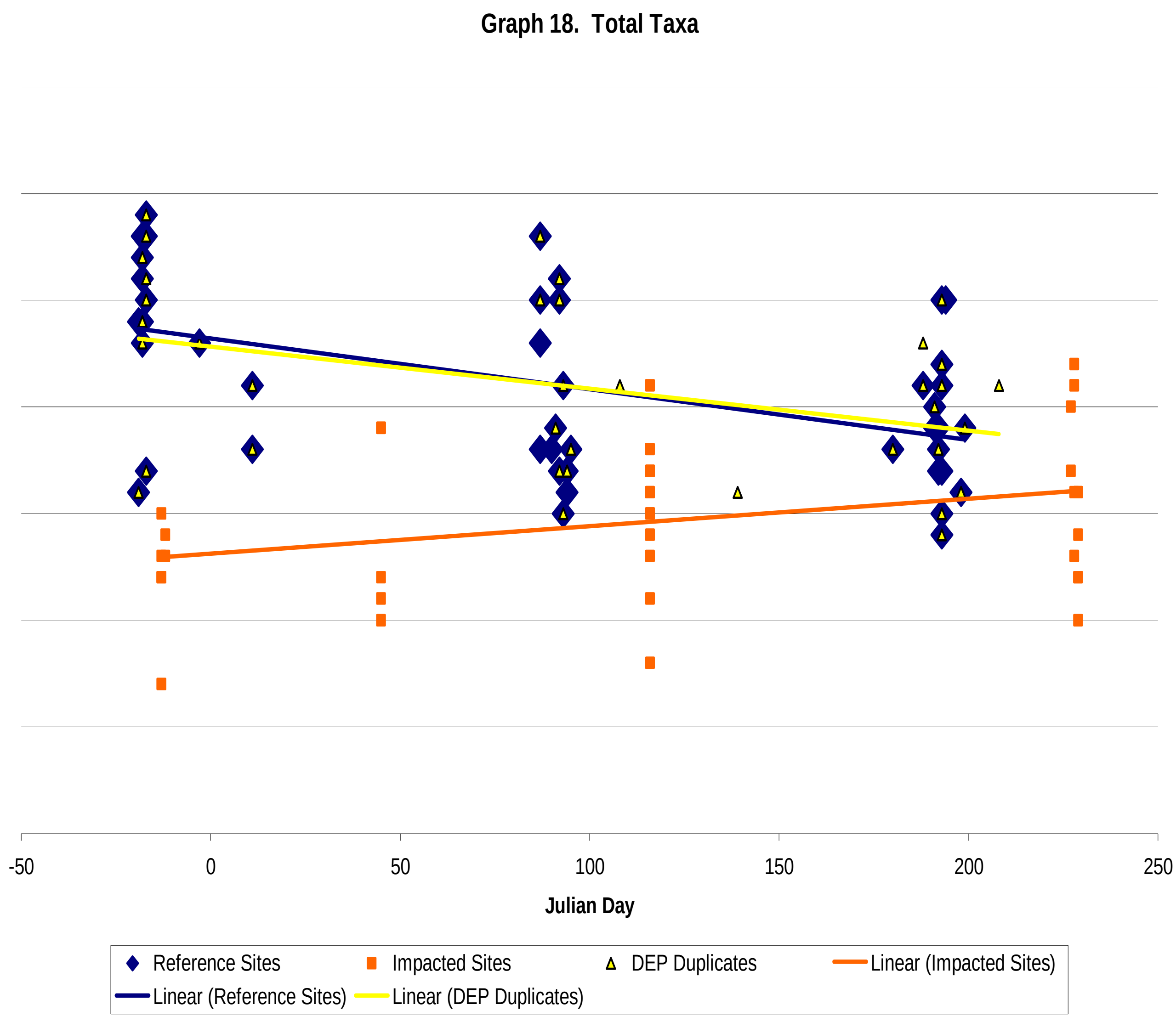
Graph 16. %EPT



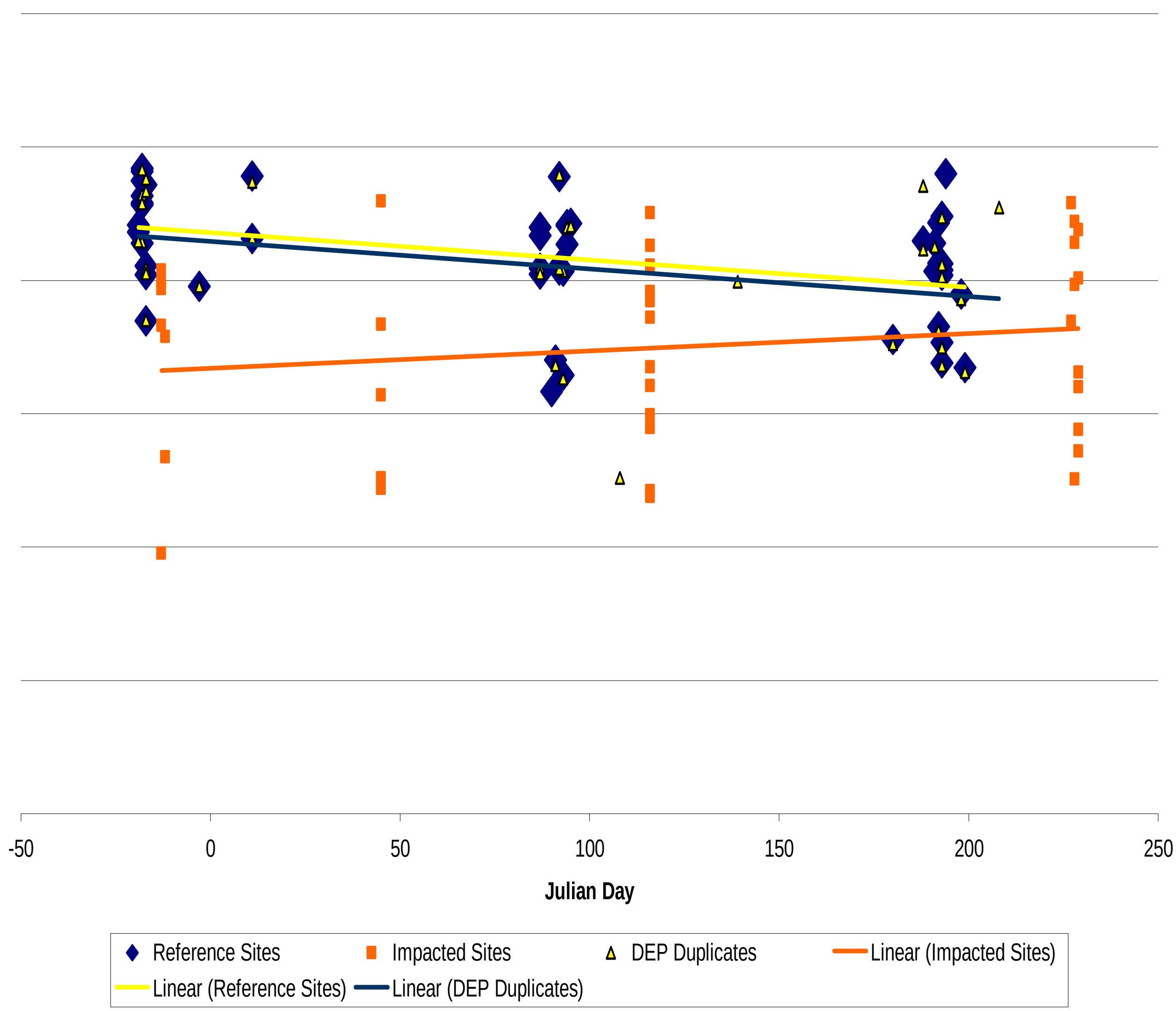
-50
0
50
100
150
200
250
Julian Day
Reference Sites
Impacted Sites
DEP Duplicates
Linear (Impacted Sites)
Linear (DEP Duplicates)
Linear (Reference Sites)

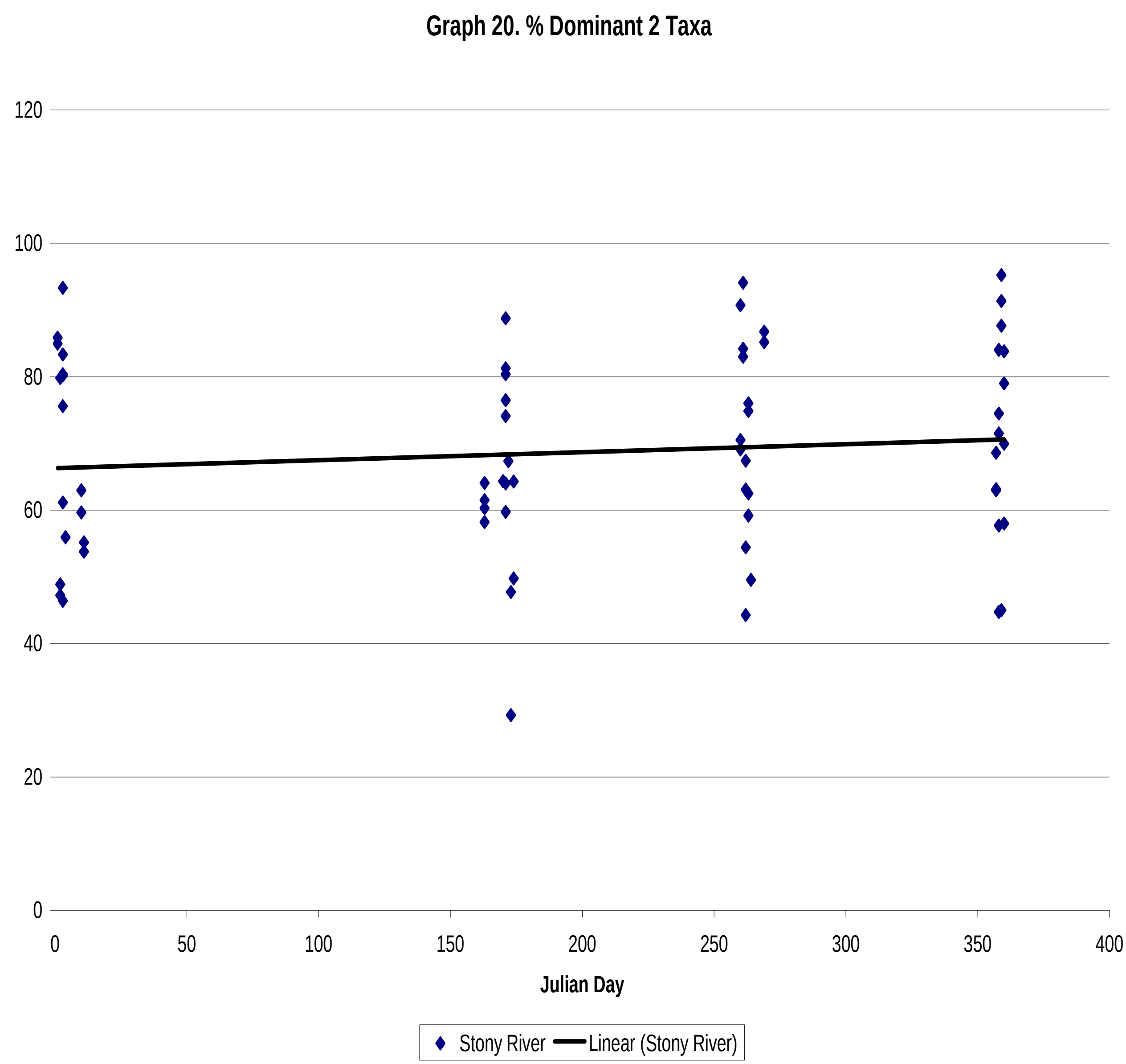
Graph 17. EPT Taxa



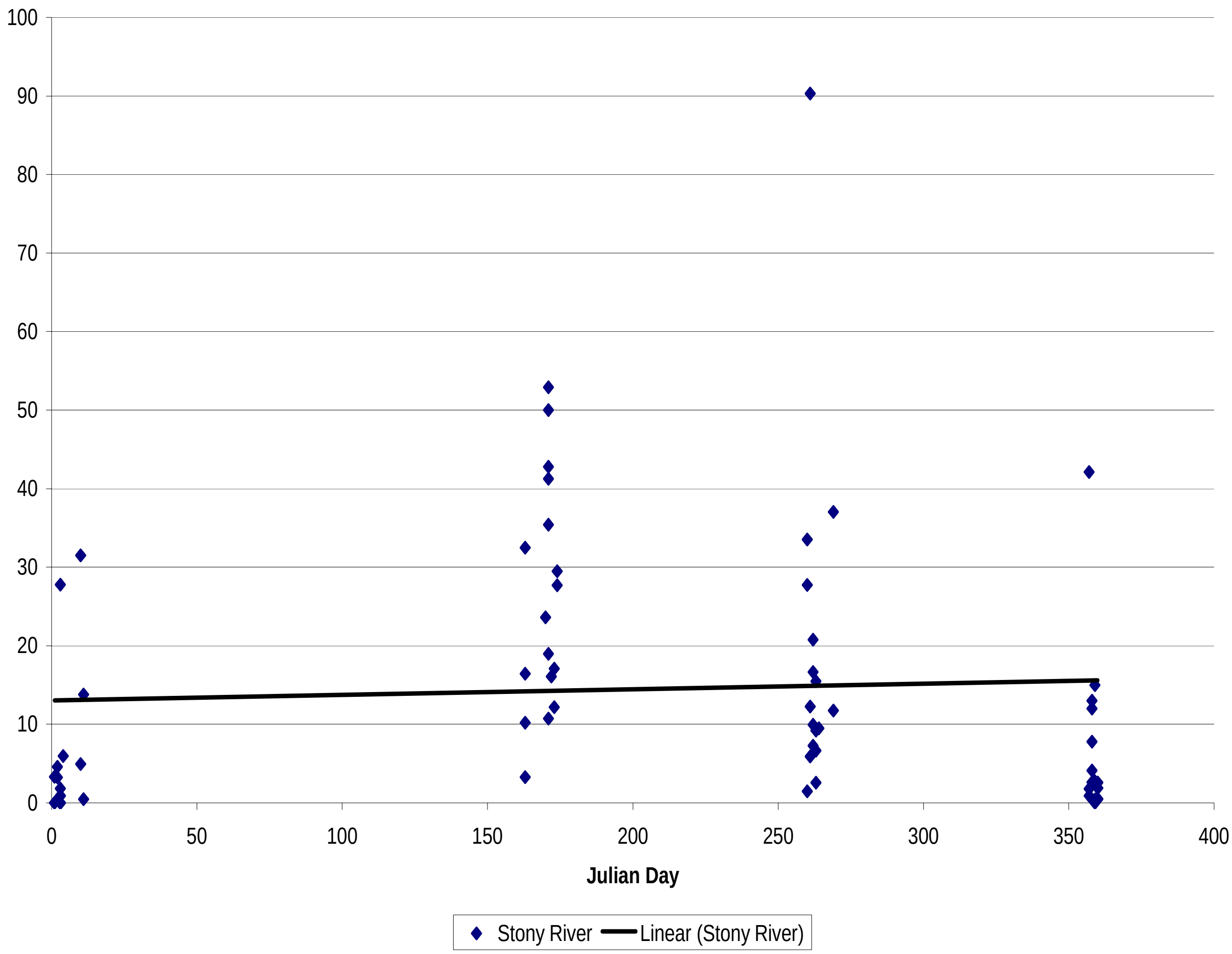

Graph 18. Total Taxa
-50
0
50
100
150
200
250
Julian Day
Reference Sites
Impacted Sites
DEP Duplicates
Linear (Impacted Sites)
Linear (Reference Sites)
Linear (DEP Duplicates)

Graph 19. WVSCI

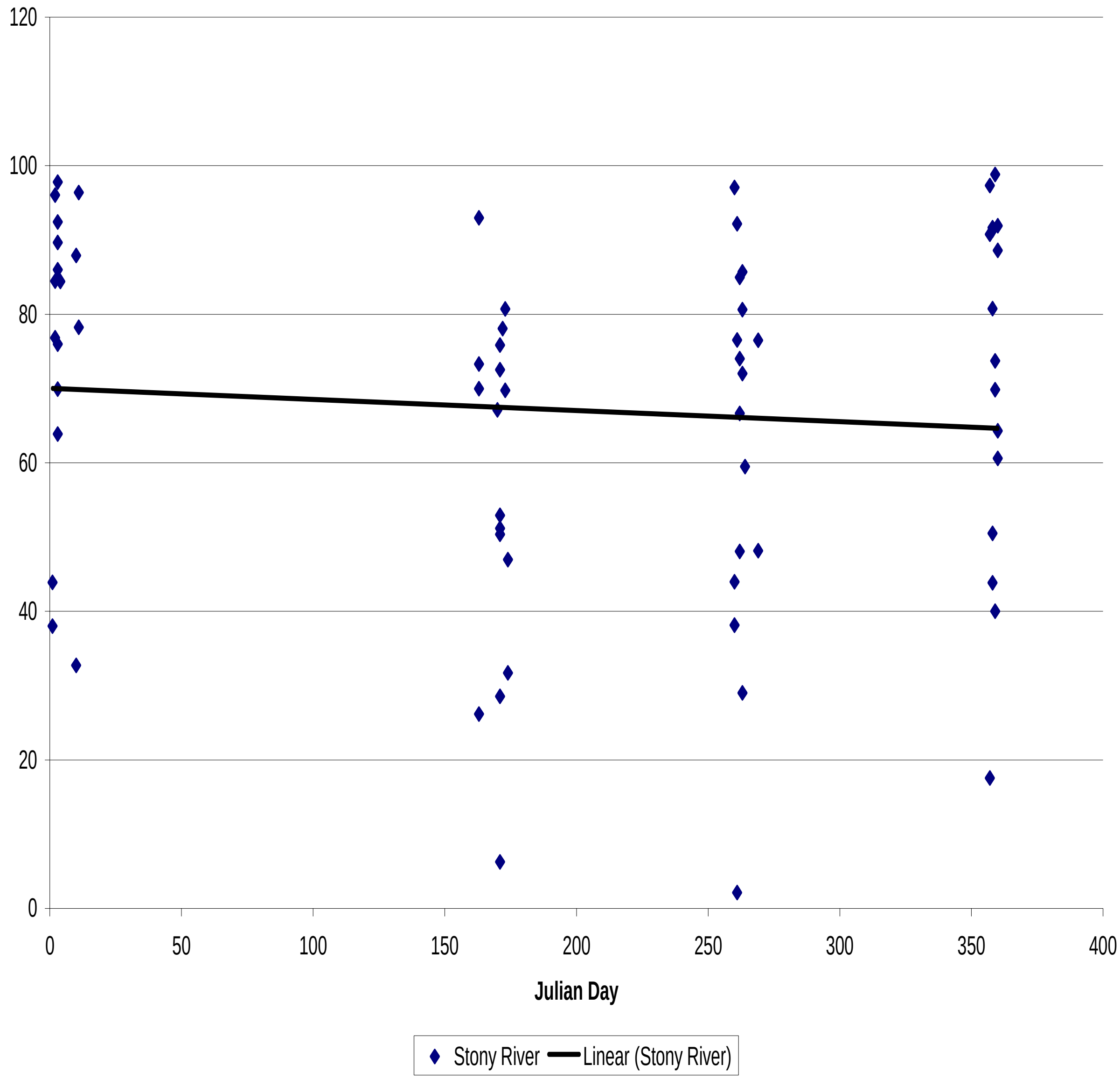



Graph 20. % Dominant 2 Taxa
120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
Julian Day
Stony River
Linear (Stony River)

Graph 21. % Chironomidae

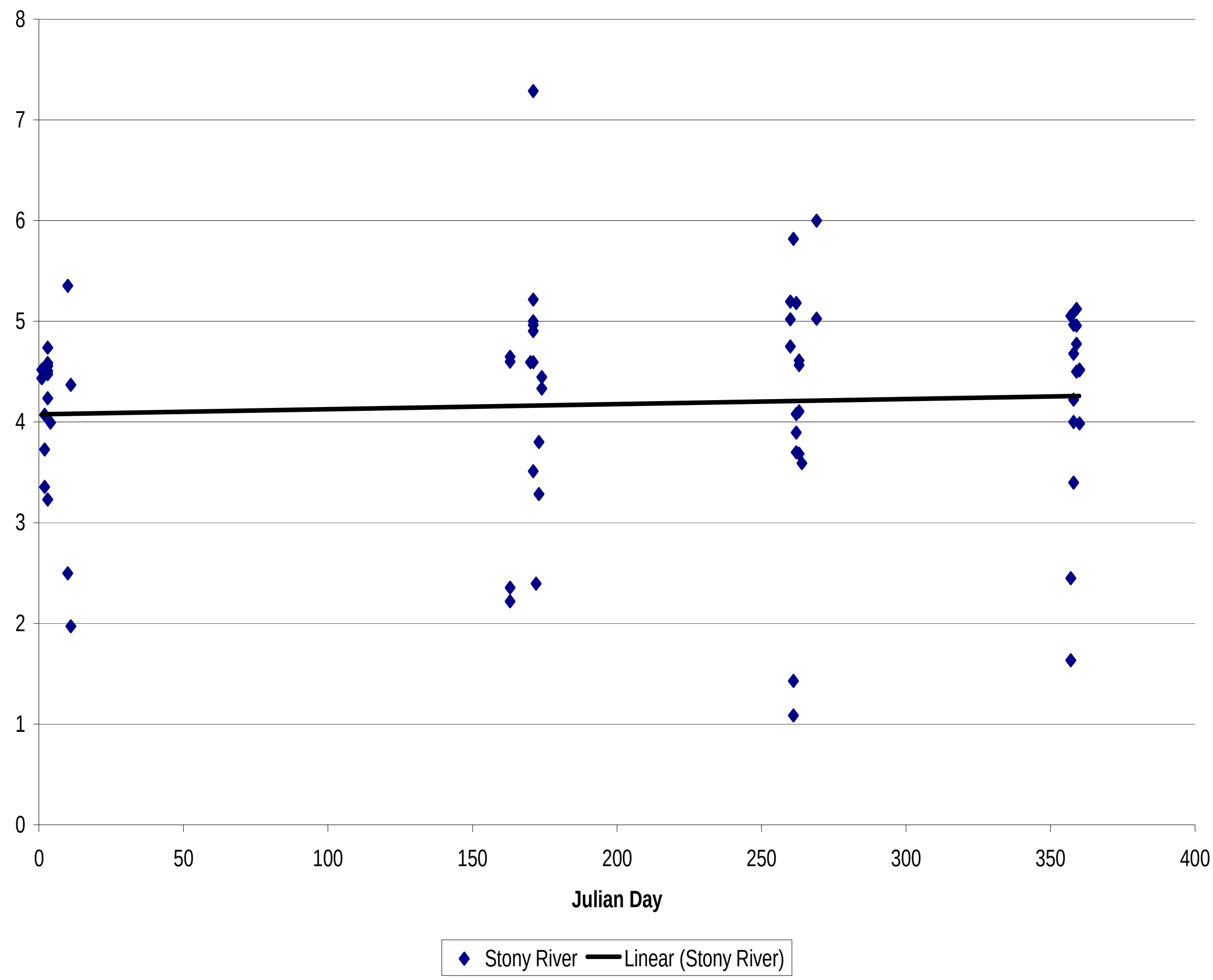


Graph 22. % EPT

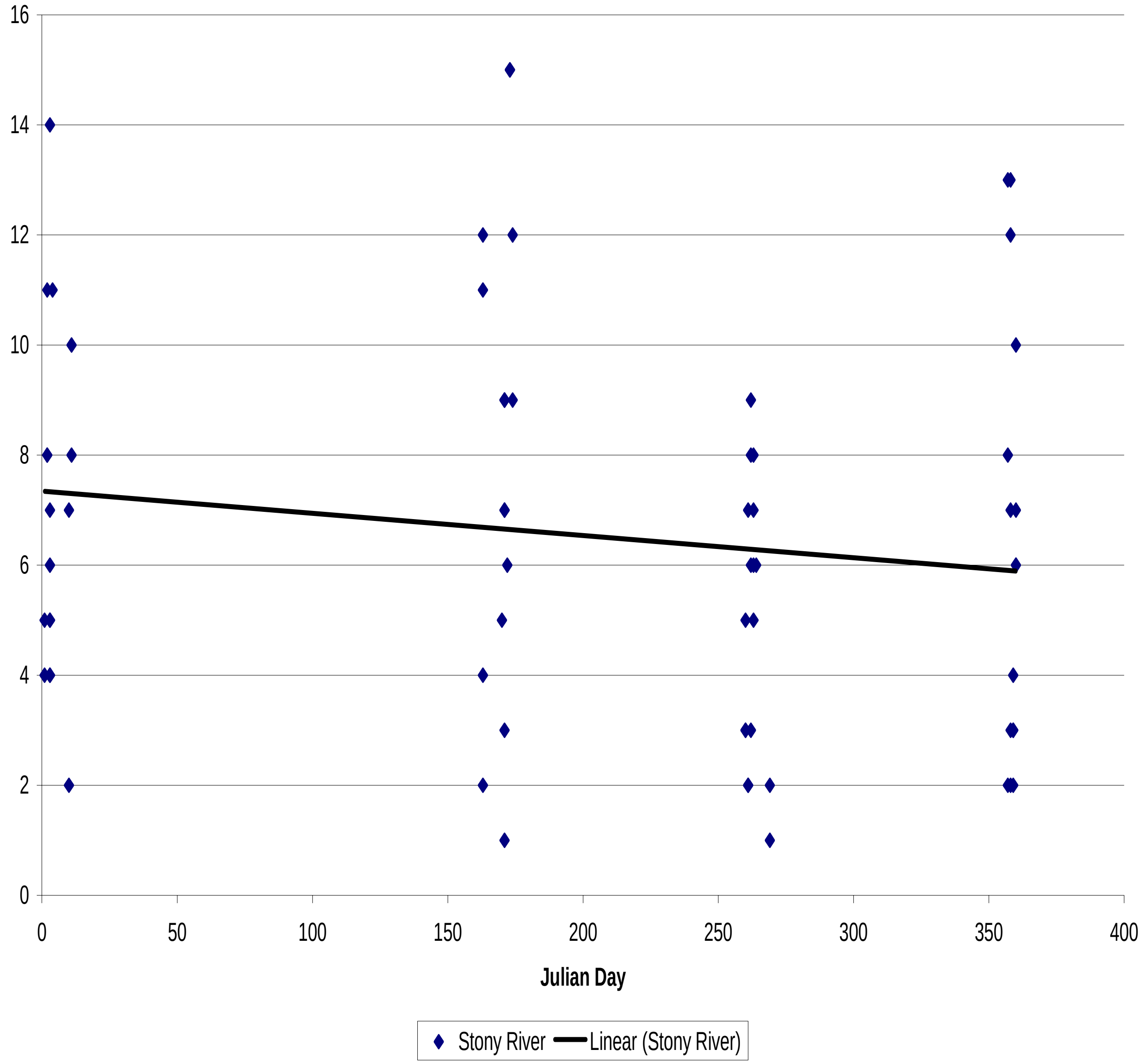


120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
Julian Day
Stony River
Linear (Stony River)

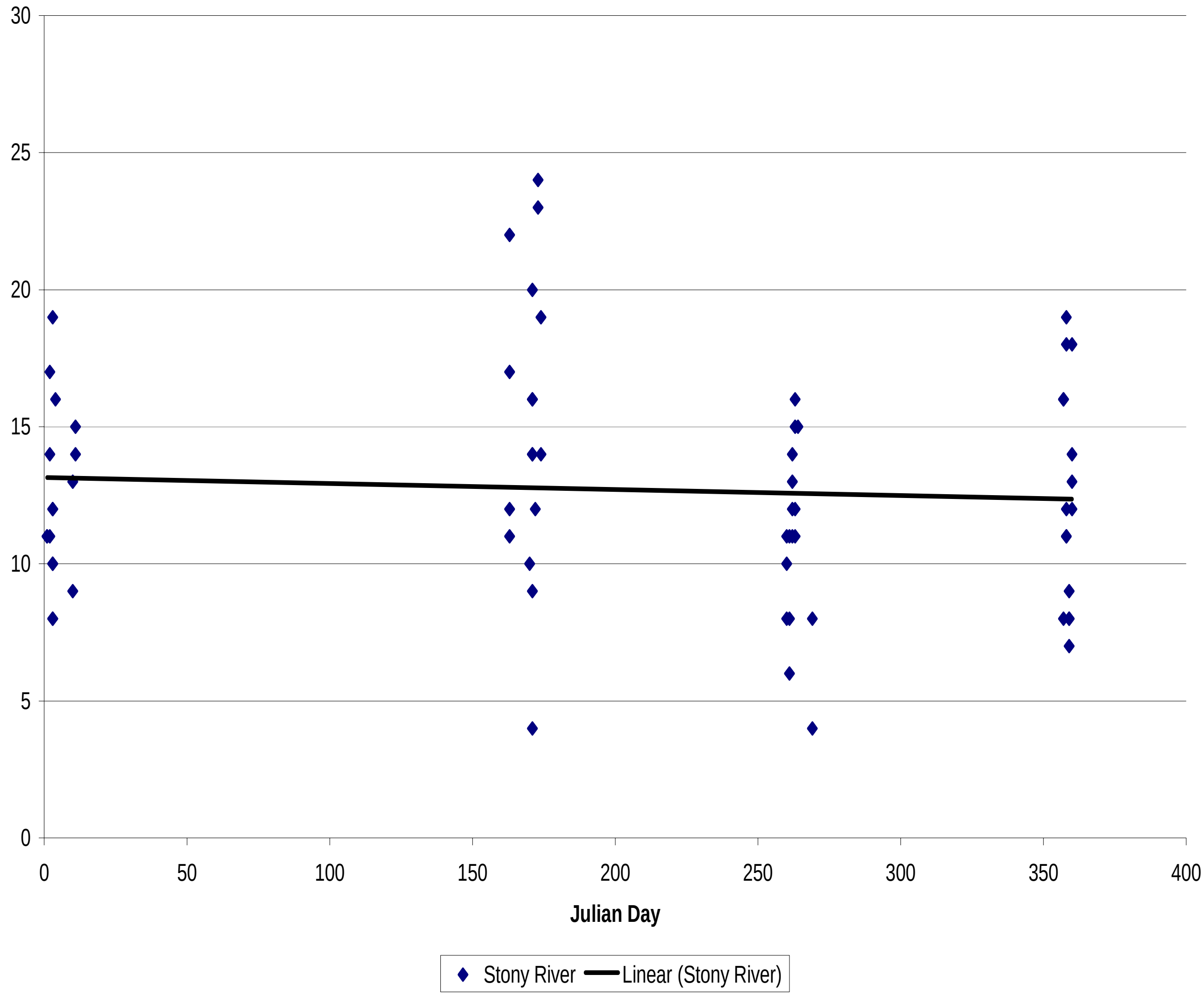
Graph 23. HBI Score

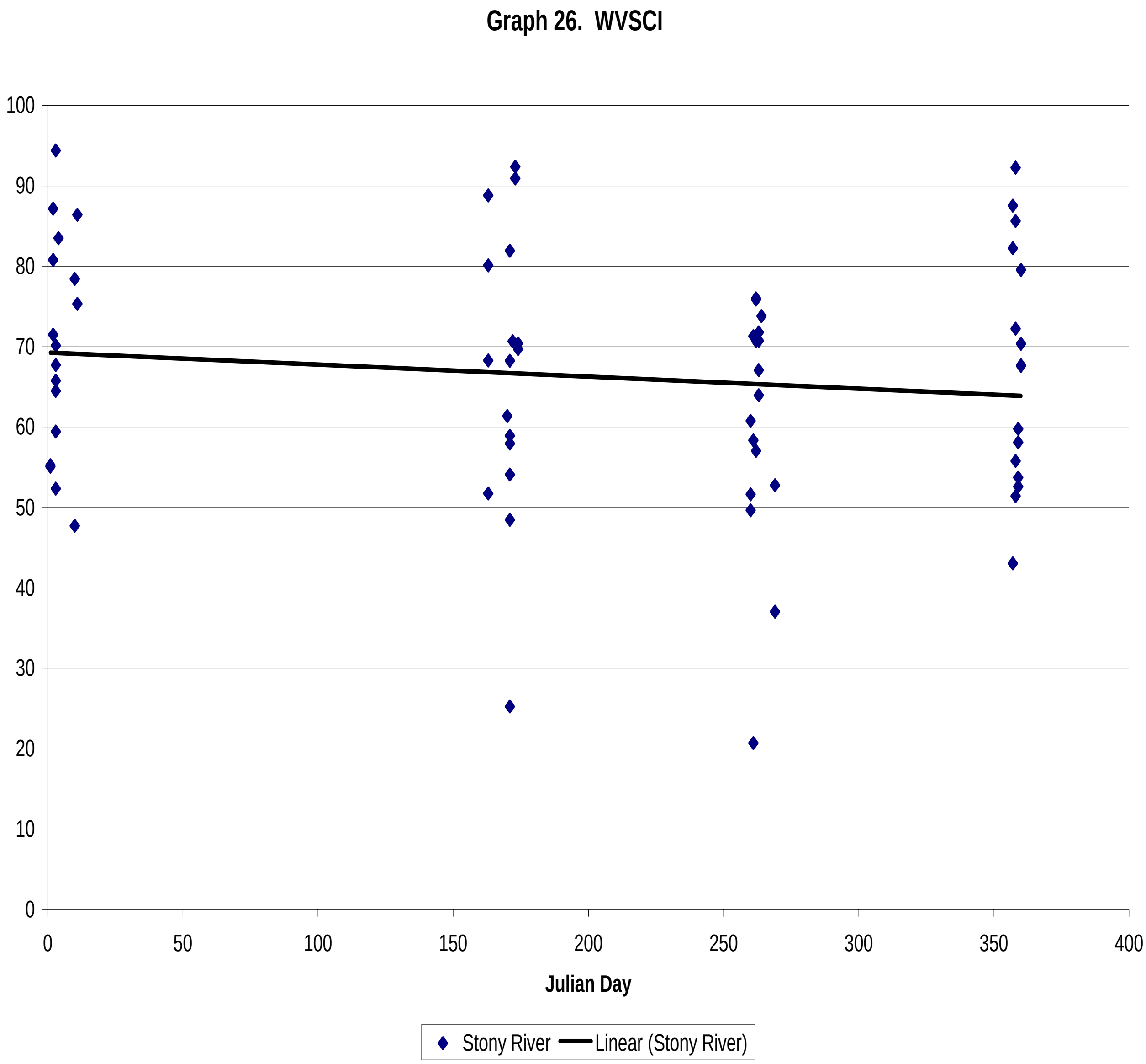


Graph 24. EPT Taxa



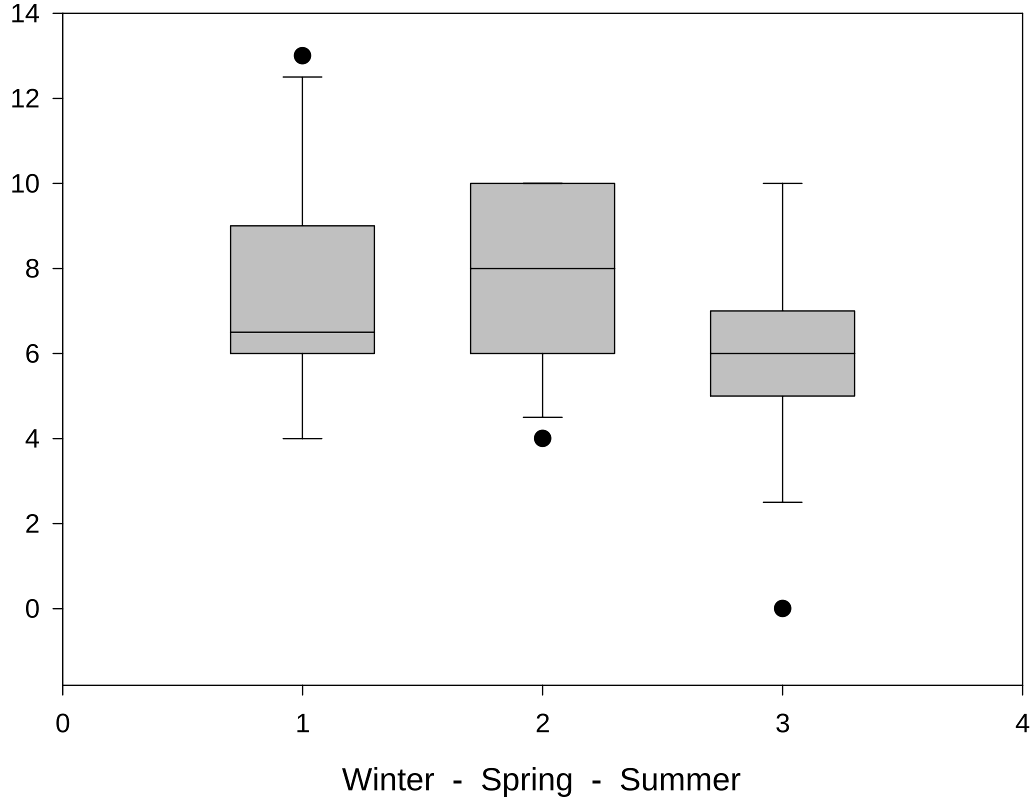
Graph 25. Total Taxa



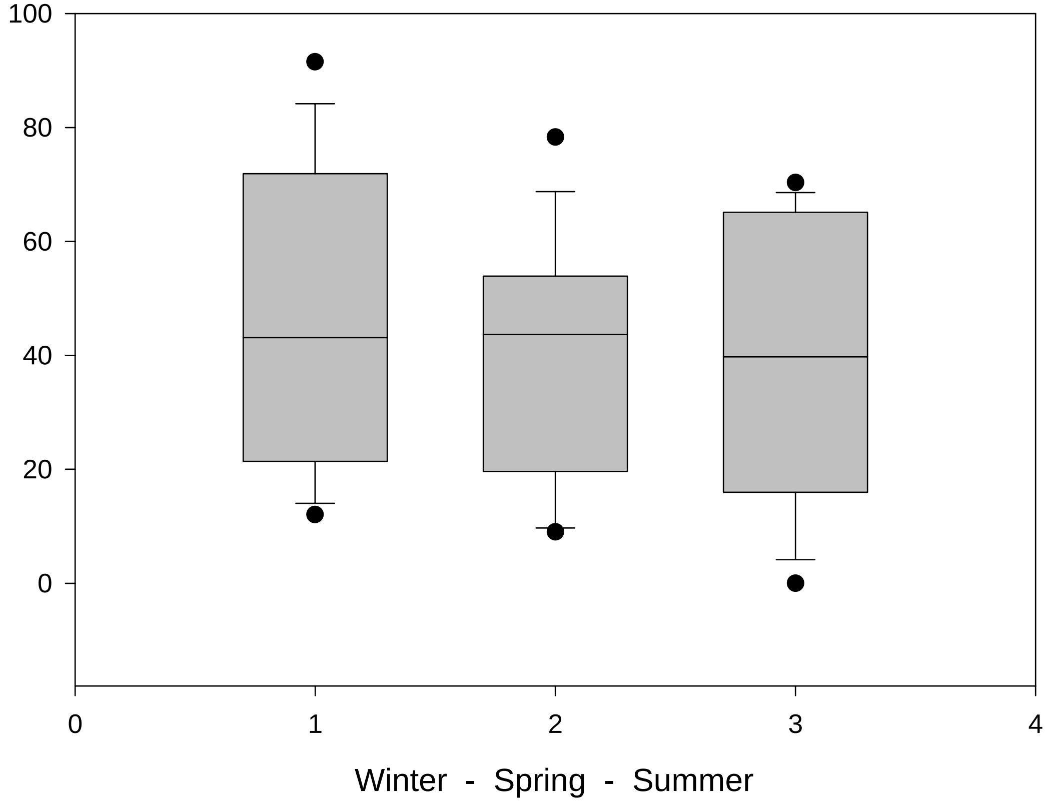

Graph 26. WVSCI
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
350
400
Julian Day
Stony River
Linear (Stony River)

Appendix C: Box and Whisker Plots

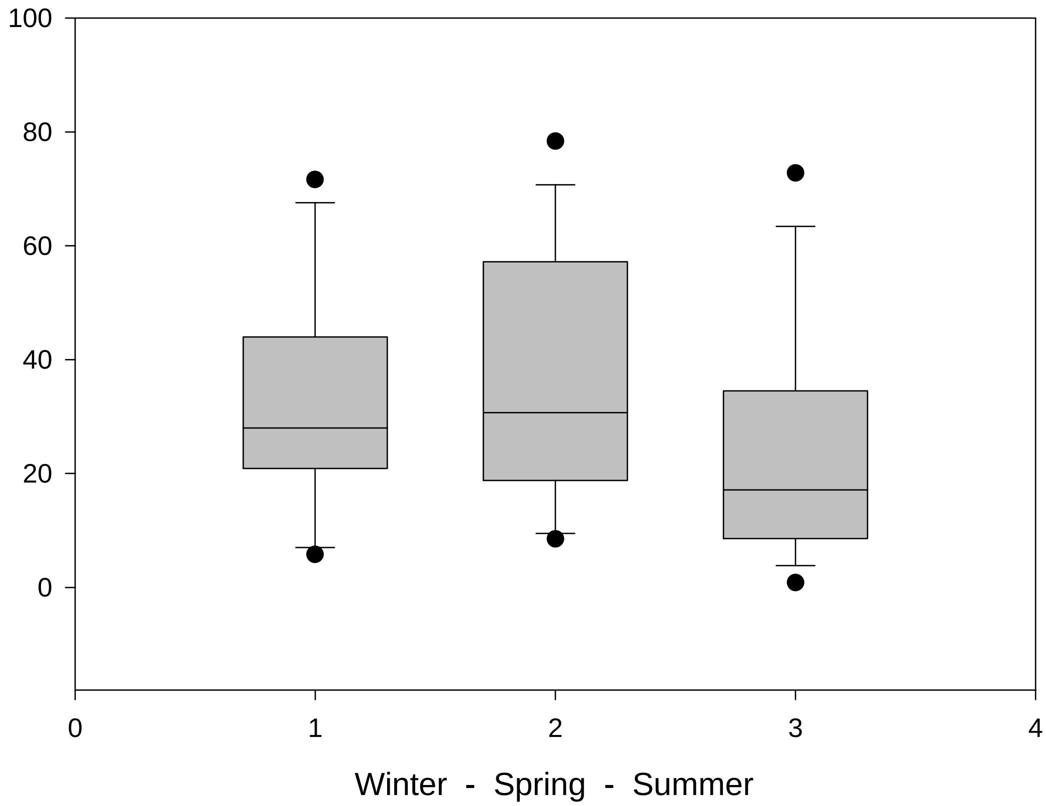
Graph 27. EPT Taxa (Nutrient/Sediment)



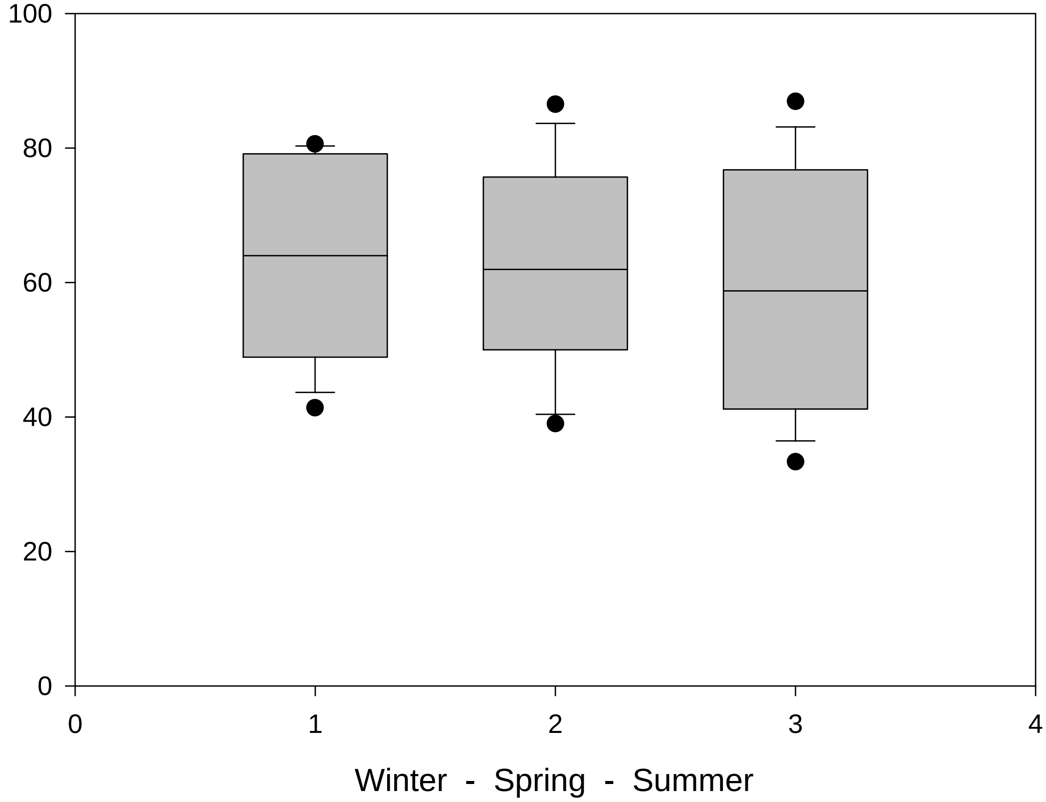
Graph 28. EPT % (Nutrient/Sediment)



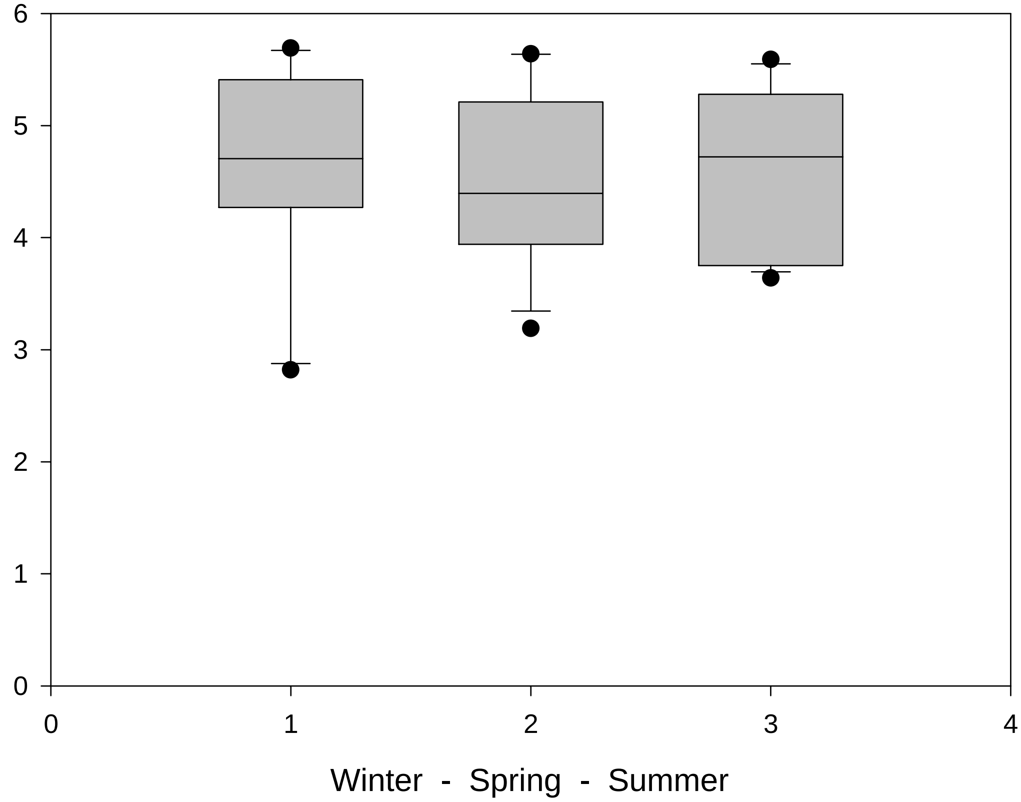
Graph 29. Chironomidae % (Nutrient/Sediment)



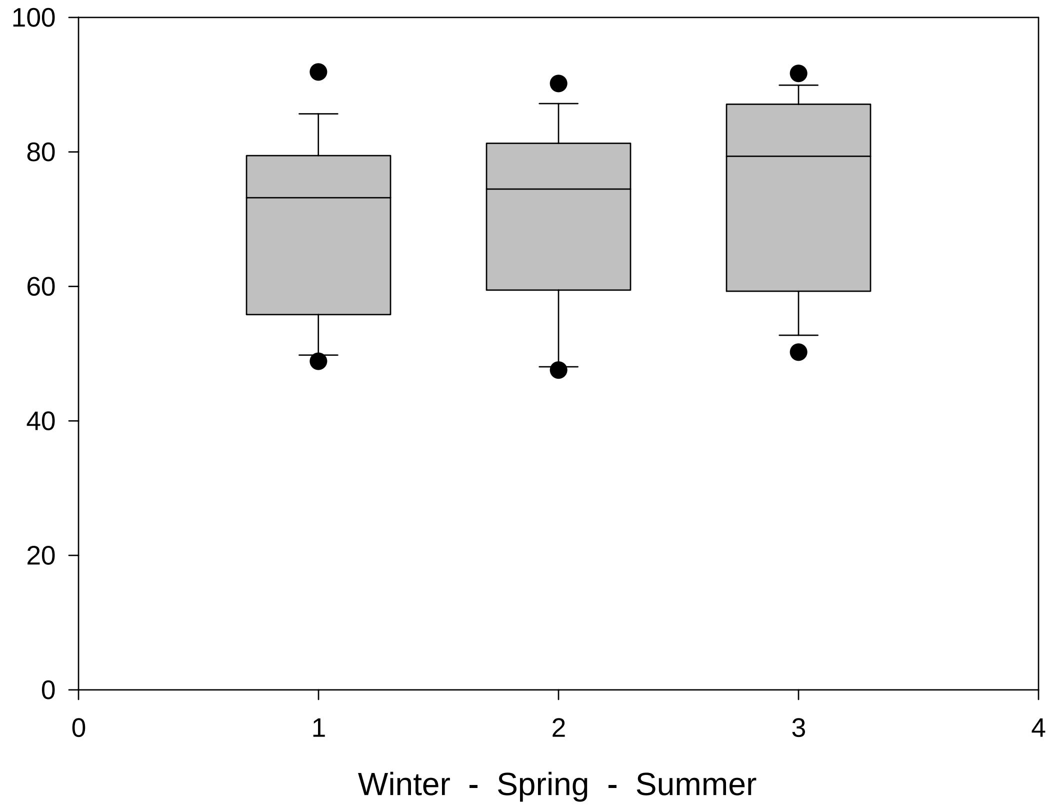
Graph 30. % Dom 2 Taxa (Nutrient/Sediment)



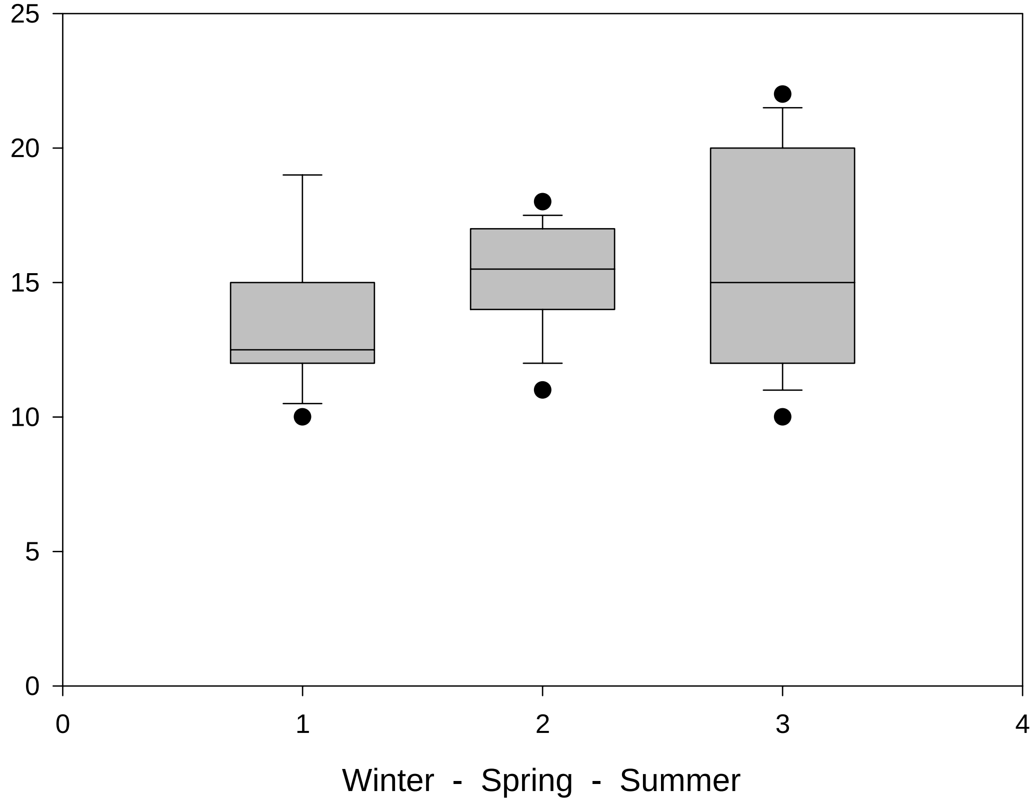
Graph 31. Hilsenhoff Biotic Index (Nutrient/Sediment)



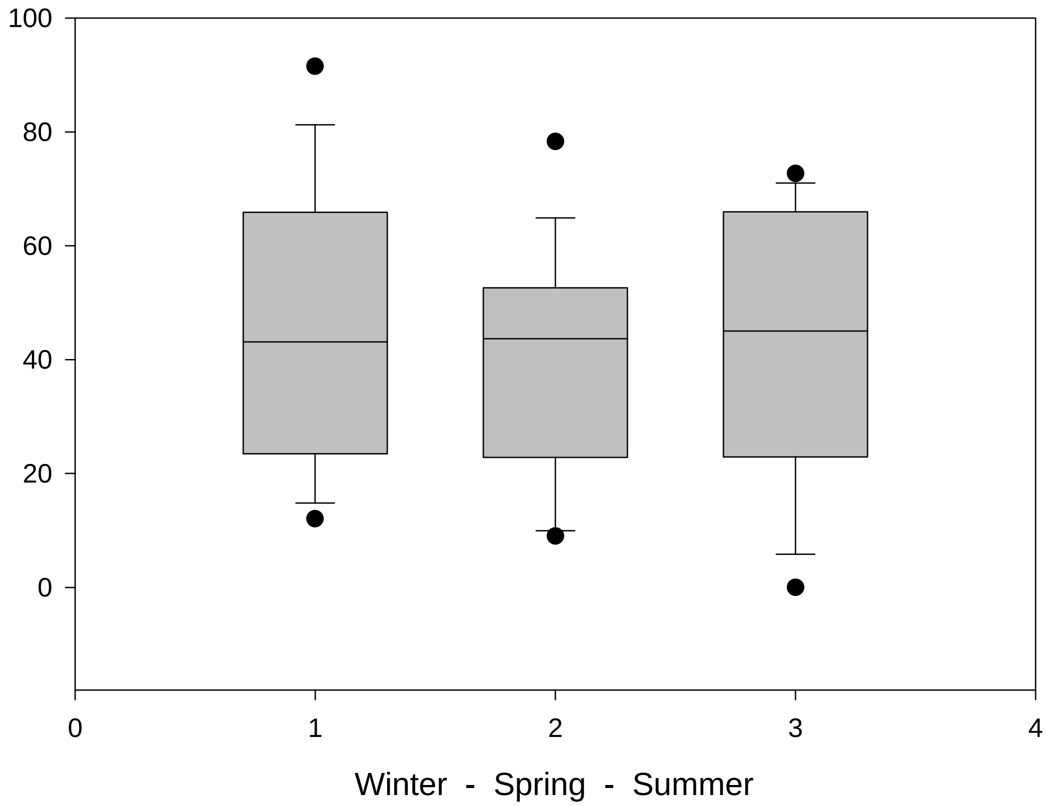
Graph 32. WVSCI (Nutrients/Sediment)



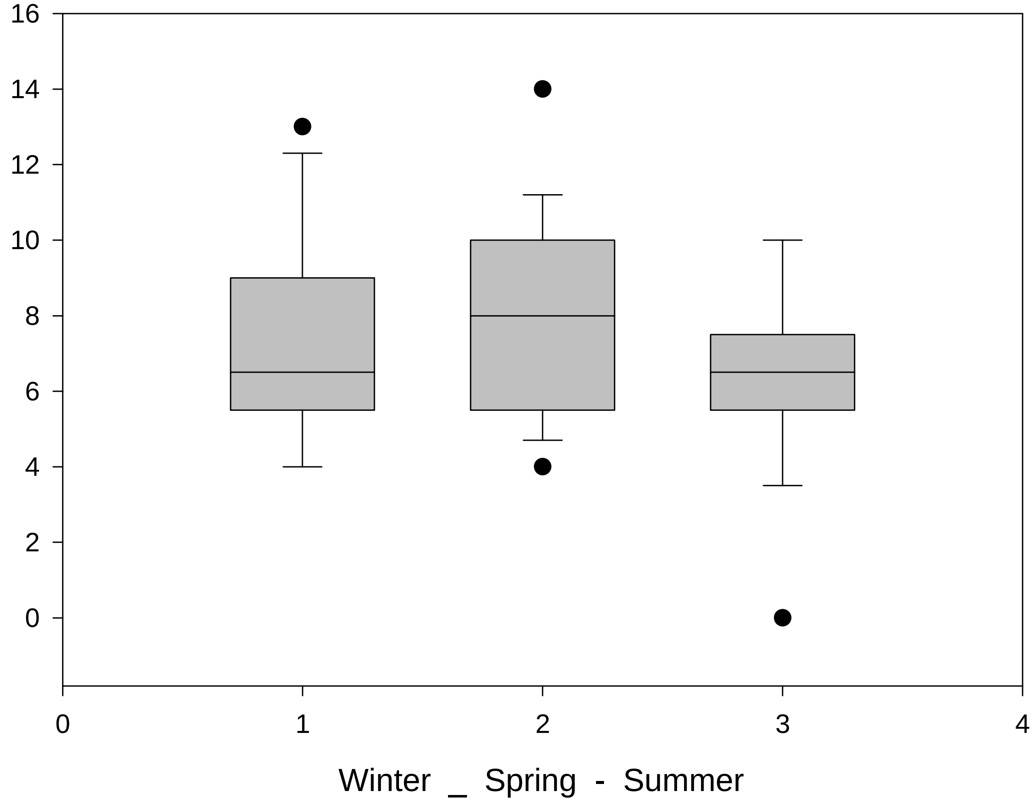
Graph 33. Total Taxa (Nutrient/Sediment)



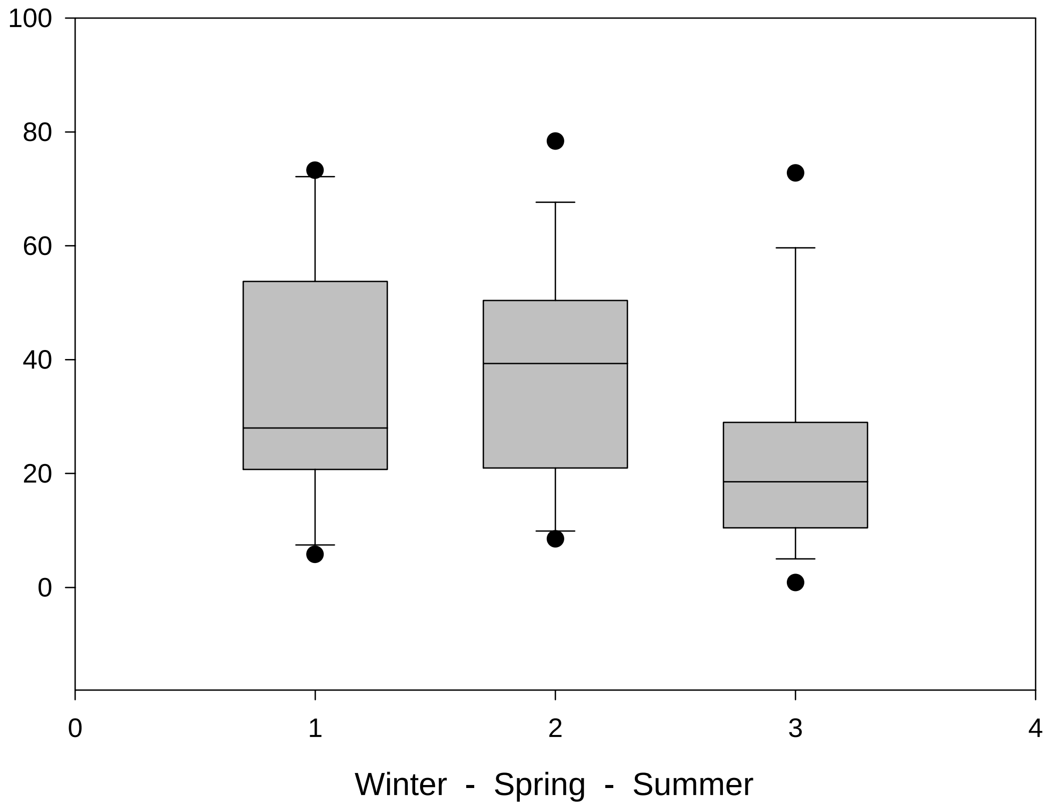
Graph 34. EPT % (All Impacts)



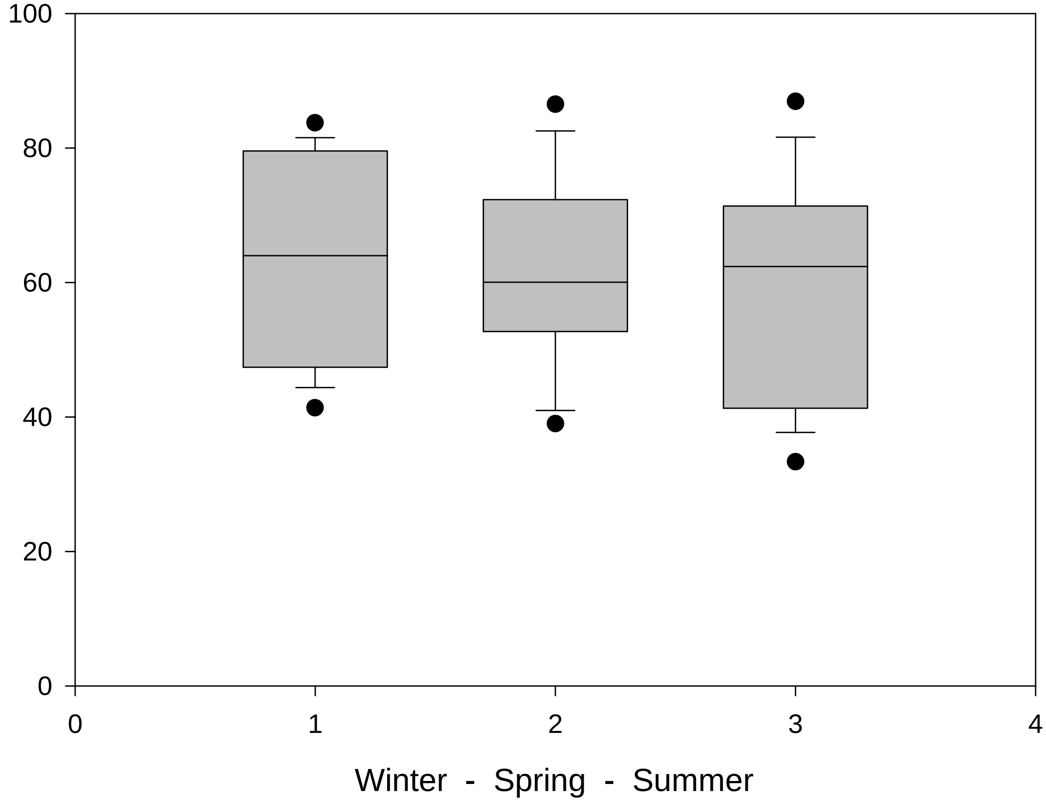
Graph 35. EPT Taxa (All Impacts)



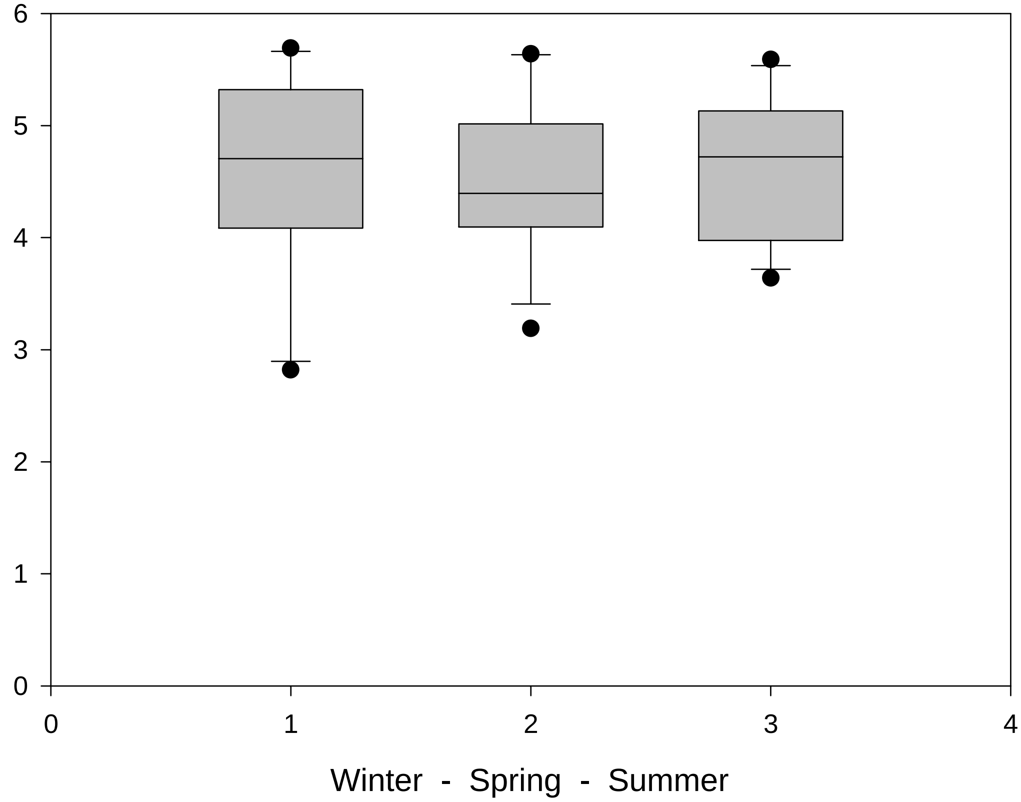
Graph 36. Chironomidae % (All Impacts)



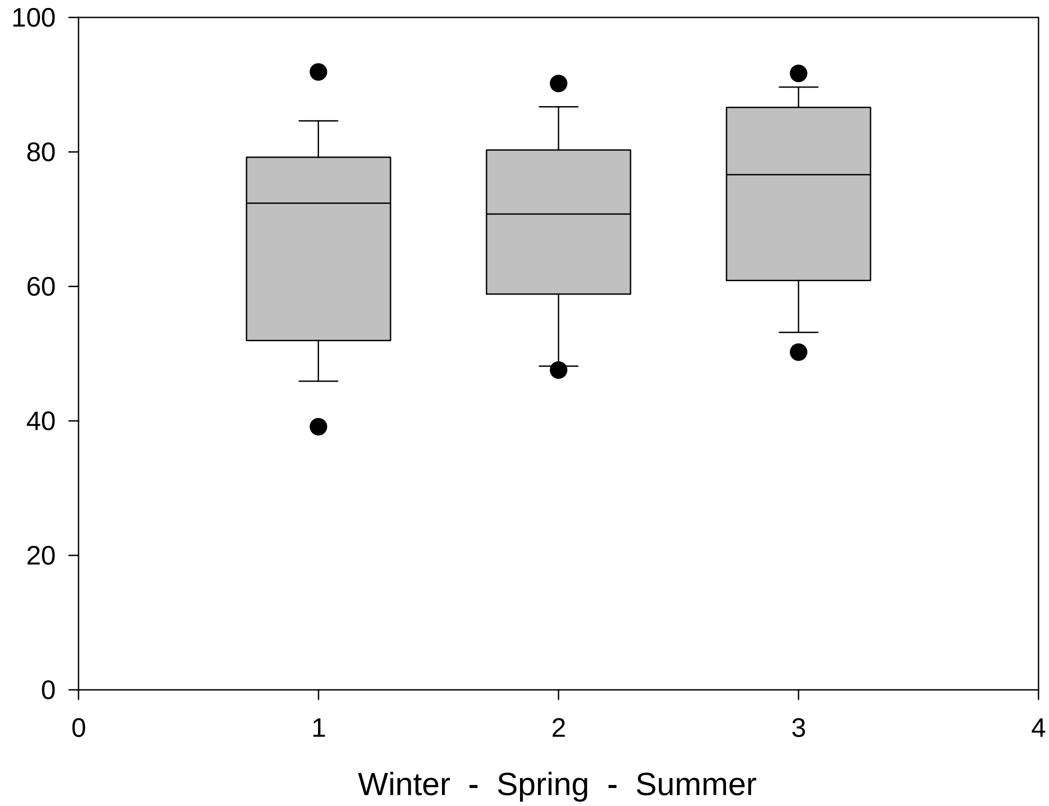
Graph 37. %Dom2Taxa (All Impacts)



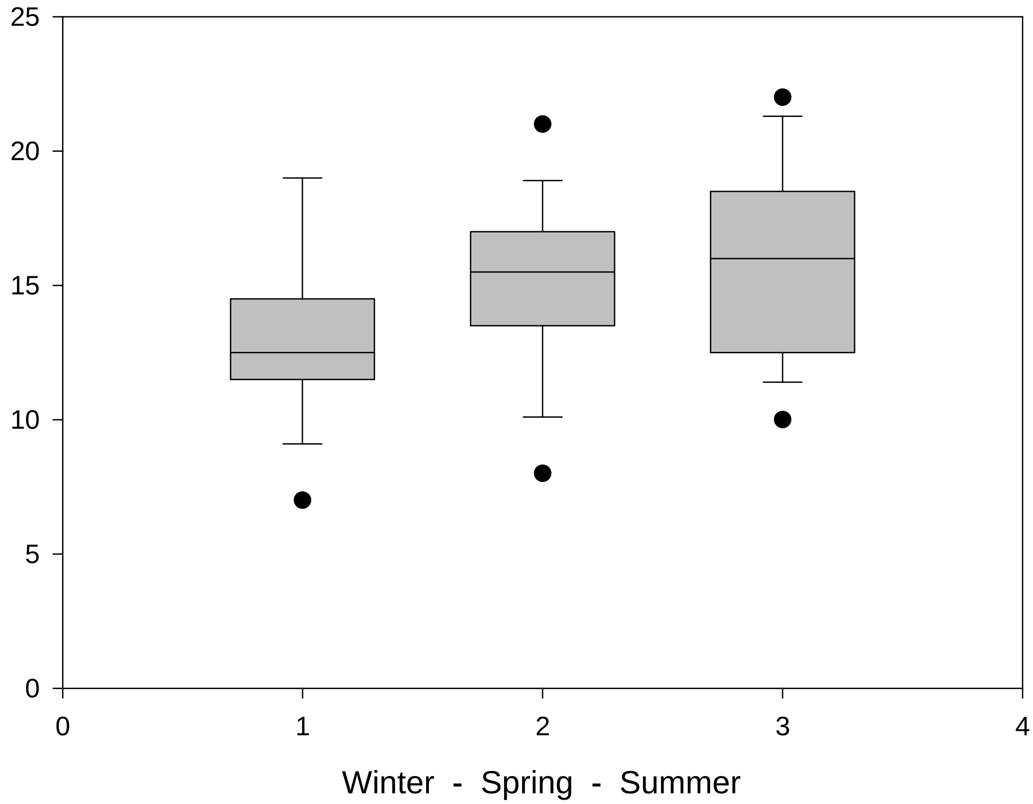
Graph 38. Hilsenhoff Biotic Index (All Impacts)



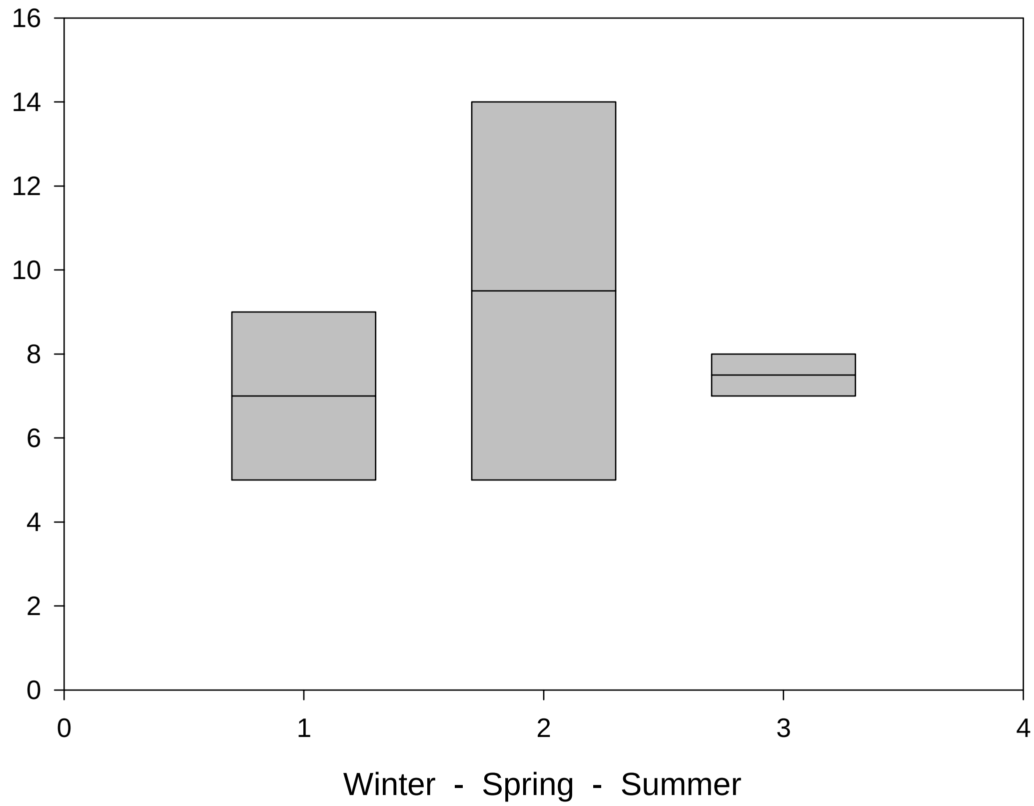
Graph 39. WVSCI (All Impacts)



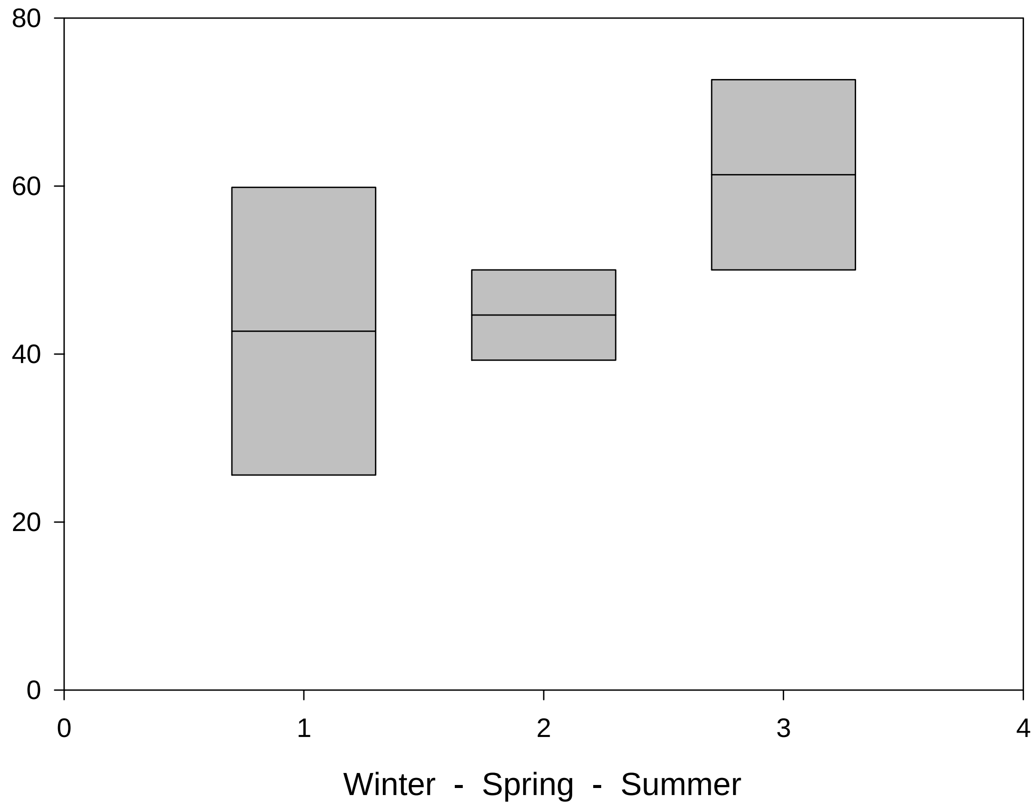
Graph 40. Total Taxa (All Impacts)



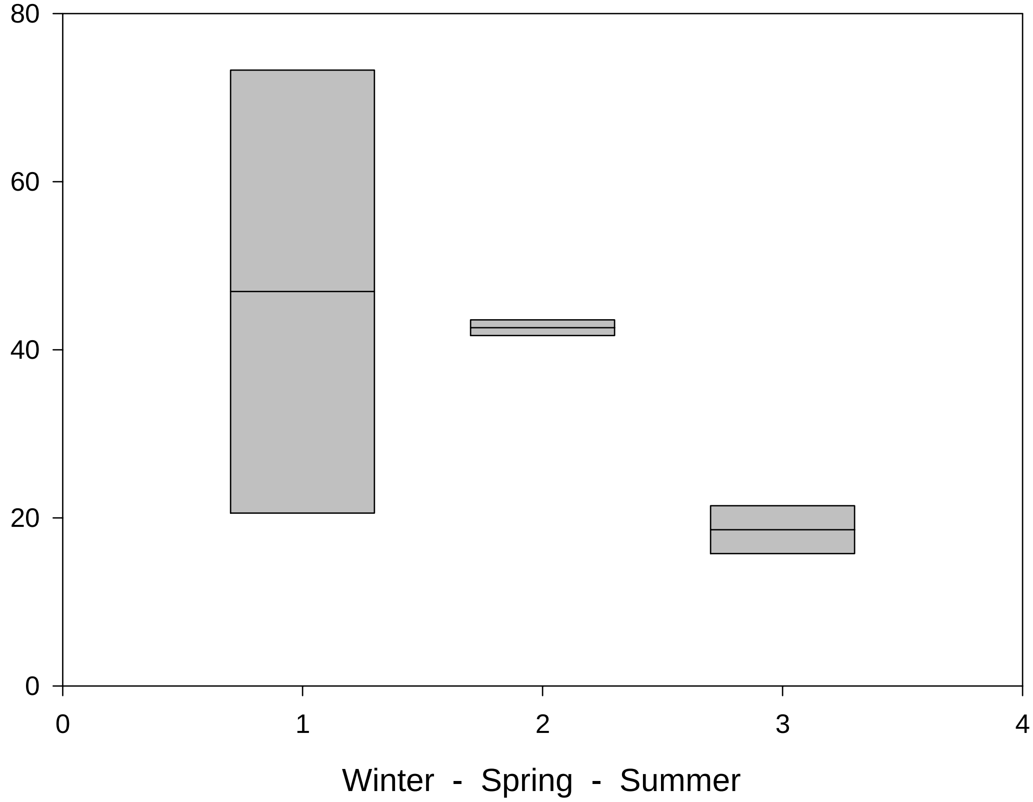
Graph 41. EPT Taxa (AMD)



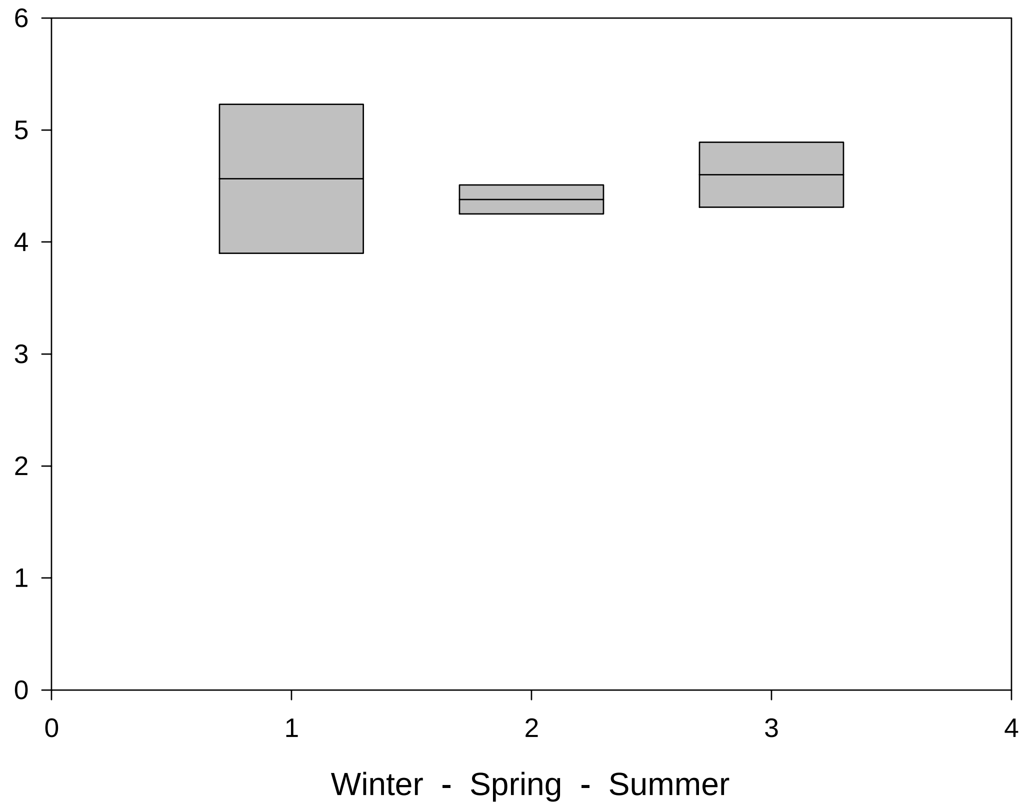
Graph 42. EPT% (AMD)



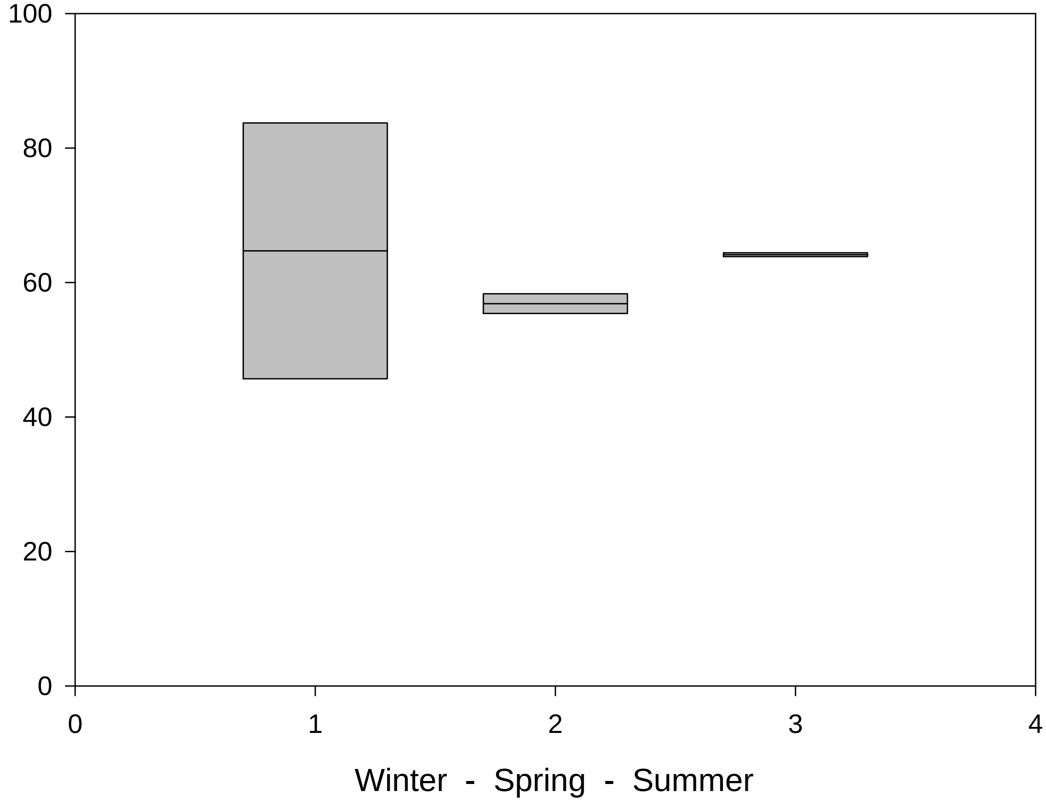
Graph 43. Chironomidae% (AMD)



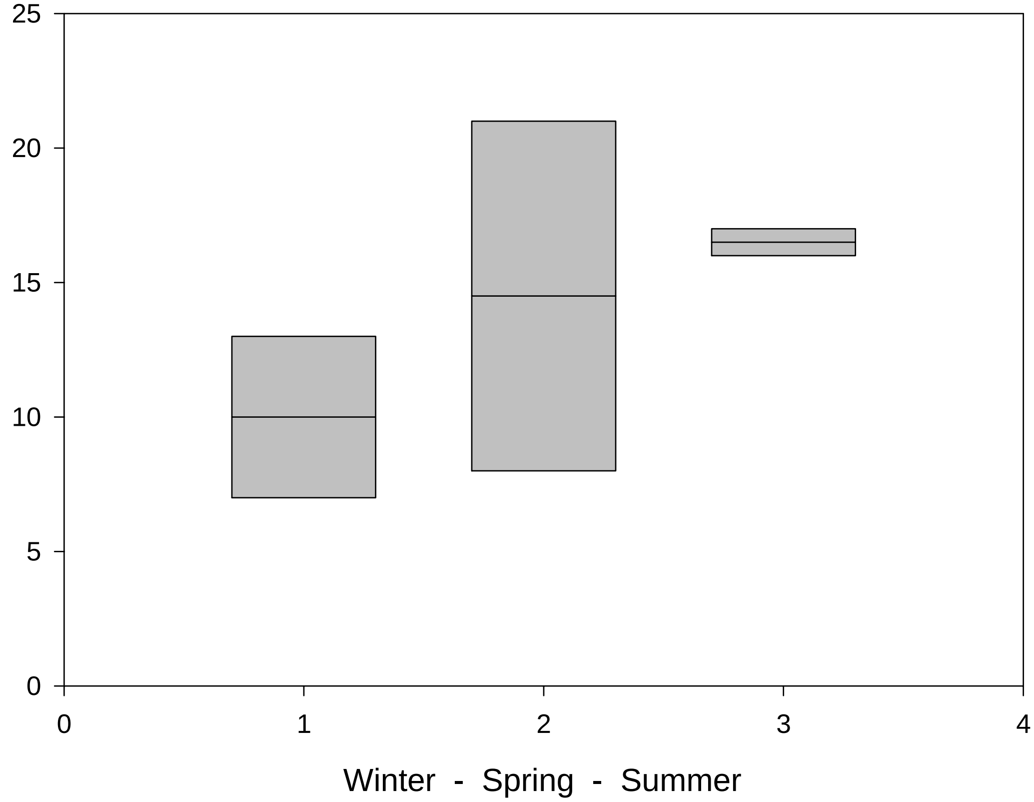
Graph 44. Hilsenhoff Biotic Index (AMD)



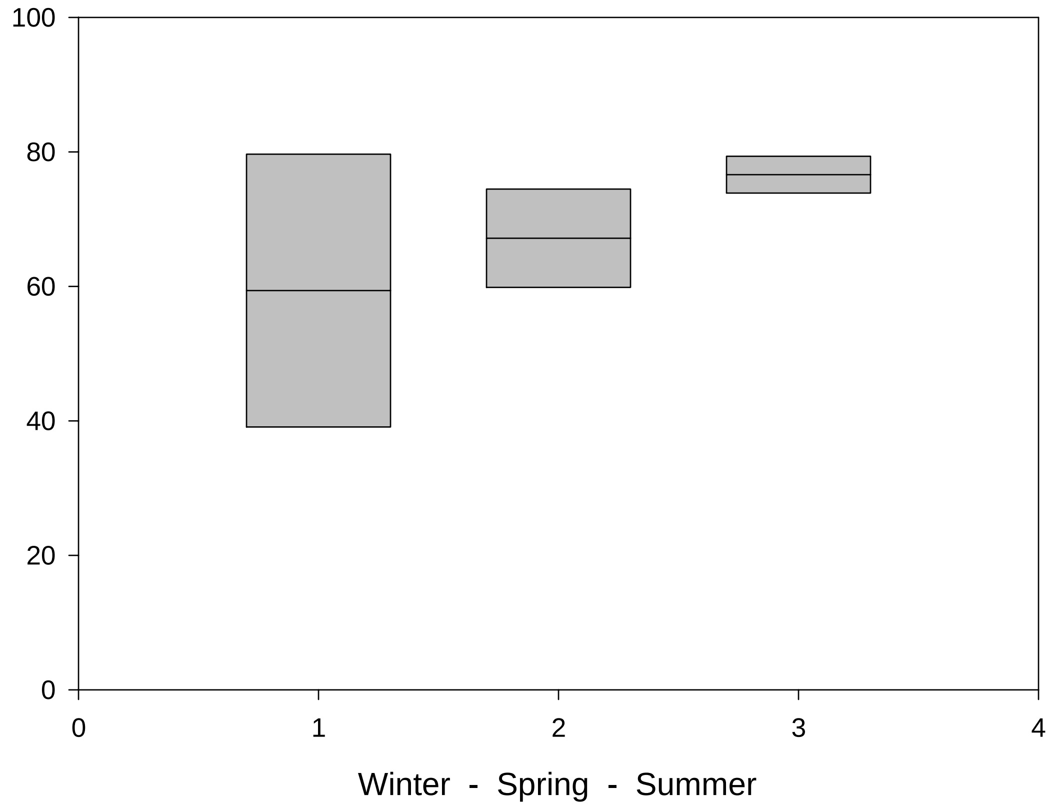
Graph 45. %Dom2Taxa (AMD)



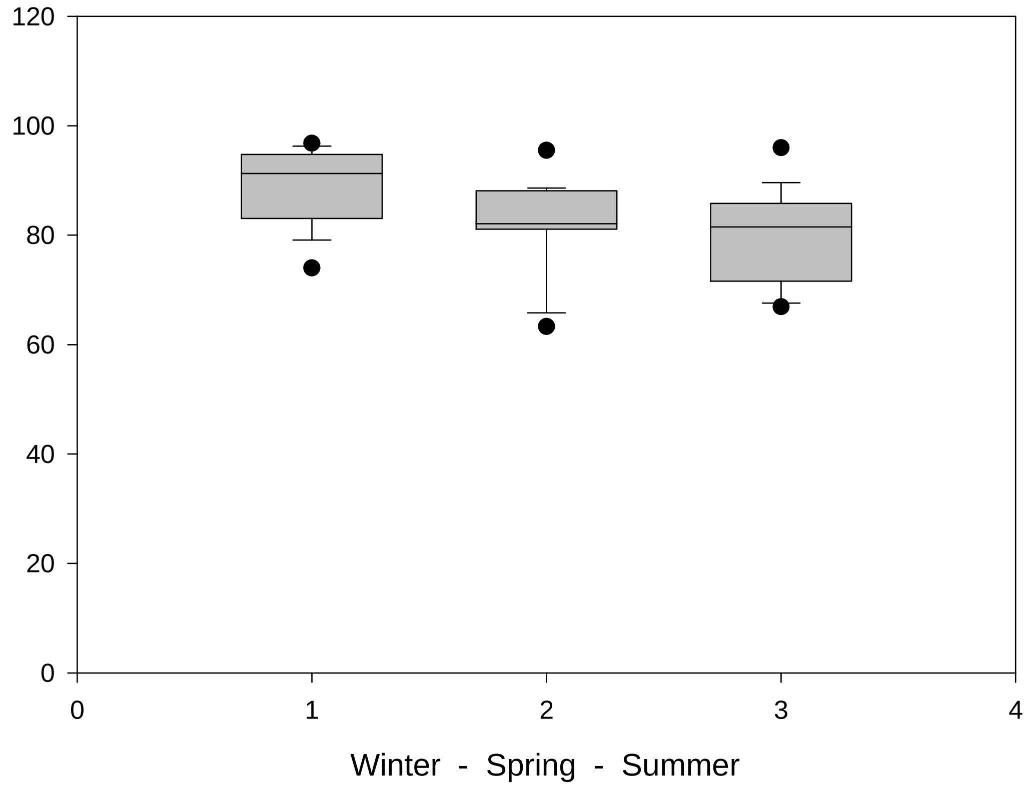
Graph 46. Total Taxa (AMD)



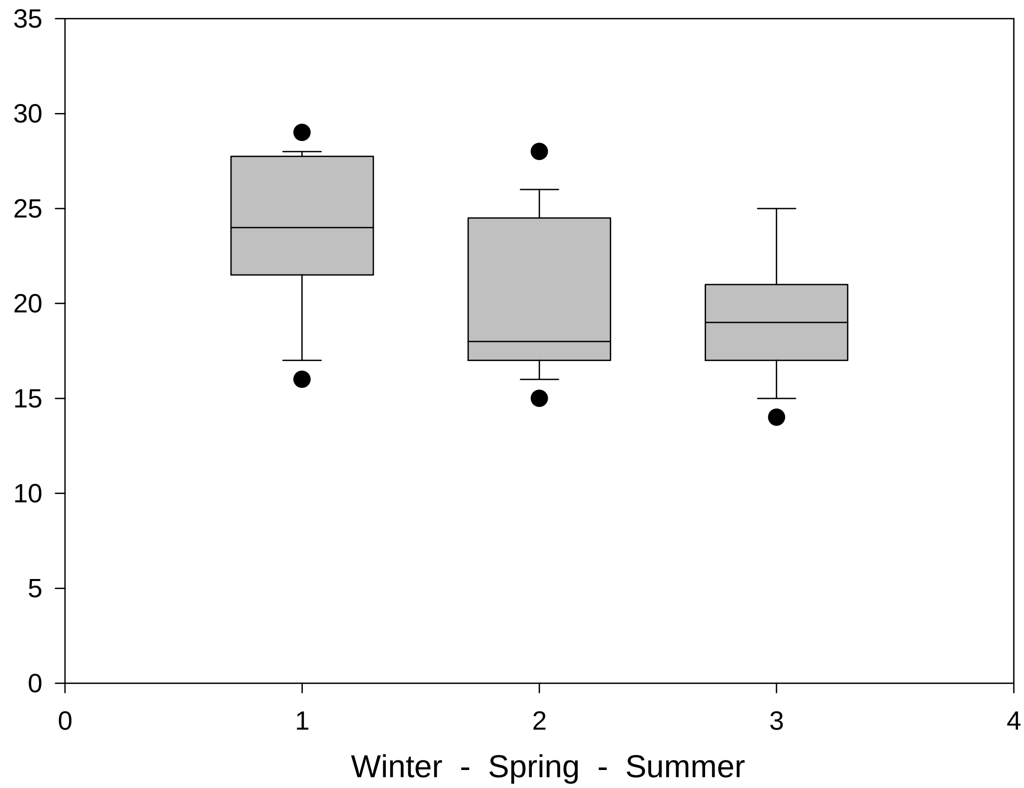
Graph 47. WVSCI (AMD)



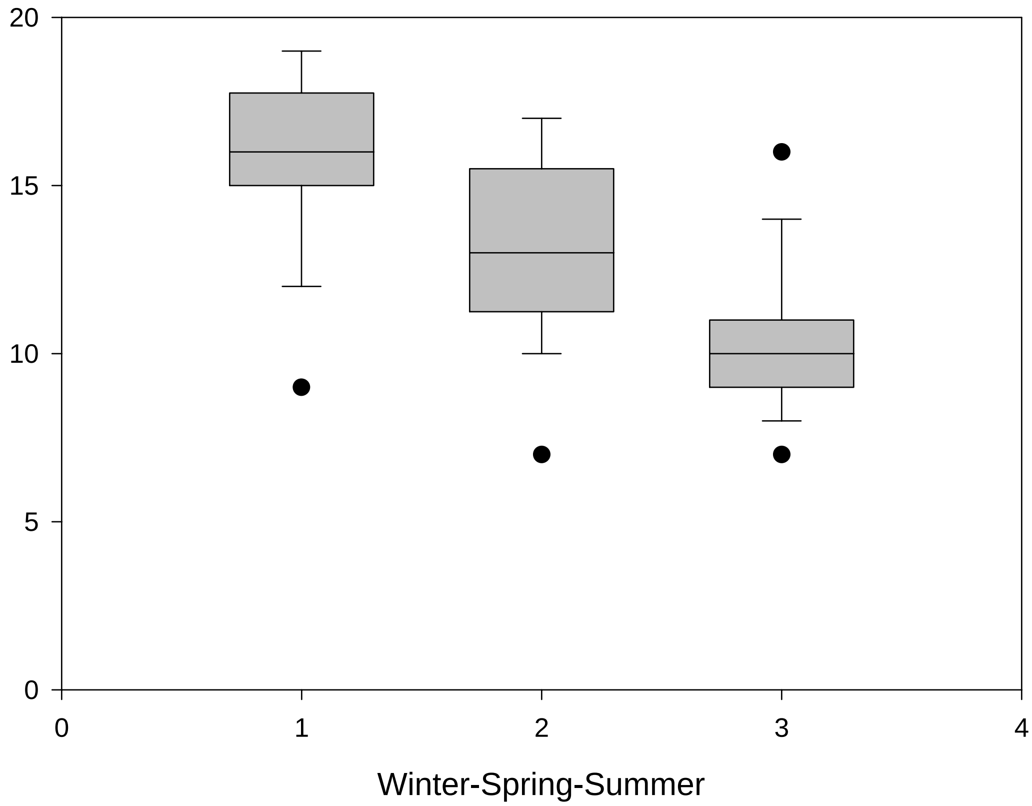
Graph 48. WVSCI (WVDEP Reference)



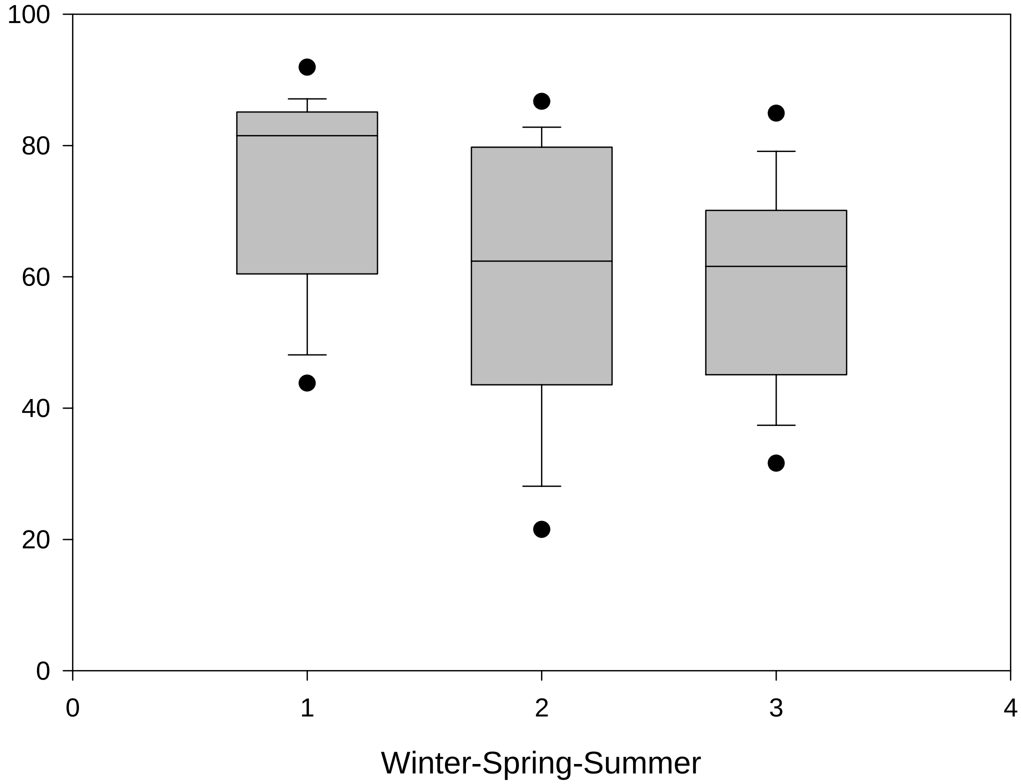
Graph 49. Total Taxa (WVDEP Reference)



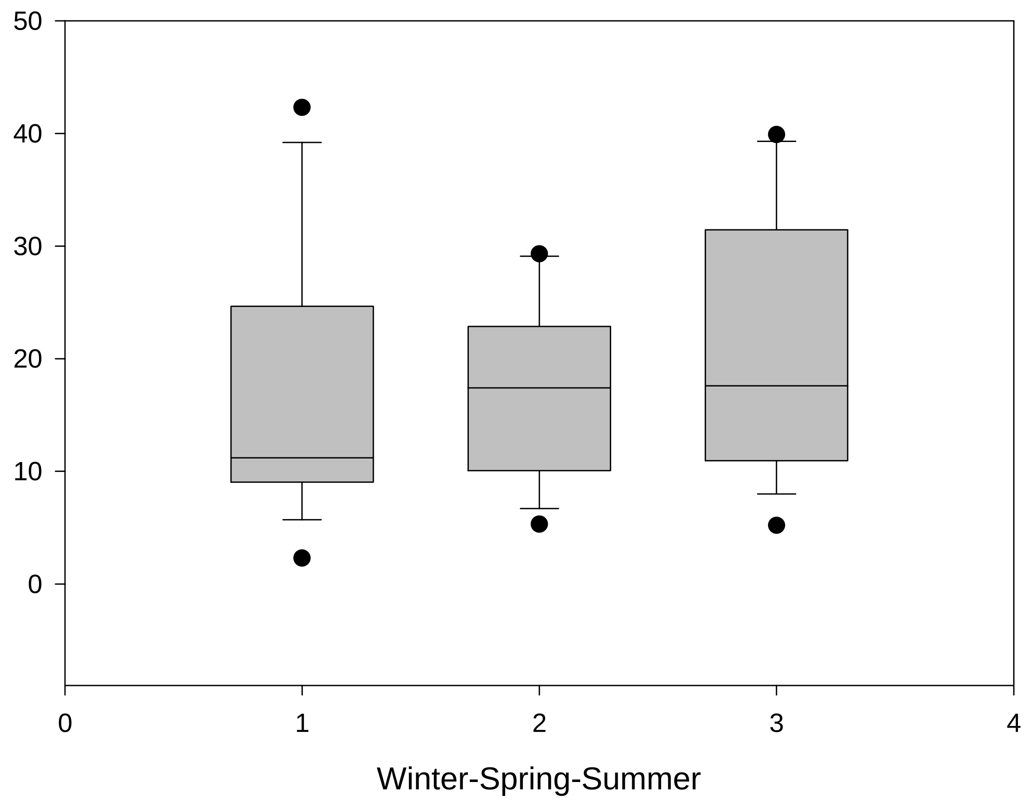
Graph 50. EPT Taxa (WVDEP Reference)



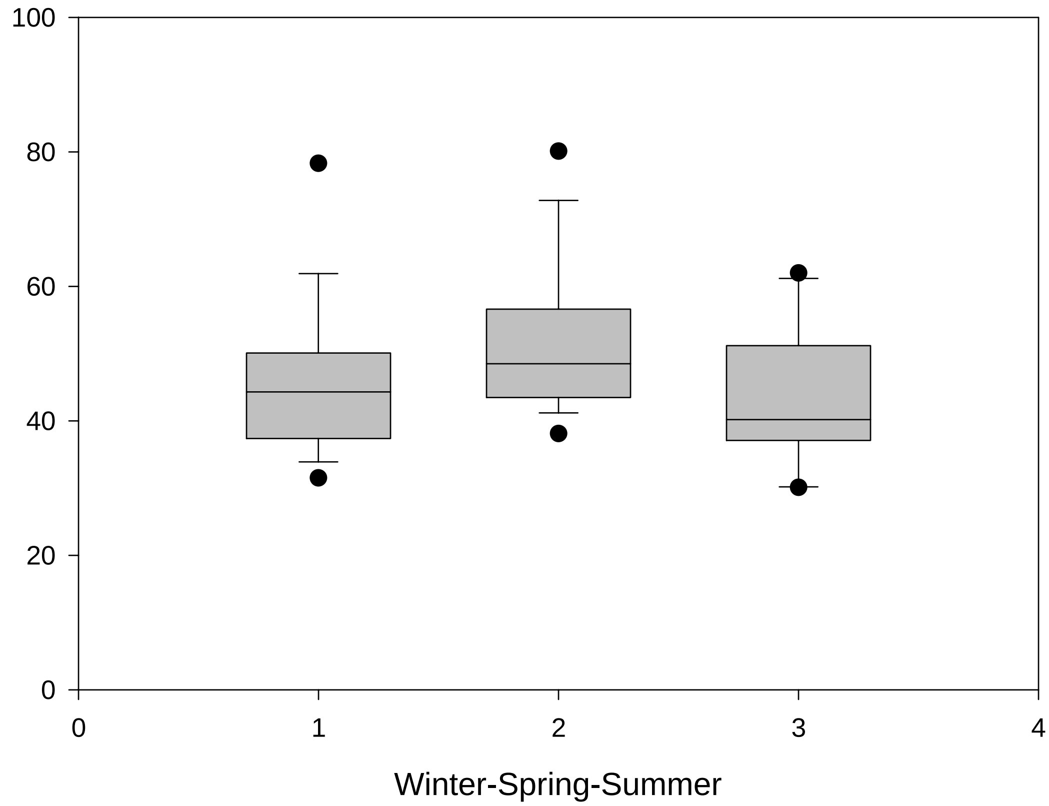
Graph 51. EPT % (WVDEP Reference)



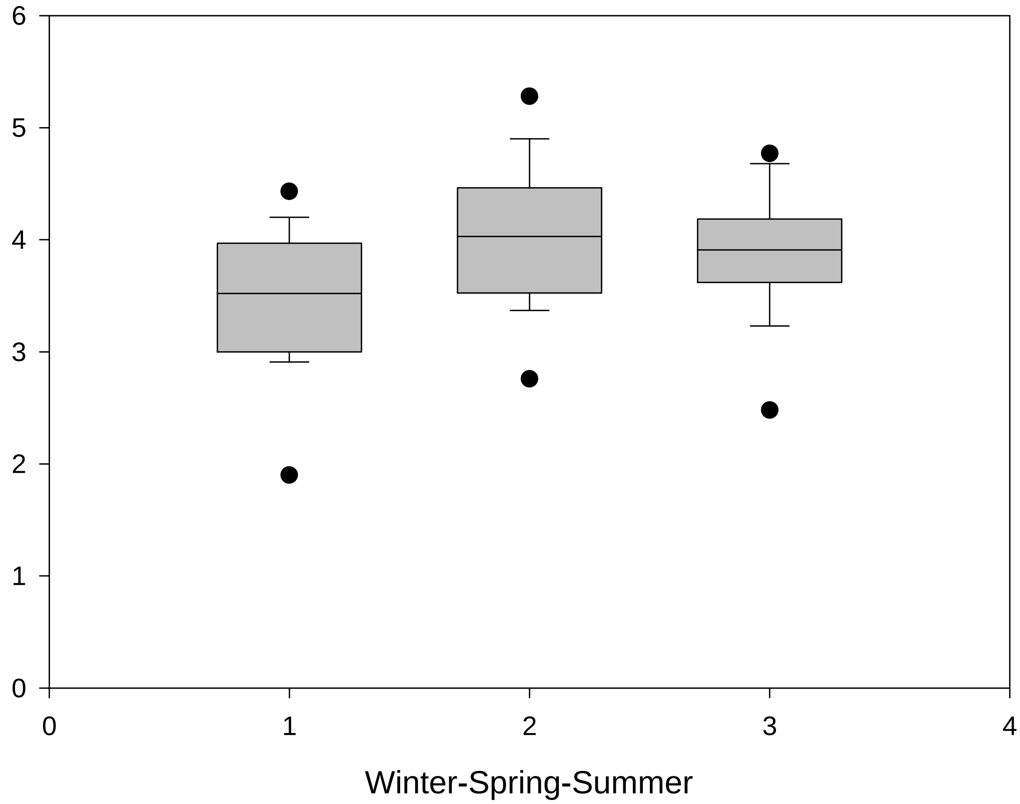
Graph 52. Chironomidae % (WVDEP Reference)



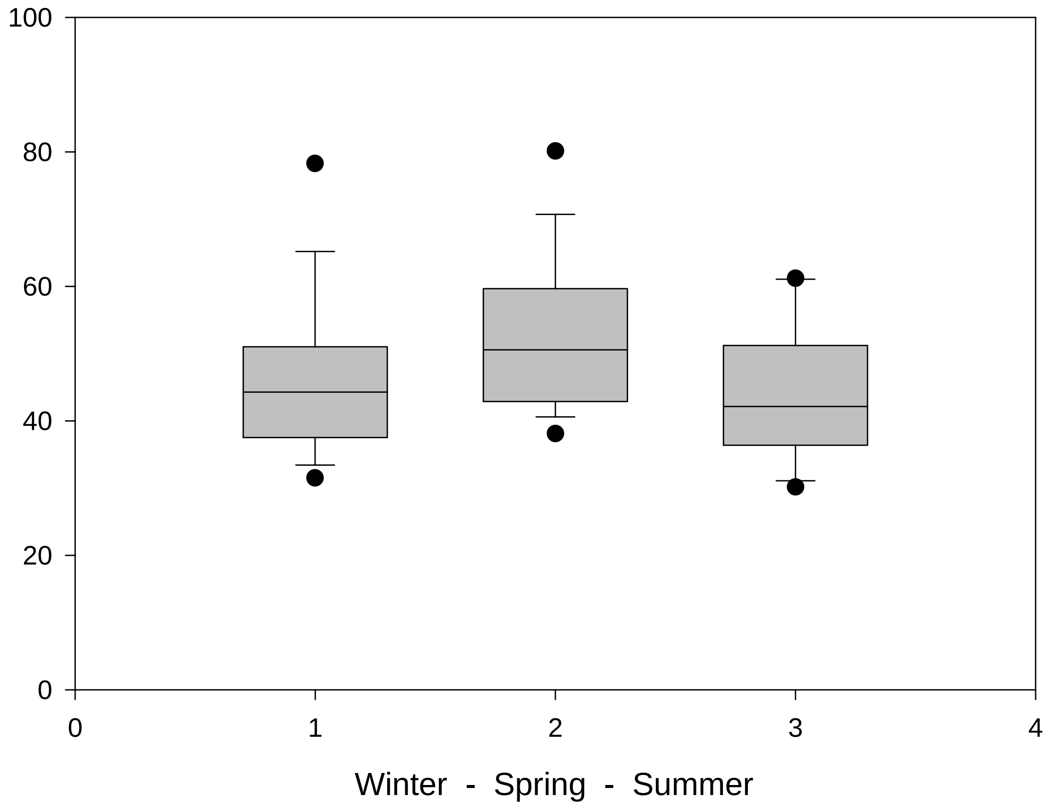
Graph 53. %Dominant 2 Taxa (WVDEP Reference)



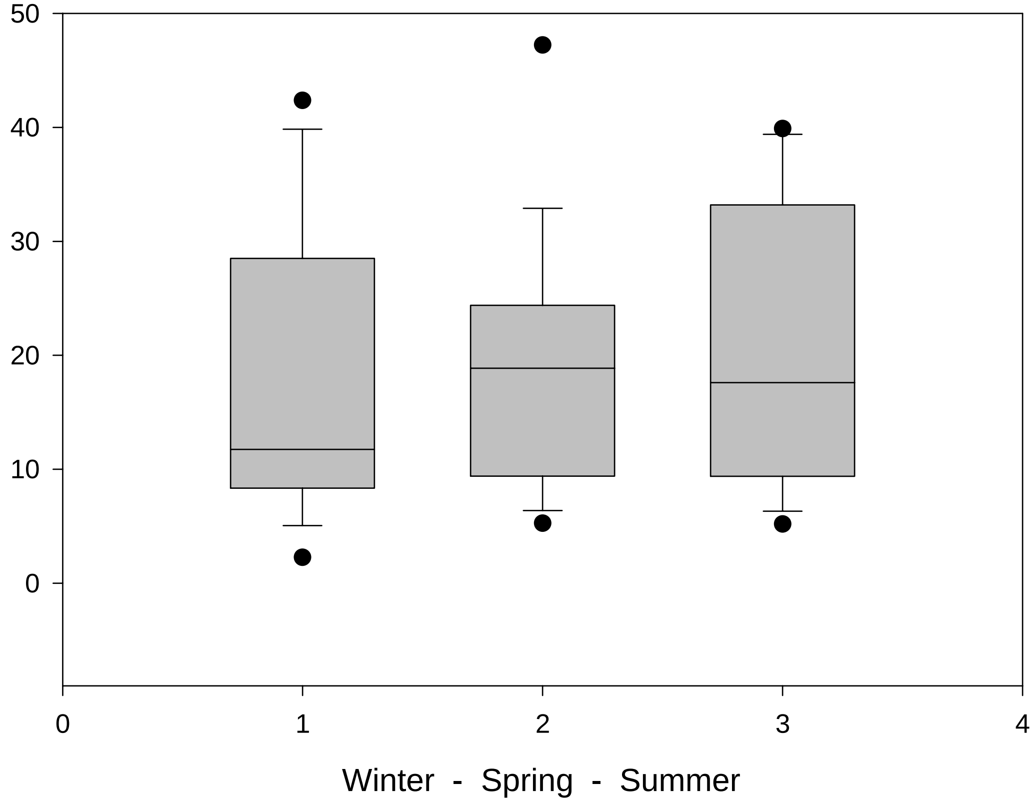
Graph 54. Hilsenhoff Biotic Index (WVDEP Reference)



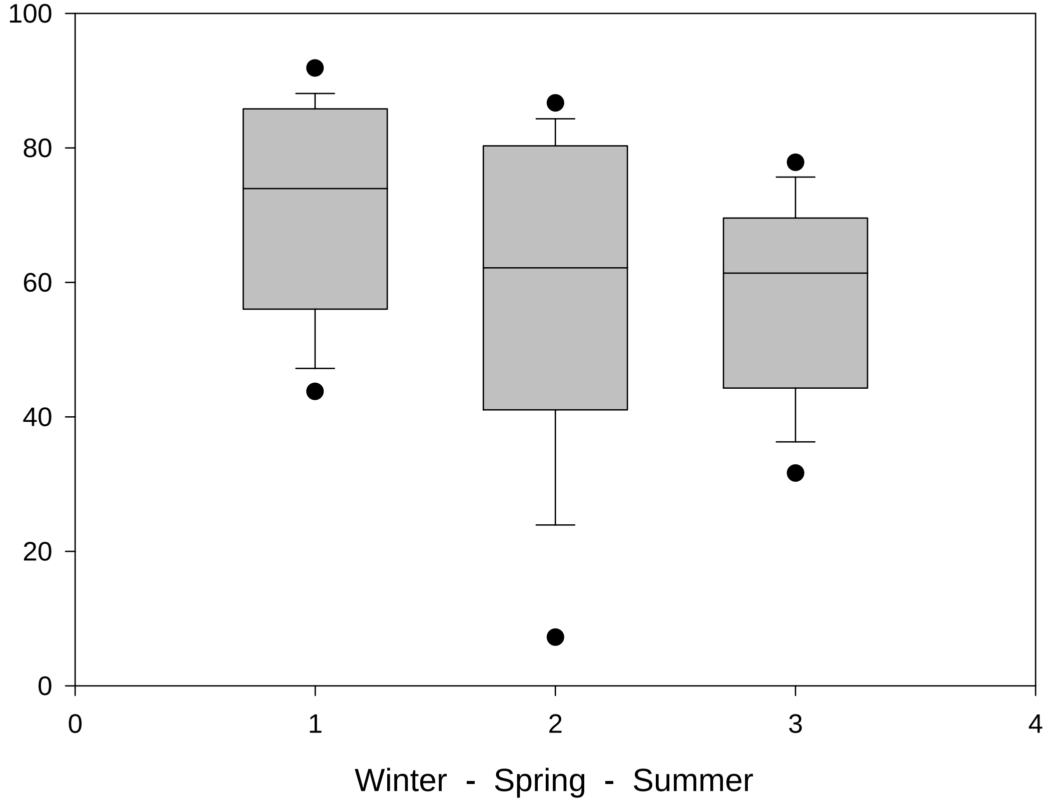
Graph 55. %Dominant 2 Taxa (WVDEP Repeat)



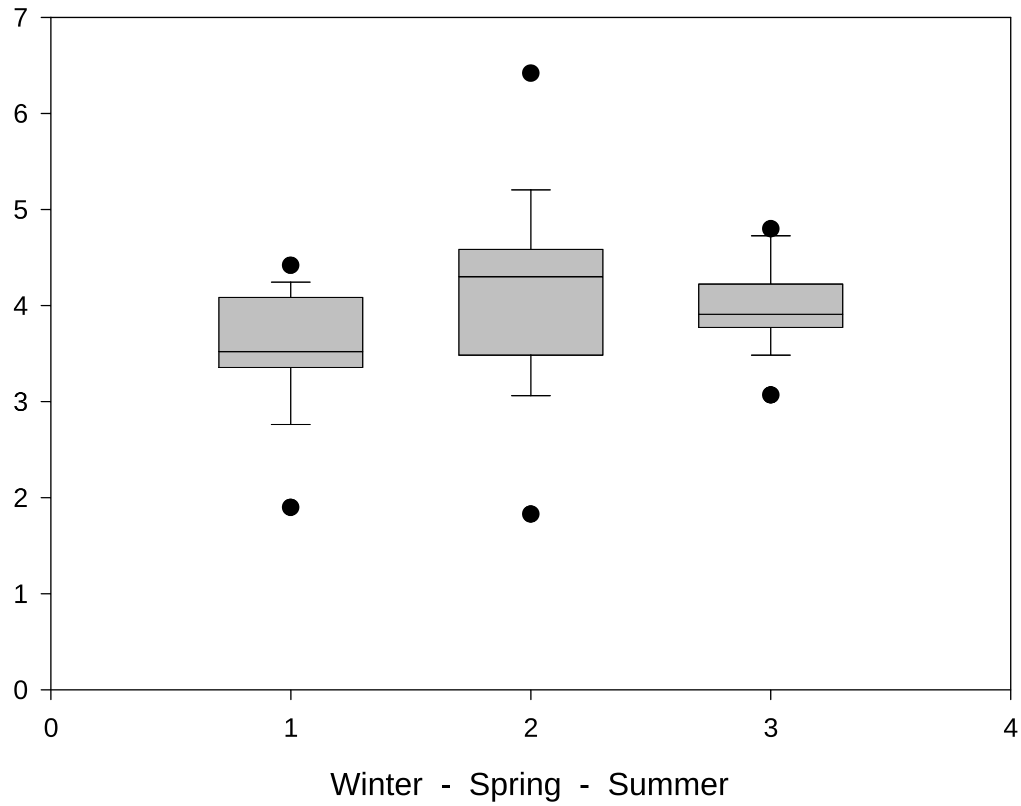
Graph 56. % Chironomidae (WVDEP Repeat)



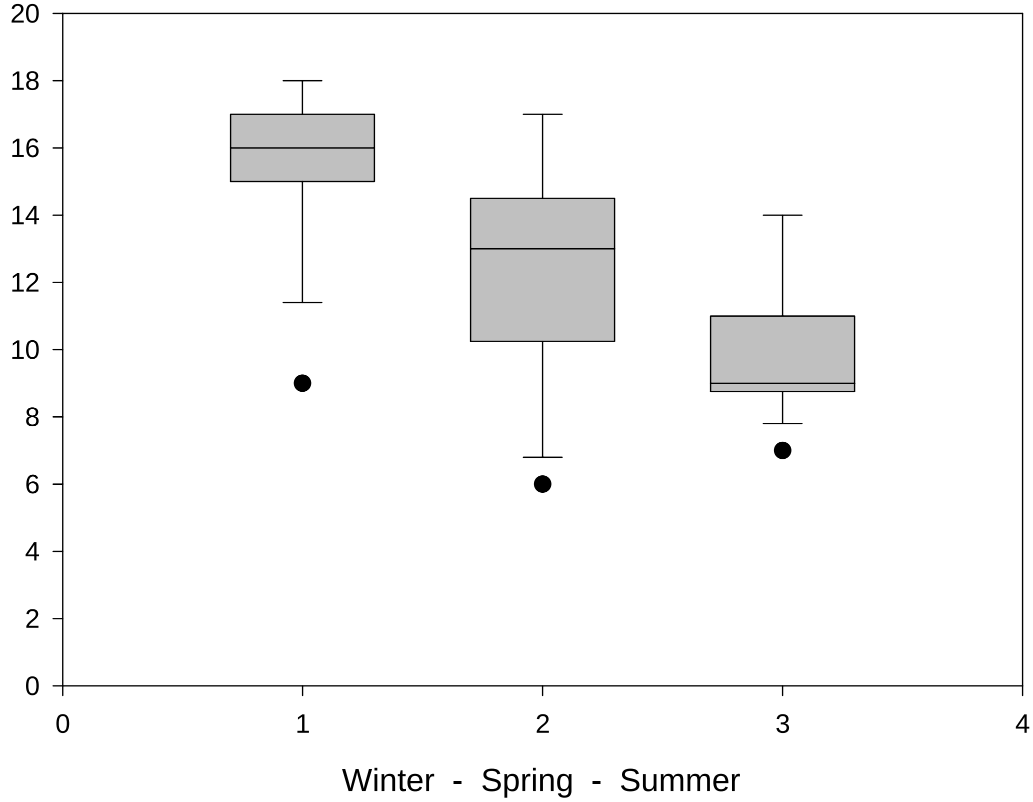
Graph 57. % EPT (WVDEP Repeat)



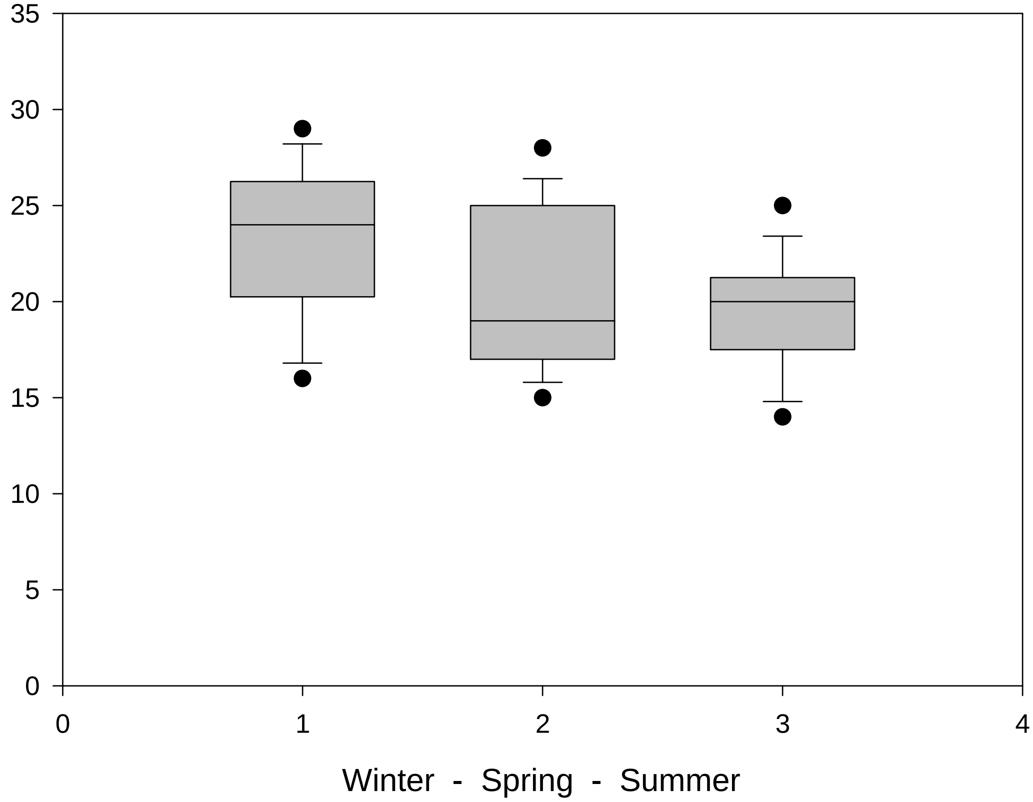
Graph 58. Hilsenhoff Biotic Index (WVDEP Repeat)



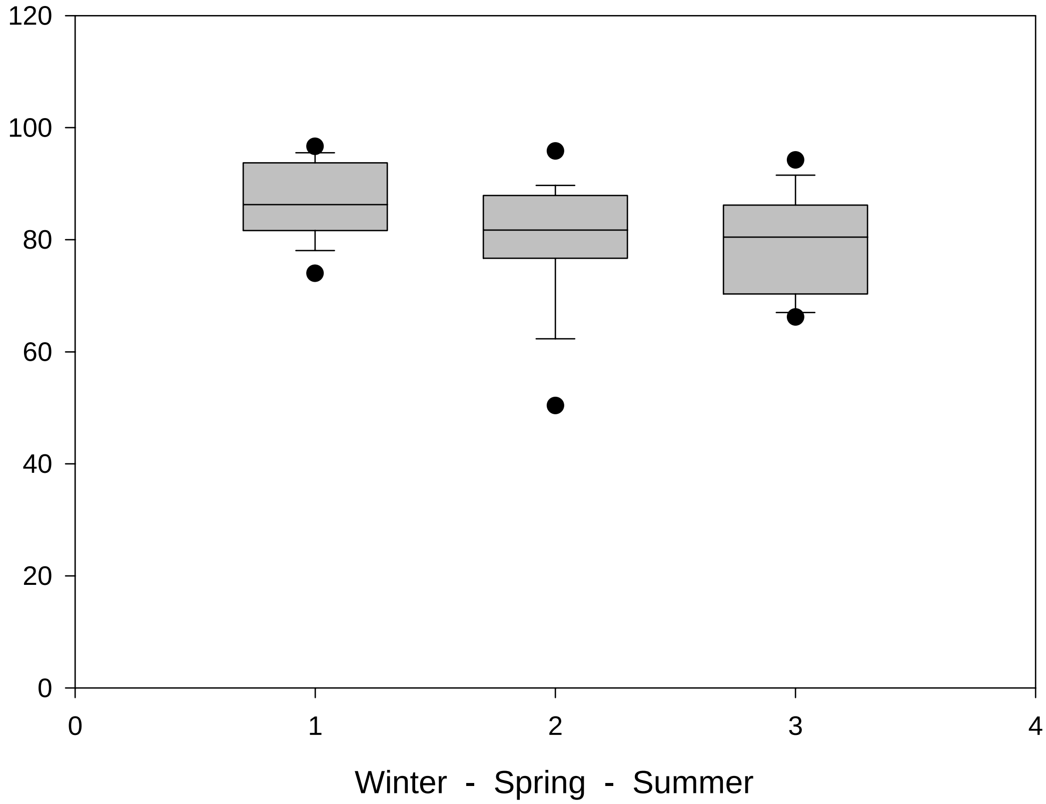
Graph 59. EPT Taxa (WVDEP Repeat)



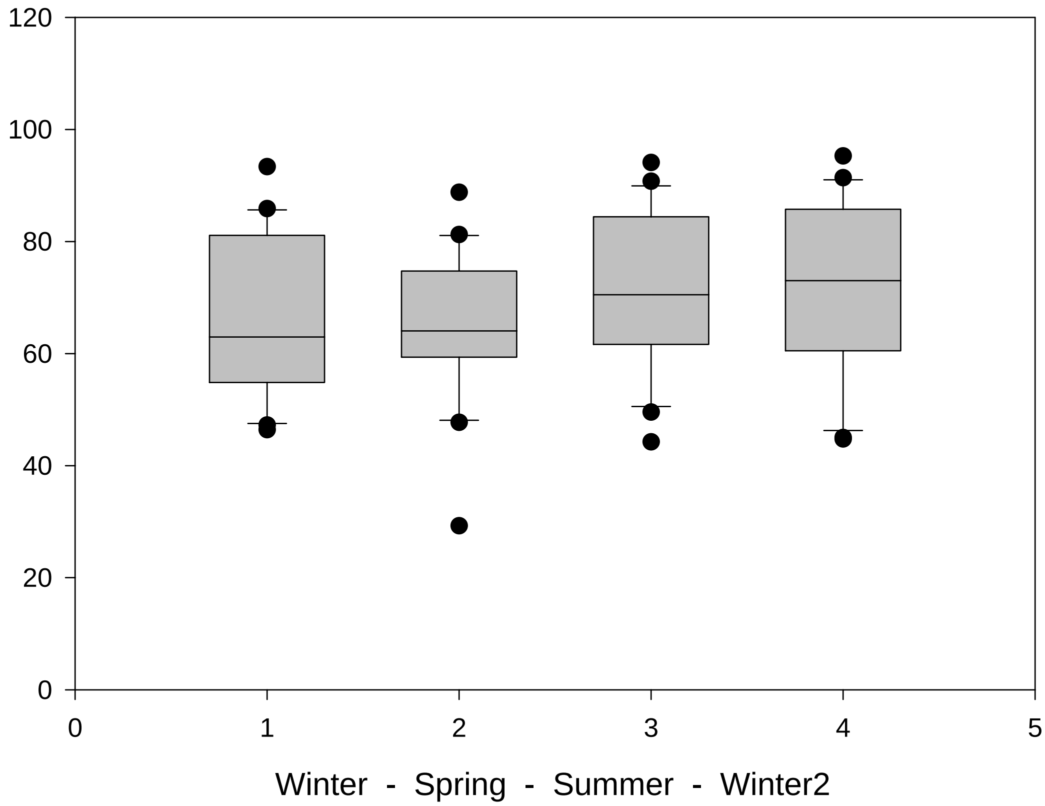
Graph 60. Total Taxa (WVDEP Repeat)



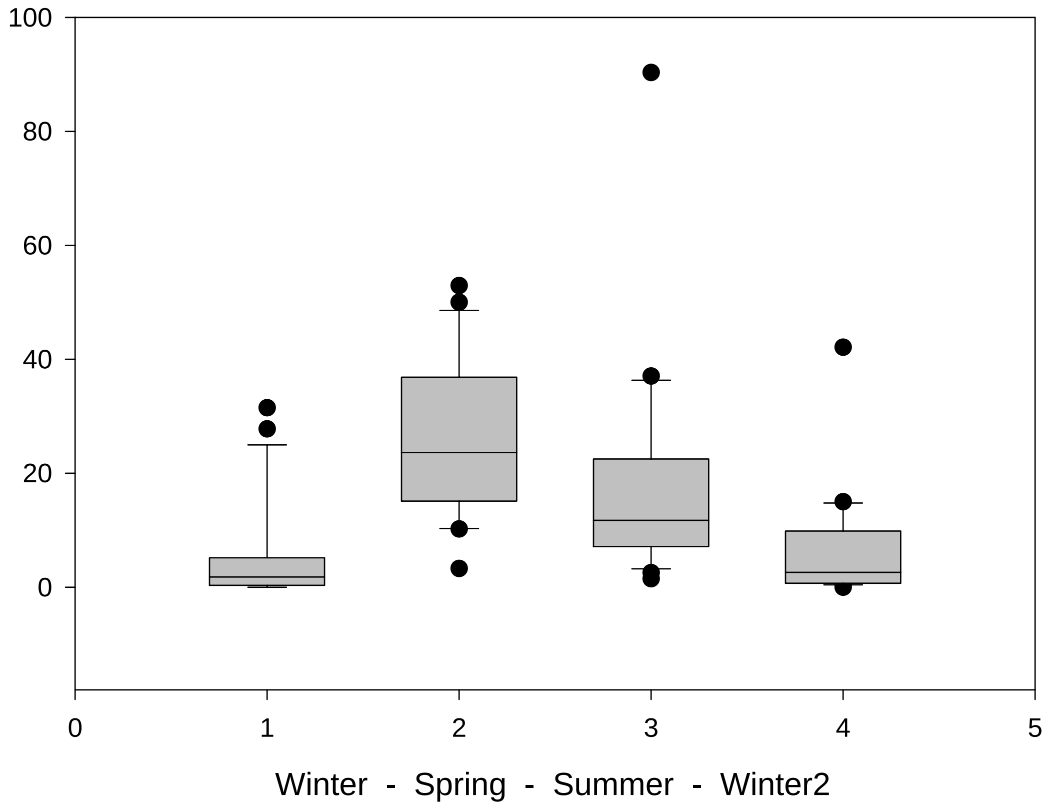
Graph 61. WVSCI (WVDEP Repeat)



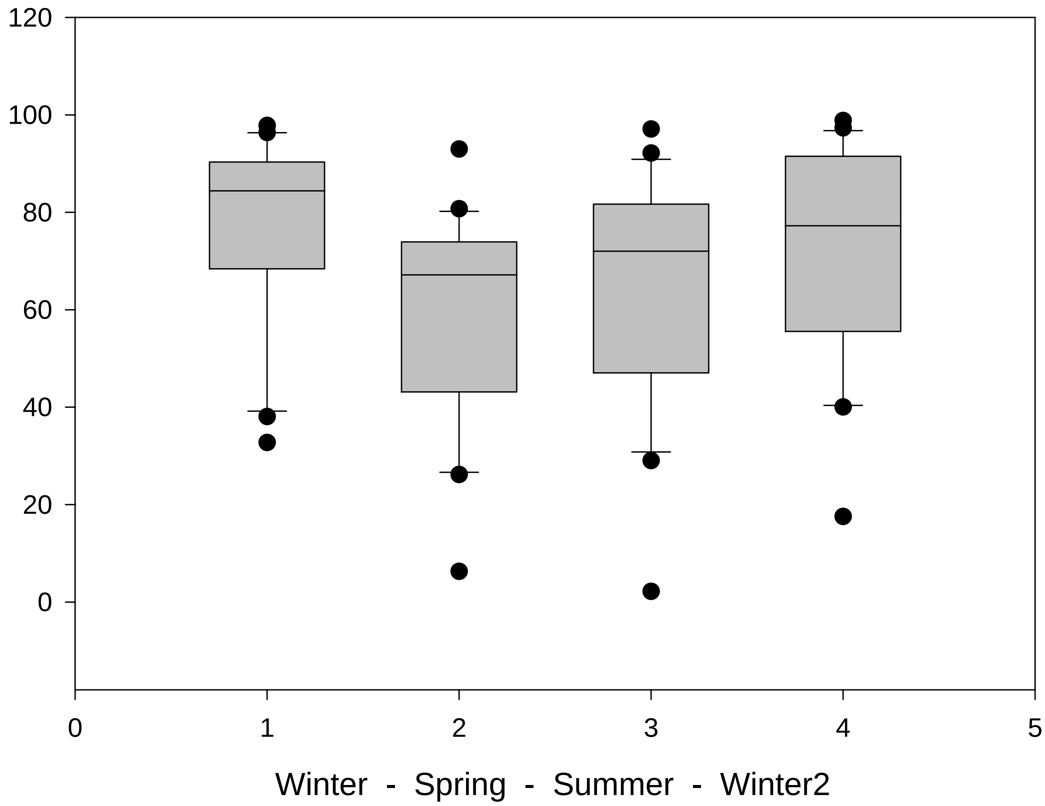
Graph 62. %Dominant 2 Taxa (Stony River)



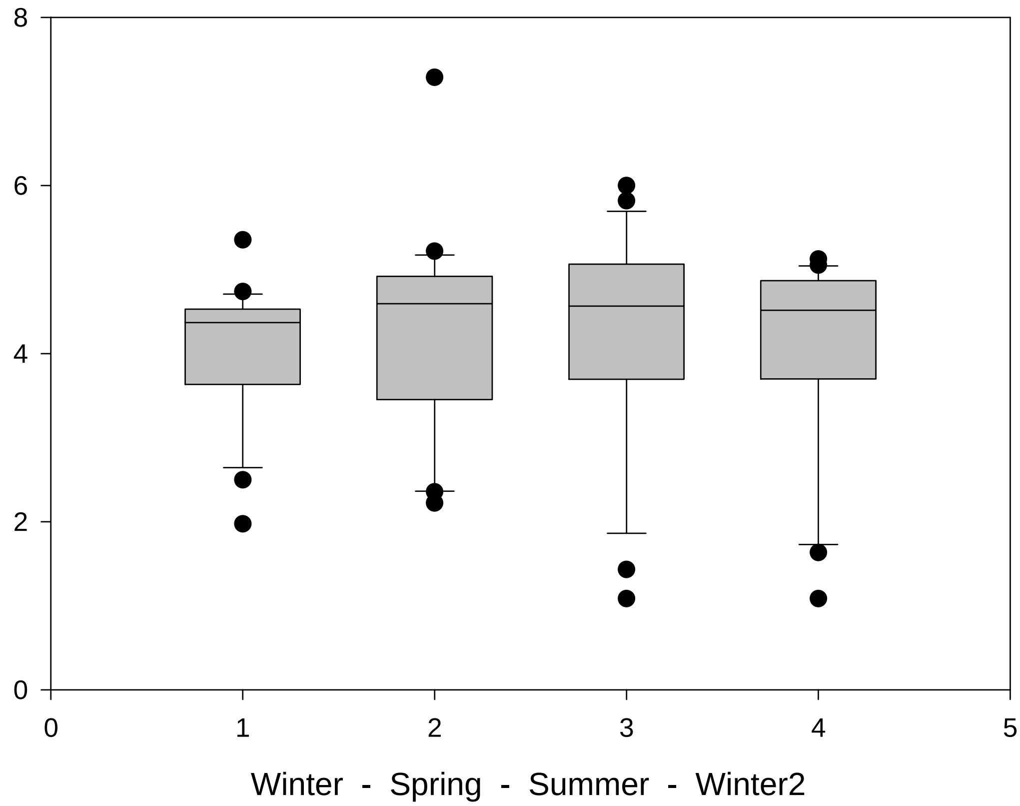
Graph 63. % Chironomidae (Stony River)



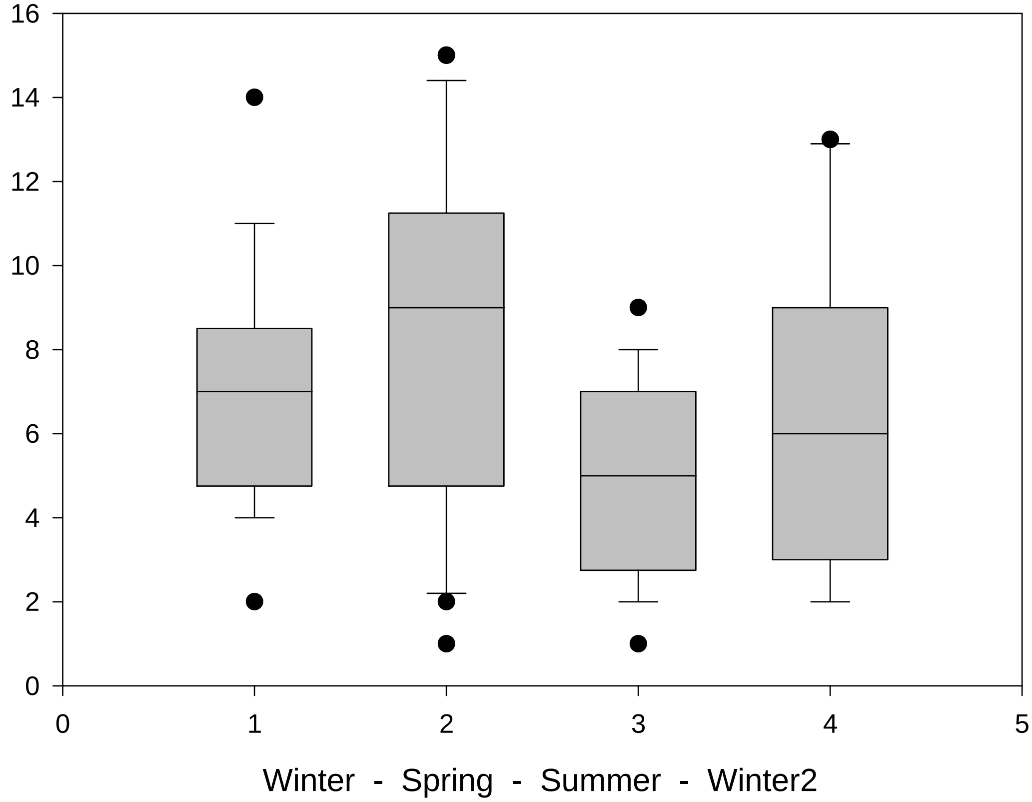
Graph 64. %EPT (Stony River)



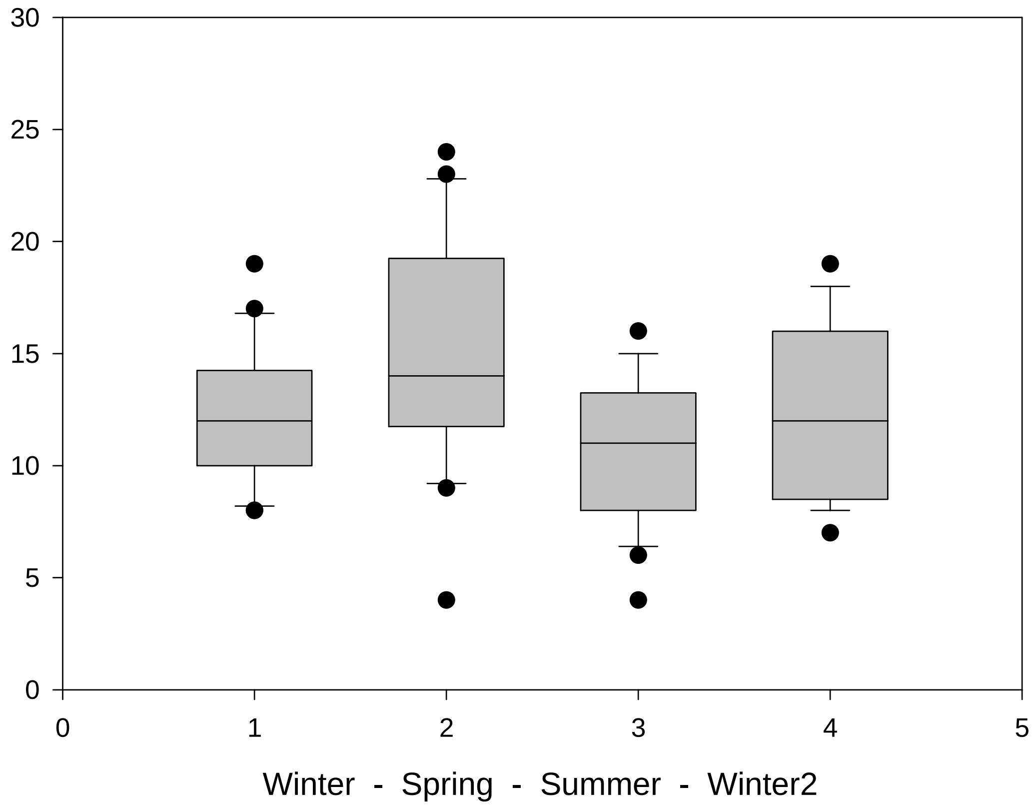
Graph 65. Hilsenhoff Biotic Index (Stony River)



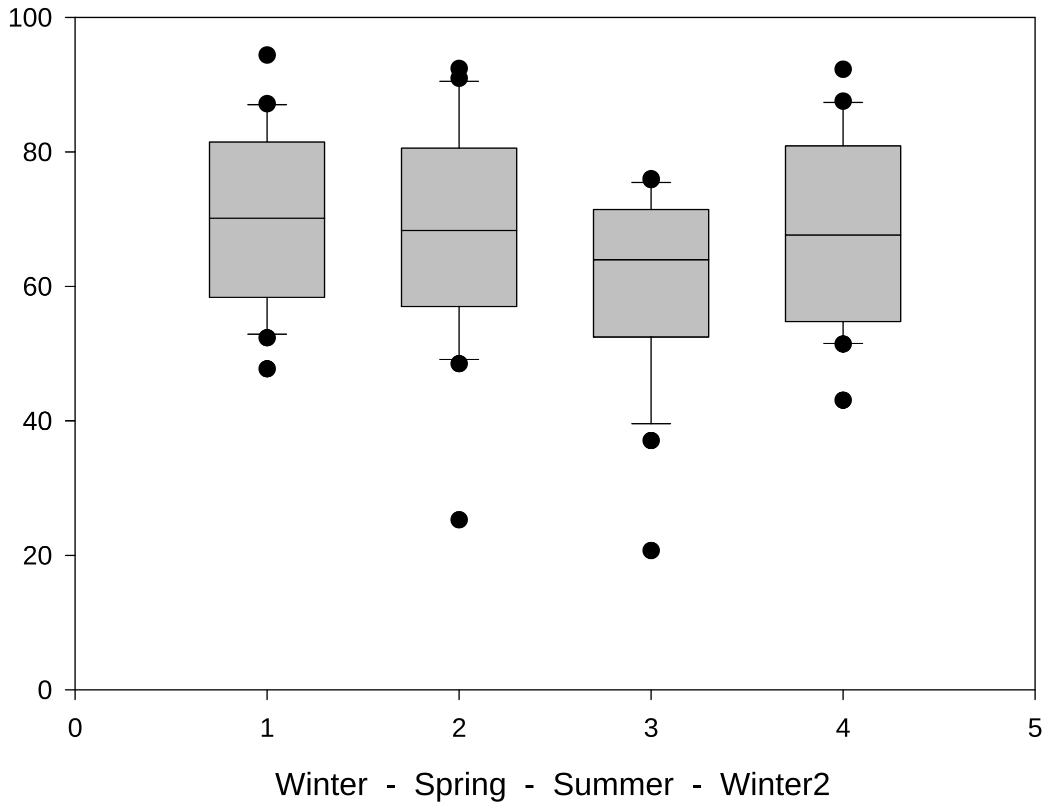
Graph 66. EPT Taxa (Stony River)



Graph 67. Total Taxa (Stony River)



Graph 68. WVSCI (Stony River)



Appendix D: Metric Difference Data

Table 3. Mean Difference Total Taxa

Stream Name	Total Taxa Winter	Mean Difference	Total Taxa Spring	Mean Difference	Total Taxa Summer	Mean Difference
AMD Creeks						
Buffalo Creek	7	-3.67	8	-2.67	17	6.33
Deakin Run	13	-3.67	21	4.33	16	-0.67
Nutrients and Sediment						
Cross Creek	14	1.7	11	-1.3	12	-0.3
Grave Creek	13	-1.33	16	1.67	14	-0.33
Howard Creek	11	-5	15	-1	22	6
Lunice Creek	15	-1	17	1	16	0
Meadow Creek	19	0	18	-1	20	1
Mill Creek	12	0	15	3	10	-2
Shock Run	19	2	16	-1	16	-1
Thorny Creek	10	-6	17	1	21	5
Tuscarora Creek	12	-0.66	14	1.34	12	-0.66
Stonecoal	12	-0.6	13	0.4	13	0.4

Table 4. Mean Difference EPT Taxa

Stream Name	EPT Taxa Winter	Mean Difference	EPT Taxa Spring	Mean Difference	EPT Taxa Summer	Mean Difference
AMD Creeks						
Buffalo Creek	5	-0.67	5	-0.67	7	1.33
Deakin Run	9	-1.33	14	3.67	8	-2.33
Nutrients and Sediment						
Cross Creek	9	2	6	-1	6	-1
Grave Creek	4	-2.33	9	2.67	6	-0.33
Howard Creek	7	-1	8	0	9	1
Lunice Creek	8	0.33	8	0.33	7	-0.67
Meadow Creek	13	2	10	-1	10	-1
Mill Creek	6	0	7	1	5	-1
Shock Run	12	2.33	10	0.33	7	-2.67
Thorny Creek	4	-4	10	2	10	2
Tuscarora Creek	6	1	4	-1	5	0
Stonecoal	6	0.4	5	-0.6	6	0.4

Table 5. Mean Difference EPT%

Stream Name	EPT% Winter	Mean Difference	EPT% Spring	Mean Difference	EPT% Summer	Mean Difference
AMD Creeks						
Buffalo Creek	25.58	-16.28	50	8.14	50	8.14
Deakin Run	59.82	2.58	39.25	-17.99	72.66	15.42
Nutrients and Sediment						
Cross Creek	71.91	31.13	10.36	-30.42	40.08	-0.7
Grave Creek	16.02	-2.27	9	-9.29	29.84	11.55
Howard Creek	38	-9.33	43.05	-4.28	60.93	13.6
Lunice Creek	50.78	-13.36	78.29	14.15	65.12	0.98
Meadow Creek	76.81	13	44.29	-19.52	70.39	6.58
Mill Creek	91.51	29.92	53.88	-7.71	39.38	-22.21
Shock Run	40.89	-14.73	59.15	3.53	66.8	11.18
Thorny Creek	12.04	-27.65	51.37	11.68	55.66	15.97
Tuscarora Creek	45.33	20.91	19.65	-4.77	8.29	-16.13
Stonecoal	21.39	0.25	26.06	4.92	15.96	-5.18

Table 6. Mean Difference Chironomidae %

Stream Name	Chiro% Winter	Mean Difference	Chiro% Spring	Mean Difference	Chiro% Summer	Mean Difference
AMD Creeks						
Buffalo Creek	73.26	27.81	41.67	-3.78	21.43	-24.02
Deakin Run	20.55	-6.06	43.55	16.94	15.73	-10.88
Nutrients and Sediment						
Cross Creek	22.13	-24.27	63.06	16.66	54.01	7.61
Grave Creek	63.46	4.68	78.38	19.6	34.5	-24.28
Howard Creek	44	14.48	23.15	-6.37	21.4	-8.12
Lunice Creek	26.7	14.68	8.51	-3.51	0.84	-11.18
Meadow Creek	8.18	-2.16	10.5	0.16	12.33	1.99
Mill Creek	5.8	-16.28	36.99	14.91	23.45	1.37
Shock Run	40.89	16.85	24.41	0.37	6.81	-17.23
Thorny Creek	29.32	9.41	18.81	-1.1	8.6	-11.31
Tuscarora Creek	20.89	-9.43	57.21	26.89	12.86	-17.46
Stonecoal	71.64	9.45	42.18	-20.01	72.77	10.58

Table 7. Mean Difference % Dominant 2 Taxa

Stream Name	DOM2Taxa Winter	Mean Difference	DOM2Taxa Spring	Mean Difference	DOM2Taxa Summer	Mean Difference
AMD Creeks						
Buffalo Creek	83.72	15.09	58.33	-10.3	63.84	-4.79
Deakin Run	45.66	-9.49	55.38	0.23	64.42	9.27
Nutrients and Sediment						
Cross Creek	80	-0.86	75.68	-5.18	86.92	6.06
Grave Creek	74.36	0.46	86.49	12.59	60.85	-13.05
Howard Creek	57	7.53	50	0.53	41.4	-8.07
Lunice Creek	41.36	-14.7	60.85	4.79	65.97	9.91
Meadow Creek	45.91	-1.51	63.01	15.59	33.33	-14.09
Mill Creek	70.98	6.5	80.82	16.34	56.64	-7.84
Shock Run	53.69	8.68	41.78	-3.23	39.57	-5.44
Thorny Creek	79.12	26.02	38.99	-14.11	41.18	-11.92
Tuscarora Creek	48.89	-15.99	69	4.12	76.76	11.88
Stonecoal	80.6	7.54	59.24	-13.82	79.34	6.28

Table 8. Hilsenhoff Biotic Index

Stream Name	HBI Winter	Mean Difference	HBI Spring	Mean Difference	HBI Summer	Mean Difference
AMD Creeks						
Buffalo Creek	5.23	0.44	4.25	-0.54	4.89	0.1
Deakin Run	3.9	-0.34	4.51	0.27	4.31	0.07
Nutrients and Sediment						
Cross Creek	4.7	-0.5	5.63	0.43	5.28	0.08
Grave Creek	5.41	0.07	5.64	0.3	4.98	-0.36
Howard Creek	4.71	0.56	3.19	-0.96	4.55	0.4
Lunice Creek	4.3	0.3	3.5	-0.5	4.2	0.2
Meadow Creek	2.82	-0.79	4.37	0.76	3.64	0.03
Mill Creek	2.93	-1.15	4.42	0.34	4.89	0.81
Shock Run	4.79	0.63	3.94	-0.22	3.75	-0.41
Thorny Creek	5.69	1.09	4.36	-0.24	3.75	-0.85
Tuscarora Creek	4.27	-0.72	5.21	0.22	5.51	0.52
Stonecoal	5.65	0.35	4.82	-0.48	5.5	0.2

Table 9. Mean Difference West Virginia Stream Condition Index

Stream Name	WVSCI Winter	Mean Difference	WVSCI Spring	Mean Difference	WVSCI Summer	Mean Difference
AMD Creeks						
Buffalo Creek	39.1	-18.5	59.84	2.24	73.86	16.26
Deakin Run	79.67	1.84	74.47	-3.36	79.36	-1.53
Nutrients and Sediment						
Cross Creek	71.58	13.74	47.53	-10.31	54.41	-3.43
Grave Creek	53.49	-2.53	48.4	-7.62	66.18	10.16
Howard Creek	62.77	-12.81	78.31	2.73	85.66	10.08
Lunice Creek	78.76	-2.67	85.21	3.78	80.33	-1.1
Meadow Creek	91.88	5.07	76.9	-9.91	91.65	4.84
Mill Creek	81.51	10.64333	67.03	-3.83667	64.06	-6.80667
Shock Run	73.4	-10.31	90.16	6.45	87.57	3.86
Thorny Creek	50.4	-23.42	82.26	8.44	88.8	14.98
Tuscarora Creek	73.2	10.29	57.86	-5.05	57.67	-5.24
Stonecoal	48.83	-5.58	64.21	9.8	50.19	-4.22

Appendix E: ANOVAS and Kruskal-Wallis

Table 10. EPT%

One Way Analysis of Variance

Data source: All Impacts

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.631)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	12	0	45.843	25.354	7.319
Spring	12	0	40.366	20.736	5.986
Summer	12	0	42.845	24.991	7.214

Source of Variation	DF	SS	MS	F	P
Between Groups	2	180.559	90.279	0.160	0.853
Residual	33	18670.786	565.781		
Total	35	18851.345			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.853).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 11. EPT Taxa

One Way Analysis of Variance

Data source: All Impacts

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.778)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	12	0	7.417	2.906	0.839
Spring	12	0	8.000	2.828	0.816
Summer	12	0	6.417	2.610	0.753

Source of Variation	DF	SS	MS	F	P
Between Groups	2	15.389	7.694	0.993	0.381
Residual	33	255.833	7.753		
Total	35	271.222			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.381).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 12. %Chironomidae

One Way Analysis of Variance

Data source: All Impacts

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.792)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	12	0	35.568	23.306	6.728
Spring	12	0	37.368	21.500	6.207
Summer	12	0	23.728	20.889	6.030

Source of Variation	DF	SS	MS	F	P
Between Groups	2	1318.071	659.035	1.371	0.268
Residual	33	15859.528	480.592		
Total	35	17177.599			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.268).

Power of performed test with alpha = 0.050: 0.101

The power of the performed test (0.101) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 13. %Dominant 2 Taxa

One Way Analysis of Variance

Data source: All Impacts

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.548)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	12	0	63.441	16.128	4.656
Spring	12	0	61.631	14.579	4.209
Summer	12	0	59.185	17.274	4.987

Source of Variation	DF	SS	MS	F	P
Between Groups	2	109.481	54.741	0.213	0.809
Residual	33	8481.564	257.017		
Total	35	8591.045			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.809).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 14. HBI

One Way Analysis of Variance

Data source: All Impacts

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.702)

Group Name	**N**	**Missing**	**Mean**	**Std Dev**	**SEM**
Winter	12	0	4.533	0.953	0.275
Spring	12	0	4.487	0.758	0.219
Summer	12	0	4.612	0.687	0.198

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Between Groups	2	0.0958	0.0479	0.0735	0.929
Residual	33	21.506	0.652		
Total	35	21.601			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.929).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 15. Total Taxa

One Way Analysis of Variance

Data source: All Impacts

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.831)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	12	0	13.083	3.423	0.988
Spring	12	0	15.083	3.370	0.973
Summer	12	0	15.750	3.793	1.095

Source of Variation	DF	SS	MS	F	P
Between Groups	2	46.222	23.111	1.851	0.173
Residual	33	412.083	12.487		
Total	35	458.306			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.173).

Power of performed test with alpha = 0.050: 0.176

The power of the performed test (0.176) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

<u>Table 16. WVSCI</u>

One Way Analysis of Variance

Data source: All Impacts

Normality Test: Passed (P = 0.046)

Equal Variance Test: Passed (P = 0.972)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	12	0	67.049	15.992	4.617
Spring	12	0	69.348	14.091	4.068
Summer	12	0	73.312	14.432	4.166

Source of Variation	DF	SS	MS	F	P
Between Groups	2	240.852	120.426	0.545	0.585
Residual	33	7288.404	220.861		
Total	35	7529.257			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.585).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 17. %Dominant 2 Taxa

One Way Analysis of Variance

Data source: WVDEP Reference Sites

Normality Test: Passed (P = 0.057)

Equal Variance Test: Passed (P = 0.833)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	17	1	45.127	12.766	3.192
Spring	17	1	48.209	17.202	4.301
Summer	17	1	43.883	10.902	2.726

Source of Variation	DF	SS	MS	F	P
Between Groups	2	158.785	79.392	0.412	0.665
Residual	45	8666.096	192.580		
Total	47	8824.880			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.665).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 18. %Chironomidae

One Way Analysis of Variance

Data source: WVDEP Reference Sites

Normality Test: Passed (P = 0.021)

Equal Variance Test: Passed (P = 0.612)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	17	1	17.336	12.544	3.136
Spring	17	2	16.981	7.664	1.979
Summer	17	1	20.546	11.358	2.839

Source of Variation	DF	SS	MS	F	P
Between Groups	2	121.638	60.819	0.523	0.596
Residual	44	5117.294	116.302		
Total	46	5238.932			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.596).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

<u>Table 19. %EPT</u>

One Way Analysis of Variance

Data source: WVDEP Reference Data

Normality Test: Passed (P = 0.112)

Equal Variance Test: Passed (P = 0.325)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	17	1	71.694	16.124	4.031
Spring	17	2	60.315	20.839	5.381
Summer	17	1	58.309	16.125	4.031

Source of Variation	DF	SS	MS	F	P
Between Groups	2	1657.743	828.872	2.628	0.084
Residual	44	13880.026	315.455		
Total	46	15537.770			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.084).

Power of performed test with alpha = 0.050: 0.314

The power of the performed test (0.314) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

<u>Table 20. HBI</u>

One Way Analysis of Variance

Data source: WVDEP Reference Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.327)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	17	1	3.448	0.619	0.155
Spring	17	2	4.071	0.680	0.176
Summer	17	1	3.861	0.541	0.135

Source of Variation	DF	SS	MS	F	P
Between Groups	2	3.138	1.569	4.157	0.022
Residual	44	16.605	0.377		
Total	46	19.743			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.022).

Power of performed test with alpha = 0.050: 0.571

The power of the performed test (0.571) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Spring vs. Winter	0.623	3	3.992	0.019	Yes
Spring vs. Summer	0.210	3	1.345	0.611	No
Summer vs. Winter	0.413	3	2.690	0.150	No

Table 21. EPT Taxa

One Way Analysis of Variance

Data source: WVDEP Reference Data

Normality Test: Passed (P = 0.054)

Equal Variance Test: Passed (P = 0.250)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	17	1	15.813	2.536	0.634
Spring	17	2	13.067	2.764	0.714
Summer	17	1	10.188	2.257	0.564

Source of Variation	DF	SS	MS	F	P
Between Groups	2	253.170	126.585	19.906	<0.001
Residual	44	279.808	6.359		
Total	46	532.979			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Winter vs. Summer	5.625	3	8.922	<0.001	Yes
Winter vs. Spring	2.746	3	4.285	0.011	Yes
Spring vs. Summer	2.879	3	4.493	0.008	Yes

<u>Table 22. Total Taxa</u>

One Way Analysis of Variance

Data source: WVDEP Reference Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.230)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	17	1	23.813	4.053	1.013
Spring	17	2	20.200	4.144	1.070
Summer	17	1	19.125	3.160	0.790

Source of Variation	DF	SS	MS	F	P
Between Groups	2	192.221	96.111	6.643	0.003
Residual	44	636.588	14.468		
Total	46	828.809			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.003).

Power of performed test with alpha = 0.050: 0.846

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Winter vs. Summer	4.688	3	4.929	0.003	Yes
Winter vs. Spring	3.613	3	3.737	0.030	Yes
Spring vs. Summer	1.075	3	1.112	0.713	No

Table 23. WVSCI

One Way Analysis of Variance

Data source: WVDEP Reference Data

Normality Test: Passed (P = 0.072)

Equal Variance Test: Passed (P = 0.769)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	17	1	88.582	6.857	1.714
Spring	17	2	81.709	9.193	2.374
Summer	17	1	80.121	8.363	2.091

Source of Variation	DF	SS	MS	F	P
Between Groups	2	643.957	321.978	4.823	0.013
Residual	44	2937.462	66.761		
Total	46	3581.419			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.013).

Power of performed test with alpha = 0.050: 0.664

The power of the performed test (0.664) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Winter vs. Summer	8.461	3	4.142	0.015	Yes
Winter vs. Spring	6.873	3	3.310	0.061	No
Spring vs. Summer	1.588	3	0.765	0.852	No

Table 24. %Dominant 2 Taxa

One Way Analysis of Variance

Data source: WVDEP Repeat Data

Normality Test: Passed (P = 0.142)

Equal Variance Test: Passed (P = 0.887)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	14	1	46.414	13.274	3.682
Spring	14	1	52.813	12.385	3.435
Summer	14	1	43.782	10.488	2.909

Source of Variation	DF	SS	MS	F	P
Between Groups	2	560.863	280.432	1.914	0.162
Residual	36	5275.063	146.530		
Total	38	5835.926			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.162).

Power of performed test with alpha = 0.050: 0.188

The power of the performed test (0.188) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 25. %Chironomidae

One Way Analysis of Variance

Data source: WVDEP Repeat Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.760)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	14	1	18.453	13.648	3.785
Spring	14	1	19.116	11.516	3.194
Summer	14	1	20.528	12.653	3.509

Source of Variation	DF	SS	MS	F	P
Between Groups	2	29.213	14.607	0.0915	0.913
Residual	36	5747.815	159.662		
Total	38	5777.028			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.913).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 26. %EPT

One Way Analysis of Variance

Data source: WVDEP Repeat Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.169)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	14	1	71.592	16.284	4.516
Spring	14	1	57.918	24.401	6.768
Summer	14	1	56.730	15.194	4.214

Source of Variation	DF	SS	MS	F	P
Between Groups	2	1773.607	886.803	2.438	0.102
Residual	36	13097.374	363.816		
Total	38	14870.981			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.102).

Power of performed test with alpha = 0.050: 0.277

The power of the performed test (0.277) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 27. HBI

One Way Analysis of Variance

Data source: WVDEP Repeat Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.094)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	14	1	3.548	0.640	0.178
Spring	14	1	4.095	1.073	0.297
Summer	14	1	3.968	0.458	0.127

Source of Variation	DF	SS	MS	F	P
Between Groups	2	2.128	1.064	1.803	0.179
Residual	36	21.245	0.590		
Total	38	23.374			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.179).

Power of performed test with alpha = 0.050: 0.169

The power of the performed test (0.169) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 28. EPT Taxa

One Way Analysis of Variance

Data source: WVDEP Repeat Data

Normality Test: Passed (P = 0.055)

Equal Variance Test: Passed (P = 0.280)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	14	1	15.308	2.463	0.683
Spring	14	1	12.231	3.539	0.982
Summer	14	1	9.923	2.139	0.593

Source of Variation	DF	SS	MS	F	P
Between Groups	2	189.744	94.872	12.286	<0.001
Residual	36	278.000	7.722		
Total	38	467.744			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.993

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Winter vs. Summer	5.385	3	6.986	<0.001	Yes
Winter vs. Spring	3.077	3	3.992	0.021	Yes
Spring vs. Summer	2.308	3	2.994	0.101	No

<u>Table 29. Total Taxa</u>

One Way Analysis of Variance

Data source: WVDEP Repeat Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.459)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	14	1	23.154	4.140	1.148
Spring	14	1	20.385	4.312	1.196
Summer	14	1	19.462	3.205	0.889

Source of Variation	DF	SS	MS	F	P
Between Groups	2	96.000	48.000	3.130	0.056
Residual	36	552.000	15.333		
Total	38	648.000			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.056).

Power of performed test with alpha = 0.050: 0.397

The power of the performed test (0.397) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 30. WVSCI

One Way Analysis of Variance

Data source: WVDEP Repeat Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.575)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	14	1	87.538	7.142	1.981
Spring	14	1	79.254	11.914	3.304
Summer	14	1	79.255	9.432	2.616

Source of Variation	DF	SS	MS	F	P
Between Groups	2	594.670	297.335	3.164	0.054
Residual	36	3382.934	93.970		
Total	38	3977.604			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.054).

Power of performed test with alpha = 0.050: 0.403

The power of the performed test (0.403) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 31. % Dominant 2 Taxa

One Way Analysis of Variance

Data source: Stony River Data

Normality Test: Passed (P = 0.016)

Equal Variance Test: Passed (P = 0.542)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	18	1	67.920	15.614	3.787
Spring	18	1	64.208	14.128	3.427
Summer	18	1	71.465	14.721	3.570
Winter	17	1	72.265	15.870	3.967

Source of Variation	DF	SS	MS	F	P
Between Groups	3	683.540	227.847	1.001	0.398
Residual	63	14339.620	227.613		
Total	66	15023.159			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.398).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Table 32. % Chironomidae

One Way Analysis of Variance

Data source: Stony River Data

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: Stony River Data

Group	N	Missing	Median	25%	75%
Winter	18	1	1.802	0.329	5.190
Spring	18	1	23.611	15.119	36.870
Summer	18	1	11.765	7.131	22.511
Winter	17	1	2.614	0.701	9.881

H = 27.186 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Spring vs Winter	30.294	4.533	Yes
Spring vs Winter	27.199	4.007	Yes
Spring vs Summer	10.412	1.558	No
Summer vs Winter	19.882	2.975	Yes
Summer vs Winter	16.787	2.473	No
Winter vs Winter	23.096	0.456	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Table 33. %EPT

One Way Analysis of Variance

Data source: Stony River Data

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: Stony River Data

Group	N	Missing	Median	25%	75%
Winter	18	1	84.404	68.411	90.332
Spring	18	1	67.130	43.135	73.935
Summer	18	1	72.038	47.044	81.704
Winter	17	1	77.238	55.553	91.495

H = 7.294 with 3 degrees of freedom. (P = 0.063)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.063)

<u>Table 34. HBI</u>

One Way Analysis of Variance

Data source: Stony River Data

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: Mount Storm Data

Group	N	Missing	Median	25%	75%
Winter	18	1	4.369	3.634	4.530
Spring	18	1	4.593	3.453	4.919
Summer	18	1	4.566	3.696	5.064
Winter	17	1	4.516	3.699	4.866

H = 1.652 with 3 degrees of freedom. (P = 0.648)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.648)

Table 35. EPT Taxa

One Way Analysis of Variance

Data source: Stony River Data

Normality Test: Passed (P = 0.054)

Equal Variance Test: Passed (P = 0.034)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	18	1	7.000	3.142	0.762
Spring	18	1	8.000	4.213	1.022
Summer	18	1	4.882	2.497	0.606
Winter	17	1	6.313	3.945	0.986

Source of Variation	DF	SS	MS	F	P
Between Groups	3	87.365	29.122	2.367	0.079
Residual	63	775.202	12.305		
Total	66	862.567			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.079).

Power of performed test with alpha = 0.050: 0.337

The power of the performed test (0.337) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

<u>Table 36. Total Taxa</u>

One Way Analysis of Variance

Data source: Stony River Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.045)

Group Name	**N**	**Missing**	**Mean**	**Std Dev**	**SEM**
Winter	18	1	12.353	3.141	0.762
Spring	18	1	15.118	5.361	1.300
Summer	18	1	10.882	3.295	0.799
Winter	17	1	12.500	3.983	0.996

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Between Groups	3	158.200	52.733	3.227	0.028
Residual	63	1029.412	16.340		
Total	66	1187.612			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.028).

Power of performed test with alpha = 0.050: 0.532

The power of the performed test (0.532) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

All Pairwise Multiple Comparison Procedures (Tukey Test):
Comparisons for factor:

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
Spring vs. Summer	4.235	4	4.320	0.017	Yes
Spring vs. Winter	2.765	4	2.820	0.201	No
Spring vs. Winter	2.618	4	2.629	0.256	Do Not Test
Winter vs. Summer	1.618	4	1.625	0.661	No
Winter vs. Winter	0.147	4	0.148	1.000	Do Not Test
Winter vs. Summer	1.471	4	1.500	0.715	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

<u>Table 37. WVSCI</u>

One Way Analysis of Variance

Data source: Stony River Data

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.930)

Group Name	N	Missing	Mean	Std Dev	SEM
Winter	18	1	70.318	13.622	3.304
Spring	18	1	67.016	17.298	4.195
Summer	18	1	60.536	14.934	3.622
Winter	17	1	67.475	14.807	3.702

Source of Variation	DF	SS	MS	F	P
Between Groups	3	869.973	289.991	1.250	0.299
Residual	63	14613.303	231.957		
Total	66	15483.276			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.299).

Power of performed test with alpha = 0.050: 0.093

The power of the performed test (0.093) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Appendix F: Habitat Information for Impaired Sites

Table 38A. Winter Habitat Scores for Impacted Sites

StreamName	Epifaunal Substrate	Embeddedness	Velocity/Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration
Howard Creek	18	16	11	11	12	13
Meadow Creek	16	9	16	11	14	16
Thorny Creek	17	12	7	12	13	7
Stonecoal Creek	9	17	10	10	13	8
Shock Run	15	17	16	11	13	15
Deakin Run	13	10	10	16	11	12
Saltlick Creek	10	10	13	10	14	8
Tuscarora Creek	10	13	8	8	15	9
Mill Creek	14	10	15	10	14	9
Lunice Creek	15	14	16	11	12	13
Emory Creek	16	14	15	15	10	15
Little Buffalo Creek	12	14	9	16	11	6
Church Run	8	5	6	15	8	15
Grave Creek	11	12	13	16	12	13
Cross Creek	15	18	16	10	15	16

Table 38B. Winter Habitat Scores for Impacted Sites

StreamName	Frequency of Riffles	Bank Stability (LB+RB)	Vegetive Protection (LB+RB)	Riparian Vegetative Zone Width (LB+RB)	Total Score
Howard Creek	13	14	11	8	127
Meadow Creek	13	17	15	15	142
Thorny Creek	8	15	13	13	117
Stonecoal Creek	10	9	9	9	104
Shock Run	15	15	11	9	137
Deakin Run	10	12	9	10	113
Saltlick Creek	14	10	9	12	110
Tuscarora Creek	7	11	9	1	91
Mill Creek	11	9	7	5	104
Lunice Creek	10	14	9	7	121
Emory Creek	7	11	13	10	126
Little Buffalo Creek	16	10	7	3	104
Church Run	13	8	7	7	92
Grave Creek	7	12	3	3	102
Cross Creek	12	14	12	9	137

Table 39A. Spring Habitat Scores for Impacted Sites

StreamName	Epifaunal Substrate	Embeddedness	Velocity/Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration
Church Run	10	4	4	14	7	13
Grave Creek	12	11	14	14	10	11
Mill Creek	13	11	16	11	11	10
Lindy Run	16	19	18	18	17	19
Howard Creek	16	15	12	10	10	15
Shock Run	16	15	14	13	15	16
LITTLE RIVER/EA FK/GREENBRIER R	18	17	16	18	19	18
Deakin Run	12	11	12	15	12	10
Cross Creek	12	14	13	9	13	14
Little Stonecoal	9	15	11	8	10	9
Saltlick Creek	9	11	11	8	13	10
Emory Creek	17	13	16	14	11	14
Tuscarora Creek	11	10	9	10	13	10
Lunice Creek	16	15	15	13	10	12
Meadow Creek	17	11	15	13	12	15
Shock Run	16	18	15	13	11	14
Thorny Creek	11	14	10	15	17	10
Toney Fork	14	10	15	15	11	13
Buffalo Creek	13	11	12	15	15	12
Cane Fork	10	6	11	13	16	14
Condon Run	18	19	19	18	18	17

Table 39B. Spring Habitat Scores for Impacted Sites

StreamName	Frequency of Riffles	Bank Stability (LB+RB)	Vegetive Protection (LB+RB)	Riparian Vegetative Zone Width (LB+RB)	Total Score
Church Run	12	8	4	6	82
Grave Creek	7	14	11	11	115
Mill Creek	12	8	9	5	106
Lindy Run	18	17	20	20	182
Howard Creek	12	15	13	11	129
Shock Run	16	17	11	10	143
Little River/East Fork	17	19	15	17	174
Deakin Run	11	10	8	8	109
Cross Creek	13	15	10	9	122
Little Stonecoal	11	8	10	10	101
Saltlick Creek	14	11	12	10	109
Emory Creek	8	12	13	12	130
Tuscarora Creek	8	10	10	6	97
Lunice Creek	11	15	10	8	125
Meadow Creek	14	18	16	14	145
Shock Run	16	14	13	10	140
Thorny Creek	8	16	15	9	125
Toney Fork	17	16	18	12	141
Little Buffalo Creek	18	15	15	13	139
Cane Fork	16	14	14	16	130
Condon Run	18	17	19	20	183

Table 40A. Summer Habitat Scores for Impacted Sites

StreamName	Epifaunal Substrate	Embeddedness	Velocity/Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration
Grave Creek	12	15	11	10	13	10
Cross Creek	14	15	15	12	12	11
Church Run	10	1	11	10	13	9
Emory Creek	12	16	13	13	10	10
Tuscarora Creek	11	8	12	11	11	10
Mill Creek	12	17	13	11	13	11
Lunice Creek	15	17	16	15	15	16
Condon Run	19	17	19	17	17	17
Little River/East Fork	17	16	20	19	16	14
Shock Run	16	15	18	14	16	16
Cane Fork	13	2	10	16	12	15
Howard Creek	16	14	16	13	14	15
Toney Fork	13	11	13	13	12	11
Big Horse Creek	12	11	12	15	12	16
Poplar Fork	11	8	9	10	6	11
Hurricane Creek	9	5	10	6	9	11
Little Buffalo Creek	12	10	13	16	15	11
Meadow Creek	16	12	16	16	15	15
Thorny Creek	10	15	8	16	16	11
Deakin Run	13	12	10	16	13	11
Meadow Creek	18	13	15	12	11	14
Little Stonecoal	10	14	12	11	9	12
Lindy Run	17	19	19	17	16	20

Table 40B. Summer Habitat Scores For Impacted Sites

StreamName	Frequency of Riffles	Bank Stability (LB+RB)	Vegetative Protection (LB+RB)	Riparian Vegetative Zone Width (LB+RB)	Total Score
Grave Creek	9	13	10	6	109
Cross Creek	10	14	16	14	133
Church Run	12	10	9	6	91
Emory Creek	15	12	9	7	117
Tuscarora Creek	10	16	8	5	102
Mill Creek	10	12	12	9	120
Lunice Creek	15	16	11	10	146
Condon Run	17	15	20	20	178
Little River/East Fork	18	18	18	17	173
Shock Run	17	18	14	11	155
Cane Fork	18	15	18	15	134
Howard Creek	16	14	14	14	146
Toney Fork	16	17	16	15	137
Big Horse Creek	15	15	14	17	139
Poplar Fork	12	11	8	10	96
Hurricane Creek	10	6	7	7	80
Little Buffalo Creek	17	16	14	13	137
Meadow Creek	16	17	18	17	158
Thorny Creek	6	17	14	8	121
Deakin Run	13	9	9	10	116
Meadow Creek	15	19	17	15	149
Little Stonecoal	12	11	8	12	111
Lindy Run	18	19	18	19	182

Appendix G: Family Information by Stream

Table 41. Family Information

StreamName	Date	Order	Family	Count
Stonecoal Creek	2/14/2002	Ephemeroptera	Ameletidae	3
Stonecoal Creek	2/14/2002	Ephemeroptera	Heptageniidae	4
Stonecoal Creek	2/14/2002	Annelida	Oligochaeta	7
Stonecoal Creek	2/14/2002	Plecoptera	Capniidae	3
Stonecoal Creek	2/14/2002	Plecoptera	Chloroperlidae	7
Stonecoal Creek	2/14/2002	Trichoptera	Hydropsychidae	18
Stonecoal Creek	2/14/2002	Trichoptera	Polycentropodidae	8
Stonecoal Creek	2/14/2002	Diptera	Ceratopogonidae	1
Stonecoal Creek	2/14/2002	Diptera	Chironomidae	144
Stonecoal Creek	2/14/2002	Diptera	Simuliidae	4
Stonecoal Creek	2/14/2002	Diptera	Tipulidae	1
Stonecoal Creek	2/14/2002	Coleoptera	Elmidae	1
Meadow Creek	2/14/2002	Ephemeroptera	Baetidae	2
Meadow Creek	2/14/2002	Ephemeroptera	Caenidae	4
Meadow Creek	2/14/2002	Ephemeroptera	Ephemerellidae	5
Meadow Creek	2/14/2002	Ephemeroptera	Heptageniidae	10
Meadow Creek	2/14/2002	Ephemeroptera	Isonychiidae	1
Meadow Creek	2/14/2002	Ephemeroptera	Leptophlebiidae	6
Meadow Creek	2/14/2002	Plecoptera	Capniidae	30
Meadow Creek	2/14/2002	Plecoptera	Perlidae	2
Meadow Creek	2/14/2002	Plecoptera	Perlodidae	22
Meadow Creek	2/14/2002	Plecoptera	Taeniopterygidae	71
Meadow Creek	2/14/2002	Trichoptera	Hydropsychidae	1
Meadow Creek	2/14/2002	Trichoptera	Philopotamidae	1
Meadow Creek	2/14/2002	Trichoptera	leptostomatidae	14
Meadow Creek	2/14/2002	Diptera	Chironomidae	18
Meadow Creek	2/14/2002	Diptera	Empididae	1
Meadow Creek	2/14/2002	Diptera	Simuliidae	26
Meadow Creek	2/14/2002	Diptera	Tipulidae	1
Meadow Creek	2/14/2002	Odonata	Gomphidae	3
Meadow Creek	2/14/2002	Coleoptera	Elmidae	2
Shock Run	2/14/2002	Ephemeroptera	Ameletidae	8
Shock Run	2/14/2002	Ephemeroptera	Baetidae	1
Shock Run	2/14/2002	Ephemeroptera	Ephemerellidae	5
Shock Run	2/14/2002	Ephemeroptera	Heptageniidae	26
Shock Run	2/14/2002	Ephemeroptera	Isonychiidae	3
Shock Run	2/14/2002	Plecoptera	Capniidae	1
Shock Run	2/14/2002	Plecoptera	Perlidae	3
Shock Run	2/14/2002	Plecoptera	Pteronarcyidae	2
Shock Run	2/14/2002	Plecoptera	Taeniopterygidae	2
Shock Run	2/14/2002	Trichoptera	Hydropsychidae	26
Shock Run	2/14/2002	Trichoptera	Limnephilidae	1
Shock Run	2/14/2002	Trichoptera	Philopotamidae	5
Shock Run	2/14/2002	Diptera	Chironomidae	83
Shock Run	2/14/2002	Diptera	Simuliidae	21
Shock Run	2/14/2002	Diptera	Tipulidae	2

Shock Run	2/14/2002	Odonata	Gomphidae	1

Table 41. Cont.

StreamName	Date	Order	Family	Count
Shock Run	2/14/2002	Coleoptera	Elmidae	11
Shock Run	2/14/2002	Coleoptera	Psephenidae	1
Shock Run	2/14/2002	Megaloptera	Corydalidae	1
LUNICE CK	12/17/2002	Ephemeroptera	Caenidae	10
LUNICE CK	12/17/2002	Ephemeroptera	Ephemerellidae	10
LUNICE CK	12/17/2002	Ephemeroptera	Heptageniidae	17
LUNICE CK	12/17/2002	Ephemeroptera	Isonychiidae	27
LUNICE CK	12/17/2002	Plecoptera	Perlidae	1
LUNICE CK	12/17/2002	Plecoptera	Taeniopterygidae	13
LUNICE CK	12/17/2002	Trichoptera	Hydropsychidae	14
LUNICE CK	12/17/2002	Trichoptera	Philopotamidae	5
LUNICE CK	12/17/2002	Diptera	Chironomidae	51
LUNICE CK	12/17/2002	Diptera	Simuliidae	1
LUNICE CK	12/17/2002	Diptera	Tipulidae	4
LUNICE CK	12/17/2002	Odonata	Coenagrionidae	3
LUNICE CK	12/17/2002	Odonata	Gomphidae	3
LUNICE CK	12/17/2002	Coleoptera	Elmidae	28
LUNICE CK	12/17/2002	Coleoptera	Psephenidae	4
Mill Creek	12/17/2002	Ephemeroptera	Ephemerellidae	85
Mill Creek	12/17/2002	Ephemeroptera	Ephemeridae	1
Mill Creek	12/17/2002	Ephemeroptera	Heptageniidae	2
Mill Creek	12/17/2002	Ephemeroptera	Isonychiidae	1
Mill Creek	12/17/2002	Plecoptera	Capniidae	74
Mill Creek	12/17/2002	Trichoptera	Hydropsychidae	42
Mill Creek	12/17/2002	Diptera	Chironomidae	13
Mill Creek	12/17/2002	Diptera	Simuliidae	1
Mill Creek	12/17/2002	Diptera	Tipulidae	1
Mill Creek	12/17/2002	Odonata	Gomphidae	1
Mill Creek	12/17/2002	Coleoptera	Elmidae	1
Mill Creek	12/17/2002	Megaloptera	Corydalidae	2
Cross Creek	12/18/2002	Ephemeroptera	Caenidae	1
Cross Creek	12/18/2002	Ephemeroptera	Ephemerellidae	1
Cross Creek	12/18/2002	Ephemeroptera	Heptageniidae	1
Cross Creek	12/18/2002	Ephemeroptera	Isonychiidae	6
Cross Creek	12/18/2002	Amphipoda		1
Cross Creek	12/18/2002	Isopoda		1
Cross Creek	12/18/2002	Plecoptera	Capniidae	14
Cross Creek	12/18/2002	Plecoptera	Taeniopterygidae	5
Cross Creek	12/18/2002	Trichoptera	Hydropsychidae	136
Cross Creek	12/18/2002	Trichoptera	Hydroptilidae	1
Cross Creek	12/18/2002	Trichoptera	Philopotamidae	4
Cross Creek	12/18/2002	Diptera	Chironomidae	52
Cross Creek	12/18/2002	Diptera	Tipulidae	2
Cross Creek	12/18/2002	Coleoptera	Elmidae	10
Church Run	12/17/2002	Trichoptera	Rhyacophilidae	1
Church Run	12/17/2002	Diptera	Ceratopogonidae	1
Church Run	12/17/2002	Diptera	Chironomidae	220

Church Run	12/17/2002	Diptera	Tipulidae	1

Table 41. Cont.

Deakin Run	12/17/2002	Ephemeroptera	Ephemerellidae	6
Deakin Run	12/17/2002	Ephemeroptera	Leptophlebiidae	7
Deakin Run	12/17/2002	Ephemeroptera	Heptageniidae	3
Deakin Run	12/17/2002	Plecoptera	Perlodidae	4
Deakin Run	12/17/2002	Plecoptera	Capniidae	39
Deakin Run	12/17/2002	Plecoptera	Taeniopterygidae	2
Deakin Run	12/17/2002	Trichoptera	Hydropsychidae	55
Deakin Run	12/17/2002	Trichoptera	Rhyacophilidae	3
Deakin Run	12/17/2002	Trichoptera	Philopotamidae	12
Deakin Run	12/17/2002	Coleoptera	Elmidae	29
Deakin Run	12/17/2002	Diptera	Chironomidae	45
Deakin Run	12/17/2002	Diptera	Tipulidae	7
Deakin Run	12/17/2002	Diptera	Simuliidae	7
Saltlick Creek	12/17/2002	Annelida	Oligochaeta	1
Saltlick Creek	12/17/2002	Ephemeroptera	Caenidae	1
Saltlick Creek	12/17/2002	Ephemeroptera	Heptageniidae	8
Saltlick Creek	12/17/2002	Plecoptera	Taeniopterygidae	40
Saltlick Creek	12/17/2002	Plecoptera	Capniidae	127
Saltlick Creek	12/17/2002	Trichoptera	Hydropsychidae	8
Saltlick Creek	12/17/2002	Trichoptera	Polycentropodidae	5
Saltlick Creek	12/17/2002	Megaloptera	Corydalidae	1
Saltlick Creek	12/17/2002	Coleoptera	Elmidae	5
Saltlick Creek	12/17/2002	Diptera	Tipulidae	2
Saltlick Creek	12/17/2002	Diptera	Chironomidae	14
Saltlick Creek	12/17/2002	Decapoda		1
Thorny Creek	2/14/2003	Trichoptera	Heptageniidae	1
Thorny Creek	2/14/2003	Ephemeroptera	Caenidae	4
Thorny Creek	2/14/2003	Plecoptera	Perlodidae	1
Thorny Creek	2/14/2003	Trichoptera	Hydropsychidae	24
Thorny Creek	2/14/2003	Coleoptera	Elmidae	16
Thorny Creek	2/14/2003	Coleoptera	Psephenidae	1
Thorny Creek	2/14/2003	Diptera	Tipulidae	4
Thorny Creek	2/14/2003	Diptera	Chironomidae	73
Thorny Creek	2/14/2003	Diptera	Simuliidae	124
Thorny Creek	2/14/2003	Gastropoda		1
Buffalo Creek	12/17/2002	Plecoptera	Perlidae	2
Buffalo Creek	12/17/2002	Trichoptera	Philopotamidae	1
Buffalo Creek	12/17/2002	Plecoptera	Capniidae	7
Buffalo Creek	12/17/2002	Diptera	Tipulidae	1
Buffalo Creek	12/17/2002	Diptera	Chironomidae	63
Buffalo Creek	12/17/2002	Trichoptera	Hydropsychidae	9
Buffalo Creek	12/17/2002	Ephemeroptera	Heptageniidae	3

Table 41. Cont.

Tuscarora Creek	12/17/2002	Ephemeroptera	Ephemerellidae	1
Tuscarora Creek	12/17/2002	Ephemeroptera	Heptageniidae	5
Tuscarora Creek	12/17/2002	Ephemeroptera	Leptophlebiidae	1
Tuscarora Creek	12/17/2002	Amphipoda		1
Tuscarora Creek	12/17/2002	Decapoda		2
Tuscarora Creek	12/17/2002	Plecoptera	Taeniopterygidae	1
Tuscarora Creek	12/17/2002	Trichoptera	Hydropsychidae	43
Tuscarora Creek	12/17/2002	Trichoptera	Philopotamidae	51
Tuscarora Creek	12/17/2002	Diptera	Chironomidae	47
Tuscarora Creek	12/17/2002	Diptera	Tipulidae	8
Tuscarora Creek	12/17/2002	Coleoptera	Elmidae	59
Tuscarora Creek	12/17/2002	Coleoptera	Psephenidae	6
Grave Creek	12/18/2002	Ephemeroptera	Caenidae	12
Grave Creek	12/18/2002	Ephemeroptera	Heptageniidae	8
Grave Creek	12/18/2002	Isopoda		1
Grave Creek	12/18/2002	Annelida	Oligochaeta	1
Grave Creek	12/18/2002	Plecoptera	Perlidae	2
Grave Creek	12/18/2002	Plecoptera	Taeniopterygidae	3
Grave Creek	12/18/2002	Diptera	Ceratopogonidae	1
Grave Creek	12/18/2002	Diptera	Chironomidae	99
Grave Creek	12/18/2002	Diptera	Simuliidae	1
Grave Creek	12/18/2002	Diptera	Tipulidae	9
Grave Creek	12/18/2002	Coleoptera	Elmidae	17
Grave Creek	12/18/2002	Coleoptera	Psephenidae	1
Grave Creek	12/18/2002	Megaloptera	Corydalidae	1
Howard Creek	2/14/2002	Ephemeroptera	Ephemerellidae	6
Howard Creek	2/14/2002	Ephemeroptera	Heptageniidae	13
Howard Creek	2/14/2002	Ephemeroptera	Isonychiidae	7
Howard Creek	2/14/2002	Ephemeroptera	Leptophlebiidae	4
Howard Creek	2/14/2002	Annelida	Oligochaeta	1
Howard Creek	2/14/2002	Plecoptera	Perlodidae	5
Howard Creek	2/14/2002	Trichoptera	Limnephilidae	2
Howard Creek	2/14/2002	Trichoptera	Philopotamidae	1
Howard Creek	2/14/2002	Diptera	Chironomidae	44
Howard Creek	2/14/2002	Diptera	Simuliidae	11
Howard Creek	2/14/2002	Diptera	Tipulidae	6

Table 41. Cont.

Meadow Creek	4/26/2003	Annelida	Oligochaeta	7
Meadow Creek	4/26/2003	Ephemeroptera	Ephemerellidae	63
Meadow Creek	4/26/2003	Ephemeroptera	Heptageniidae	1
Meadow Creek	4/26/2003	Ephemeroptera	Ameletidae	1
Meadow Creek	4/26/2003	Ephemeroptera	Baetidae	2
Meadow Creek	4/26/2003	Ephemeroptera	Leptophlebiidae	3
Meadow Creek	4/26/2003	Plecoptera	Chloroperlidae	4
Meadow Creek	4/26/2003	Plecoptera	Nemouridae	4
Meadow Creek	4/26/2003	Plecoptera	Perlodidae	15
Meadow Creek	4/26/2003	Trichoptera	Limnephilidae	1
Meadow Creek	4/26/2003	Trichoptera	Hydropsychidae	3
Meadow Creek	4/26/2003	Megaloptera	Corydalidae	1
Meadow Creek	4/26/2003	Coleoptera	Psephenidae	4
Meadow Creek	4/26/2003	Coleoptera	Elmidae	1
Meadow Creek	4/26/2003	Diptera	Chironomidae	23
Meadow Creek	4/26/2003	Diptera	Simuliidae	75
Meadow Creek	4/26/2003	Odonata	Gomphidae	2
Meadow Creek	4/26/2003	Isopoda		9
Shock Run	4/26/2003	Ephemeroptera	Ephemerellidae	75
Shock Run	4/26/2003	Ephemeroptera	Heptageniidae	21
Shock Run	4/26/2003	Ephemeroptera	Baetidae	4
Shock Run	4/26/2003	Ephemeroptera	Isonychiidae	4
Shock Run	4/26/2003	Ephemeroptera	Leptophlebiidae	40
Shock Run	4/26/2003	Plecoptera	Perlodidae	3
Shock Run	4/26/2003	Plecoptera	Perlidae	8
Shock Run	4/26/2003	Plecoptera	Chloroperlidae	11
Shock Run	4/26/2003	Plecoptera	Nemouridae	10
Shock Run	4/26/2003	Trichoptera	Polycentropodidae	1
Shock Run	4/26/2003	Trichoptera	Hydropsychidae	6
Shock Run	4/26/2003	Megaloptera	Corydalidae	1
Shock Run	4/26/2003	Coleoptera	Elmidae	4
Shock Run	4/26/2003	Coleoptera	Psephenidae	4
Shock Run	4/26/2003	Diptera	Chironomidae	32
Shock Run	4/26/2003	Diptera	Simuliidae	13
Shock Run	4/26/2003	Diptera	Tipulidae	5
Shock Run	4/26/2003	Diptera	Empididae	1
Shock Run	4/26/2003	Decapoda		2
Shock Run	4/26/2003	Odonata	Gomphidae	3
Thorny Creek	4/26/2003	Ephemeroptera	Ephemerellidae	13
Thorny Creek	4/26/2003	Ephemeroptera	Ameletidae	1
Thorny Creek	4/26/2003	Ephemeroptera	Heptageniidae	7
Thorny Creek	4/26/2003	Ephemeroptera	Leptophlebiidae	11
Thorny Creek	4/26/2003	Plecoptera	Capniidae	2
Thorny Creek	4/26/2003	Plecoptera	Perlodidae	23
Thorny Creek	4/26/2003	Plecoptera	Nemouridae	5
Thorny Creek	4/26/2003	Trichoptera	Limnephilidae	38
Thorny Creek	4/26/2003	Trichoptera	Hydropsychidae	11
Thorny Creek	4/26/2003	Trichoptera	Philopotamidae	1

Thorny Creek	4/26/2003	Coleoptera	Psephenidae	3

Table 41. Cont.

Thorny Creek	4/26/2003	Coleoptera	Elmidae	15
Thorny Creek	4/26/2003	Diptera	Chironomidae	41
Thorny Creek	4/26/2003	Diptera	Simuliidae	44
Thorny Creek	4/26/2003	Diptera	Tabanidae	1
Thorny Creek	4/26/2003	Diptera	Tipulidae	1
Thorny Creek	4/26/2003	Odonata	Gomphidae	1
Toney Fork	4/26/2003	Annelida	Oligochaeta	1
Toney Fork	4/26/2003	Ephemeroptera	Ephemerellidae	1
Toney Fork	4/26/2003	Plecoptera	Nemouridae	12
Toney Fork	4/26/2003	Trichoptera	Hydropsychidae	32
Toney Fork	4/26/2003	Coleoptera	Elmidae	3
Toney Fork	4/26/2003	Diptera	Chironomidae	163
Toney Fork	4/26/2003	Diptera	Tipulidae	1
Toney Fork	4/26/2003	Diptera	Empididae	13
Cane Fork	4/26/2003	Coleoptera	Elmidae	1
Cane Fork	4/26/2003	Diptera	Chironomidae	157
Cane Fork	4/26/2003	Diptera	Tipulidae	1
Cane Fork	4/26/2003	Diptera	Ceratopogonidae	2
Little Stonecoal	4/26/2003	Annelida	Oligochaeta	1
Little Stonecoal	4/26/2003	Ephemeroptera	Heptageniidae	8
Little Stonecoal	4/26/2003	Plecoptera	Perlodidae	15
Little Stonecoal	4/26/2003	Plecoptera	Chloroperlidae	5
Little Stonecoal	4/26/2003	Plecoptera	Nemouridae	18
Little Stonecoal	4/26/2003	Trichoptera	Hydropsychidae	9
Little Stonecoal	4/26/2003	Coleoptera	Elmidae	36
Little Stonecoal	4/26/2003	Coleoptera	Psephenidae	1
Little Stonecoal	4/26/2003	Diptera	Chironomidae	89
Little Stonecoal	4/26/2003	Diptera	Empididae	20
Little Stonecoal	4/26/2003	Diptera	Tipulidae	2
Little Stonecoal	4/26/2003	Diptera	Simuliidae	2
Little Stonecoal	4/26/2003	Bivalvia	Sphaeriidae	5
Lindy Run	4/26/2003	Annelida	Oligochaeta	2
Lindy Run	4/26/2003	Ephemeroptera	Ephemerellidae	3
Lindy Run	4/26/2003	Ephemeroptera	Caenidae	1
Lindy Run	4/26/2003	Ephemeroptera	Ameletidae	13
Lindy Run	4/26/2003	Plecoptera	Capniidae	119
Lindy Run	4/26/2003	Plecoptera	Nemouridae	48
Lindy Run	4/26/2003	Plecoptera	Perlodidae	2
Lindy Run	4/26/2003	Trichoptera	Polycentropodidae	14
Lindy Run	4/26/2003	Diptera	Simuliidae	11
Lindy Run	4/26/2003	Diptera	Tipulidae	1
Lindy Run	4/26/2003	Diptera	Chironomidae	7
Mill Creek	4/26/2003	Annelida	Oligochaeta	1
Mill Creek	4/26/2003	Ephemeroptera	Ephemerellidae	96
Mill Creek	4/26/2003	Ephemeroptera	Ephemeridae	1
Mill Creek	4/26/2003	Ephemeroptera	Baetidae	1
Mill Creek	4/26/2003	Ephemeroptera	Ameletidae	2
Mill Creek	4/26/2003	Ephemeroptera	Heptageniidae	1

Mill Creek	4/26/2003	Plecoptera	Nemouridae	1

Table 41. Cont.

Mill Creek	4/26/2003	Trichoptera	Hydropsychidae	16
Mill Creek	4/26/2003	Megaloptera	Corydalidae	1
Mill Creek	4/26/2003	Coleoptera	Elmidae	2
Mill Creek	4/26/2003	Diptera	Chironomidae	81
Mill Creek	4/26/2003	Diptera	Empididae	2
Mill Creek	4/26/2003	Coleoptera	Simuliidae	10
Mill Creek	4/26/2003	Diptera	Tipulidae	2
Mill Creek	4/26/2003	Gastropoda		2
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Ephemeroptera	Ephemerellidae	53
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Ephemeroptera	Heptageniidae	53
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Ephemeroptera	Baetidae	8
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Ephemeroptera	Leptophlebiidae	8
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Ephemeroptera	Ameletidae	2
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Plecoptera	Peltoperlidae	1
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Plecoptera	Capniidae	1
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Plecoptera	Perlodidae	1
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Plecoptera	Perlidae	2
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Plecoptera	Nemouridae	4
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Trichoptera	Hydropsychidae	8
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Megaloptera	Corydalidae	1
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Coleoptera	Elmidae	11
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Diptera	Chironomidae	17
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Diptera	Simuliidae	32
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Diptera	Athericidae	2
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Diptera	Tipulidae	5
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Decapoda		1
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Odonata	Gomphidae	1
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Ephemeroptera	Isonychiidae	2
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	Ephemeroptera	Potamanthidae	1
Buffalo Creek	4/26/2003	Ephemeroptera	Ephemerellidae	2
Buffalo Creek	4/26/2003	Plecoptera	Chloroperlidae	4

Buffalo Creek	4/26/2003	Plecoptera	Perlidae	2

Table 41. Cont.

Buffalo Creek	4/26/2003	Trichoptera	Polycentropodidae	1
Buffalo Creek	4/26/2003	Trichoptera	Hydropsychidae	3
Buffalo Creek	4/26/2003	Diptera	Empididae	1
Buffalo Creek	4/26/2003	Diptera	Tipulidae	1
Buffalo Creek	4/26/2003	Diptera	Chironomidae	10
Shock Run	4/26/2003	Ephemeroptera	Ephemerellidae	32
Shock Run	4/26/2003	Ephemeroptera	Heptageniidae	15
Shock Run	4/26/2003	Ephemeroptera	Baetidae	10
Shock Run	4/26/2003	Ephemeroptera	Leptophlebiidae	37
Shock Run	4/26/2003	Plecoptera	Nemouridae	8
Shock Run	4/26/2003	Plecoptera	Capniidae	8
Shock Run	4/26/2003	Plecoptera	Perlidae	2
Shock Run	4/26/2003	Plecoptera	Chloroperlidae	3
Shock Run	4/26/2003	Trichoptera	Hydropsychidae	9
Shock Run	4/26/2003	Trichoptera	Philopotamidae	2
Shock Run	4/26/2003	Megaloptera	Corydalidae	3
Shock Run	4/26/2003	Coleoptera	Elmidae	3
Shock Run	4/26/2003	Diptera	Chironomidae	52
Shock Run	4/26/2003	Diptera	Tipulidae	6
Shock Run	4/26/2003	Diptera	Blephariceridae	1
Shock Run	4/26/2003	Diptera	Simuliidae	22
Howard Creek	4/26/2003	Annelida	Oligochaeta	1
Howard Creek	4/26/2003	Ephemeroptera	Heptageniidae	8
Howard Creek	4/26/2003	Ephemeroptera	Ephemerellidae	39
Howard Creek	4/26/2003	Ephemeroptera	Isonychiidae	1
Howard Creek	4/26/2003	Ephemeroptera	Baetidae	23
Howard Creek	4/26/2003	Plecoptera	Perlodidae	2
Howard Creek	4/26/2003	Plecoptera	Chloroperlidae	1
Howard Creek	4/26/2003	Plecoptera	Nemouridae	10
Howard Creek	4/26/2003	Trichoptera	Hydropsychidae	9
Howard Creek	4/26/2003	Coleoptera	Psephenidae	7
Howard Creek	4/26/2003	Diptera	Chironomidae	50
Howard Creek	4/26/2003	Diptera	Empididae	1
Howard Creek	4/26/2003	Diptera	Simuliidae	5
Howard Creek	4/26/2003	Amphipoda		58
Howard Creek	4/26/2003	Odonata	Gomphidae	1
Deakin Run	4/26/2003	Ephemeroptera	Heptageniidae	3
Deakin Run	4/26/2003	Ephemeroptera	Ephemerellidae	1
Deakin Run	4/26/2003	Ephemeroptera	Ameletidae	11
Deakin Run	4/26/2003	Ephemeroptera	Leptophlebiidae	7
Deakin Run	4/26/2003	Plecoptera	Leuctridae	8
Deakin Run	4/26/2003	Plecoptera	Pteronarcyidae	1
Deakin Run	4/26/2003	Plecoptera	Perlodidae	2
Deakin Run	4/26/2003	Plecoptera	Nemouridae	8
Deakin Run	4/26/2003	Plecoptera	Perlidae	5
Deakin Run	4/26/2003	Trichoptera	Hydropsychidae	22
Deakin Run	4/26/2003	Trichoptera	Polycentropodidae	1
Deakin Run	4/26/2003	Trichoptera	Philopotamidae	2

Deakin Run	4/26/2003	Megaloptera	Corydalidae	4

Table 41. Cont.

Deakin Run	4/26/2003	Coleoptera	Elmidae	7
Deakin Run	4/26/2003	Diptera	Chironomidae	81
Deakin Run	4/26/2003	Diptera	Simuliidae	15
Deakin Run	4/26/2003	Diptera	Empididae	3
Deakin Run	4/26/2003	Diptera	Tipulidae	2
Deakin Run	4/26/2003	Odonata	Gomphidae	1
Deakin Run	4/26/2003	Plecoptera	Chloroperlidae	1
Deakin Run	4/26/2003	Plecoptera	Peltoperlidae	1
Cross Creek	4/26/2003	Annelida	Oligochaeta	3
Cross Creek	4/26/2003	Ephemeroptera	Isonychiidae	2
Cross Creek	4/26/2003	Ephemeroptera	Ephemerellidae	6
Cross Creek	4/26/2003	Ephemeroptera	Caenidae	3
Cross Creek	4/26/2003	Ephemeroptera	Ameletidae	3
Cross Creek	4/26/2003	Plecoptera	Nemouridae	1
Cross Creek	4/26/2003	Trichoptera	Hydropsychidae	8
Cross Creek	4/26/2003	Coleoptera	Elmidae	21
Cross Creek	4/26/2003	Diptera	Chironomidae	140
Cross Creek	4/26/2003	Diptera	Simuliidae	28
Cross Creek	4/26/2003	Diptera	Empididae	7
Grave Creek	4/26/2003	Annelida	Oligochaeta	3
Grave Creek	4/26/2003	Ephemeroptera	Heptageniidae	2
Grave Creek	4/26/2003	Ephemeroptera	Ephemerellidae	6
Grave Creek	4/26/2003	Ephemeroptera	Caenidae	1
Grave Creek	4/26/2003	Plecoptera	Leuctridae	1
Grave Creek	4/26/2003	Plecoptera	Perlidae	1
Grave Creek	4/26/2003	Plecoptera	Taeniopterygidae	1
Grave Creek	4/26/2003	Plecoptera	Nemouridae	2
Grave Creek	4/26/2003	Trichoptera	Hydropsychidae	5
Grave Creek	4/26/2003	Trichoptera	Psychomyiidae	1
Grave Creek	4/26/2003	Megaloptera	Corydalidae	1
Grave Creek	4/26/2003	Coleoptera	Elmidae	18
Grave Creek	4/26/2003	Coleoptera	Psephenidae	2
Grave Creek	4/26/2003	Diptera	Chironomidae	174
Grave Creek	4/26/2003	Diptera	Simuliidae	3
Grave Creek	4/26/2003	Diptera	Empididae	1
Condon Run	4/26/2003	Annelida	Oligochaeta	1
Condon Run	4/26/2003	Ephemeroptera	Heptageniidae	5
Condon Run	4/26/2003	Ephemeroptera	Ameletidae	16
Condon Run	4/26/2003	Plecoptera	Capniidae	78
Condon Run	4/26/2003	Plecoptera	Perlodidae	5
Condon Run	4/26/2003	Plecoptera	Chloroperlidae	3
Condon Run	4/26/2003	Plecoptera	Nemouridae	89
Condon Run	4/26/2003	Trichoptera	Psychomyiidae	38
Condon Run	4/26/2003	Trichoptera	Philopotamidae	2
Condon Run	4/26/2003	Trichoptera	Hydropsychidae	3
Condon Run	4/26/2003	Trichoptera	Polycentropodidae	1
Condon Run	4/26/2003	Coleoptera	Elmidae	1
Condon Run	4/26/2003	Diptera	Chironomidae	10

Condon Run	4/26/2003	Diptera	Tipulidae	1

Table 41. Cont.

Condon Run	4/26/2003	Diptera	Simuliidae	10
Condon Run	4/26/2003	Collembola	Entomobryidae	1
Saltlick Creek	4/26/2003	Annelida	Oligochaeta	6
Saltlick Creek	4/26/2003	Ephemeroptera	Ephemerellidae	5
Saltlick Creek	4/26/2003	Ephemeroptera	Ameletidae	2
Saltlick Creek	4/26/2003	Ephemeroptera	Heptageniidae	6
Saltlick Creek	4/26/2003	Ephemeroptera	Leptophlebiidae	4
Saltlick Creek	4/26/2003	Plecoptera	Perlidae	9
Saltlick Creek	4/26/2003	Plecoptera	Capniidae	7
Saltlick Creek	4/26/2003	Plecoptera	Nemouridae	22
Saltlick Creek	4/26/2003	Plecoptera	Perlodidae	9
Saltlick Creek	4/26/2003	Trichoptera	Psychomyiidae	1
Saltlick Creek	4/26/2003	Coleoptera	Elmidae	8
Saltlick Creek	4/26/2003	Diptera	Chironomidae	94
Saltlick Creek	4/26/2003	Diptera	Simuliidae	45
Saltlick Creek	4/26/2003	Diptera	Tabanidae	1
Emory Creek	4/26/2003	Plecoptera	Perlodidae	1
Emory Creek	4/26/2003	Trichoptera	Hydropsychidae	2
Emory Creek	4/26/2003	Diptera	Chironomidae	11
Emory Creek	4/26/2003	Diptera	Tipulidae	1
Tuscarora Creek	4/26/2003	Annelida	Oligochaeta	2
Tuscarora Creek	4/26/2003	Ephemeroptera	Heptageniidae	6
Tuscarora Creek	4/26/2003	Ephemeroptera	Ephemerellidae	10
Tuscarora Creek	4/26/2003	Trichoptera	Hydropsychidae	15
Tuscarora Creek	4/26/2003	Trichoptera	Philopotamidae	14
Tuscarora Creek	4/26/2003	Coleoptera	Elmidae	27
Tuscarora Creek	4/26/2003	Diptera	Chironomidae	131
Tuscarora Creek	4/26/2003	Diptera	Simuliidae	10
Tuscarora Creek	4/26/2003	Diptera	Tabanidae	2
Tuscarora Creek	4/26/2003	Diptera	Tipulidae	2
Tuscarora Creek	4/26/2003	Diptera	Empididae	4
Tuscarora Creek	4/26/2003	Decapoda		1
Tuscarora Creek	4/26/2003	Isopoda		4
Tuscarora Creek	4/26/2003	Diptera	Ceratopogonidae	1
Lunice Creek	4/26/2003	Ephemeroptera	Caenidae	2
Lunice Creek	4/26/2003	Ephemeroptera	Ephemerellidae	120
Lunice Creek	4/26/2003	Ephemeroptera	Isonychiidae	19
Lunice Creek	4/26/2003	Ephemeroptera	Heptageniidae	1
Lunice Creek	4/26/2003	Ephemeroptera	Baetidae	23
Lunice Creek	4/26/2003	Plecoptera	Nemouridae	7
Lunice Creek	4/26/2003	Trichoptera	Hydropsychidae	10
Lunice Creek	4/26/2003	Trichoptera	Psychomyiidae	2
Lunice Creek	4/26/2003	Megaloptera	Corydalidae	1
Lunice Creek	4/26/2003	Coleoptera	Elmidae	4
Lunice Creek	4/26/2003	Coleoptera	Psephenidae	7
Lunice Creek	4/26/2003	Diptera	Tabanidae	1
Lunice Creek	4/26/2003	Diptera	Tipulidae	11
Lunice Creek	4/26/2003	Diptera	Simuliidae	5

Lunice Creek	4/26/2003	Diptera	Empididae	1

Table 41. Cont.

Lunice Creek	4/26/2003	Diptera	Chironomidae	20
Lunice Creek	4/26/2003	Odonata	Gomphidae	1
Church Run	4/25/2003	Plecoptera	Capniidae	3
Church Run	4/25/2003	Trichoptera	Psychomyiidae	1
Church Run	4/25/2003	Diptera	Chironomidae	20
Church Run	4/25/2003	Diptera	Tipulidae	2
Church	8/17/2003	Megaloptera	Sialidae	2
Church	8/17/2003	Diptera	Chironomidae	242
Church	8/17/2003	Diptera	Ceratopogonidae	1
Mill Creek	8/17/2003	Ephemeroptera	Tricorythidae	1
Mill Creek	8/17/2003	Ephemeroptera	Baetidae	11
Mill Creek	8/17/2003	Ephemeroptera	Heptageniidae	1
Mill Creek	8/17/2003	Trichoptera	Hydropsychidae	75
Mill Creek	8/17/2003	Trichoptera	Philopotamidae	1
Mill Creek	8/17/2003	Megaloptera	Corydalidae	3
Mill Creek	8/17/2003	Coleoptera	Elmidae	52
Mill Creek	8/17/2003	Diptera	Chironomidae	53
Mill Creek	8/17/2003	Diptera	Empididae	16
Mill Creek	8/17/2003	Diptera	Tipulidae	13
Meadow Creek	8/15/2003	Ephemeroptera	Heptageniidae	9
Meadow Creek	8/15/2003	Ephemeroptera	Leptophlebiidae	20
Meadow Creek	8/15/2003	Ephemeroptera	Isonychiidae	6
Meadow Creek	8/15/2003	Ephemeroptera	Baetidae	23
Meadow Creek	8/15/2003	Plecoptera	Perlidae	11
Meadow Creek	8/15/2003	Plecoptera	Perlodidae	3
Meadow Creek	8/15/2003	Plecoptera	Pteronarcyidae	1
Meadow Creek	8/15/2003	Plecoptera	Capniidae	8
Meadow Creek	8/15/2003	Trichoptera	Psychomyiidae	35
Meadow Creek	8/15/2003	Trichoptera	Hydropsychidae	38
Meadow Creek	8/15/2003	Megaloptera	Corydalidae	15
Meadow Creek	8/15/2003	Coleoptera	Psephenidae	4
Meadow Creek	8/15/2003	Coleoptera	Elmidae	4
Meadow Creek	8/15/2003	Diptera	Chironomidae	27
Meadow Creek	8/15/2003	Diptera	Tipulidae	5
Meadow Creek	8/15/2003	Diptera	Empididae	4
Meadow Creek	8/15/2003	Diptera	Simuliidae	3
Meadow Creek	8/15/2003	Odonata	Gomphidae	1
Meadow Creek	8/15/2003	Odonata	Aeshnidae	1
Meadow Creek	8/15/2003	Decapoda		1
Cane Fork	8/16/2003	Ephemeroptera	Baetidae	1
Cane Fork	8/16/2003	Plecoptera	Capniidae	4
Cane Fork	8/16/2003	Trichoptera	Psychomyiidae	1
Cane Fork	8/16/2003	Trichoptera	Hydropsychidae	4
Cane Fork	8/16/2003	Megaloptera	Corydalidae	2
Cane Fork	8/16/2003	Coleoptera	Elmidae	3
Cane Fork	8/16/2003	Diptera	Chironomidae	37
Cane Fork	8/16/2003	Diptera	Tabanidae	1
Cane Fork	8/16/2003	Diptera	Simuliidae	1

Thorny Creek	8/16/2003	Ephemeroptera	Ephemeridae	1

Table 41. Cont.

Thorny Creek	8/16/2003	Ephemeroptera	Baetidae	14
Thorny Creek	8/16/2003	Ephemeroptera	Leptophlebiidae	3
Thorny Creek	8/16/2003	Ephemeroptera	Heptageniidae	1
Thorny Creek	8/16/2003	Plecoptera	Perlodidae	2
Thorny Creek	8/16/2003	Plecoptera	Capniidae	27
Thorny Creek	8/16/2003	Trichoptera	Hydropsychidae	64
Thorny Creek	8/16/2003	Trichoptera	Limnephilidae	1
Thorny Creek	8/16/2003	Trichoptera	Glossosomatidae	7
Thorny Creek	8/16/2003	Trichoptera	Philopotamidae	3
Thorny Creek	8/16/2003	Megaloptera	Corydalidae	3
Thorny Creek	8/16/2003	Coleoptera	Elmidae	27
Thorny Creek	8/16/2003	Coleoptera	Noteridae	1
Thorny Creek	8/16/2003	Coleoptera	Psephenidae	7
Thorny Creek	8/16/2003	Diptera	Athericidae	13
Thorny Creek	8/16/2003	Diptera	Chironomidae	19
Thorny Creek	8/16/2003	Diptera	Tipulidae	4
Thorny Creek	8/16/2003	Diptera	Tabanidae	13
Thorny Creek	8/16/2003	Gastropoda		6
Thorny Creek	8/16/2003	Odonata	Aeshnidae	3
Thorny Creek	8/16/2003	Decapoda		2
Emory Creek	8/17/2003	Plecoptera	Capniidae	6
Emory Creek	8/17/2003	Trichoptera	Hydropsychidae	27
Emory Creek	8/17/2003	Trichoptera	Psychomyiidae	3
Emory Creek	8/17/2003	Megaloptera	Corydalidae	1
Emory Creek	8/17/2003	Coleoptera	Elmidae	2
Emory Creek	8/17/2003	Diptera	Chironomidae	13
Emory Creek	8/17/2003	Diptera	Empididae	1
Emory Creek	8/17/2003	Diptera	Simuliidae	6
Condon Run	8/17/2003	Ephemeroptera	Heptageniidae	7
Condon Run	8/17/2003	Ephemeroptera	Baetidae	1
Condon Run	8/17/2003	Ephemeroptera	Ameletidae	3
Condon Run	8/17/2003	Ephemeroptera	Caenidae	5
Condon Run	8/17/2003	Plecoptera	Capniidae	102
Condon Run	8/17/2003	Plecoptera	Perlodidae	12
Condon Run	8/17/2003	Plecoptera	Nemouridae	4
Condon Run	8/17/2003	Trichoptera	Psychomyiidae	36
Condon Run	8/17/2003	Trichoptera	Hydropsychidae	16
Condon Run	8/17/2003	Diptera	Chironomidae	19
Condon Run	8/17/2003	Diptera	Empididae	1
Condon Run	8/17/2003	Diptera	Simuliidae	7
Condon Run	8/17/2003	Amphipoda		1
Condon Run	8/17/2003	Decapoda		2
Toney Fork	8/15/2003	Ephemeroptera	Baetidae	12
Toney Fork	8/15/2003	Plecoptera	Capniidae	12
Toney Fork	8/15/2003	Trichoptera	Hydropsychidae	108
Toney Fork	8/15/2003	Trichoptera	Philopotamidae	1
Toney Fork	8/15/2003	Trichoptera	Rhyacophilidae	1
Toney Fork	8/15/2003	Megaloptera	Corydalidae	6

Toney Fork	8/15/2003	Coleoptera	Elmidae	17

Table 41. Cont.

Toney Fork	8/15/2003	Diptera	Chironomidae	34
Toney Fork	8/15/2003	Diptera	Empididae	29
Toney Fork	8/15/2003	Diptera	Simuliidae	1
Toney Fork	8/15/2003	Diptera	Athericidae	1
Toney Fork	8/15/2003	Diptera	Tipulidae	1
Toney Fork	8/15/2003	Collembola		1
Lindy Run	8/16/2003	Ephemeroptera	Heptageniidae	35
Lindy Run	8/16/2003	Ephemeroptera	Ameletidae	1
Lindy Run	8/16/2003	Plecoptera	Capniidae	109
Lindy Run	8/16/2003	Plecoptera	Perlodidae	5
Lindy Run	8/16/2003	Plecoptera	Nemouridae	11
Lindy Run	8/16/2003	Trichoptera	Psychomyiidae	28
Lindy Run	8/16/2003	Trichoptera	Hydropsychidae	4
Lindy Run	8/16/2003	Diptera	Chironomidae	17
Lindy Run	8/16/2003	Diptera	Athericidae	7
Howard Creek	8/16/2003	Annelida	Oligochaeta	5
Howard Creek	8/16/2003	Ephemeroptera	Heptageniidae	43
Howard Creek	8/16/2003	Ephemeroptera	Isonychiidae	20
Howard Creek	8/16/2003	Ephemeroptera	Baetidae	14
Howard Creek	8/16/2003	Ephemeroptera	Leptophlebiidae	5
Howard Creek	8/16/2003	Ephemeroptera	Caenidae	4
Howard Creek	8/16/2003	Plecoptera	Capniidae	2
Howard Creek	8/16/2003	Plecoptera	Perlodidae	3
Howard Creek	8/16/2003	Trichoptera	Hydropsychidae	37
Howard Creek	8/16/2003	Trichoptera	Philopotamidae	3
Howard Creek	8/16/2003	Megaloptera	Corydalidae	8
Howard Creek	8/16/2003	Coleoptera	Dytiscidae	1
Howard Creek	8/16/2003	Coleoptera	Hydrophilidae	1
Howard Creek	8/16/2003	Coleoptera	Elmidae	3
Howard Creek	8/16/2003	Coleoptera	Psephenidae	5
Howard Creek	8/16/2003	Diptera	Chironomidae	46
Howard Creek	8/16/2003	Diptera	Tipulidae	1
Howard Creek	8/16/2003	Diptera	Simuliidae	6
Howard Creek	8/16/2003	Isopoda		1
Howard Creek	8/16/2003	Decapoda		1
Howard Creek	8/16/2003	Odonata	Gomphidae	3
Howard Creek	8/16/2003	Coleoptera	Noteridae	3
Tuscarora CreeK	8/17/2003	Annelida	Oligochaeta	1
Tuscarora CreeK	8/17/2003	Ephemeroptera	Baetidae	7
Tuscarora CreeK	8/17/2003	Ephemeroptera	Heptageniidae	1
Tuscarora CreeK	8/17/2003	Ephemeroptera	Ephemerellidae	1
Tuscarora CreeK	8/17/2003	Trichoptera	Hydropsychidae	7
Tuscarora CreeK	8/17/2003	Trichoptera	Philopotamidae	4
Tuscarora CreeK	8/17/2003	Coleoptera	Elmidae	30
Tuscarora CreeK	8/17/2003	Diptera	Simuliidae	154
Tuscarora CreeK	8/17/2003	Diptera	Chironomidae	31
Tuscarora CreeK	8/17/2003	Diptera	Empididae	1
Tuscarora CreeK	8/17/2003	Decapoda		1

Tuscarora CreeK	8/17/2003	Isopoda		3

Table 41. Cont.

Deakin Run	8/16/2003	Ephemeroptera	Ameletidae	11
Deakin Run	8/16/2003	Ephemeroptera	Baetidae	10
Deakin Run	8/16/2003	Ephemeroptera	Leptophlebiidae	2
Deakin Run	8/16/2003	Plecoptera	Capniidae	27
Deakin Run	8/16/2003	Plecoptera	Perlidae	4
Deakin Run	8/16/2003	Trichoptera	Hydropsychidae	130
Deakin Run	8/16/2003	Trichoptera	Philopotamidae	8
Deakin Run	8/16/2003	Plecoptera	Peltoperlidae	2
Deakin Run	8/16/2003	Megaloptera	Corydalidae	3
Deakin Run	8/16/2003	Coleoptera	Elmidae	3
Deakin Run	8/16/2003	Diptera	Chironomidae	42
Deakin Run	8/16/2003	Diptera	Simuliidae	10
Deakin Run	8/16/2003	Diptera	Athericidae	5
Deakin Run	8/16/2003	Diptera	Tipulidae	2
Deakin Run	8/16/2003	Diptera	Empididae	7
Deakin Run	8/16/2003	Decapoda		1
Stonecoal creek	8/16/2003	Ephemeroptera	Heptageniidae	11
Stonecoal creek	8/16/2003	Ephemeroptera	Baetidae	2
Stonecoal creek	8/16/2003	Ephemeroptera	Caenidae	2
Stonecoal creek	8/16/2003	Plecoptera	Perlodidae	3
Stonecoal creek	8/16/2003	Trichoptera	Hydropsychidae	14
Stonecoal creek	8/16/2003	Trichoptera	Philopotamidae	2
Stonecoal creek	8/16/2003	Coleoptera	Elmidae	7
Stonecoal creek	8/16/2003	Coleoptera	Noteridae	1
Stonecoal creek	8/16/2003	Diptera	Chironomidae	155
Stonecoal creek	8/16/2003	Diptera	Athericidae	1
Stonecoal creek	8/16/2003	Diptera	Simuliidae	8
Stonecoal creek	8/16/2003	Diptera	Empididae	5
Stonecoal creek	8/16/2003	Isopoda		2
Hurricane Creek	8/15/2003	Annelida	Oligochaeta	1
Hurricane Creek	8/15/2003	Ephemeroptera	Isonychiidae	1
Hurricane Creek	8/15/2003	Ephemeroptera	Heptageniidae	1
Hurricane Creek	8/15/2003	Trichoptera	Hydropsychidae	57
Hurricane Creek	8/15/2003	Coleoptera	Elmidae	4
Hurricane Creek	8/15/2003	Diptera	Chironomidae	139
Hurricane Creek	8/15/2003	Diptera	Simuliidae	7
Hurricane Creek	8/15/2003	Diptera	Ceratopogonidae	1
Hurricane Creek	8/15/2003	Odonata	Calopterygidae	1
Hurricane Creek	8/15/2003	Bivalvia	Sphaeriidae	3
Cross CreeK	8/17/2003	Ephemeroptera	Isonychiidae	5
Cross CreeK	8/17/2003	Ephemeroptera	Baetidae	1
Cross CreeK	8/17/2003	Ephemeroptera	Caenidae	3
Cross CreeK	8/17/2003	Plecoptera	Capniidae	7
Cross CreeK	8/17/2003	Trichoptera	Hydropsychidae	78
Cross CreeK	8/17/2003	Trichoptera	Philopotamidae	1
Cross CreeK	8/17/2003	Megaloptera	Corydalidae	1
Cross CreeK	8/17/2003	Coleoptera	Elmidae	7
Cross CreeK	8/17/2003	Diptera	Chironomidae	128

Cross CreeK	8/17/2003	Diptera	Simuliidae	1

Table 41. Cont.

Cross CreeK	8/17/2003	Diptera	Tipulidae	3
Cross CreeK	8/17/2003	Amphipoda		2
Lunice Creek	8/17/2003	Annelida	Oligochaeta	1
Lunice Creek	8/17/2003	Ephemeroptera	Isonychiidae	35
Lunice Creek	8/17/2003	Ephemeroptera	Heptageniidae	2
Lunice Creek	8/17/2003	Ephemeroptera	Caenidae	1
Lunice Creek	8/17/2003	Ephemeroptera	Baetidae	9
Lunice Creek	8/17/2003	Plecoptera	Pteronarcyidae	1
Lunice Creek	8/17/2003	Trichoptera	Hydropsychidae	100
Lunice Creek	8/17/2003	Trichoptera	Philopotamidae	7
Lunice Creek	8/17/2003	Megaloptera	Corydalidae	15
Lunice Creek	8/17/2003	Coleoptera	Elmidae	57
Lunice Creek	8/17/2003	Coleoptera	Psephenidae	1
Lunice Creek	8/17/2003	Diptera	Chironomidae	2
Lunice Creek	8/17/2003	Diptera	Tipulidae	2
Lunice Creek	8/17/2003	Diptera	Simuliidae	2
Lunice Creek	8/17/2003	Diptera	Empididae	1
Lunice Creek	8/17/2003	Diptera	Athericidae	2
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Ephemeroptera	Baetidae	19
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Ephemeroptera	Isonychiidae	3
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Ephemeroptera	Heptageniidae	1
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Plecoptera	Perlidae	32
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Plecoptera	Pteronarcyidae	13
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Plecoptera	Perlodidae	9
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Plecoptera	Capniidae	8
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Plecoptera	Peltoperlidae	3
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Trichoptera	Hydropsychidae	59
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Trichoptera	Polycentropodidae	5
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Trichoptera	Philopotamidae	14
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Megaloptera	Corydalidae	13
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Coleoptera	Psephenidae	5
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Coleoptera	Elmidae	14
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Diptera	Chironomidae	18
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Diptera	Tipulidae	13
LITTLE RIVER/EA	8/17/2003	Diptera	Athericidae	4

FK/GREENBRIER R

Table 41. Cont.

LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Diptera	Empididae	2
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Diptera	Simuliidae	5
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	Odonata	Gomphidae	1
Shock Run	8/17/2003	Ephemeroptera	Isonychiidae	25
Shock Run	8/17/2003	Ephemeroptera	Baetidae	11
Shock Run	8/17/2003	Ephemeroptera	Heptageniidae	15
Shock Run	8/17/2003	Plecoptera	Perlidae	12
Shock Run	8/17/2003	Plecoptera	Perlodidae	1
Shock Run	8/17/2003	Trichoptera	Philopotamidae	65
Shock Run	8/17/2003	Trichoptera	Hydropsychidae	28
Shock Run	8/17/2003	Megaloptera	Corydalidae	3
Shock Run	8/17/2003	Coleoptera	Elmidae	16
Shock Run	8/17/2003	Coleoptera	Psephenidae	3
Shock Run	8/17/2003	Diptera	Chironomidae	16
Shock Run	8/17/2003	Diptera	Athericidae	6
Shock Run	8/17/2003	Diptera	Simuliidae	28
Shock Run	8/17/2003	Diptera	Empididae	1
Shock Run	8/17/2003	Odonata	Gomphidae	2
Shock Run	8/17/2003	Decapoda		3
Poplar Fork	8/15/2003	Ephemeroptera	Isonychiidae	32
Poplar Fork	8/15/2003	Ephemeroptera	Heptageniidae	3
Poplar Fork	8/15/2003	Ephemeroptera	Baetidae	32
Poplar Fork	8/15/2003	Trichoptera	Hydropsychidae	81
Poplar Fork	8/15/2003	Coleoptera	Elmidae	48
Poplar Fork	8/15/2003	Coleoptera	Psephenidae	3
Poplar Fork	8/15/2003	Diptera	Chironomidae	24
Poplar Fork	8/15/2003	Diptera	Tabanidae	3
Poplar Fork	8/15/2003	Diptera	Simuliidae	4
Poplar Fork	8/15/2003	Diptera	Tipulidae	1
Poplar Fork	8/15/2003	Decapoda		6
Buffalo Creek	8/15/2003	Plecoptera	Capniidae	1
Buffalo Creek	8/15/2003	Plecoptera	Perlidae	2
Buffalo Creek	8/15/2003	Trichoptera	Hydropsychidae	95
Buffalo Creek	8/15/2003	Trichoptera	Psychomyiidae	7
Buffalo Creek	8/15/2003	Trichoptera	Hydroptilidae	1
Buffalo Creek	8/15/2003	Trichoptera	Philopotamidae	4
Buffalo Creek	8/15/2003	Trichoptera	Glossosomatidae	2
Buffalo Creek	8/15/2003	Megaloptera	Corydalidae	3
Buffalo Creek	8/15/2003	Coleoptera	Elmidae	5
Buffalo Creek	8/15/2003	Coleoptera	Psephenidae	1
Buffalo Creek	8/15/2003	Diptera	Chironomidae	48
Buffalo Creek	8/15/2003	Diptera	Simuliidae	11
Buffalo Creek	8/15/2003	Diptera	Athericidae	12
Buffalo Creek	8/15/2003	Diptera	Empididae	26
Buffalo Creek	8/15/2003	Diptera	Tipulidae	3
Buffalo Creek	8/15/2003	Odonata	Gomphidae	2

Buffalo Creek	8/15/2003	Decapoda		1

Table 41. Cont.

Grave Creek	8/17/2003	Ephemeroptera	Heptageniidae	1
Grave Creek	8/17/2003	Ephemeroptera	Caenidae	9
Grave Creek	8/17/2003	Ephemeroptera	Baetidae	11
Grave Creek	8/17/2003	Plecoptera	Perlodidae	3
Grave Creek	8/17/2003	Plecoptera	Perlidae	2
Grave Creek	8/17/2003	Trichoptera	Hydropsychidae	51
Grave Creek	8/17/2003	Megaloptera	Corydalidae	4
Grave Creek	8/17/2003	Coleoptera	Elmidae	68
Grave Creek	8/17/2003	Coleoptera	Psephenidae	2
Grave Creek	8/17/2003	Diptera	Chironomidae	89
Grave Creek	8/17/2003	Diptera	Empididae	8
Grave Creek	8/17/2003	Diptera	Tipulidae	6
Grave Creek	8/17/2003	Diptera	Tabanidae	2
Grave Creek	8/17/2003	Decapoda		2
Big Horse Creek	8/15/2003	Annelida	Oligochaeta	6
Big Horse Creek	8/15/2003	Ephemeroptera	Ameletidae	2
Big Horse Creek	8/15/2003	Ephemeroptera	Baetidae	2
Big Horse Creek	8/15/2003	Ephemeroptera	Caenidae	3
Big Horse Creek	8/15/2003	Plecoptera	Capniidae	1
Big Horse Creek	8/15/2003	Trichoptera	Philopotamidae	1
Big Horse Creek	8/15/2003	Trichoptera	Hydropsychidae	26
Big Horse Creek	8/15/2003	Megaloptera	Corydalidae	8
Big Horse Creek	8/15/2003	Coleoptera	Elmidae	27
Big Horse Creek	8/15/2003	Diptera	Simuliidae	84
Big Horse Creek	8/15/2003	Diptera	Tipulidae	2
Big Horse Creek	8/15/2003	Diptera	Empididae	14
Big Horse Creek	8/15/2003	Diptera	Chironomidae	9
Big Horse Creek	8/15/2003	Odonata	Aeshnidae	3

Appendix H: WVSCI Scores

Table 42. WVSCI Information

StreamName	Date	TOTAL TAXA SCORE	EPT TAXA SCORE	EPT% SCORE	CHIRO % SCORE	DOM2 % SCORE	HBI SCORE	WVSCI
Shock Run	2/14/2003	90.48	146.15	44.49	59.70	72.3522167487685	73.41	73.40
Thorny Creek	2/14/2003	47.62	76.92	13.11	71.38	32.6305220883534	60.75	50.40
Howard Creek	2/14/2003	52.38	84.62	41.35	56.55	67.1875	74.51	62.77
Stonecoal Creek	2/14/2003	57.14	92.31	23.28	28.64	30.3171641791045	61.31	48.83
Meadow Creek	2/14/2003	90.48	146.15	83.59	92.73	84.5170454545455	101.09	91.88
Deakin Run	12/17/2002	61.90	100.00	65.09	80.24	84.9029680365297	85.86	79.67
Saltlick Creek	12/17/2002	57.14	92.31	96.55	94.35	33.744131455399	111.68	79.02
Church Run	12/17/2002	19.05	30.77	0.49	1.36	1.40134529147982	56.91	18.33
Tuscarora Creek	12/17/2002	57.14	92.31	49.33	79.89	79.8611111111111	80.69	73.20
Mill Creek	12/17/2002	57.14	92.31	99.58	95.13	45.3404017857143	99.53	81.51
LUNICE CK	12/17/2002	71.43	115.38	55.26	74.02	91.6230366492147	80.23	78.76
Grave Creek	12/18/2002	61.90	100.00	17.44	36.90	40.0641025641026	64.64	53.49
Cross Creek	12/18/2002	66.67	107.69	78.25	78.64	31.25	74.68	71.58

Table 42. Cont. WVSCI Information

StreamName	Date	TOTAL TAXA SCORE	EPT TAXA SCORE	EPT% SCORE	CHIRO % SCORE	DOM2 % SCORE	HBI SCORE	WVSCI
Church Run	4/25/2003	19.05	30.77	16.74	23.31	18.0288461538461	69.88	29.63
Grave Creek	4/26/2003	76.19	123.08	9.80	21.84	21.1148648648649	61.48	48.40
Mill Creek	4/26/2003	71.43	115.38	58.63	63.64	29.9657534246575	78.53	67.03
Lindy Run	4/26/2003	52.38	84.62	98.47	97.79	38.1787330316742	112.17	78.57
Howard Creek	4/26/2003	71.43	115.38	46.85	77.61	78.125	95.85	78.31
LITTLE RIVER/EA FK/GREENBRIER R	4/26/2003	100.00	161.54	73.22	92.97	78.8551401869159	85.36	88.40
Deakin Run	4/26/2003	100.00	161.54	42.71	57.01	69.7244623655914	77.39	74.47
Cross Creek	4/26/2003	52.38	84.62	11.27	37.30	38.0067567567568	61.60	47.53
Little Stonecoal	4/26/2003	61.90	100.00	28.36	58.39	63.6848341232227	72.89	64.21
Saltlick Creek	4/26/2003	66.67	107.69	32.30	57.64	57.0776255707763	72.74	64.40
Emory Creek	4/26/2003	19.05	30.77	21.76	26.93	20.8333333333333	64.79	30.69
Tuscarora Creek	4/26/2003	66.67	107.69	21.38	43.22	48.4443231441048	67.47	57.86
Lunice Creek	4/26/2003	80.95	130.77	85.20	92.39	61.1702127659574	91.52	85.21
Meadow Creek	4/26/2003	85.71	138.46	48.20	90.38	57.791095890411	79.30	76.90
Shock Run	4/26/2003	95.24	153.85	80.29	87.96	83.7953629032258	93.65	90.16
Thorny Creek	4/26/2003	80.95	130.77	55.90	82.00	95.3268348623853	79.40	82.26
Toney Fork	4/26/2003	38.10	61.54	21.67	28.15	21.4325221238938	61.82	38.78
Buffalo Creek	4/26/2003	38.10	61.54	54.41	58.91	65.1041666666667	80.99	59.84
Condon Run	4/26/2003	76.19	123.08	98.92	97.16	57.4100378787879	112.62	88.28

Table 42. Cont. WVSCI Information

StreamName	Date	TOTAL TAXA SCORE	EPT TAXA SCORE	EPT% SCORE	CHIRO % SCORE	DOM2 % SCORE	HBI SCORE	WVSCI
Buffalo Creek	8/15/2003	80.95	130.77	54.41	79.35	56.5011160714286	71.93	73.86
Hurricane Creek	8/15/2003	47.62	76.92	29.86	35.70	13.8081395348837	60.40	44.05
Toney Fork	8/15/2003	61.90	100.00	65.09	85.66	57.1986607142857	72.31	73.69
Poplar Fork	8/15/2003	52.38	84.62	67.95	90.76	71.2025316455696	81.30	74.70
Big Horse Creek	8/15/2003	66.67	107.69	20.26	96.16	63.9960106382979	63.83	68.48
Meadow Creek	8/15/2003	95.24	153.85	76.52	88.54	104.166666666667	89.59	91.65
Thorny Creek	8/16/2003	100.00	161.54	60.56	92.31	91.9117647058823	88.01	88.80
Stonecoal creek	8/16/2003	61.90	100.00	17.37	27.50	32.2769953051643	62.09	50.19
Deakin Run	8/16/2003	76.19	123.08	79.06	85.10	55.5945692883895	80.18	79.36
Howard Creek	8/16/2003	104.76	169.23	66.30	79.38	91.5697674418605	76.71	85.66
Lindy Run	8/16/2003	42.86	69.23	96.78	93.08	52.5633640552995	110.14	75.75
Cane Fork	8/16/2003	42.86	69.23	20.15	31.79	37.6157407407407	66.25	44.65
Shock Run	8/17/2003	76.19	123.08	72.70	94.11	94.4148936170213	87.98	87.57
Emory Creek	8/17/2003	38.10	61.54	66.39	78.74	50.3177966101695	74.00	61.51
Condon Run	8/17/2003	66.67	107.69	93.70	92.11	56.4236111111111	107.26	84.82
Tuscarora CreeK	8/17/2003	57.14	92.31	9.03	88.00	36.3070539419087	63.23	57.67
Cross CreeK	8/17/2003	57.14	92.31	43.62	46.45	20.4377637130802	66.50	54.41
LITTLE RIVER/EA FK/GREENBRIER R	8/17/2003	95.24	153.85	74.95	93.45	97.2510373443983	90.70	91.93
Grave Creek	8/17/2003	66.67	107.69	32.48	66.15	61.1676356589147	70.64	66.18
Mill Creek	8/17/2003	47.62	76.92	42.85	77.31	67.7544247787611	71.92	64.06
Lunice Creek	8/17/2003	76.19	123.08	70.87	100.14	53.1775210084034	81.73	80.33