A Survey of Eastside Ecosystem Benthic Invertebrates

Dr. Judith L. Li , Kristopher Wright

Oregon State University, Department of Fisheries and Wildlife

and

Dr. Joseph Furnish

Bureau of Land Management, Salem District

Submitted to the Eastside Ecosystem Management Project

March 1, 1995

Table of Contents

EXECUTIVE SUMMARY

By choosing assemblage measures that captured essential qualities of macroinvertebrate populations, we have been able to characterize the ranges of macroinvertebrate assemblage conditions on regional scales. Taxa richness, EPT taxa, EPT/Chironomids, total abundance, and percentage represented by the most dominant taxa, were used for our multivariate analyses. Principal components analysis provided a useful tool in making distinctions between stream assemblages in the Blue Mountain Eastern Cascade and Columbia Plateau ecoregions.

The Blue Mountains were most taxa-rich, with high numbers of intolerant taxa at best quality sites. When riverine samples were excluded, assemblage measures for the Columbia Plateau and High Desert were simliar to each other. A few high elevation streams in the Eastern Cascades, Blue Mountains, and Northern Rockies had the highest numbers of EPT taxa, high diversity and lower overall abundance. Very few taxa were ubiqutous over the entire basin and only a handful of taxa distinguished particular streams within ecoregions. The stonefly *Yoraperla*, mayflies *Drunella*, *Serratella*, or *Epeorus* characterized high elevation, presumably healthy streams. In the Columbia Plateau *Paraleptophlebia* was typical for disturbed streams.

Lmitations to our survey included small sample sizes and occasionally differences in sampling gear. Though we included 25 1 streams from 19 major sources of information conclusions were limited by the number and distribution of streams represented. It is essential to recognize that our analyses were made for particular streams, and do not generalize to streams for which we did not have data. The differences between streams in

close proximity demonstrated the importance of restricting distribution patterns to specific streams.

Nevertheless the database available for stream macroinvertebrates was extensive and made possible a basin-wide perspective of assemblages. We hope our survey will serve as a context for assessing new survey information on macroinvertebrate assemblages in the Columbia Basin. As more studies in a given area are identified, metrics and taxa lists can be compared with streams already identified for the appropriate ecoregion to estimate relative health of the invertebrate community. With appropriate information on physical and geomorphic stream attributes, macroinvertebrate assemblage characteristics have the potential for using information on individual streams to assess patterns across large regional expanses.

1.1 Introduction

The purpose of this report was to summarize available information about benthic invertebrates, excluding molluscs, for the Columbia River basin east of the the Cascade crest. Part of the challenge was to identify sources of information; thus, evaluating the kinds of data appropriate for this broad-scale approach became a portion of this final report. After identifying the divergent data sources, the next task was to organize them into managable, interpretable pieces of information. Most stream invertebrate surveys include great diversity; healthy streams generally have numerous taxa (often more than 100 species in any given sample) that are quite variable during a year. In addition the project area covers a vast landscape with a wide array of climatic, vegetative and hydraulic conditions. Our approach was to summarize invertebrate information into assemblage and life history characteristics, then attempt to associate those generalized descriptions with current landscape patterns.

We have organized the data according to aquatic ecoregions developed by Omemik and Gallant (1986)(Figure 1). This classification system helped to break the vast Eastside Columbia River basin into workable land bases and watersheds, grouped according to similarities in climate regimes, soils, geomorphology, and vegetation. Sometimes these factors coincided with landuse patterns. This form of organization crosses state and other jurisdictional lines, but provides a likely template for biological similarities. Seven ecoregions are included within the Eastside Ecosystem Management Project (Ecoregions 6, 7, 8, 9, 10, 11, 12 and 15); only the parts of ecoregion 12 within the project area were included.

The basic assemblage characterizations we used were: taxa diversity, relative abundances of different taxa, and sensitivity of taxa to stream degradation. High species diversity is generally considered an indicator of habitat diversity and healthy conditions (see Magurran 1988 for review). Biomonitoring studies of aquatic macroinvertebrate communities are usually restricted to comparisons of genera, rather than species, but the concept still applies. The interpretation of abundance is more ambiguous, but very high abundance coupled with low taxa diversity and high dominance by one or a few taxa generally indicates degraded habitat with loss in potential habitat diversity. EPT taxa (i.e., Ephemeroptera--mayflies, Plecoptera-stoneflies, and Trichoptera--caddisflies) generally are sensitive to low oxygen, high silt loads, and high temperatures, and are therefore classified as "intolerant" taxa. In contrast, chironomid midge larvae (Chironomidae) are considered "tolerant" taxa, and the ratio of EPT to chironomid larvae abundance is a metric commonly used in assessing the health of stream ecosystems. High species richness and abundance of EPT, and a high EPT:chironomid ratio generally indicate good water quality with abundant resources related to riparian vegetation.

The sources of information most useful for this report were biomonitoring reports available from federal (e.g. reports from M. Vinson, EPA and F. Mangum) and state (such as state DEQ) agencies (Table 1). Often data providing physical information about study sites was limited, and constrained our ability to interpret results. There was less assemblage information at appropriate scales in the scientific literature, but these published studies often provided associated landuse patterns or other relevant physical data. Sometimes raw data was given to us, and this was converted into comparable metrics for our analysis. We are grateful to the many scientists who graciously shared their information for this project. In particular we would like to acknowledge Mark Vinson, Rob Plotnikoff, William Clark Fred Mangum, Chris Robinson, Wayne Minshall, Tom Whittier, Bob Wisseman, C. Burt Cushing, Rich Hafele, Larry Caton, Ric Hauer, Alan Munhall, Bill Bogue, Paul James, Bill Funk, and Mark Munn.

2.1 Methods

The approach of this report was to characterize aquatic invertebrate assemblages in two kinds of analyses: multivariate Principal Components Analysis (PCA) and Detrended Correspondence Analysis (DECORANA)(Ludwig and Reynolds 1988). Assemblage measures (metrics) that described abundance, diversity, and relative abundances of either tolerant or sensitive total taxa within each ecoregion, were compared by using PCA A previous review of some of these streams examined differences between ecoregions (Whittier et al 1988), but did not characterize differences within ecoregions. Where our analysis separated discrete clusters of streams we examined the original data for possible differences in physical conditions, areas of potential degradation or recovery, or geographical gradients.

Total abundance was the primary measure of abundance per stream. The total number of taxa per stream was used as an unambiguous measure of diversity; however this was not an indicator of relative abundances among taxa. Aquatic invertebrate assemblages, like other biological communities, tend to to be dominated by a very few taxa, and contain high amounts of relatively rare or uncommon taxa (Preston 1948; Elliiott 198 1). To reflect how skewed the distribution was, we used the percentage of the total abundance contributed by the most dominant taxon in a stream (DOMTAX). EPT, the total taxa represented by Ephemeroptera, Plecoptera and Trichoptera, was chosen to express the relative abundance of intolerant taxa. Two other indices were included in our analysis if there were sufficient numbers of studies providing these numbers: the proportion of EPT abundance to numbers of chironomids (EPT/C), indicating relative abundance of intolerant taxa to tolerant ones, and the Hilsenhoff Biotic Index (HBI) which rates taxa according to tolerance and intolerance (Hilsenhoff 1987). The lowest values of HBI (i.e. near 1) represent intolerant assemblages.

A second multivariate approach was based on identifying the ten most abundant taxa in each stream. Biological communities often are comprised of a few very abundant taxa, higher numbers of common, but less abundant taxa, and greatest frequencies of rare taxa (Preston 1948; Elliott 198 1). In a study of western Oregon streams most lotic macroinvertebrate assemblages fit a log series abundance curve (Figure 2). We used this community assemblage structure as the basis for choosing the ten most common taxa for the DECORANA analysis. Given the high number of streams in the survey and the high numbers of taxa in each stream, we tried to find a practical number that would provide taxa-specific comparisons between streams. We assumed we had included at least the most dominant and most of the common taxa.

The DECOIUNA analysis resulted in ordinations of closely associated taxa for each ecoregion. We studied these associations for similarities in life history characteristics, habitat preferences, pollution or siltation tolerances, and functional feeding groups (Rosenberg and Resh 1993; Merrit and Cumins 1987). Because macroinvertebrates are often omnivorous and difficult to classify into trophic levels, classification by the ways in which they acquire food is convenient. These functional feeding groups are: predators,. shredders that eat leaves and small bits of wood, wood borers that burrow into wood as they eat, scrapers that utilize microscopic algae, collector gatherers that pick up small pieces of organic debris, and collector filterers that use either nets or feeding appendages adapted for sieving out small organic debris (Merritt and Cummins

1987)(Appendix A. l-5.). Patterns found for taxa associated with particular streams were integrated with results from PCA analysis and summarized in the narrative our report.

Taxa lists utilizing only the top ten taxa also were developed for each ecoregion to distinguish between those taxa found in only one stream from those found more generally within the ecoregion (Tables 2-6). Those taxa listed as unique are not necessarily rare, but merely unique among the limited number of collections made.

3.1 Basinwide Comparisons: Assemblage Measures

Generalizations about any ecoregion and comparisons across the entire basin were limited by the number of streams included within the survey information. The distribution of study sites was quite broad; however the northern range of the Columbia River basin (northern Washington, Idaho, and Montana) was poorly represented. Current research by C. Robinson and W. Minshall in Idaho, R. Plotnikoff and C. Lange with his students in Washington will fill this gap.

Stream assemblage metrics provided a range of average attributes across the Columbia River basin (Table 7). The Blue Mountain ecoregion (ecoregion 9) that includes the John Day River and Grande Ronde River basins, was the most taxa rich, with high numbers of EPT and low dominance by the most abundant taxa (Table 7). The Columbia Plateau ecoregion in eastern Washington (ecoregion 7) exhibited the lowest taxa richness, high DOMTAX, and surprisingly low tolerant taxa as represented by HBI. These values were influenced by Lower Snake River samples that were very low in several metrics. Other streams within the Columbia Plateau ecoregion have characteristics more similar to the High Desert ecoregion of the Great Basin in southern Oregon and Idaho. These distinctions within the Columbia Plateau demonstrated the importance of examining within-region variability. Within the information available for the

Northern Rockies ecoregion, streams from the Bitteroot Mountains were distinctly more diverse than streams from upper Salmon River tributaries. When the two groups were combined the assemblage measures for the Northern Rockies appeared to be fairly average in comparison with other ecoregions. The least amount of variability was demonstrated for the High Desert ecoregion in eastern Oregon (ecoregion 10), which also appears to have the least habitat variation within the project area.

3.2 Basinwide Comparisons: Distribution of Taxa

From our lists of the ten most common taxa for each stream (Tables 8 & 9) we identifkd trends among the most ubiqutous and most unique taxa (Table 10). These assessments were made for insect genera with the exception of midges (Chironomidae) that were grouped at the family level for consistency between datasets. Two ecoregions, the Eastern Cascades and the High Desert, exhibited the highest proportion of taxa unique to that particular ecoregion. Because there were more streams reported for the High Desert there was a higher probability that there were higher numbers of unique taxa; the number of invertebrates and samples counted are often correlated with the numbers of kinds identified (see Discussion section). However the potential for unique habitats in that arid region likely contribute to the number of unique organisms. Similarly the combination of diverse high elevation sites dominated by coniferous riparian zones probably increased the potential for unique taxa in the Eastern Cascades, but we were not able to discern a clear trend among the kinds of unique taxa found.

Not surprisingly *Baetis* mayflies and Chironomidae midges were in almost every stream, and were not useful in finding distribution patterns. The scraper may-fly, *Cinygmula* was widespread in the Blue Mountain ecoregion (ii 20 of 26 streams included in DECORANA analysis), and common in the Eastern Cascades and upper Salmon River of the Northern Rockies (occuring in half the streams in our survey), but was not found in the Columbia Plateau. Similarly, the free-living predaceous caddisfly, *Rhycophila*, occured in 19 of 26 streams in the Blue Mountains, 10 of 21 streams in the Northern Rockies and 5 of 14 streams in the Eastern 'Cascades, but did not occur in Columbia Plateau samples. In contrast, the filter-feeding caddisfly *Hydropsyche* and riffle beetle *Optioservus* were ubiqutous in the Columbia Plateau and common in the Northern Rockies. But *Hydropsyche* was found only rarely in the Eastern Cascades and Blue Mountains, and *Optioservus* was collected in only 5 of 26 Blue Mountains streams, and 4 of 14 Eastern Cascade streams. Given the constraint that we limited these lists to only dominant and more common taxa, we were surprised that there were not more widely distributed genera.

For ecoregions where multiple distinct clusters of streams were discernible (6,7 and 9) there were a few taxa that helped discriminate between clusters. These might be considered "keystone" or assemblage indicator taxa for their respective regions. Without further study we cannot tell if they function as keystone species described in classical marine biological studies (Paine et al 1966). For example, streams associated with Crater Lake in the Eastern Cascades generally were typified by the shredder stonefly *Yoraperla* as well as *Cinygmula* (in 4 out of 5 streams in both cases). In the Columbia Plateau the collector mayfly *Paraleptophlebia* characterized the disturbed streams identified in PCA, but was found in a few other streams as well. Though not unique, some taxa in the Blue Mountains strongly characterized particular clusters. In addition to *Cinygmula* and *Rhyacophia* discussed previously, the mayflies *Drunella, Seratella* and *Epeorus* are found in most of the good and best quality streams in the Grande Ronde (11 of 16 and 12 of 16 respectively). Another scraper mayfly *Rithrogena* appears to be restricted to the high elevation streams in the Blue Mountains and also in the Eastern Cascades, where *Rithrogena* was collected in only two streams.

4 Macroinvertebrate Assemblages Within Ecoregions

4.1. Ecoregion Six: Eastern Cascades

Taxa richness, associations with riparian vegetation, and tolerances to stream degradation (e.g. higher temperatures and more silt) follow elevational gradients to some extent in the watersheds of the Eastern Cascades. High elevation, forested sites (between 4000 and 5000 feet) tend to have high numbers of EPT taxa and few tolerant taxa (Table 1 1), and assemblages are often taxa-rich (averaging 54 taxa per stream), not strongly dominated by any particular taxon, and characterized by moderate to high total abundance of organisms (average 3915 per m^2 at highest sites, 10,561 per m^2 at others) (Environmental Protection Agency 1994; Wisseman 1992b; Whittier et al. 1988). These assemblage measures, and habitat associations identified in DECORANA (Appendix A. 1. & B. 1.) indicate taxa representing cold, fast water streams, from erosional habitats in which many invertebrate species are closely tied to riparian vegetation, i.e. shredders and wood borers. However these conditions do not appear to be uniformly distributed across the landscape. There are higher numbers of tolerant taxa in some streams, most of them within the Mt. Jefferson Wilderness in Oregon (Wisseman 1992b) (Cluster 2 in Figure 3,Table 2, Figure 4). Diverse, apparently healthy assemblages are frequently found in close proximity to more degraded assemblages in nearby streams. This suggests a need for identifying the causes of such differences, which in turn may help maximize the potential for rehabilitating the degraded communities.

Streams in the more southerly Warner and Klamath basins on the Oregon-California border have higher proportions of tolerant taxa and relatively low ratios of EPT to chironomid midges (Environmental Protection Agency 1994; Wisseman 1992a & 1992b; Whittier et al. 1988) (Cluster 4 in Figure 3, Table 11, Figure 4). Other examples of assemblages indicating degraded streams are scattered across the Eastern Cascades region. Attributes of these streams include very low numbers of EPT (average 8), low taxa richness (average 22 taxa per stream in comparison to an eastern Cascades regional average of 37), and high dominance of common taxa (68% of total abundance due to most common taxon). Two such streams occur in the lower Deschutes River valley (Dry and Mary's Canyon Creeks), in close proximity to streams with more diverse and less tolerant assemblages (Mangum 1992). Many insects are good colonizers; therefore, assemblages with greater diversity generally reflect increased potential for recovery.

Overall, when compared to other eastside provinces, Eastern Cascades stream systems appear to exhibit relatively high total abundances of stream invertebrates, moderately high taxa richness but also moderately high dominance by common taxa, moderate numbers of EPT taxa, and a moderate ratio of EPT to chironomid midge larvae (Table 7). These statistics suggest overall good health., but a few depauperate, possibly degraded streams requiring further study.

4.2. Ecoregion Seven: The Columbia Plateau

Our analysis revealed that assemblages in riverine reaches of the lower Snake River are very different from those in smaller tributaries (Dorband 1980). The benthic assemblages from lower river reaches are characterized by low taxa richness (average 6), very low total abundance of organisms (average 49 per m^2), high dominance by the most common taxon (average 70%), and few EPT (average 2 taxa) (cluster 4 in Figure 5, Table 12, Figure 6). These characteristics may be attributable in part to the more lake-like conditions of the large rivers; EPT taxa generally prefer fast-moving, cold streams. The systems might exhibit greater community diversity if organisms in the water column (plankton) were taken into account. Unfortunately, such information is unavailable.

Other distinct stream assemblages are found in the Columbia Plateau along the piedmont fringe, in higher elevation streams that are spring-fed, and in seasonally flashy streams (Environmental Protection Agency 1994; Gaines et al 1992; Furnish 1989; Whittier et al 1988; Gaines 1987). Like watersheds of the Great Basin in southeastern Oregon and southern Idaho, intermittent and ephemeral streams dominate the landscape of the Columbia Plateau.

Streams on the piedmont fringe of the Columbia Plateau generally flow out of the mountains, and are the most diverse in this region. Relatively higher taxa richness (average 32), low total abundance (average 652 per m^2), and low dominance by the most common taxa (24%) typify these streams (Wenatchee National Forest 1993; Plotnikoff 1992). Relatively high abundances of the sensitive EPT taxa further suggest that these streams may represent the highest potential as source populations for restorative efforts within the Columbia Plateau ecoregion. Higher-elevation, spring-fed streams exhibit higher abundances than those on the piedmont fringe (average 6906 per m^2), but lower taxa richness (average 25) and much fewer EPT (average 9). These streams are seasonally flashy, systems that include organisms adapted to frequent disturbances and therefore are good colonizers. A combination of warm and cool water, erosional and depositional, collectors and scraper invertebrates are found in these falshy streams.

In comparison to other major provinces east of the Cascades, the Columbia Plateau overall, including Snake River samples, ranked lowest for total abundance of organisms, moderate for taxa richness, moderately low for EPT representation, and moderate in terms of dominance of common taxa (Table 7). When the riverine samples were excluded assemblages were similar to those in the High Desert streams.

4.3. Ecoregion Eight: The Northern Rockies

High elevation (approximately 5,000 -11,000 feet) dominates this portion of the Columbia Basin. Though invertebrate data from this region were restricted to the Upper Salmon River drainage in eastern Idaho and the Bitterroot River watershed of western Montana, contrasts between these watersheds based on assemblage metrics and dominant taxa were apparent (Figure 7, Table 13, Figure 8). The Idaho streams generally had been grazed, and assemblages exhibited low taxa diversity , EPT richness and abundances (averages 21, 11 and 2 199 per m^2 respectively)(Vinson 1994). In contrast, the Bitterroot streams were rich in overall and EPT taxa (averages 39 and 21 respectively) and but contained extremely high abundances (19,3 80 per m^2)(Vinson 1994). Taxa identified for this region use primarily erosional habitats, which lends them easily to comparison. Loss in taxa richness and EPT diversity between Bitteroot and grazed streams was almost twofold. These differences suggested dramatic changes in water and habitat quality.

When compared to other ecoregions, metrics of the Northern Rockies generally were near the mid-range values for the entire Columbia Basin. Given metric values at opposite extremes, the calculated averages may not be as representative for this region as in others where a large number of streams exhibited approximately average characteristics for that. The dramatic shift in metric values reflecting grazing effects in the Northern Rockies also was observed in the Blue Mountains ecoregion.

4.4. Ecoregion Nine: The Blue and Wallowa Mountains

Despite semi-arid climatic conditions and decades of landscape disturbance, our survey revealed that diversity and potential for recovery remains high in the John Day River basin and the Ochoco Mountains (Furnish 1990; Environmental Protection Agency 1994; Li et al 1994; Tait and Li 1994). Bear Creek and East Fork Canyon Creek are somewhat higher elevation streams with very high taxa richness (average 59), low dominance by the most common taxon (29%), and many EPT (average 30) (Table 14, Figures 9 & 10). These are streams with good riparian canopy, which probably helps maintain cool temperatures. Other streams that have protected or restored riparian vegetation--many largely exclosed from cattle grazing-are also taxa-rich (average 39), but have fewer EPT (average 18). Service, Camp (on the Middle Fork John Day River), Deardorf, Willow Creeks and the South Fork of the Crooked River are among the latter (Table 14).

The Ochoco National Forest and John Day River basin also contain many, widely-distributed examples of streams with relatively lower taxa diversity (average 25), more numerous tolerant taxa, very low numbers of EPT taxa (average 8), and stronger dominance by one taxon (average 43%). Within this group of streams Rock Creek and Alder Creek are examples of overgrazing, dewatering for irrigation, and loss of riparian vegetation that have resulted in depauperate macroinvertebrate assemblages because of high temperatures and siltation (Li et al. 1994; Tait et al. 1994). However, as in the Eastern Cascades, close spatial association of healthy streams and those characterized by less diverse, more tolerant assemblages points out the potential for recovery of the degraded systems.

The Grand Ronde River system, which divides the Blue and Wallowa Mountains, contains many streams with very diverse assemblages, but there are also a few badly degraded streams (Carlson 1989; Carlson et al 1990; Environmental Protection Agency 1994). Mann and Catherine Creeks exhibited among the highest diversities (65 and 62 taxa, respectively) for streams covered in a survey of eastside ecosystems (Environmental Protection Agency 1994). Numbers of EPT taxa were also high, particularly in Catherine Creek where the ratio of EPT taxa to generally tolerant midges was very high (29: 1). Catherine Creek has been treated with extensive exclosure (to restrict grazing) and restoration efforts in the past decade (McIntosh 1992). Taxa richness (average 43) and abundances of EPT (average 30) were high for other healthy streams in the basin, as well. Long-lived invertebrates (one to two year life spans) such as the stoneflies *Doroneuria, Visoka, Hesperoperla*, and *Zapada*, distinguish several of these cold water streams (Appendix A.4. & B.4.). Given the great diversity and high numbers of sensitive taxa in other streams of the Grande Ronde River basin, low taxa richness (14), low numbers of EPT (7), and high dominance of the most common taxon (56%) at Thirty-mile Creek are surprising (Carlson et al. 1990). This was an unlogged site so reasons for these values are not clear.

Overall, the Blue Mountain ecoregion system ranked highest among the eastside provinces in terms of taxa richness, EPT taxa representation, and EPT to chironomid larvae ratio, and near lowest in terms of dominance of common taxa (Table 7). These statistics indicate generally healthy ecosystems with strong potential as sources of colonizers for recovering streams in the region.

4.5. Ecoregion Ten: The High Desert

The macroinvertebrate fauna of streams in the Great Basin lowlands of southeastern Oregon and southern Idaho appeared relatively uniform across the landscape (Environmental Protection Agency 1994; Viison 1994; Robinson and Minshall 1991). We were unable to recognize distinct PCA clusters for this ecoregion (Table 15, Figures 11 & 12). This uniformity is probably related to the constancy of the physical environment imposed by aridity and severe climatic conditions. Given similarities in physical features, similarities with Columbia Plateau stream assemblage characteristics were not surprising. A few streams, including Trail, Burnt, and Indian Creeks, are distinguished by cold, fast water taxa such as the stoneflies *Megarcys*, mayflies *Epeorus* and the caddisflies *Parapsyche*. However these tend to be the exceptions to the generally warm-temperature tolerant, burrowing and filter-feeding taxa found in most streams (Appendix A.5. & B.5.) Typical taxa representing these assemblages are the dragonfly *Ophiogomphus*, caddisflies *Hydropsyche* and *Dicosmoecus*, and mayfly *Caenis*.

Overall, High Desert streams were characterized by relatively high total abundances of organisms (average 5936 per m^2), but the fewest EPT taxa (average 10), high proportions of tolerant taxa (low EPT:chironomid ratio of 5.5), strong dominance by the most common taxa (average 43%), and low taxa richness (average 26 taxa) compared to other eastside systems (Table 7).

4.6 Ecoregion Twelve:

Data from this region were limited to 16 streams in the upper Snake River drainage in Caribou National Forest of southeastern Idaho. Based on dates of the monitoring (1976), we concluded that deriving generalizations from these more historical collections would have limited relevance to this report.

5. Discussion and Recommendations

Principal components analysis, using broadly descriptive assemblage metrics, provided a useful tool in making distinctions between stream assemblages in several ecoregions. We queried a few researchers most familiar with particular ecoregions (especially the Columbia Plateau and Blue Mountains) about our results, and were encouraged that the clusters made biological sense to them. By choosing assemblage measures that capture essential qualities of macroinvertebrate populations, we have been able to characterize the ranges of conditions on regional scales. Taxa richness, EPT taxa, EPT/Chironomids, total abundance, and percentage represented by the most dominant taxa, are easily understood and readily calculable measures. These attributes can be used by managers to compare future samples to the general trends for each region provided in this initial survey.

Our survey was limited by the number of streams included within the studies we identified. In addition to basic literature surveys covering the project area, we contacted all federal and state agencies, private consultants, and academic programs that we thought might have conducted research in the region. We identified 84 sources of information; from this group the requirements of our analyses allowed us to include 19 major sources and 25 1 streams. Information on hot springs has been discussed in a related report by J. Lattin; but very little information has been collected on either hot or cold springs. Work in progress by T. Anderson examines springs on Bridge Creek (ii the John Day River basin), where several unnamed mites have been found, along with taxa associated more with terrestrial than lotic systems. Also conspicuously missing are studies on riverine systems. In addition to limitations in the kinds of habitats and distribution of available information, the kinds of data reported varied. Consequently not all studies could be included in our analysis. Some streams included in either PCA or DECORANA analysis were not included in the other multivariate analysis because appropriate data was unavailable.

One function of this report was to uncover what information was available on stream macroinvertebrates. We also collected information on lake zooplankton, and those data are being incorporated into a separate survey of lake data by W. Liss, B. Deimling and R. Hoffmann. We were encouraged greatly by the extensive biomonitoring databases being built. Some of these were not ready to be included in this report. The repository developed by M. Viison and F. Mangum at Utah State University, and the EPA database were invaluable. However there are likely other surveys residing at individual USFS district offices, BLM offices, and various state offices that we could not identify. Work performed by individual contractors for agencies or private companies is not necessarily indexed in ways available for general distribution. Because these reports are not in the published literature, they are not easily located. An accessible indexing system of surveys completed for public agencies would be very useful.

It is essential to recognize that our analyses were made for particular streams, and do not generalize to streams for which we did not have data. The differences between streams in close proximity demonstrated the importance of restricting distribution patterns to specific streams. Differences within a stream also may be important, especially when the numbers of samples were limited as in most of the studies examined by our survey. We believe these constraints must be considered if the information were to be used in a GIS application. Furthermore this information should be considered as prehminary even for individual streams because sample sizes were small, and sampling gear occasionally was variable. In general, further studies should be made to validate information from streams of particular interest.

Most assemblage measures are sensitive to the numbers of samples taken and numbers of organisms counted (Canton and Chadwick 1988; Magurran 1988; Li et al in preparation). For example, in a study of macroinvertebrates of western Oregon in progress, taxa richness increases with numbers of invertebrates counted exponentially for small sample sizes (2 to 5), and continues to increase for at least 12 samples, when added taxa are likely to be rare relative to total stream diversity. Therefore comparing between stream surveys using varying samples per site is problematic. The surveys we used for our report generally included 3 to 5 samples per site (Table 1). Variation among stream replicates would probably be high, and comparisons between streams should be considered for large, rather then subtle differences. We believe that our multivariate approach, that looks for “clusters” of similarities, provides appropriate bases for comparisons.

Despite the limitations of the survey data we identified, the database available for stream macroinvertebrates was extensive and made possible a basin-wide perspective of assemblages. More importantly we hope our survey will serve as a context for assessing new survey information on macroinvertebrate assemblages in the Columbia Basin. As more studies in a given area are identified, metrics and taxa lists can be compared with streams already identified for the appropriate ecoregion to estimate relative health of the invertebrate community. To examine how well these basic assemblage measures correlate with stream condition corresponding physical data will be necessary. Data available to us often excluded physical descriptors, and advice from researchers who made the original collections was pivotal in the analysis. The achievable levels of diversity and abundance are dependent on regionally specific constraints such as climate, hydraulics, and geomorphology. With appropriate information on physical and geomorphic stream attributes, these assemblage characteristics have the potential for using information on individual streams to assess patterns across large regional expanses.

Figure 1. Ecoregions of the Columbia River Basin east of the Cascades (6= Eastern Cascades, 7= Columbia Plateau, 8= Northern Rockies, 9= Blue Mountains, 10= High Desert, 11= Montana Valley, 12= Middle Rockies, 15= Northern Basin and Range).

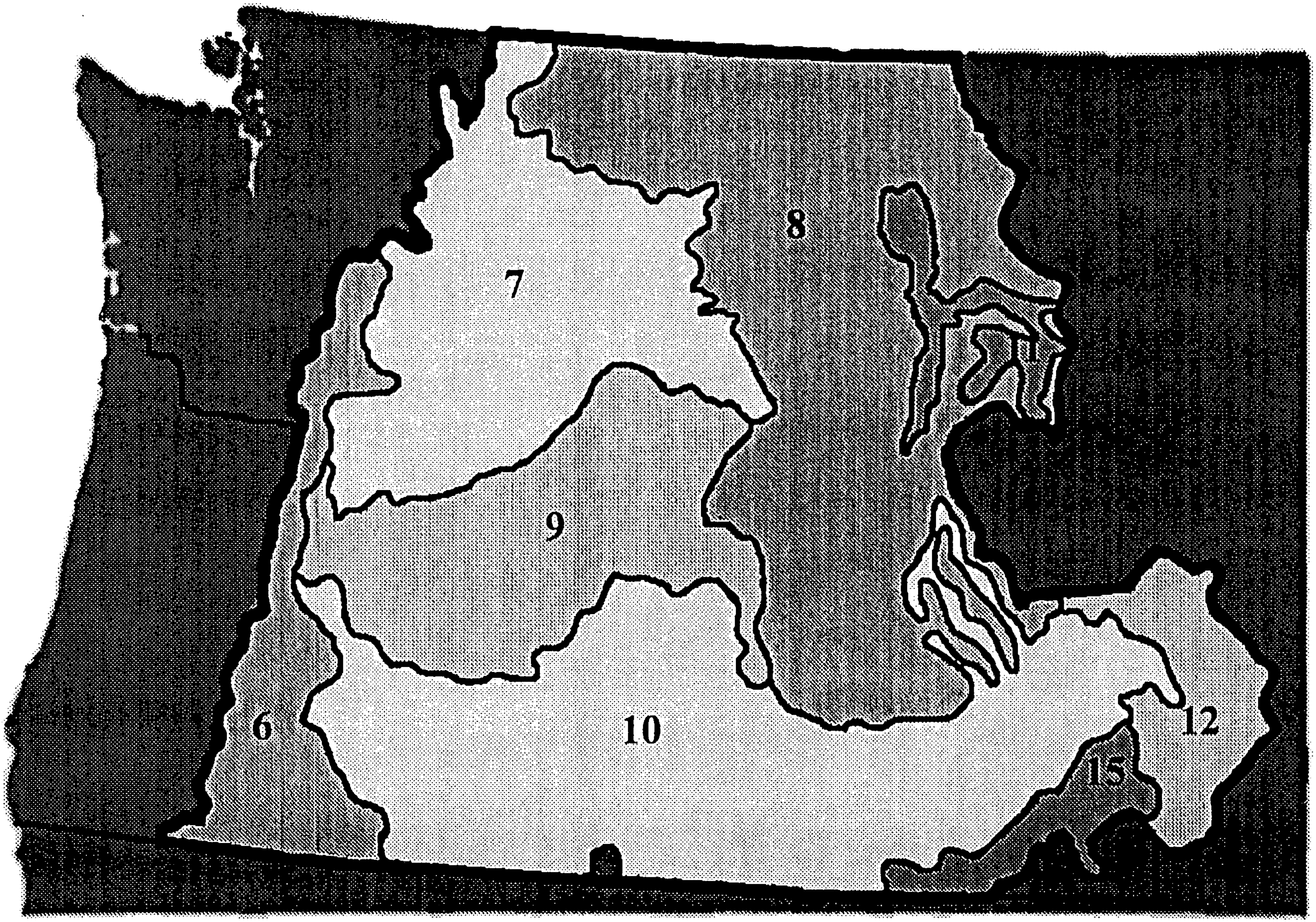


Figure 2. Taxa abundance curves for two streams in western Oregon, illustrating log series abundance. Each symbol denotes abundance of a particular taxon. Arrow is drawn to show percent of total abundance represented by 10 taxa.

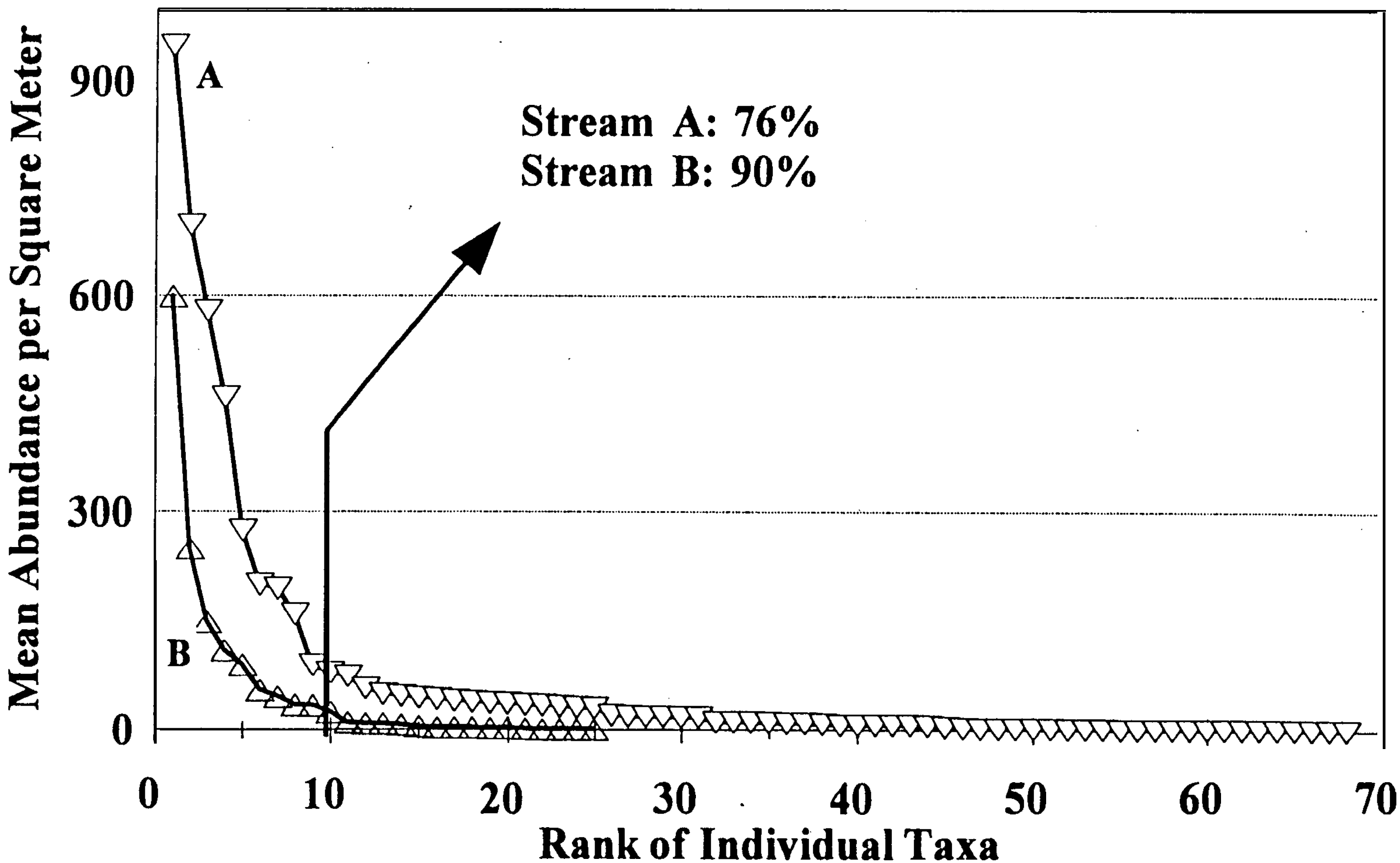


Figure 3. Map of stream clusters for the Eastern Cascades ecoregion.

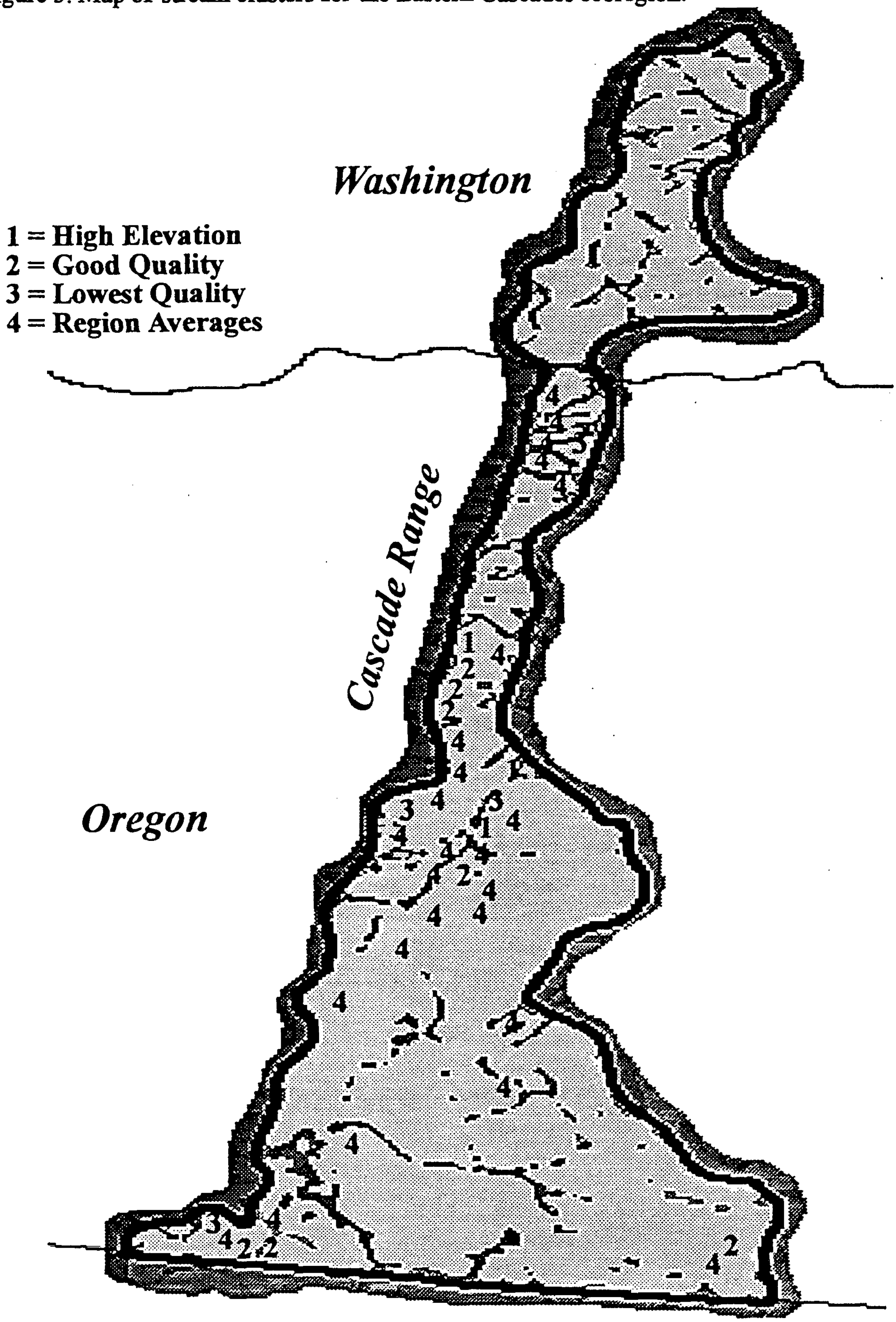


Figure 4. Streams plotted from PCA analysis within the Eastern Cascades ecoregion.

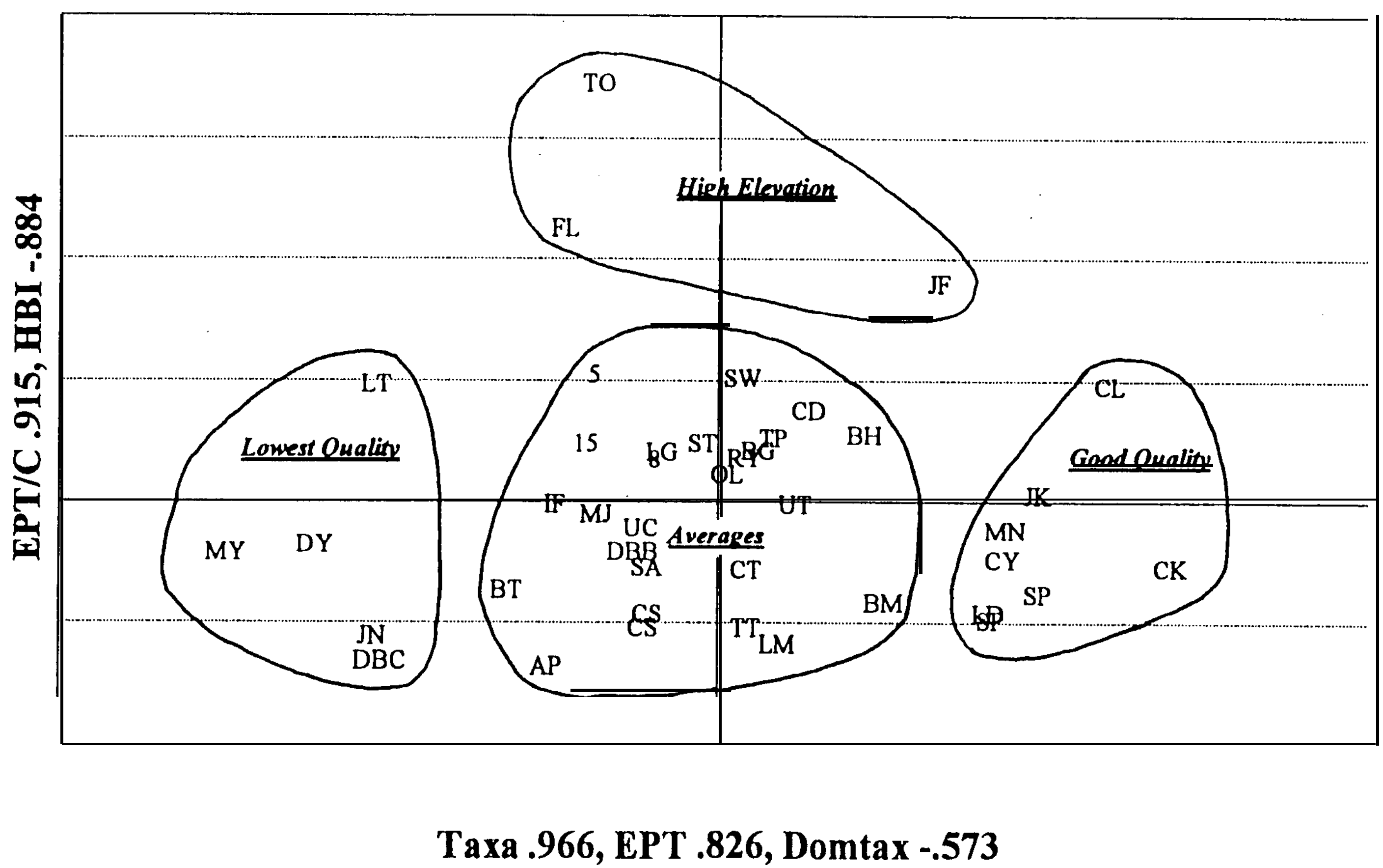


Figure 5. Map of stream clusters for the Columbia Plateau ecoregion.

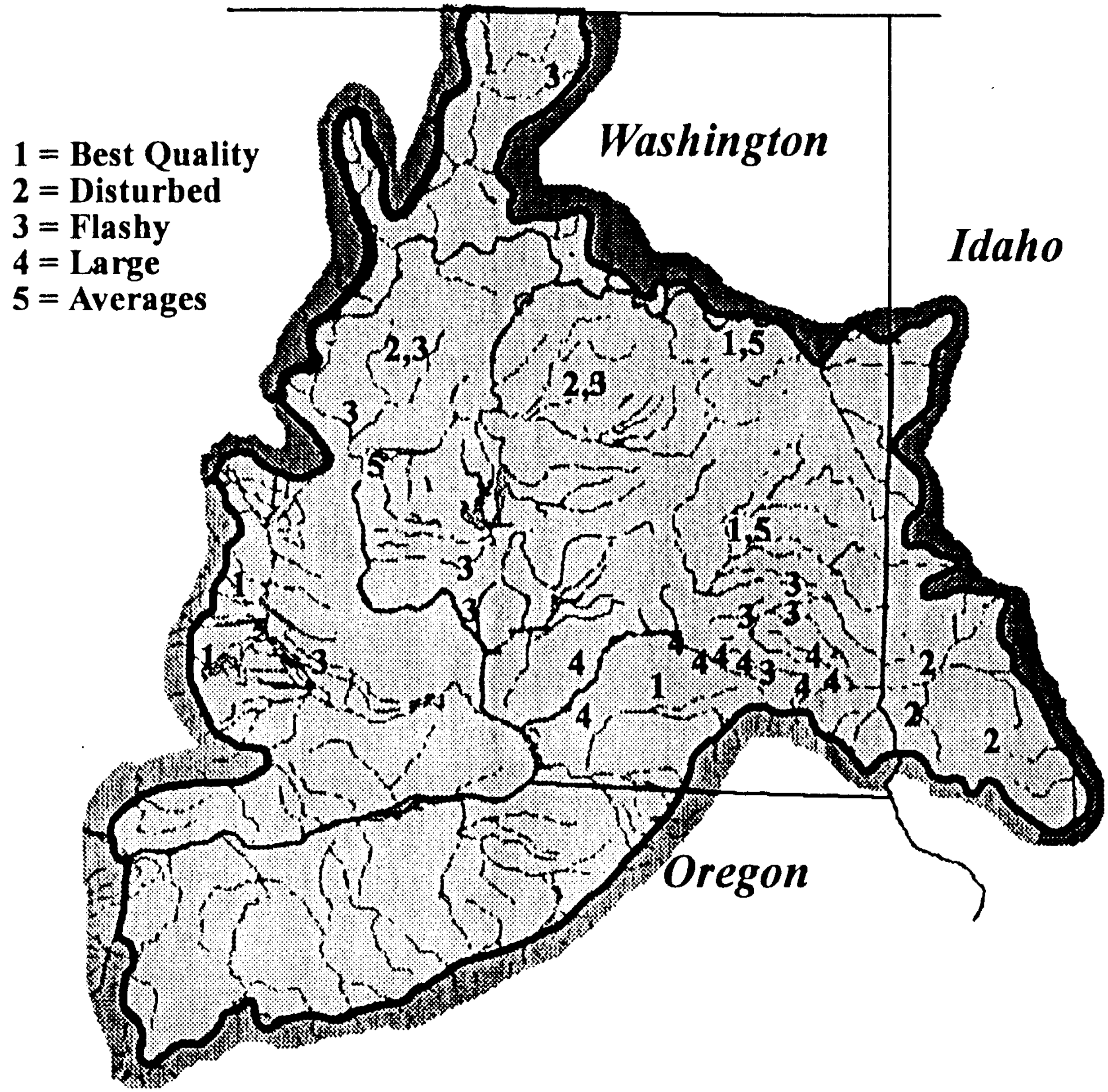


Figure 6. Clusters of streams plotted from PCA analysis within the Columbia Plateau ecoregion.

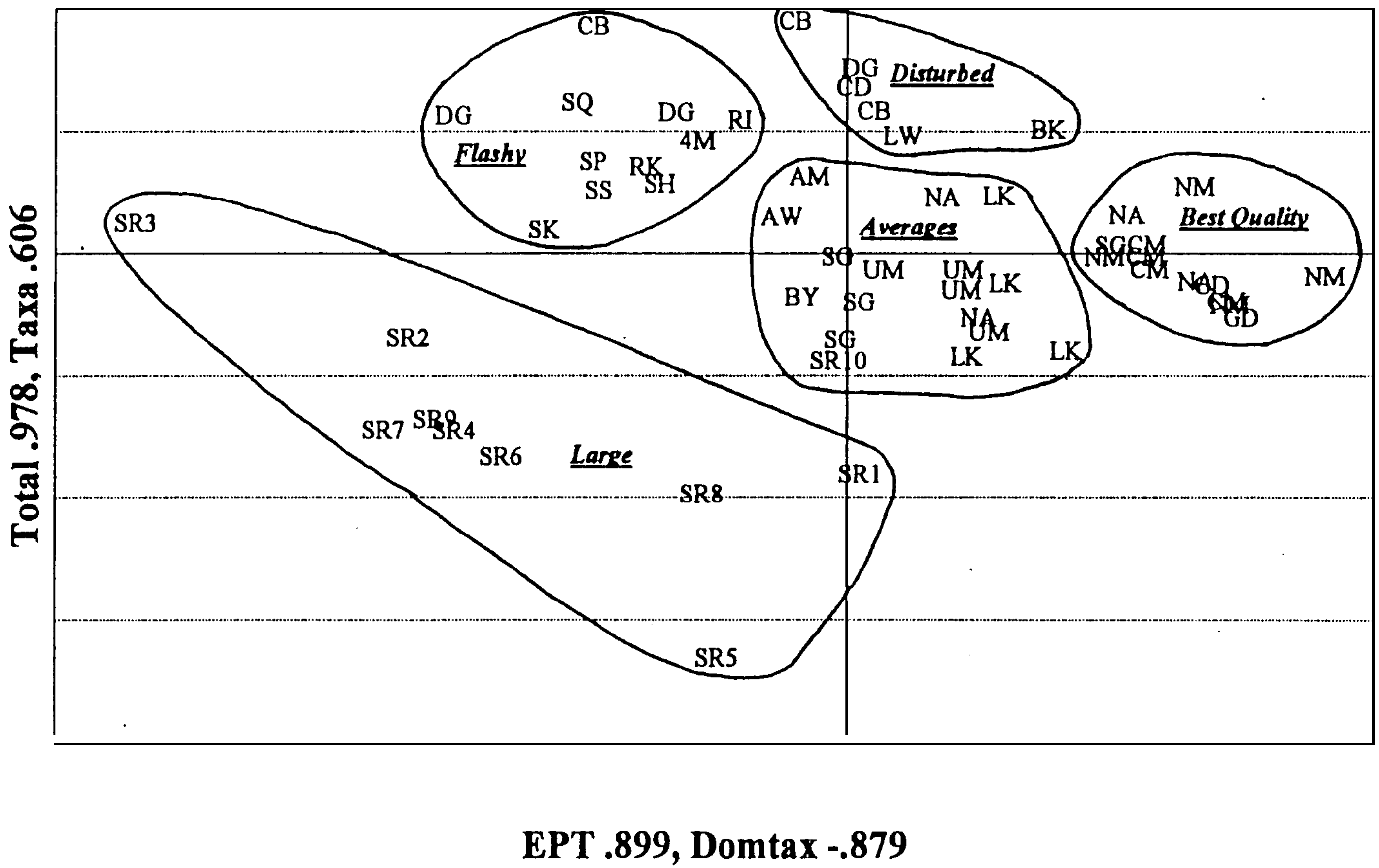


Figure 7. Map of stream clusters for the Northern Rockies ecoregion.

1= High Quality
2= Disturbed

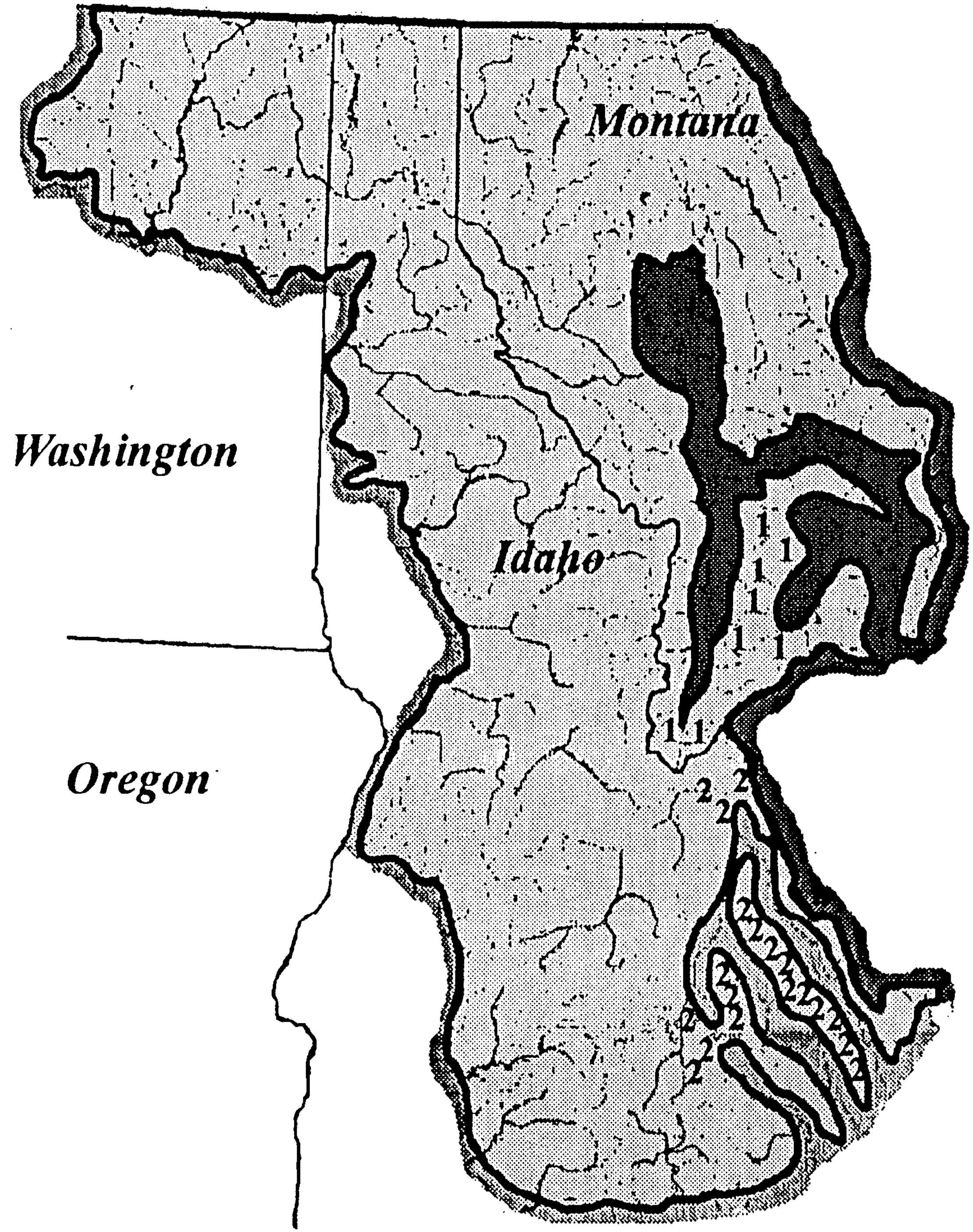


Figure 8. Clusters of streams plotted from PCA analysis within the Northern Rockies ecoregion.

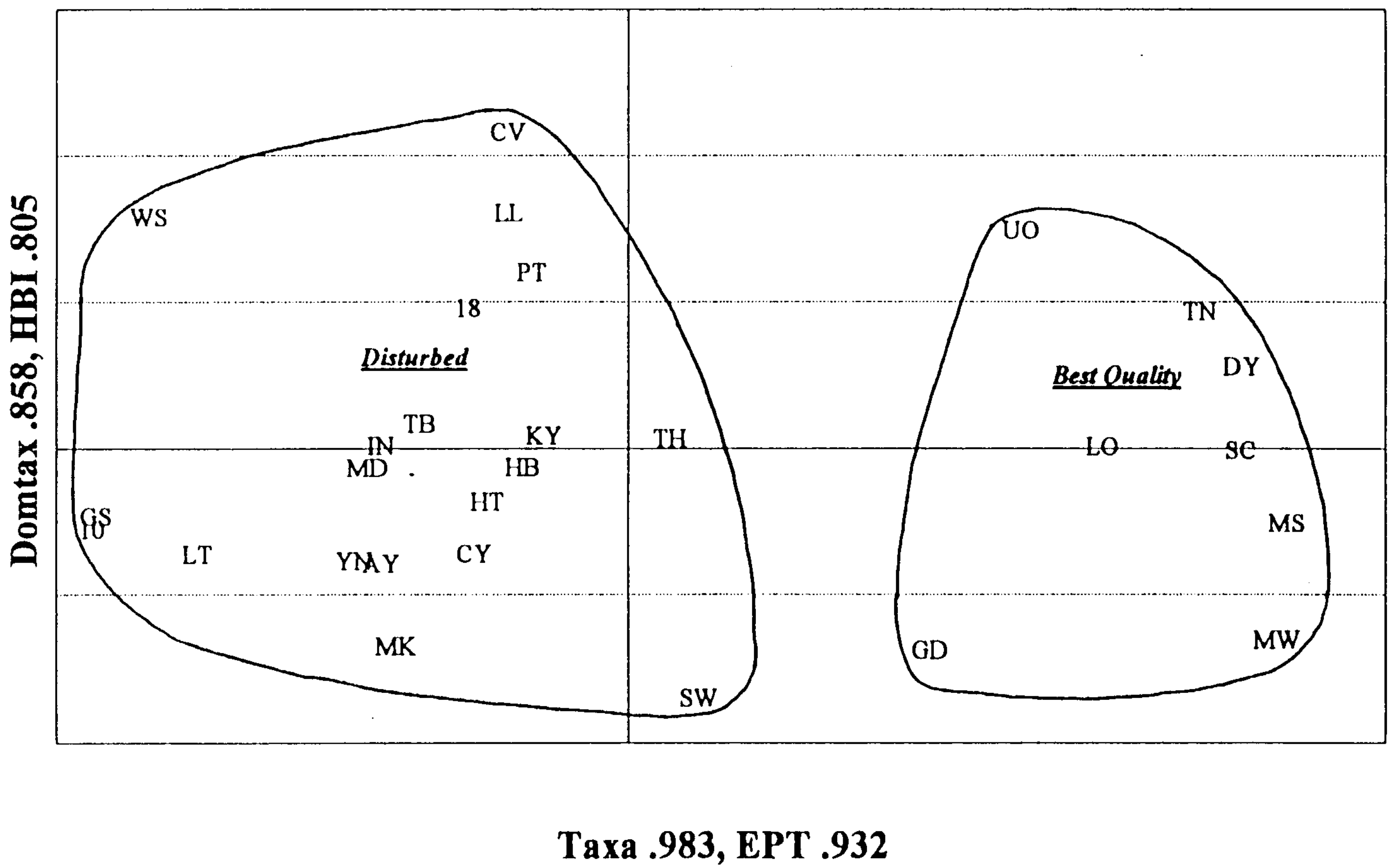


Figure 9. Map of stream clusters for the Blue Mountains ecoregion.

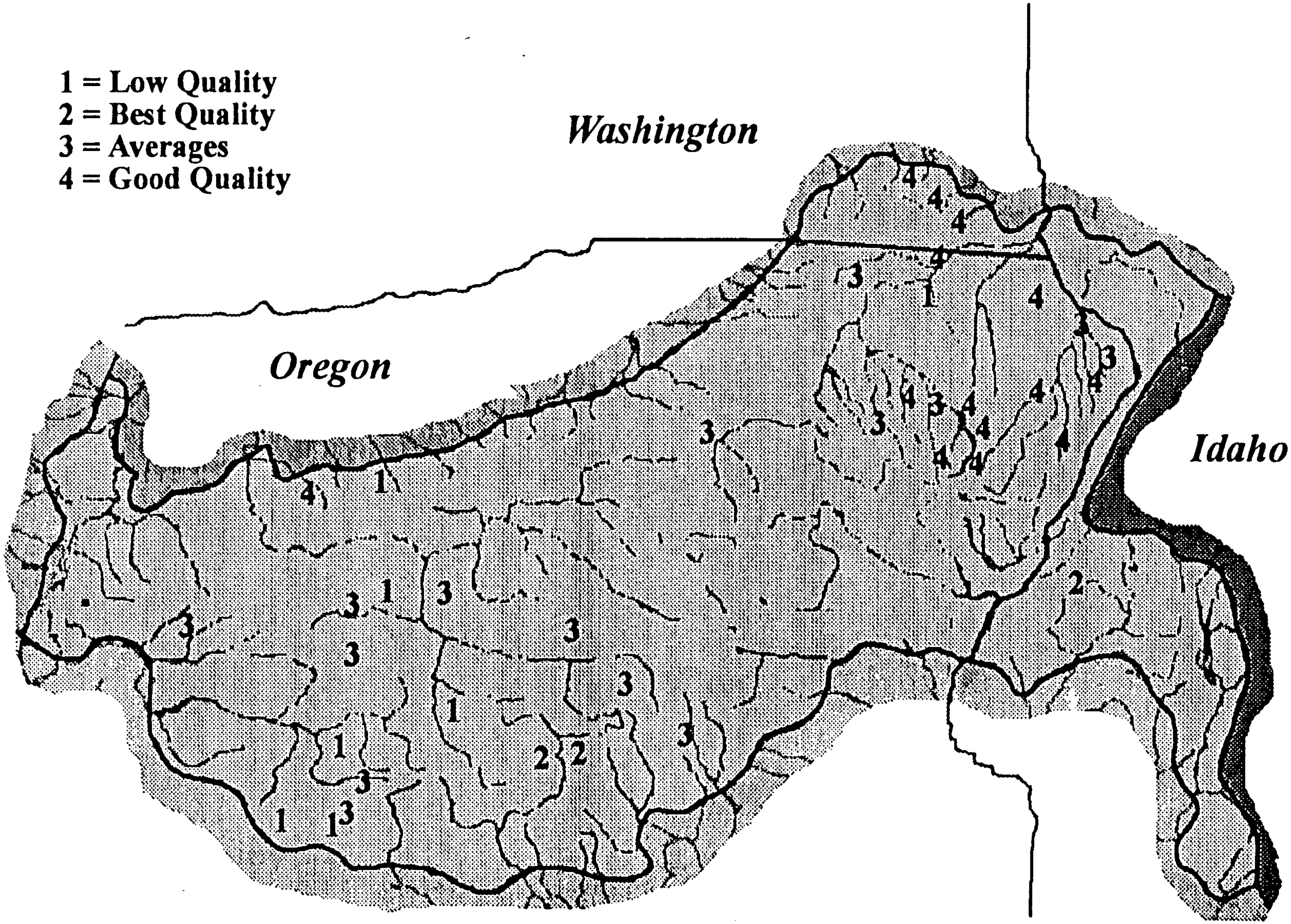


Figure 10. Clusters of streams plotted from PCA analysis within the Blue Mountains ecoregion.

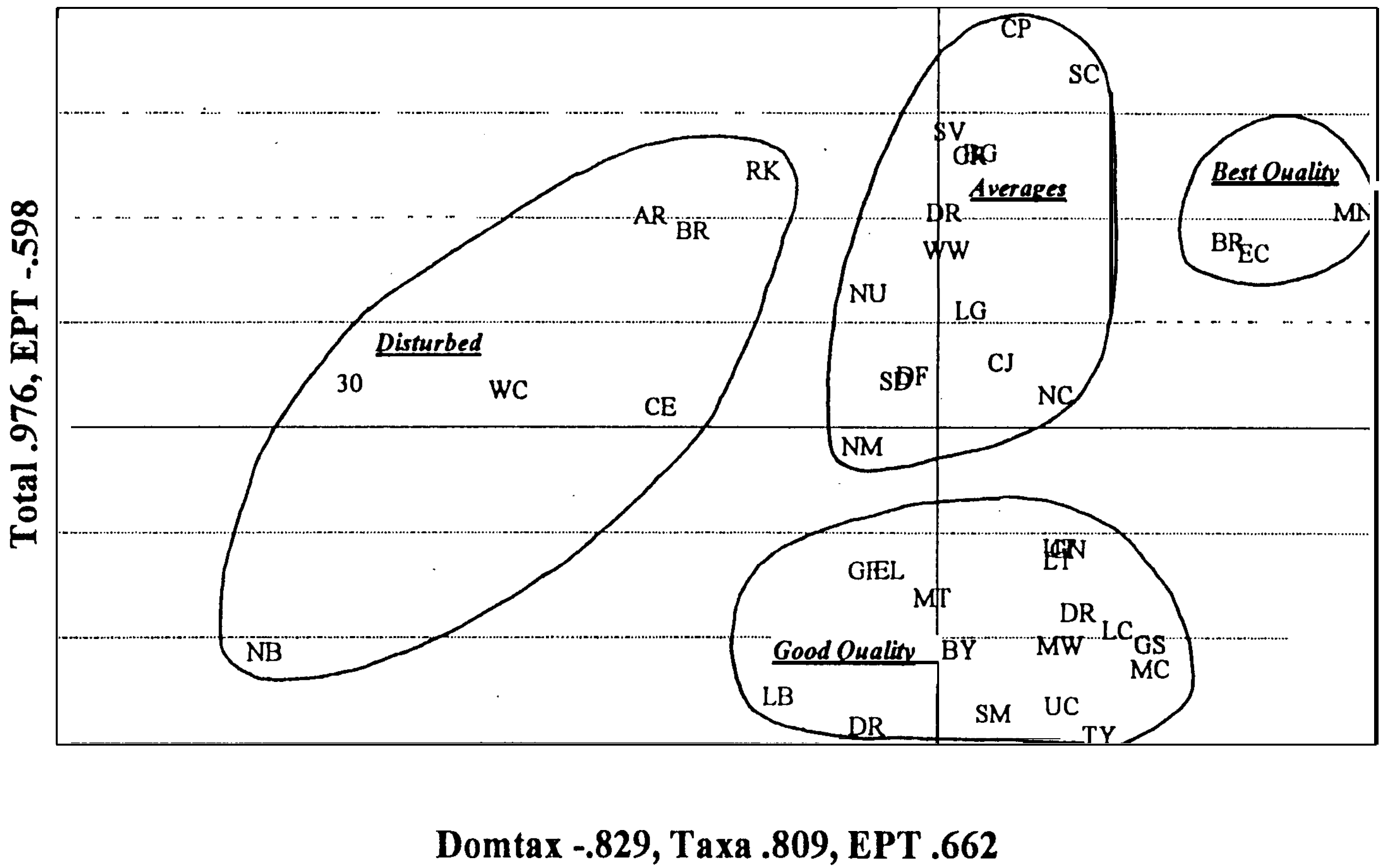


Figure 11. Map of stream locations for the High Desert ecoregion.

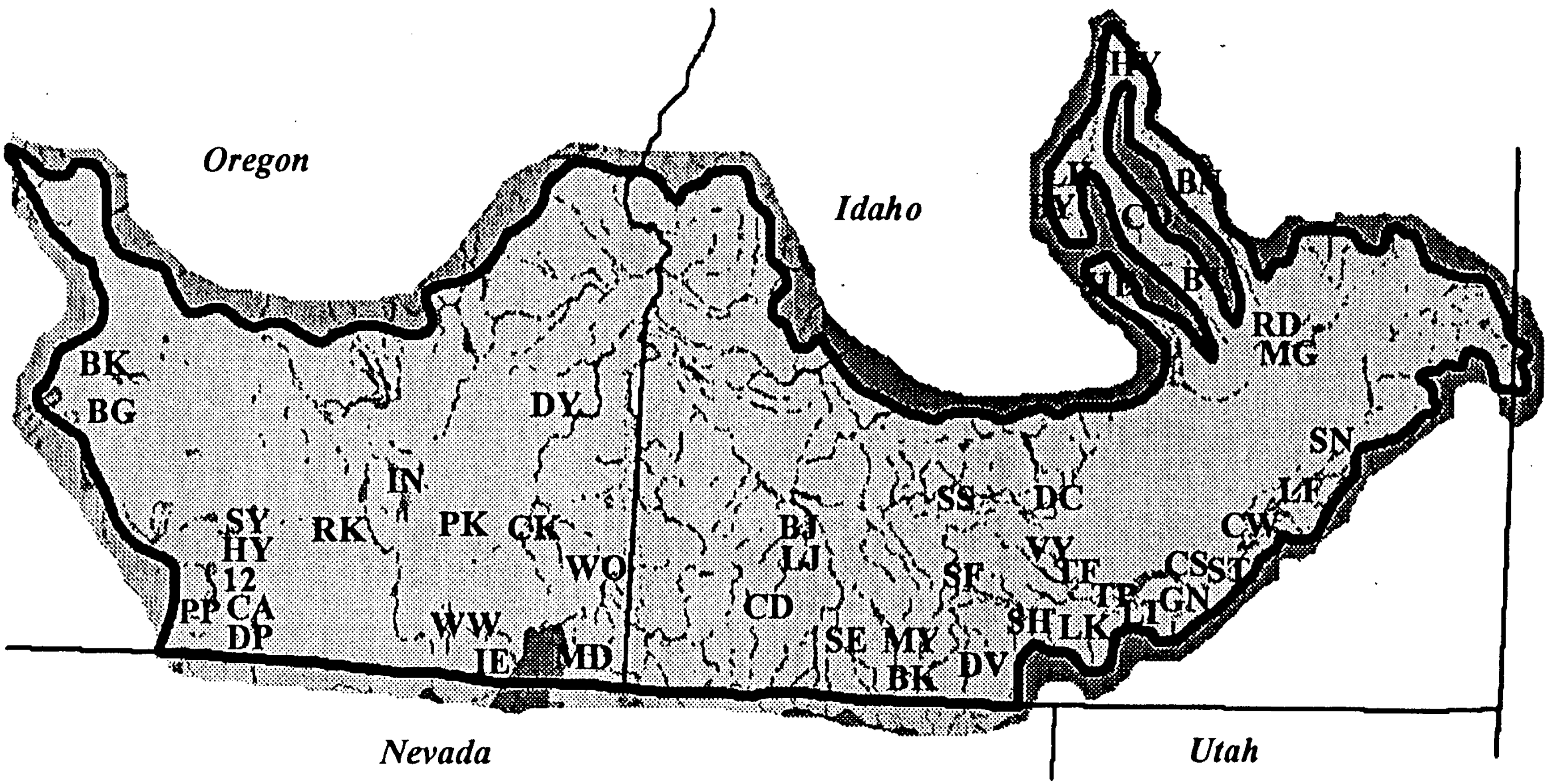


Figure 12. Streams plotted from PCA analysis within the High Desert ecoregion.

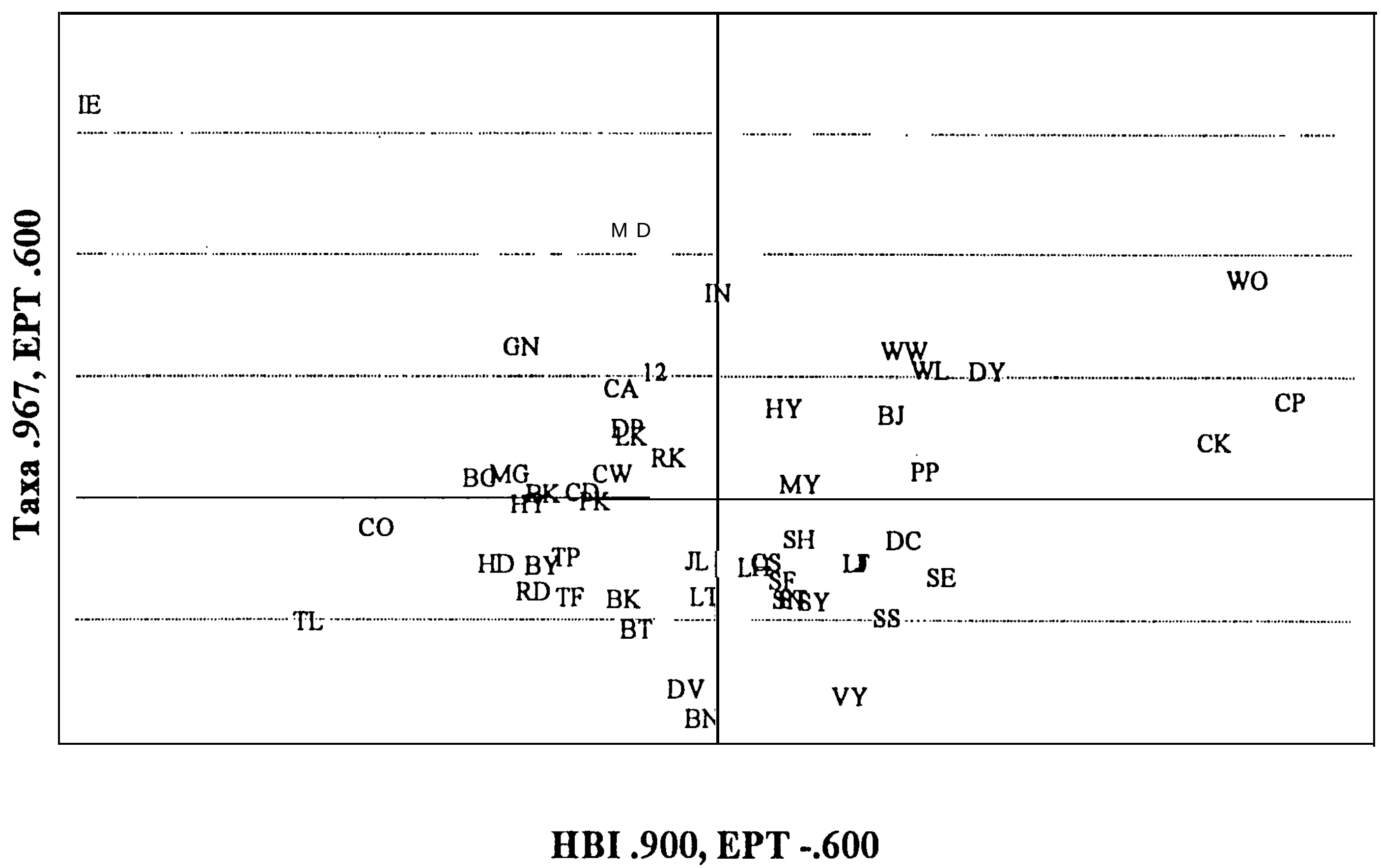


Table 1. Major sources of macroinvertebrate data for this report, including sampling techniques.

Sources	State	Ecoregion	Replicates/Site	Sites/Stream	Sample/Year	No. Years	Methods
Environmental Protection Agency (EPA)	OR	6	3	1	1	1	Surber
Wisseman, R.W. (private consultant)	OR	6	3	3-6	1	1	Kick Net
Dorband W.R.	WA	7	12	10	12	2	Basket, Ponar dredge
EPA	WA	7	3	1	1	1	Surber
Gaines W.L.	WA	7	3	1-2	12	1	Surber
Gaines W.L., Cushing C.E., Smith S.D.	WA	7	3	1	12	1	PIBS, Surber
Plotnikoff R. (Washington Dept. of Ecology)	WA	7	4	1	4	1	Kick Net
Plotnikoff R. (Washington Dept. of Ecology)	WA	7	4	1	4	1	Kick Net
EPA	OR	8	3	1	1	1	Surber
Furnish J. (Bureau of Land Management)	ID	8	3	1	1	1	Surber
Gilpin B.R.	ID	8	3	1-3	6	3	Bottom, Canister, Drift, Basket
Hoiland W.K., Rabe F.W.	ID	8	3-6	1-2	2	1	Hess
Richards C., G.W. Minshall	ID	8	5	1	1	4	Surber
Russel, K.	WA	8	3	5	6	1	Surber
Savage N.L., Rabe F.W.	ID	8	3	3	1	3	Surber
Vinson M. (Bureau of Land Management)	MT	8	3	1	3	1	Surber
Vinson M. (Bureau of Land Management)	ID	8	3	2	2	1	Surber, Kick Net
Carlson J.Y.	OR	9	5	1-2	1	1	Kick Net
Carlson J.Y., Andrus C.W., Froehlich H.A.	OR	9	5	1-2		1	Kick Net
Caton L.	OR	9	3	2-4	3	3	Kick Net
EPA	OR	9	3	1	1	1	Surber
Hafle R.	OR	9	3	5	1	2	Surber
EPA	OR	10	3	1	1	1	Surber
Furnish J. (Bureau of Land Management)	OR	10	3	5	5	1	Kick Net
Griffith J.S., Fuller R.K., Andrews D.A.	ID	10	2	3	2	2	Substrate, Kick Net, Drift
Robinson C.T., Minshall G.W.	ID	10	3	1	3	2	D-scoop
Vinson M. (Bureau of Land Management)	OR	10	2	1	2	2	Surber

Table 2. Representation of specific **taxa** within the Eastern Cascades ecoregion.

Common Taxa	No. Sites	Unique Taxa
Coleoptera		***Coleoptera***
Optioservus	9	Hydaticus
Heterlimnius	6	Oreodytes
Cleptelmis	2	Zaitzevia
Diptera		***Diptera***
Chironomidae	33	Maruina
-Cricotopus	4	Prosimulium
-Micropsectra	3	Pericoma
-Rheotanytarsus	3	Dicranota
-Thienemannimyia	3	Ceratopogonidae
-Paraphaenocladius	2	*Chironomidae:*
Simulium	11	-Tanytarsus
Chelifera	4	-Cladotanytarsus
Antocha	2	-Pagastia
Hemerodromia	2	-Rheocrictopus
Hexatoma	2	-Synorthocladius
Ephemeroptera		-Psectrocladius
Baetis	30	-Nanocladius
Cinygmula	15	***Ephemeroptera***
Drunella	13	Attenella
Serratella	7	Ironodes
Ephemerella	6	Tricorythodes
Caudatella	6	***Plecoptera***
Paraleptophlebia	6	Pteronarcys
Rhithrogena	5	Amphinemura
Epeorus	5	***Tricoptera***
Ameletus	2	Agapetus
Plecoptera		Neothremma
Yoroperla	12	Ecclisomyia
Sweltsa	10	Ochrotrichia
Zapada	7	Parapsyche
Malenka	6	Oxyethira
Doroneuria	5	***Crustacea***
Skwala	5	Ostracoda
Capniidae	4	***Mites***
Isoperla	2	Hydracarina
Trichoptera		***Other***
Micrasema	7	Turbellaria
Glossosoma	7	Hydra
Rhyacophila	6	Planariidae
Hydroptila	4	
Dolophilodes	4	
Wormaldia	3	
Hydropsyche	3	
Mites		
Acari	3	
Pelecypoda		
Sphaeriidae	3	
Pisidium	2	
Other		
Oligochaeta	15	
Nematoda	3	

Note: Chironoxnidae genera were not used for statistical analyses.

Table 3. Representation of specific taxa within the Columbia Plateau ecoregion.

Common Taxa	No. Sites	Unique Taxa
Coleoptera		***Coleoptera***
Optioservus	10	Coptotomus
Zaitzevia	3	Helophorus
Dubiraphia	2	Heterlimnius
Ordobrevia	2	***Diptera***
Diptera		Chelifera
Chironomidae	15	Hemerodromia
Simulium	8	***Ephemeroptera***
Dicranota	6	Ameletus
Limonia	2	Caenis
Muscidae	2	Epeorus
Antocha	2	Ephemerella
Ephemeroptera		Rhithrogena
Baetis	14	Serratella
Heptagenia	5	***Plecoptera***
Paraleptophlebia	5	Hesperoperla
Tricorythodes	4	Isoperla
Plecoptera		Zapada
Malenka	6	***Tricoptera***
Skwala	4	Brachycentrus
Trichoptera		Glossosoma
Hydropsyche	14	Lepidostoma
Hydroptila	4	Parapsyche
Cheumatopsyche	2	***Lepidoptera***
Odonata		Petrophila
Ophiogomphus	6	***Mites***
Argia	2	Sialis
Mites		***Gastropoda***
Hydracarina	3	Lymnaea
Crustacea		***Crustacea***
Ostracoda	2	Hyallela
Other		
Oligochaeta	3	
Planaria	2	

Table 4. Representation of specific taxa within the Northern Rockies ecoregion.

Common Taxa	No. Sites
Coleoptera	
Optioservus	11
Heterlimnus	6
Oreodytes	4
Zaitzevia	2
Diptera	
Chironomidae	34
Simulium	15
Atherix	7
Empididae	4
Hexatoma	2
Antocha	2
Ephemeroptera	
Baetis	28
Serratella	13
Drunella	11
Cinygmula	10
Epeorus	10
Paraleptophlebia	3
Plecoptera	
Suwallia	5
Zapada	4
Skwala	3
Hesperoperla	3
Kogotus	2
Malenka	2
Trichoptera	
Hydropsyche	15
Rhyacophila	14
Brachycentrus	12
Neophylax	7
Arctopsyche	6
Hydroptila	5
Glossosoma	5
Micrasema	4
Agapetus	3
Helicopsyche	2
Apatania	2
Pelecypoda	
Sphaeriidae	3
Mites	
Lebertia	3
Other	
Oligochaeta	3
Planariidae	2

Unique Taxa
Coleoptera
Haliplus
Lara
Microcylloepus
Ordobrevia
Diptera
Caloparyphus
Chelifera
Muscidae
Ephemeroptera
Ephemerella
Pseudocloeon
Rhithrogena
Plecoptera
Doroneuria
Isogenoides
Megarcys
Paraperla
Pteronarcys
Trichoptera
Cheumatopsyche
Chimarra
Lepidostoma
Neotrichia
Wormaldia
Gastropoda
Flumincola
Pelecypoda
Pisidium
Other
Nematoda

Table 5. Representation of specific **taxa** within the Blue Mountains ecoregion.

Common Taxa	No. Sites	Unique Taxa
Coleoptera		***Coleoptera***
Heterlimnius	14	Hydaticus
Optioservus	8	Hydroporus
Zaitzevia	7	Psephenus
Narpus	5	***Diptera***
Ordobrevia	2	Ceratopogonidae
Diptera		Oerodytes
Chironomidae	31	Pericoma
Simulium	6	Prosimulium
Empididae	4	***Ephemeroptera***
Antocha	4	Callibaetis
Ephemeroptera		Leptophlebia
Baetis	33	***Plecoptera***
Cinygmula	20	Hesperoperla
Serratella	18	Megarcys
Epeorus	17	Pteronarcys
Drunella	17	Yoraperla
Rhithrogena	8	***Trichoptera***
Ameletus	8	Arctopsyche
Heptagenia	2	Dolophilodes
Paraleptophlebia	2	Ecclisomyia
Plecoptera		Glossosoma
Doroneuria	10	Ochrotrichia
Malenka	8	***Hemiptera***
Visoka	5	Corisella
Zapada	5	Gerris
Sweltsa	4	Graptocorixa
Calineuria	4	***Pelecypoda***
Skwala	2	Pisidium
Trichoptera		***Odonata***
Rhyacophila	18	Argia
Parapsyche	8	***Other***
Hydropsyche	7	Collembola
Neophylax	6	
Brachycentrus	5	
Wormaldia	2	
Lepidostoma	2	
Micrasema	2	
Crustacea		
Ostracoda	2	
Mites		
Hydracarina	4	
Other		
Oligochaeta	4	

Table 6. Representation of specific taxa within the High Desert ecoregion.

Common Taxa	No. Sites	Unique Taxa
Coleoptera		***Coleoptera***
Optioservus	29	Deronectes
Zaitzevia	12	Brychius
Rhizelmis	11	Psephenidae
Heterlimnius	6	Haliplus
Hydroporus	3	Eubrianax
Carabidae	3	***Diptera***
Dubiraphia	3	Atherix
Gyrinus	2	Dixa
Tropisternus	2	Rhabdomastix
Peltodytes	2	Muscidae
Laccophilus	2	Bezzia
Oreodytes	2	Pericoma
Diptera		***Ephemeroptera***
Chironomidae	70	Centroptilum
Simulium	26	Leptohyphes
Antocha	10	Pseudocloen
Ceratopogonidae	8	***Hemiptera***
Hexatoma	6	Notonecta
Dicranota	5	Naucoridae
Prosimulium	5	Gerris
Oerodytes	5	Corisella
Hemerodromia	4	Hesperocorixa
Empididae	2	***Plecoptera***
Atrichopogon	2	Beloneuria
Ephemeroptera		Capniidae
Baetis	40	Cascadoperla
Paraleptophlebia	14	Megarcys
Tricorythodes	13	Yugus
Ephemerella	10	Isoperla
Serratella	10	Amphinemura
Heptagenia	9	***Trichoptera***
Cinygmula	8	Apatania
Epeorus	8	Cheumatopsyche
Drunella	7	Gumaga
Callibaetis	5	Leucotrichia
Leurocuta	5	Neothremma
Rhithrogena	4	Ceraclea
Caenis	2	Oxyethira
Ameletus	2	***Crustacea***
Plecoptera		Cladocera
Skwala	9	Copepoda
Hesperoperla	7	Gammarus
Malenka	6	***Gastropoda***
Calineuria	5	Gyraulus
Chloroperlidae	4	Physella
Alloperla	4	Psychoglypha
Pteronarcella	3	***Lepidoptera***
Zapada	2	Petrophila
Sweltsa	2	***Pelecypoda***
Doroneuria	2	Sphaeriidae
Suwallia	2	

Table 6. Representation of specific taxa within the High Desert ecoregion.

Common Taxa	No. Sites	Unique Taxa
Claassenia	2	
Trichoptera		
Hydropsyche	23	
Rhyacophila	7	
Micrasema	7	
Grensia	5	
Helicopsyche	5	
Hydroptila	4	
Glossosoma	4	
Neophylax	3	
Arctopsyche	3	
Dicosmoecus	2	
Wormaldia	2	
Lepidostoma	2	
Amiocentrus	2	
Parapsyche	2	
Crustacea		
Ostracoda	17	
Hyallela	3	
Gastropoda		
Physa	5	
Mites		
Hydracarina	28	
Sialis	4	
Odonata		
Ophiogomphus	7	
Zoniagrion	5	
Argia	2	
Pelecypoda		
Pisidium	17	
Other		
Oligochaeta	23	
Nematoda	9	
Planariidae	3	
Turbellaria	2	

Table 7. Average Assemblage Measures, based on streams used for Principal Components Analysis.

	Total Number	Total Taxa	EPT	EPT/C	DOMTAX	HE31
Eastern Cascades	6707	37	18	8.5	39.0	3.6
Columbia Plateau	2881	23	11	5.5	43.7	2.7
Northern Rockies	5635	25	13		36.0	4.3
Blue Mountains	4236	42	23	5.4	28.4	3.9
High Desert	5936	26	10	5.5	43.4	5.0

Total number = Average total number of organisms/square meter

Total taxa = Average total taxa per stream

EPT = Average total number of Ephemeroptera, Plecoptera and Trichoptera taxa per stream

EPT/C = Ratio of number of EPT organisms to total number of midges

DOMTAX = Percent of total number represented by most dominant taxon in the stream

HBI = Hilsenhoff Biotic Index (indicator of tolerant organism abundance)

Table 8. Ten most abundant **taxa** ranked, for streams ecoregions **6, 7, 8, 9** and 10. **(1=** most abundant)

Site	1	2	3	4	5	6	7	8	9	10
Ecoregion Six										
Antelope	Baetis	Simulium	Dolophilodes	Chironomidae	Cinygmula	Epeorus	Sweltsa	Rhyacophila	Doroneuria	Serratella
Big Marsh	Chironomidae	Optioservus	Micrasema	Paraleptophlehia	Hydroptila	Micropsectra	Cricotopus	Cleptelmis	Rheotanytarsus	Thienemannimyia
Bridge	Baetis	Chironomidae	Cinygmula	Dolophilodes	Yoraperla	Simulium	Serratella	Micrasema	Sweltsa	Malenka
Brush	Cinygmula	Paraleptophlehia	Sweltsa	Chironomidae	Baetis	Micrasema	oligochaeta	Doroneuria	Dnmella	Zapada
Burnt	Chirouomidae	Simulium	Baetis	Wormaldia	Hydropsyche	Optiservus	Antocha	Skwala	Glossosoma	Hexatoma
Candle	Chironomidae	Dnmella	Baetis	Neothremma	Epeorus	Caudatella	Cinygmula	Zapada	Oligochaeta	Glossosoma
Canyon	Chironomidae	Yoraperla	Baetis	Tvetinia	Parapbaenocladius	oligochaeta	Micropsectra	Caudatella	Chelifera	Drunella
Cold	Chironomidae	Yoraperla	Baetis	Malenka	Micrasema	Planariidae	Dnmella	Pisidium	Tubificidae	Hydracarina
Crescent	Ol'gochaeta	Chironomidae	Acari	Sphaeriidae	Hemerodromia	Thienemannimyia	Nematoda	Diphetor		
Crescent **a.**	Baetis	Chironomidae	Optioservus	Sweltsa	Tricorythodes	Skwala	Wonualdia	Serratella	Dnmella	Pteronarcys
Crooked	Baetis	Cbironomidae	Glossosoma	Heterlimnius	Cinygmula	Serratella	Dnmella	Dolophilodes	Zapada	Doroneuria
Cultus	Oligochaeta	Sphaeriidae	Baetis	Cbironomidae	Yoraperla	Heterlimnius	Cricotopus	Turbellaria	Chelifera	Cinygmula
Deschutes(Browns)	Chironomidae	Rheotanytarsus	Hydra	Simulium	Synorthocladius	Nanocladius	Hemerodromia	Oligochaeta	Baetis	
Deschutes(Bull)	Chironomidae	Ephemerella	Oligochaeta	Isoperla	Rheotanytarsus	Baetis	Glossosoma	Cladotanytarsus	Rhithrogena	Hydropsyche
Fall	Drunella	Yoraperla	Cinygmula	Zapada	Capniidae	Heterlimnius	Oligochaeta	Baetis	Chironomidae	Rhyacophila
Hayden	Simulium	Tubificidae	Baetis	chironomidae	Ostracoda	Simuliidae	Ochrottichia	Pisidium	Oreodytes	Hydaticus
Indian Ford	Optiservus	Oligochaeta	Capniidae	Cbironomidae	Skwala	Glossosoma	Nematoda	Dicranota	Parapbaenocladi	Pagastia
Jack	Yoraperla	Chironomidae	Dnmella	Heterlinmius	Acari	Nematoda	Baetis	Caudatella	Zapada	
Jefferson	Caudatella	Drunella	Yoraperla	Chironomidae	Baetis	Glossosoma	Paraleptophlebia	Rhithrogena	Chelifera	
Little Deschutes	Chironomidae	Baetis	Dnmella	Stempellina	Diphetor	Micrasema	Hydroptila	Ephemerella	Attenella	
Long	Baetis	Sweltsa	Optiservus	Chironomidae	Drunella	Serratella	Skwala	Doroneuria	Simulium	Chelifera
Low Big Marsh	Optioservus	Chironomidae	Baetis	Psectrocladius	Oligochaeta	Tanytarsus	Hydoptila	Thienemannimyi	Cleptelmis	Oxyethira
Low Trapper	Chironomidae	Ephemerella	Cricotopus	Cinygmula	Yoraperla	Caudatella	Micropsectra	Baetis	Ecclisomyia	oligochaeta
Major	Malenka	Baetis	Chironomidae	Simulium	Maruina	Optioservus	Paraleptophlebia	Wormaldia	Hydropsyche	Epeorus
Miners	Cbironomidae	Malenka	Baetis	Zaitzevia	Ironodes	Serratella	Dolophilodes	Simulium	Rhyacophila	Capnia
Odell	Ephemerella	Heterlimnius	Spbaeriidae	Paraleptophlebia	Cinygmula	Optioservus	Amaletus	Zapada	Baetis	
Scott	Yoroperla	Prosimulium	Chironomidae	Sweltsa	Cinygma	Perlodidae	Baetis	Epeorus	Zapada	Rhithrogena
Snow	Yoraperla	Sweltsa	Cinygmula	Cbironomidae	Simulium	Baetis	Isoperla	Doroneuria	Malenka	Rhyacophila
Soda	Oligochaeta	Ceratopogonidae	Chironomidae	Cinygmula	Sweltsa	Cricotopus	Rheocrictopus	Capniidae	Ostracoda	Druuella
Trapper	Cinygma	Ephemerella	Chironomidae	Sweltsa	Oligochaeta	Paraleptophlebia	Baetis	Rhithrogena	Yoraperla	Caudatella
Trout	chironomidae	Baetis	Simulium	Hydroptila	Pericoma	Skwala	Malenka	Parapsyche	Agapetus	Amphinemura
Tumalo	Rhithrogena	Baetis	Epeorus	Drunella	cbirouomidae	Cinygmula	Rhyacophila	Hexatoma	Sweltsa	Glossosoma
upper Crescent	Chironomidae	oligochaeta	Ephemerella	Micrasema	Baetis	Optioservus	Antocha	Acari	Drunella	

Note: Subscript letters **after stream** names denote different sample dates. Numbers denotes different streams with the same name.

Table 8. Ten most abundant **taxa** ranked, for streams ecoregions **6, 7, 8, 9** and **10**. **(1=** most abundant)

Site	1	2	3	4	5	6	7	8	9	10
Upper Tygh	**Chironomidae**	**Seratella**	Baetis	Simulium	Cinygmula	**Heterlimnius**	**Micrasema**	**Ameletus**	**Rhyacophila**	**Yoraperla**
Ecoregion Seven										
Alpowa	**Optioservus**	Baetis	Hydropsyche	Dicranota	**Brachycentrus**	**Chironomidae**	**Simulium**	**Skwala**	Tipula	**Malenka**
Altoma	**Baetis**	Skwala	**Hydropsyche**	Chironomidae	**Optioservus**	**Simulium**	**Antocha**	**Tipula**	**Dicranota**	**Chelifera**
Bedrock	**Hydropsyche**	Chironomidae	**Optioservus**	**Malenka**	**Paraleptophlebia**	**Ordobrevia**	**Zaitzevia**	Baetis	Skwala	**Sialis**
Brushy	**Chironomidae**	Paraleptophlebia	Baetis	Heptagenia	Hydroptila	**Optioservus**	**Heterlimnius**	**Simulium**	**Hydropsyche**	**Serratella**
Cottonwood	**Baetis**	**Hydropsyche**	Heptagenia	Chironomidae	Zaitzevia	**Optioservus**	**Epeorus**	Paraleptophlebia	**Simulium**	**Malenka**
Crab	**Chironomidae**	**Optioservus**	Hydropsyche	Baetis	Ptychopteridae	**Lymnaea**	**Hydracarina**	Cheumatopsyche	Zaitzevia	**Physidae**
Crab a.	**Orthocladiinae**	**Optioservus**	**Planaria**	Baetis	**Lymnaea**	**Ostracoda**	**Chironomidae**	**Tubificidae**	**Hydracarina**	**Hydropsyche**
Crab b.	**Optioservus**	Orthocladiinae	**Planaria**	Elmidae	Cheumatopsyche	**Hyalella**	**Argia**	**Hydracarina**	Chifonomidae	**Tubificidae**
Douglas	Baetis	Simuliidae	Elmidae	Cheumatopsyche	Chironomidae	**Hydracarina**	Parapleptophlebia	**Ostracoda**	**Malenka**	**Oligochaeta**
Douglas a.	**Hydropsyche**	Chironomidae	**Baetis**	Dicranota	**Simulium**	**Limonia**	**Hydroptila**	**Malenka**	Helophorus	**Muscidae**
Four Mile	**Optioservus**	**Hydropsyche**	**Argia**	**Tricorythodes**	Lepidostoma	Baetis	**Caenis**	**Dubiraphia**	Dicranota	**Coptotomus**
Lapwai	**Hydropsyche**	**Baetis**	**Optioservus**	Heptagenia	Skwala	**Chironomidae**	**Ordobrevia**	**Paraleptophlebia**	**Antocha**	**Zaitzevia**
Rock Island	**Baetis**	**Simulium**	Malenka	**Parapsyche**	**Hydropsyche**	Heptagenia	**Chironomidae**	Dicranota	**Tipula**	**Zapada**
S.F. **Palouse** River	**Tricorythodes**	Chironomidae	**Optioservus**	Hydropsyche	Ophigomphus	Dubiraphia	**Hemerodromia**			
Similkameen	**Chironomidae**	Hydropsyche	**Ameletus**	**Isoperla**	Rbithrogena	Ephemerella	**Heptagenia**	Baetis	**Coenagrionidae**	**Hesperoperla**
Spanish Hollow	**Chironomidae**	Baetis	Hydropsyche	Caloparyphus	**Simulium**	Hydroptila	**Coenagrionidae**	Limonia	**Paraleptophlebia**	**Malenka**
Squaw	**Baetis**	Simulium	**Optioservus**	**Chironomidae**	Dicranota	**Tricorythodes**	**Muscidae**	**Hydropsyche**	**Hydroptila**	**Glossosoma**
Ecoregion Eight										
Agency	Simulium!	Chironomidae	**Optioservus**	**Agapetus**	Simuliidae	**Arctopsyche**	B r a c e	Wormaldia	**Rhyacophila**	Sphaeriidae
Canyon	Chironomidae	Micrasema	Baetis	**Brachycentrus**	**Tricoptera**	**Neophylax**	**Optioservus**	**Rhyacophila**	**Hydropsyche**	Diptera
Clover	**Chironomidae**	Baetis	Hydropsyche	Stactobiella	Simulium	**Naididae**	Hexatoma	**Optioservus**	Zaitzevia	Calopaxyphus
Daly	Baetis	**Tubificidae**	**Zapada**	**Heterlimnius**	**Serratella**	**Rhyacophila**	**Orthocladiinae**	**Chironominae**	Heptageniidae	Polycelis
Eighteenmile	**Chironomidae**	Baetis	Drunella	**Heterlimnus**	**Epeorus**	Cinygmula	**Megarcys**	Serratella	**Rhyacophila**	**Kogotus**
Grouse	**Chironomidae**	Serratella	**Optioservus**	Heterlimnius	Cinygmula	**Drunella**	Hydropsychidae	**Naididae**	Baetis	**Malenka**
Hay	**Chironomidae**	**Optioservus**	**Epeorus**	**Brachycentrus**	Serratella	**Micrasema**	**Drunella**	Baetis	**Rhyacophila**	Glossosoma
Horse Basin	**Simulium**	**Heterlimnius**	**Apatania**	Baetis	Chironomidae	**Planariidae**	**Optioservus**	**Pisidium**	**Malenka**	**Pteronarcella**
Iron	**Epeorus**	Cinygmula	Chironomidae	Baetis	Naididae	**Serratella**	**Glossosoma**	**Hesperoperla**	**Arctopsyche**	Rhyacophila
Kenny	Chironomidae	Serratella	Dnmella	Cinygmula	Baetis	**Epeorus**	**Neophylax**	**Brachycentrus**	Kogotus	**Rhyacophila**
Little **Loon**	Chironomidae	Tubificidae	Baetis	**Microcylloepus**	**Hydropsyche**	**Flumincola**	**Helicopsyche**	**Chimarra**	**Simulium**	Neotrichia
Little Timber	Chironomidae	**Arctopsyche**	**Epeorus**	Baetis	**Brachycentrus**	**Micrasema**	**Hydropsyche**	Simuliidae	Sphaeriidae	**Oerodytes**
McDevitt	Chironomidae	**Heterlimnius**	**Optioservus**	Baetis	**Neophylax**	**Rhyacophila**	**Agapetus**	Serratella	**Lara**	Dxunella
McKim	**Glossosoma**	**Epeorus**	Baetis	Cinygmula	**Simulium**	Chironomidae	Dnmella	Planariidae	**Serratella**	Simuliidae

Note: Subscript letters after **stream** names denote different sample dates. Numbers denotes different streams with the same name.

Table 8. Ten most **abundant taxa ranked,** for streams ecoregions **6, 7, 8, 9** and 10. **(1=** most abundant)

Site	1	2	3	4	5	6	7	8	9	10
Pattee	**Chironomidae**	**Optioservus**	**Agapetus**	Serratella	Naididae	Paraperla	**Brachycentrus**	**Baetis**	**Pseudocloeon**	**Drunella**
Squaw	**Chironomidae**	**Brachycentrus**	Baetis	Simulium	Heterlimnius	**Hesperoperla**	Serratella	Cinygmula	**Zapada**	**Rhyacophila**
Tenmile	**Heterlimnius**	Cinygmula	**Naididae**	Dnmella	Chironomidae	Hexatoma	Apatania	**Neophylax**	**Doroneuria**	**Glossosomatidae**
Thompson	**Simulium**	Chironomidae	Baetis	**Rhyacophil**	Serratella	Dnmella	**Epeorus**	Neophylax	**Cinygmula**	**Optioservus**
Timber	**Chironomidae**	**Epeorus**	Elmidae	**Cinygmula**	**Hesperoperla**	Baetis	**Brachycentrus**	Dnmella	Simulium	**Rhyacophila**
Yearin	**Chironomidae**	Dnmella	**Cinygmula**	**Epeorus**	**Glossosoma**	Simulium	**Trichoptera**	Baetis	Serratella	**Paraleptophlebia**
Ecoregion Nine										
Bear	**Chironomidae**	**Rhithrogena**	Baetis	**Cinygmula**	**Heterlimnius**	Visoka	Dnmella	**Ecclisomyia**	**Sweltsa**	**Epeorus**
Billy	**Cinygmula**	Serratella	Chironomidae	**Narpus**	**Ameletus**	**Chloroperlidae**	Neophylax	Baetis	**Micrasema**	**Rhyacophilidae**
Coutney	**Chironomidae**	Zaitzevia	**Malenka**	**Leptophlebia**	Baetis	**Optioservus**	**Ordobrevia**	Hydracarina	Calineuria	**Psephenus**
Deer	**Baetis**	**Hydropsyche**	Simulium	**Optioservus**	Chironomidae	**Malenka**	Zaitzevia	**Antocha**	**Neophylax**	**Epeorus**
Deer	**Cinygmula**	Dnmella	Baetis	Empididae	**Neophylax**	Parapsyche	**Rhithrogena**	Rhyacophila	**Epeorus**	**Visoka**
Devil's **Run**	**Chironomidae**	Hydropsyche	Serratella	**Zaitzevia**	**Antocha**	Rhyacophila	**Optioservus**	Heterlimnius	**Baetis**	Tipulidae
East Fork Canyon	**Chironomidae**	**Baetis**	Cinygmula	Skwala	Drunella	Heterlimnius	**Malenka**	Simulium	**Rhyacophila**	**Pericoma**
East Fork **Lostine**	**Baetis**	**Chironomidae**	Simulium	**Epeorus**	**Rhithrogena**	**Ameletus**	Sweltsa	**Rhyacophila**	**Zapada**	Doroneuria
Gordon	**Chironomidae**	**Cinygmula**	**Narpus**	Serratella	cbloroperlidae	**Heterlimnius**	**Zaitzevia**	**Perlodidae**	**Rhyacophila**	Drunella
Griffith	**Heterlimnius**	**Optioservus**	Baetis	**Hydropsyche**	Serratella	**Rhyacophila**	**Epeorus**	**Cinygmula**	Psychodidae	**Narpus**
Grouse	**Cinygmula**	Empidiae	Serratella	**Brachycentrus**	Dnmella	**Rhyacophila**	**Epeorus**	**Heterlimnius**	**Narpus**	Glossosoma
Lightening	**Baetis**	Wormaldia	**Epeorus**	Calineuria	**Hydropsyche**	Chimnomidae	**Optioservus**	Serratella	**Pteronarcella**	Arctopsyche
Little Bear	**Baetis**	**Epeorus**	Cinygmula	**Rhithrogena**	Chironomidae	**Parapsyche**	Rhyacophila	Doroneuria	Yoraperla	**Zapada**
Lower Carrol	**Heterlimnius**	**Cinygmula**	Empididae	Serratella	Rhyacophila	Dnmella	**Epeorus**	Tipulidae	Baetis	Parapsyche
Lower Tucannon	**Serratella**	Chironomidae	Heterlimnius	**Brachycentrus**	**Drunella**	Rhyacophila	Baetis	Doroneuria	Cinygmula	**Chloroperlidae**
Mann	**Optioservus**	Chironomidae	Serratella	Ameletus	Baetis	Cinygmula	Drunella	**Lepidostoma**	**Wormaldia**	**Epeorus**
Meadow	**Cinygmula**	Chironomidae	**Chironomidae**	Rhyacophila	**Heterlimnius**	Doroneuria	**Baetis**	**Zapada**	**Serratella**	Parapsyche
Middle Carrol	**Cinygmula**	Chironomidae	Heterlimnius	**Brachycentrus**	Rhyacophila	Serratella	Drunella	Baetis	**Ameletus**	**Doroneuria**
Mottet	**Chironomidae**	Cinygmula	**Narpus**	**Epeorus**	Serratella	Baetis	Visoka	Lepidostoma	**Chloroperlidae**	**Neophylax**
Mud	**Chironomidae**	**simulium**	Baetis	**Hydracarina**	Hydropsyche	**Malenka**	**Zaitzevia**	**Heterlimnius**	**Antocha**	**Epeorus**
North Fork Catherine	**Baetis**	Rhithrogeua	**Epeorus**	Drunella	Rhyacophila	**Chironomidae**	**Zapada**	Parapsyche	Dolophilodes	**Megarcys**
North Fork Malheur	**Chironomidae**	Sweltsa	Baetis	**Heterlimnius**	Serratella	**Rhyacophila**	Rhithrogena	**Ameletus**	Skwala	**Micrasema**
North Fork **Umatilla**	**Baetis**	**Rhithrogena**	Chironomidae	**Epeorus**	Doroneuria	**Sweltsa**	**Cinygmula**	Rhyacophila	**Hesperoperla**	**Drunella**
Sickfoot	**Chironomidae**	**Heptageniidae**	**Malenka**	serratella	Naididae	**Paraleptophlebia**	Baetis	Hydropsyche	Calineuria	**Ostracoda**
Silver	**Helicopsyche**	**Chironomidae**	**Optioservus**	**Hydropsyche**	**Musculum**	Baetis	**Dicosmoecus**	Argia	**Neophylax**	**Zaitzevia**
South Fork Desolation	**Rhithrogena**	Rhyacophila	**Doroneuria**	Baetis	Sweltsa	**Chironomidae**	**Ameletus**	**Cinygmula**	**Epeorus**	**Drunella**
Summer	**Cinygmula**	**Chironomidae**	Dnmella	**Rhyacophila**	**Doroneuria**	V i	**Heterlimnius**	**Parapsyche**	**Ameletus**	**Chloroperlidae**

Note: Subscript letters after sham names denote **different** sample dates. Numbers denotes different streams with the same name.

Table 8. Ten most **abundant taxa ranked**, for streams ecoregions **6, 7, 8, 9** and 10. **(1=** most abundant)

Site	1	2	3	4	5	6	7	8	9	10
Tyee	**Cinygmula**	**Empididae**	**Epeorus**	**Rhyacophila**	Dnmella	**Parapsyche**	Perlodidae	Serratella	**Zapada**	**Chloroperlidae**
Upper Carrol	**Brachycentrus**	**Cinygmula**	Chironomidae	**Rhyacophila**	Serratella	**Heterlimnius**	Baetis	Dnmella	Ameletus	**Doroneuria**
Upper Tucannon	**Chironomidae**	**Visoka**	Serratella	Heterlimnius	Dnmella	**Brachycentrus**	Cinygmula	**Baetis**	**Chloroperlidae**	**Neophylax**
Wallupa	**Chironomidae**	**Ephemerellidae**	Paraleptophle	Baetis	**Ordobrevia**	Hydracarina	Antocha	**Malenka**	**Calineuria**	Rhithrogena
Willow	**Optioservus**	**Parapsyche**	**Epeorus**	chironomidae	**Baetis**	**Callibaetis**	**Corisella**	Prosimulium	**Gerris**	**Graptocorixa**
Ecoregion Ten										
12 mile	**Chironomidae**	**Baetis**	Hydracarina	Heptagenia	**Paraleptophlebia**	**Paragyractis**	**Zaitzevia**	**Optioservus**	**Antocha**	**Elmidae**
Basin	**Baetis**	**Simulium**	Chironomidae	Simuliidae	**Optioservus**	**Pteronarcella**	**Arctopsyche**	**Brachycentrus**	**Deronecetes**	**Emphidae**
Bayhorse	**Chironomidae**	**Baetis**	Cinygmula	Drunella	**Epeorus**	**Rhyacophila**	Serratella	Naididae	Polycelis	**Neophylax**
Bayhorse a.	**Chironomidae**	**Baetis**	Cinygmula	Drunella	**Epeorus**	Rhyacophila	Serratella	**Naididae**	Polycelis	**Neophylax**
Big Jack's (lower)	**Hydropsyche**	**Chironomidae**	**Oreodytes**	**Coenagrionidae**	Oligochaeta	Ophiogomphus	Hexatoma	**Antocha**	**Claasenia**	Sialis
Big Jack's (upper)	**Chironomidae**	**Ophiogomphus**	Hydracarina	Oligochaeta	Sialis	Hexatoma	**Antocha**	**Grensia**	**Argia**	**Brachycentrus**
Big Lost River	**Chironomidae**	**Peltodytes**	Baetis	**Simulium**	**Centroptilum**	**Oreodytes**	**Laccophilus**	**Ephemerella**	**Tricorythodes**	**Ostracoda**
Big Lost River a.	**Baetis**	**Chironomidae**	Simulium	Ephemerella	**Optioservus**	**Tricorythodes**	**Isoperla**	Notonecta	**Laccophilus**	**Gammarus**
Bridge	**Chironomidae**	**Baetis**	Heptagenia	**Zapada**	**Optioservus**	**Chloroperlidae**	Serratella	Hydracarina	Cinygmula	**Paraleptophlebia**
Bridge a.	**Cinygmula**	**Heptagenia**	**Optioservus**	Chironomidae	**Tricorythodes**	**Zaitzevia**	**Rhithrogena**	Sweltsa	**Capniidae**	**Paraleptophlebia**
Bridge b.	**Chironomidae**	**Zapada**	Cinygmula	Plecoptera	**Rhabdomastix**	Baetis	**Optioservus**	Simulium	Tuhificidae	Suwallia
Bridge c.	**Chironomidae**	**Eaetis**	**Plecoptera**	**Optioservus**	Serratella	Suwallia	Cinygmula	**Hydropsychidae**	Leptophlebiidae	**Wormaldia**
Buck	**Rhizelmis**	**Chironomidae**	Prosimulium	**Hesperoperla**	**Amiocentrus**	Simulium	**Hydropsyche**	**Oreodytes**	**Brachycentrus**	Pisilium
Buck a.	**Chironomidae**	**Sweltsa**	Nematoda	**Ostracoda**	**Optioservus**	Hydracarina	Paraleptophlebia	Ephemerella	**Micrasema**	Oligochaeta
Buck b.	**Chironomidae**	**Chloroperlidae**	Orthocladiina	Hydracarina	sphaeriidae	**Tanypodinae**	**Optioservus**	Hexatoma	Zaitzevia	**Gumaga**
Buck c.	**Baetis**	**Chloroperlidae**	Orthocladiina	Hydracarina	Chironomidae	Naididae	Pisidium	**Micrasema**	**Serratella**	Tanypodinae
Buck d.	**Chironomidae**	**Orthocladiinae**	**Chloroperlida**	**Serratella**	Sphaeriidae	**Optioservus**	**Ceraclea**	**Zaitzevia**	**Hydracarina**	Capniidae
Buck e.	**Chironomidae**	**Plumiperla**	**Zaitzevia**	Ephemerella	**Hydracarina**	Baetis	Perlodidae	Hexatoma	Heptagenia	Pelecypuda
Burnt	**Chironomidae**	**Cinygmula**	Drunella	Planariidae	Pisidium	**Epeorus**	Hydracarina	**Baetis**	**Optioservus**	Apatimia
Camas	**Hydracarina**	**Chironomidae**	**Tricorythodes**	Baetis	**Optioservus**	Hydropsyche	**Zaitzevia**	Helicopsyche	**Tinodes**	**Cheumatopsyche**
Camas a.	**Chironomidae**	**Hydracarina**	**Optioservus**	Heptagenia	**Tricorythodes**	Baetis	**Paraleptophlebia**	**Bezzia**	**Chloroperlidae**	Oligochaeta
Camas b.	**Chironomidae**	**Rhithrogena**	Baetis	Hydropsyche	**Optioservus**	Plecoptera	**Skwala**	Paraleptophlebia	Ophiogomphus	Simulium
Camas c.	**Optioservus**	**Leurocuta**	**Chironomidae**	**Baetis**	**Hydracarina**	**Capniidae**	**Hydropsychidae**	Helicopsyche	Hydropsyche	Hexatoma
Cassia	**Chironomidae**	**Rhizelmis**	**Skwala**	**Hydropsyche**	oligochaeta	**Hydracarina**	**Brachycentrus**	Simulium	**Hymenoptera**	**Calineuria**
Catnip	**Chironomidae**	**Callibaetis**	**Baetis**	**Hydroptila**	**Muscidae**	**Oreodytes**	**Gyrinus**	**Hydroporus**	Dicranota	**Ceratopogonidae**
Cottonwood Low	**Chironomidae**	**Skwala**	oligochaeta	**Dubiraphia**	**Alloperla**	**Calineuria**	Hydmpsyche	**Sialis**	Ephemerella	**Pisidium**
Cottonwood Up	**Chironomidae**	**Rhizelmis**	**Hydropsyche**	**Brachycentrus**	**Grensia**	Pisidium	**Turbellaria**	**Nematoda**	**Ephemerella**	**Arctopsyche**
Cow	**Baetis**	**Drunella**	**Chironomidae**	**Cinygmula**	**Epeorus**	**Suwallia**	**Rhithrogena**	**Doroneuria**	Simulium	**Rhyacophila**

Note: Subscript **letters after stream names** denote diierent sample dates. Numbers denotes different streams with the same name.

Table 8. Ten most abundant taxa ranked, for streams ecoregions 6, 7, 8, 9 and 10. (1= most abundant)

Site	1	2	3	4	5	6	7	8	9	10
Crooked	Callibaetis	Baetis	Tricorythodes	Hesperocorixa	Chironomidae	Zoniagrion	Corixidae	Corisella	Haliplus	Ceratopogonidae
Deep	Orthocladiinae	Baetis	Chironomidae	Optioservus	Leurocuta	Tricorythodes	Zaitzevia	Tanypodinae	Paraleptophlebia	Helicopsyche
Deep a.	Optioservus	Chironomidae	Tanypodinae	Tubificida	Leurocuta	Orthocladiinae	Leptophlebiidae	Zaitzevia	Baetis	Helicopsyche
Deep b.	Orthocladiinae	Hydropsyche	Rhithrogena	Chironomidae	Optioservus	Tanypodinae	Baetis	Paraleptophlebia	Ephemerellidae	Zaitzevia
Deep c.	Chironomidae	Optioservus	Tricorythodes	Heptagenia	Antocha	Glossosoma	Baetis	Ostracoda	Zoniagrion	Oligochaeta
Deep d.	Tricorythodes	Chifonomidae	Optioservus	Oligochaeta	Hydropsyche	Antocha	Hydracarina	Nematoda	Hexatoma	Ephemerella
Devil's Corral	Chironomidae	Pisidium	Oligochaeta	Argia	ostracoda	Hemerodromia	Simulium	Oerodytes	Physa	Dixa
Doolittle	Pisidium	Hyallela	Chironomidae	Hydracarina	Malenka	Tubificidae	Physella	Hydropsyche	Baetis	Zaitzevia
Dove	Turbellaria	oligochaeta	Hydracarina	Chironomidae	Prosimulium	Antocha	Carabidae	Ostracoda	Pisidium	
Dry	Chironomidae	Hydropsyche	Caenis	Baetis	Simulium	Helicopsyche	Zoniagrion	Lepidostoma	Tricorythodes	Ceratopogonidae
Duncan	Hydracarina	Chironomidae	Ostracoda	Physa	Rhizelmis	Oligochaeta	Turbellaria	Oreodytes		
Green	Simulium	Chironomidae	Turbellaria	Calineuria	Hydracarina	Brachycentrus	Parapsyche	Skwala	Nematoda	Emphididae
Haynes	Chironomidae	Brachycentrus	Simulium	Optioservus	Serratella	Baetis	Simuliidae	Heterlimnius	Epeorus	Cinygmula
Herd	Brachycentrus	Chironomidae	Simulium	Baetis	Epeorus	Drunella	Serratella	Glossosomatidae	Heterlimnius	Neophylax
Honey	Chironomidae	Tricorythodes	ostracoda	Optioservus	Hydracarina	Oligochaeta	Paragyractis	Paraleptophlebia	Psephenidae	Gumaga
Honey a	Chironomidae	Baetis	Hydracarina	Optioservus	Hydroptila	Antocha	Epeorus	Heptagenia	Oligochaeta	Neothremma
Honey b.	Baetis	Chironomidae	Zaitzevia	Optioservus	Hydracarina	Stactobiella	Hydropsyche	Leurocuta	Paraleptophlebia	Eubrianix
Honey c.	Chironomidae	Optioservus	Hydropsyche	Tricorythodes	Paraleptophlebia	Baetis	Hemerodromia	Hydracarina	Ostracoda	Baetidae
Indian 1	Brachycentrus	Serratella	Rhithrogena	Chironomidae	Pseudo&eon	Optioservus	Baetis	Neuphylax	Hydroptila	Drunella
Indian 2	Chironomidae	Hydropsyche	Optioservus	Baetis	Heptagenia	Wormaldia	Hesperoperla	Simulimn	Ameletus	Malenka
Indian 2a	Chironomidae	Malenka	Baetis	Hydracarina	ostracoda	Leurocuta	Micrasema	Hydropsyche	Leucotrichia	Hesperoperla
Lake	Simulium	Chironomidae	Baetis	Optioservus	Brachycentrus	Rhyacophila	Simuliidae	Hesperoperla	luicrasema	Stactobiella
Lake Fork	Chironomidae	Brachycentrus	Rhizelmis	Ostracoda	Hexatoma	Hydracarina	Yugus	Prosimulium	Oligochaeta	Pisidimn
Little Hat	Baetis	Simulium	Optioservus	Malenka	Heterlimnius	Leurocuta	Pisidium	Lumbriculidae	Pteronarcella	Hyallela
Little Jack"s	Chironomidae	Grensia	Antocha	ostracoda	oligochaeta	Hydropsyche	Calineuria	Hydracarina	Carabidae	Sialis
Little Whitehorse	Zaitzevia	Baetis	Paraleptophle	Optioservus	Tubifkidae	Micrasema	Pisidium	Malenka	Chironomidae	Pericoma
Mary's	Chironomidae	Arctopsyche	Oligochaeta	Dytiscidae	Physa	Rhizelmis	Coenagrionidae	Corixidae	Hydracarina	Skwala
McDermitt	Baetis	Chironomidae	Skwala	Dicranota	Heptagenia	Optioservus	Simulium	Tricorythodes	Hesperoperla	Glossosoma
McDermitt a.	Chironomidae	Baetis	Hydropsyche	Zaitzevia	Optioservus	Hydracarina	Helicopsyche	Simulium	Dicranota	Ophiogomphus
Morgan	Optioservus	Chironomidae	Brachycentrus	Epeorus	Pisidium	Baetis	Oreodytes	Drunella	Classenia	Atherix
Parsnip	Chironomidae	Hyallela	Ostracoda	Hydracarina	Tricorythodes	Oxyethira	Caenis	Coenagrionidae	Nematoda	Paraleptophlebia
Parsnip a.	Ostracoda	Tricorythodes	Optioservus	Chifonomidae	oligochaeta	Leptohyphes	Planaria	Hydracarina	Bezzia	Argia
Parsnip b.	Chironomidae	Ostracoda	Leptohyphes	Baetis	Serratella	oligochaeta	Hydroptila	Callibaetis	Optioservus	Copepoda
Pike	Baetis	Simulium	Skwala	Rhyacophila	Brachycentrus	wormaldia	Dicranota	Chironomidae	Dicosmoecus	Zaitzevia

Note: Subscript letters after stream names denote different sample dates. Numbers denotes different streams with the same name.

Table 8. **Ten most abundant taxa ranked,** for streams ecoregions 6, 7, 8, 9 and 10. (1= most abundant)

Site	1	2	3	4	5	6	7	8	9	10
Road	Chironomidae	Heterlimnius	Baetis	Brachycentrus	Micrasema	Neothremma	Planariidae	Pteronarcella	Rhyacophila	Simulium
Rock	Chironomidae	Baetis	Hesperoperla	Malenka	Psychoglypha	Skwala	Paraleptophlehia	Lepidostoma	Limnephilidae	Hydropsyche
Rock (3rd Fork)	Heterlimnius	Chironomidae	Hydropsyche	Pisidium	Antocha	Rhyacophila	Oligochaeta	Ceratopogonidae	Carabidae	
S.F. Blitzen	Chironomidae	Zaitzevia	Optioservus	Baetis	Antocha	Brachycentrus	Epeorus	Micrasema	Serratella	Hydropsyche
Salmon Falls	Chironomidae	Rhizelmis	Ostracoda	Hydracarina	Ophiogomphus	Pisidium	Simulium	Physa	Ceratopogonidae	Nematoda
Sand Springs	Chironomidae	Prosimulium	Hydracarina	Hemerodromia	Pisidium	Homoptera	Oligochaeta	Grensia	Corixidae	
Sheep	Simulium	Chironomidae	Naucoridae	Calinemia	Nematoda	Ephemerella	Cascadoperla	oligochaeta	Hydracarina	Hydropsyche
shoshone	Ephemerella	Chironomidae	Hydropsyche	Pisidium	Dubiraphia	Dicosmoecus	Physa	oligochaeta	Gyraulus	Pisidium
Snyder	Chironomidae	Cladocera	Ostracoda	Tubificidae	Callibaetis	Atrichopogon	Fossaria	Corixidae	Diptera	Peltodytes
Station Fork	Pisidium	Ostracoda	Oligochaeta	Hydracarina	Simulium	Chironomidae	Amphineumura	Rhizelmis	Brachycentrus	Dicronota
Stinson	Prosimulium	Rhizelmis	Chironomidae	Brachycentrus	Alloperla					
Thomas	Ceratopogonida	Baetis	Chironomidae	Serratella	Skwala	Heptagenia	Rhithrogena	Hydroporus	Hydropsyche	Glossosoma
Trail	Epeorus	Cinygmula	Chironomidae	Rhyacophila	Dnmella	Planariidae	Glossosoma	Baetis	Parapsyche	Megarcys
Trapper	Rhizelmis	Brachycentrus	Ostracoda	Simulium	Hydracarina	Chironomidae	Grensia	Pisidium	Nematoda	Belonemia
Trapper (lower)	Brachycentrus	Rhizelmis	Ophiogomphu	Chironomidae	Ephemerella	Hemerodromia	Alloperla	Simulium	Ostracoda	Oligochaeta
Twelve Mile	Chironomidae	Tricorythodes	Helicopsyche	Paraleptophlehia	Leurocuta	Tubificida	Ceratopogonidae	Optioservus	Hydracarina	Petrophila
Twelve Mile a	Chironomidae	Baetis	Dnmella	Leurocuta	Nematoda	Paraleptophlebia	Brachycentrus	Rhithrogena	Hydropsyche	Ordobrevia
Vineyard	Chironomidae	Oligochaeta	Hexatoma	Hemerodromia	Heterlimnius					
Wall	Hydropsyche	Tricorythodes	Baetis	Chironomidae	Zaitzevia	Ceratopogonidae	Antocha	Tropisternus	Zoniagrion	Ophiogomphus
West Little Owyhee	Chironomidae	Callibaetis	Gyrinus	Hexatoma	Zoniagrion	Tropisternus	Brychius	Baetis	Gerris	Hydroptila
Willow	Simulium	Chironomidae	Baetis	Heptagenia	Brachycentrus	Hydroporus	Hydropsyche	Zaitzevia	Pteronarcys	Hesperoperla

Note: Subscript letters after stream names denote different sample dates. Numbers denotes different streams with the same name.

Table 9. Representation of taxa by ecoregion for the Columbia River Basin.

Common Taxa	Ecoregions	Unique Taxa	Ecoregion
Coleoptera		***Coleoptera***	
Dubiraphia	7,10	Brychius	10
Eubrianax	6,10	Carabidae	10
Haliplus	8,10	Cleptelmis	6
Heterlimnius	6,7,8,9,10	Coptotomus	7
Hydaticus	6,9	Deronectes	10
Hydroporus	9,10	Gyrinus	10
Optioservus	6,7,8,9,10	Helophorus	7
Ordobrevia	7,8,9	Laccophilus	10
Oreodytes	6,8,10	Lara	8
Psephenidae	9,10	Microcylloepus	8
Zaitzevia	6,7,8,9,10	Narpus	9
Diptera		Peltodytes	10
Antocha	6,7,8,9,10	Rhizelmis	10
Atherix	8,10	Tropisternus	10
Caloparyphus	7,8	***Diptera***	
Ceratopogonidae	6,9,10	Atrichopogon	10
Chelifera	6,7,8	Bezzia	10
Chironomidae	6,7,8,9,10	Dixa	10
Dicranota	6,7,10	Glutops	6
Empididae	8,9,10	Limonia	7
Hemerodromia	6,7,10	Maruina	6
Hexatoma	6,8,10	Rhabdomastix	10
Muscidae	7,8,10	Tabanus	8
Oerodytes	9,10	***Ephemeroptera***	
Pericoma	6,9,10	Attenella	6
Prosimulium	6,9,10	Caudatella	6
Simulium	6,7,8,9,10	Centroptilum	10
Ephemeroptera		Ironodes	6
Ameletus	6,7,9,10	Leptohyphes	10
Baetis	6,7,8,9,10	Leptophlebia	9
Caenis	6,7,10	Leurocuta	10
Callibaetis	9,10	***Plecoptera***	
Cinygmula	6,8,9,10	Alloperla	10
Drunella	6,8,9,10	Beloneuria	10
Epeorus	6,7,8,9,10	Cascadoperla	10
Ephemerella	6,7,8,9,10	Claassenia	10
Heptagenia	7,8,9,10	Kogotus	8
Paraleptophlebia	6,7,8,9,10	Paraperla	8
Pseudocloeon	6,8,10	Setvena	6
Rhithrogena	6,7,8,9,10	Soliperla	6
Serratella	6,7,8,9,10	Isogenoides	8
Tricorythodes	6,7,10	Visoka	9
Plecoptera		Yugus	10
Amphinemura	6,10	***Trichoptera***	
Calineuria	9,10	Amiocentrus	10
Capniidae	6,10	Ceraclea	10
Doroneuria	6,8,9,10	Chimarra	8
Hesperoperla	6,7,8,9,10	Dicosmoecus	10
Isoperla	6,7,10	Grensia	10
Malenka	6,7,8,9,10	Gumaga	10

Table 9. Representation of taxa by ecoregion for the Columbia River Basin.

Common Taxa	Ecoregions
Megarcys	6,8,9,10
Pteronarcys	6,8,10
Pteronarcella	9,10
Skwala	6,7,8,9,10
Suwallia	8,10
Sweltsa	6,9,10
Yoraperla	6,8,9
Zapada	6,7,8,9,10
Trichoptera	
Agapetus	6,8
Apatania	8,10
Arctopsyche	8,9,10
Brachycentrus	7,8,9,10
Cheumatopsyche	6,7,8,10
Dolophilodes	6,9
Ecclisomyia	6,9
Glossosoma	6,7,8,9,10
Helicopsyche	8,10
Hydropsyche	6,7,8,9,10
Hydroptila	6,7,8,10
Lepidostoma	7,8,9,10
Micrasema	6,8,9,10
Neophylax	8,9,10
Neothremma	6,8,10
Ochrotrichia	6,9
Oxyethira	6,10
Parapsyche	6,7,9,10
Rhyacophila	6,8,9,10
Wormaldia	6,8,9,10
Crustacea	
Copepoda	6,10
Daphnia	6,10
Hyallela	7,10
Ostracoda	6,7,9,10
Gastropoda	
Fluminicola	6,8
Gyraulus	6,10
Hemiptera	
Corisella	9,10
Gerris	9,10
Lepidoptera	
Petrophila	7,10
Mites	
Hydracarina	6,7,8,9,10
Megaloptera	
Sialis	7,10
Odonata	
Argia	6,7,8,9,10
Ophiogomphus	7,10
Pelecypoda	

Unique Taxa	Ecoregion
Leucotrichia	10
Neotrichia	8
Crustacea	
Bosmina	6
Gammarus	10
Gastropoda	
Fossaria	10
Lymnaea	7
Physa	10
Physella	10
Planorbula	6
Psychoglypha	10
Hemiptera	
Graptocorixa	9
Hesperocorixa	10
Naucoridae	10
Notonecta	10
Mites	
Acari	6
Lebertia	8
Odonata	
Zoniagrion	10
Other	
Hydra	6
Unknown	
Diphetor	6
Glossida	8
Lepidoma	8
Stempellina	6

Table 9. Representation of **taxa** by ecoregion for the Columbia River Basin.

Common Taxa	Ecoregions	Unique Taxa	Ecoregion
Pisidium	6,8,9,10		
Sphaeriidae	6,8,10		
Other			
Collembolla	6,9		
Nematoda	6,8,10		
Oligochaeta	6,7,8,9,10		
Planariidae	6,7,8,10		
Turbellaria	6,8,10		

Table 10. Numbers of unique **taxa** found only in each **ecoregion,** based on ten most common **taxa** per stream.

	Eastern Rockies	Columbia Plateau	Northern Rockies	Blue Mountains	**High** Desert
Number **Taxa** per Ecoregion	64	47	60	60	117
Number **Taxa** Unique to Each Ecoregion	14	4	11	4	35
Percent of Basinwide Unique **Taxa**	23	10	18	**7**	30

Table 11. Stream names, assemblage metrics and location coordinates of streams within the Eastern Cascades ecoregion.

Stream Clusters	Code	Source	State	Latitude	Longitude	Year	No. TAXA	TOTAL	HBI	EPT/C	EPT	DOMTAX
High Elevation												
Tumalo Creek	TO	**10**	**OR**	44.04	121.45	84	36	3264	1.86	28.84	24	41.00
Fall River	FL	**44**	OR	43.75	121.60	92	32	5172	2.21	20.58	**15**	14.76
Jefferson Creek	JF	44	OR	44.60	121.75	92	45	3310	1.62	11.48	32	27.77
Cluster Average							38	3915	**1.90**	20.30	24	27.84
Good Quality												
Crooked Creek	CK	10	OR	42.35	120.25	84	64	8636	4.05	2.42	28	31.90
Spencer Creek	**SP**	43	OR	42.10	122.10	92	54	27242	4.33	0.99	22	27.70
Spencer Creek	SP	43	OR	42.10	122.10	92	52	28433	4.65	0.80	19	21.69.
Miners Creek	**MN**	43	OR	42	122	92	53	2580	3.32	0.71	27	35.35
Candle Creek	CL	44	OR	44.58	121.75	92	52	6571	2.15	6.90	33	11.26
Canyon Creek	**CY**	44	OR	44.50	121.70	92	51	2763	3.82	1.15	26	16.39
Jack Creek	**JK**	44	OR	44.49	121.70	92	52	5875	3.13	3.18	27	18.73
Little Deschutes	LD	44	OR	43.68	121.60	92	53	2388	4.67	0.76	25	25.21
Cluster Average							54	10561	3.77	2.12	26	23.53
Lowest Quality												
Johnson Creek	JN	43	OR	42.10	122.20	92	20	600	5.79	0.00	13	50.70
Dry	DY	25	OR	45.50	121.05	92	21	27025	4.60	0.01	7	93.80
May's Canyon	**MY**	25	OR	45.45	121.10	92	19	9688	5.00	1.46	5	93.10
Deschutes (Browns)	DBC	44	OR	43.80	121.60	92	26	4147	5.61	0.20	2	46.54
Lower Trapper	LT	44	OR	43.70	122.01	92	23	653	3.39	**9.96**	15	54.82
Cluster Average							22	8422	4.88	2.33	8	67.79
Averages												
Snow Creek	SW	**10**	OR	43.85	121.75	84	40	1184	2.81	10.71	22	20.20
Long Creek	LG	10	OR	42.84	121.24	84	36	14%	3.32	7.12	17	21.40
Cold Creek	CD	43	OR	42.10	122.20	92	48	1378	2.24	6.31	20	40.35
Scott creek	ST	10	OR	42.89	121.93	84	37	426	3.07	6.11	22	21.60
Major Creek	**MJ**	10	WA	45.72	121.33	84	35	588	4.02	5.88	14	18.00
Bridge Creek	BG	10	OR	43.03	**121.18**	84	37	996	3.23	5.82	24	18.50
Upper Tygh Creek	UT	10	OR	45.31	**121.33**	84	41	548	3.37	2.46	24	23.80

Note: Sources are identified by their numbers within the bibliography.

Table 11. Stream names, assemblage metrics and location coordinates of streams within the Eastern Cascades ecoregion.

Stream Clusters	Code	Source	State	Latitude	Longitude	Year	No. TAXA	TOTAL	HBI	EPT/C	EPT	DOMTAX
Crescent Creek	CS	44	OR	43.50	121.80	92	38	1512	4.66	0.21	13	35.16
Burnt Creek	BT	10	OR	42.12	120.17	84	29	1060	4.63	2.16	9	18.50
Antelope Creek	AP	43	OR	42	122	92	31	3728	6.00	1.98	9	24.80
Trout Creek	TT	10	OR	42.55	121.69	84	45	5440	5.22	0.36	17	63.80
Eightmile	8	25	OR	45.50	121.10	92	34	14958	3.35	3.22	19	70.10
15Mile	15	25	OR	45.41	121.10	92	32	21173	3.40	3.97	17	80.00
5Mile	5	25	OR	45.55	121.10	92	34	10197	3.10	9.14	19	71.19
Ramsey	RY	25	OR	45.45	121.10	92	37	10147	3.04	2.19	22	62.20
Lower Big Marsh	LM	44	OR	43.39	121.96	92	47	3066	5.02	0.61	14	34.78
Big Marsh Creek	BM	44	OR	43.41	121.96	92	48	7786	4.40	1.21	17	19.86
Brush Creek	BH	44	OR	44.54	121.70	92	46	1691	3.15	8.20	24	17.13
Crescent Creek	CS	44	OR	43.48	121.85	84	39	2028	5.56	2.27	15	48.30
Upper Crescent	UC	44	OR	43.50	121.85	92	35	628	3.37	0.93	16	27.89
Cultus River	CT	44	OR	43.15	121.82	92	39	7198	4.52	2.99	16	24.14
Deschutes (Bull Bend)	DBB	44	OR	43.12	121.60	92	33	5096	3.83	1.65	11	19.37
Indian Ford Creek	IF	44	OR	44.40	121.55	92	36	4873	3.79	4.41	10	59.33
Ode11 Creek	OL	44	OR	43.55	121.96	92	39	1723	3.51	6.11	19	22.97
Soda Creek	SA	44	OR	44.01	121.75	92	37	5560	4.75	1.78	17	65.43
Trapper Creek	TP	44	OR	43.65	122.01	92	36	771	2.68	4.16	25	15.09
Cluster **Average**							-38	4433	3.85	3.92	17	36.30
Ecoregion Average							37	6707	3.57	8.53	**18**	38.99

Note: Sources are identified by their numbers within the bibliography.

Table 12. Stream names, assemblage metrics and location coordinates of streams within the Columbia Plateau ecoregion.

Stream Clusters	Code	Source	State	Latitud	Longitud	Year	No. TAXA	TOTAL	EPT	DOMTAX
Best Quality										
Gold Creek	GD	41	WA	46.75	121.00	93	35	305	22	24.5
Gold Creek	GD	41	WA	46.15	121.00	93	34	166	21	34.5
Naneum Creek	NM	32	WA	47.10	120.55	91	26	966	22	28.2
Cummins Creek	CM	32	WA	46.45	118.10	90	33	243.	24	28
N.F. Asotin Creek	NA	32	WA	46.15	117.30	90	22	267	14	29.5
Cummins Creek	CM	32	WA	46.45	118.10	91	31	924	21	22.7
Naneum Creek	NM	32	WA	47.10	120.55	91	40	309	25	18.6
Naneum Creek	NM	32	WA	47.10	120.55	90	32	276	23	21.7
Spring Creek	SG	32	WA	47.80	117.90	91	35	584	16	20.5
Cummins Creek	CM	32	WA	46.45	118.10	91	32	560	17	12.8
Naneum Creek	NM	32	WA	47.10	120.55	91	39	1755	22	22.2
Cummins Creek	CM	32	WA	46.45	118.10	91	32	670	19	19.4
N.F. Asotin Creek	NA	32	WA	46.15	117.30	91	29	1446	17	44.3
Cluster Average							32	**652**	21	24.15
Disturbed										
Lapwai Creek	LW	10	ID	46.35	116.63	84	31	4346	15	41.1
Cottonwood Creek	CD	10	ID	46.04	116.18	84	32	11708	11	32.2
Bedrock Creek	BK	10	ID	46.53	116.57	84	40	3736	15	24.2
Douglas Creek	DG	14	WA	47.48	119.89	85+86	22	9383	8	46
Crab Creek	CB	40	WA	47.50	119.00	91	29	10666	11	25.2
Cluster Average							31	7968	12	33.74
Flashy										
Crab Creek	CB	40	WA	47.50	119.00	91	36	22418	13	50.4
Almota Creek	AM	10	WA	46.69	117.45	84	27	2578	6	27.7
Alpowa Creek	AW	10	WA	46.42	117.33	84	22	1328	9	41.2
Rock Island Creek	RI	10	WA	47.37	120.08	84	29	3944	11	56.4
squaw creek	SW	10	WA	46.82	120.45	84	29	3272	5	67.5
Douglas Creek	DG	10	WA	41.48	119.89	84	18	4616	5	74.1
S.F. Palouse River	SP	10	WA	46.84	117.28	84	21	2628	3	52.2
Spanish Hollow Creek	SH	10	OR	45.67	120.90	84	21	1908	6	51.1

Note: Sources are identified by their numbers within the bibliography.

Table 12. Stream names, assemblage metrics and location coordinates of streams within the Columbia Plateau ecoregion.

Stream Clusters	Code	Source	State	Latitud	Longitud	Year	No. TAXA	TOTAL	EPT	DOMTAX
Snively Springs	SS	13	WA	46.60	119.50	85	14	3301	3	42
Similkameen Creek	SK	40	WA			87+88	14	590	11	81.1
Crab Creek	CB	40	WA	47.50	119.00	92	32	11158	11	76.8
Four Mile Creek	4M	10	WA	46.82	117.25	84	28	2840	6	49.6
Douglas Creek	DG	40	WA	47.48	119.89	89	29	20309	17	43.7
Rattlesnake Springs	RK	14	WA	46.60	119.55	85+86	18	4183	5	42.5
Snively Springs	SS	14	WA	46.60	119.50	85+86	14	3301	3	42
Cluster Average							23	5892	8	53.22
Large River										
Lower Snake River (clw1)	SR1	8	WA	46.43	117.00	76+77	12	15.3	7	35
Lower Snake River (sr107)	SR7	8	WA	46.55	117.45	76+77	5	9	2	90
Lower Snake River (srl35)	SR9	8	WA	46.42	117.10	76+77	7	11	4	89
Lower Snake River (sr18)	SR2	8	WA	46.40	118.80	76+77	11	47	2	86
Lower Snake River (sr129)	SR8	8	WA	46.44	117.10	76+77	4	14	1	37
Lower Snake River (sr70)	SR4	8	WA	46.50	118.00	76+77	5	14	1	78.9
Lower Snake River (sr40)	SR3	8	WA	46.45	118.75	76+77	6	320	1	98
Lower Snake River (sr90)	SR6	8	WA	46.55	117.90	76+77	2	15	0	67
Lower Snake River (sr83)	SR5	8	WA	46.51	117.95	76+77	2	0.4	0	50
Cluster Average							6	49	2	70.1
Averages.										
Lower Snake River (sr140)	SR10	8	WA	46.20	117.05	76+77	15	124	10	39.9
Brushy Creek	BY	10	WA	47.12	120.02	84	21	264	7	39.4
Little Klickitat River	LK	32	WA	45.75	121.00	91	27	366	15	31.7
Spring Creek	SG	32	WA	47.80	117.90	90	17	172	9	36.7
Umtanum Creek	UM	32	WA	46.90	120.60	91	24	416	12	25.6
Spring Creek	SG	32	WA	47.80	117.90	91	24	506	10	41.9
Spring Creek	SG	32	WA	47.80	117.90	91	18	359	12	39.6
Little Klickitat River	LK	32	WA	45.75	121.00	91	36	729	20	54.9
Little Klickitat River	LK	32	WA	45.75	121.00	90	25	134	14	20.1
N.F. Asotin Creek	NA	32	WA	46.15	117.30	91	31	534	20	12.7
Umtanum Creek	UM	32	WA	46.90	120.60	91	26	522	12	26.4

Note: Sources are identified by their numbers within the bibliography.

Table 12. Stream names, assemblage metrics and location coordinates of streams within the Columbia Plateau ecoregion.

Stream Clusters	Code	Source	State	Latitud	Longitud	Year	No. TAXA	TOTAL	EPT	DOMTAX
Umtanum Creek	UM	32	WA	46.90	120.60	90	22	221	12	21.7
Umtanum Creek	UM	32	WA	47.10	120.55	91	24	427	12	40.9
N.F. Asotin Creek	NA	32	WA	46.15	117.30	91	35	1158	19	23.3
Little Klickitat River	LK	32	WA	45.75	121.00	91	20	123	14	34.3
Cluster Average							24	404	13	32.61
Ecoregion Average							22	1879	11	43.8

Note: Sources are identified by their numbers within the bibliography.

Table 13. Stream names, assemblage metrics and location coordinates of streams within the Northern Rockies ecoregion.

Stream Clusters	Code	Source	State	Latitude	Longitude	Year	No. TAXA	TOTAL	HBI	EPT	DOMTAX
High Quality											
Moose Creek	MS	40	MT	46.00	114.00	93	40	18760	4.27	24	29.30
Meadow Creek	MW	40	MT	46.00	114.00	93	42	8710	3.83	24	21.90
Lower Overwhich Creek	LO	40	MT	45.65	114.10	93	38	6437	5.04	19	27.30
Upper Overwhich Creek	u o	40	MT	45.65	114.05	93	35	16398	4.94	20	55.40
Tolan Creek	TN	40	MT	46.00	114.00	93	39	43683	4.95	20	43.40
Sleeping Child Creek	SC	40	MT	46.10	114.00	93	40	16989	4.84	22	29.35
Gold Creek	CD	40	MT	46.00	114.00	93	31	6660	3.52	17	20.60
Daly Creek	DY	40	MT	46.17	113.95	93	40	24683	5.15	21	34.90
Cluster Average							38	17790	4.57	21	32.77
Disturbed											
Tenmile Creek	10	40	ID	45.02	113.55	93	10	122	4.27	6	26.50
Squaw Creek	SW	40	ID	44.18	114.28	93	29	280	3.62	17	19.75
Pattee Creek	PT	40	ID	45.00	113.25	93	21	2500	4.48	15	56.40
Clover Creek	c v	40	ID	44	113	93	26	6445	5.09	7	59.80
Agency Creek	AY	40	ID	44.57	113.32	93	18	319	3.97	11	28.15’
Warm Springs Creek	w s	40	ID	44.55	113.57	93	12	1000	5.13	4	49.80
Yearin Creek	YN	40	ID	44.52	113.32	93	16	943	3.72	9	27.95
Thompson Creek	TH	40	ID	44.17	114.31	93	29	780	4.60	15	36.90
Timber Creek	TB	40	ID	44.37	113.22	93	20	513	3.84	14	49.50
Canyon Creek	CY	40	ID	44.42	113.32	93	20	1431	3.59	11	31.90
Iron Creek	IN	40	ID	44.55	114.00	93	22	462	3.65	12	48.80
Kenny Creek	KY	40	ID	45.02	113.37	93	21	1531	4.14	14	41.30
Horse Basin Creek	HB	40	ID	44.11	114.10	93	24	1217	4.35	10	32.25
Grouse Creek	GS	40	ID	44.52	113.47	93	11	168	4.00	6	31.90
Hat Creek	HT	40	ID	44.47	114.02	93	21	1742	3.26	13	44.70
McKim Creek	MK	40	ID	44.55	114.00	93	21	821	2.77	10	32.80
Eighteenmile Creek	18	40	ID	44.30	113.05	93	20	865	4.85	13	48.10
McDevitt Creek	MD	40	ID	44.55	113.20	93	17	441	4.32	11	35.00
Little Loon	LL	40	ID	44	113	93	22	6307	5.32	7	46.10
Little Timber Creek	LT	40	ID	44.37	113.22	93	14	190	3.64	9	34.00
Cluster Average							20	1404	4.13	11	39.08

Note: Sources are identified by their numbers within the bibliography

Table 13. Stream names, assemblage metrics and location coordinates of streams within the Northern Rockies ecoregion.

Stream	Clusters	Code	Source	State	Latitude	Longitude	Year	No. TAXA	TOTAL	HBI	EPT	DOMTAX
Ecoregion Average								**25**	**5635**	**4.26**	**13**	**36.01**

Note: Sources are identified by their numbers **within the bibliography**

Table 14. Stream names, assemblage metrics and location coordinates of streams within the Blue Mountains ecoregion.

Stream Clusters	Code	Source	State	Latitude	Longitude	Year	No. TAXA	TOTAL	EPT/C	EPT	DOMTAX
Low Quality											
West Fork Camp Creek	WC	12	OR	43.96	120.27	88	30	2433	3.24	7	53.33
Committee Creek	CE	12	OR	44.25	120.25	88	23	1410	3.96	10	33.97
North Fork Beaver	NB	12	OR	44.25	119.75	88	13	386	1.53	5	56.74
Thirtymile Creek	30	3&4	OR	45.88	117.90	87	14	3708	4.40	7	56.28
Rock Creek	RK	12	OR	45.25	119.95	88	21	7746	1.81	8	27.22
Bear Creek	BR	12	OR	43.95	120.70	88	32	6406	1.34	8	41.84
Alder Creek	AR	38	OR	44.95	119.96	89	28	10724	0.81	11	45.90
Cluster Average							**23**	**4688**	**2.44**	**8**	**45.04**
Best Quality											
Mann Creek	MN	10	ID	44.50	116.95	84	65	5872	4.27	30	14.70
Bear Creek	BR	10	OR	44.22	118.68	84	53	5760	3.56	29	17.20
E.F. Canyon Creek	EC	10	OR	44.26	118.88	84	61	6192	2.48	31	22.70
Cluster Average							**59**	**5941**	**3.44**	**30**	**18.20**
Averages											
Lightning Creek	LG	10	OR	45.84	116.75	84	41	1700	14.17	16	18.90
N.F. Umatilla River	NU	10	OR	45.72	118.18	84	41	5008	17.26	24	35.40
N.F. Catherine Creek	NC	10	OR	45.13	117.64	84	62	1724	29.05	32	31.50
S.F. Desolation Creek	SD	38	OR	44.95	120.07	89	42	16435	1.21	18	33.49
N.F. Malheur River	NM	10	OR	44.28	118.38	84	43	1576	1.28	21	37.20
Deer Creek	DR	3&4	OR	45.51	117.55	87	37	180	10.70	30	27.80
Willow Creek	WW	10	OR	44.56	121.10	84	41	3100	4.10	12	24.00
Devil's Run	DV	3&4	OR	45.81	116.90	87	47	431	2.36	33	21.80
Camp Creek JD	CJ	38	OR	44.60	118.65	91	40	2236	3.67	23	19.00
Deardorf	DF	38	OR	44.40	118.55	91	27	1992	1.02	20	44.00
Grande Ronde	GR	38	OR	45.35	118.35	90	27	9780	1.96	17	40.80
Camp Creek	CP	12	OR	44.05	120.18	88	32	17545	5.73	13	15.06
South Fork Crooked	SC	12	OR	44.10	120.05	88	42	9957	9.00	14	14.24
Bridge Creek	BG	12	OR	44.60	120.20	88	47	14051	17.54	25	32.81
Service Creek	SV	10	OR	44.80	118.68	84	41	2028	17.26	24	30.20
Cluster Average							**41**	**5850**	**9.09**	**22**	**28.41**

Note: Sources are identified by their numbers within the bibliography.

Table 14. Stream names, assemblage metrics and location coordinates of streams within the Blue Mountains ecoregion.

Stream Clusters	Code	Source	State	Latitude	Longitude	Year	No. TAXA	TOTAL	EPT/C	EPT	DOMTAX
Good Quality											
E.F. Lostine River	EL	10	OR	45.25	117.38	84	35	414	2.36	21	24.20
Billy Creek	BY	3&4	OR	45.81	116.95	87	40	359	6.39	32	25.60
Griffith Creek	GF	3&4	OR	45.41	117.00	87	38	522	20.80	29	28.50
Lower Carrol	LC	3&4	OR	43.40	117.01	87	51	418	3.34	36	22.50
Middle Carrol	MC	3&4	OR	43.40	117.01	87	52	313	3.30	38	20.40
Upper Carrol	UC	3&4	OR	43.40	117.01	87	43	146	5.45	31	14.90
Grouse Creek	GS	3&4	OR	45.35	116.88	87	52	417	3.95	39	21.60
Tyee Creek	TY	3&4	OR	45.35	116.88	87	53	241	6.35	41	26.10
Little Bear Creek	LB	3&4	OR	45.47	117.50	87	32	224	16.00	28	30.40
Deer Creek	DR	10	OR	44.81	119.36	84	39	5976	7.40	17	26.30
Gordon Creek	GN	3&4	OR	45.75	117.98	87	46	733	2.10	32	23.10
Mottet	MT	3&4	OR	45.87	117.90	87	37	387	2.60	25	23.50
Summer Creek	SM	12	OR	45.20	120.39	81	44	203	8.90	34	24.10
Meadow Creek	MW	3&4	WA	46.20	117.75	87	49	427	6.78	37	26.00
Lower Tucannon	LT	3&4	WA	46.30	117.70	87	52	963	3.80	36	31.30
Upper Tucannon	UT	3&4	WA	46.30	117.70	87	45	621	3.20	30	21.20
Cluster Average							44	773	6.42	32	24.36
Ecoregion Average							42	4313	5.35	23	29.01

Note: Sources are identified by their numbers within the bibliography.

Table 15. Stream names, assemblage metrics and location coordinates of streams within the High Desert ecoregion.

Streams	Code	Source	State	Latitude	Longitud	Year	No. TAXA	HBI	EPT	DOMTAX
Trapper Creek	TP	34	ID	42.16	114.13	90	23	4.12	10	42.00
Station Creek	SN	34	ID	42.33	113.00	90	19	5.05	7	28.00
Pike Creek	PK	10	OR	42.58	118.50	84	26	4.28	12	38.00
Indian Creek	IE	10	OR	42.02	117.93	84	55	2.08	30	33.60
Crocked Creek	CK	10	OR	42.68	117.85	84	26	6.98	7	30.90
Low Trapper Creek	LT	34	ID	42.16	114.05	90	20	4.65	8	26.00
Buck Creek	BK	43	OR	43.05	121.10	90-'93	27	4.03	13	33.50
Green Creek	GN	34	ID	42.25	113.71	90	34	4.21	21	20.00
McDermitt Creek	MD	10	OR	42.01	117.08	84	45	4.31	18	43.90
Wall Creek	WL	10	NV	41.13	119.82	84	40	4.91	6	27.10
Salmon Falls Creek	SF	34	ID	42.42	114.83	90	23	4.75	4	44.00
Shoshone Creek	SH	34	ID	42.03	114.50	90	25	4.84	8	11.00
Stinson Creek	ST	34	ID	42.25	113.69	90	13	5.85	7	87.00
Big Jack Low Creek	JL	34	ID	42.58	116.00	90	23	4.54	9	20.00
Lake Fork Creek	LF	34	ID	42.33	113.03	90	22	5.21	7	18.00
Little Jack Creek	LJ	34	ID	42.58	116.00	90	22	5.21	7	18.00
Cottonwood Creek	CD	34	ID	42.25	113.69	90	24	4.76	16	36.00
Rock Creek	RK	10	OR	42.57	119.65	84	29	4.54	12	35.70
3rd Fork Creek	TF	34	ID	42.25	114.25	90	19	4.29	10	42.00
Dove Creek	DV	34	ID	42.08	114.91	90	15	4.52	3	50.00
Dry Creek	DY	10	OR	43.58	117.48	84	34	5.77	10	30.50
Cottonwood Creek	c w	34	ID	42.53	116.08	90	28	4.07	12	28.00
Indian Creek	IN	43	OR	42.70	118.85	93	32	4.78	15	43.20
Devil's Corral	DC	34	ID	42.58	114.33	90	20	5.85	7	58.00
Catnip Creek	CP	10	NV	41.92	119.48	84	31	7.02	4	41.10
Cassia Creek	c s	34	ID	42.25	113.50	90	21	5.01	9	26.00
Mary's Creek	MY	34	ID	42.16	115.55	90	25	5.28	11	36.00
Willow Creek	w w	43	OR	42.10	118.20	93	37	4.36	16	30.75
Sand Springs	SS	34	ID	42.61	114.83	90	17	5.51	5	35.00
Sheep Creek	SE	34	ID	42.25	115.75	90	18	5.92	6	45.00
Big Jack Creek	BJ	34	ID	42.58	116.03	90	32	5.34	9	39.00
W. Little Owyhee River	w o	10	OR	42.22	117.25	84	39	6.88	7	56.80
Vineyard Creek	VY	34	ID	42.58	114.33	90	10	5.66	2	72.00

Note: Sources are identified by their numbers within the bibliography.

Table 15. Stream names, assemblage metrics and location coordinates of streams within the High Desert ecoregion.

Streams	Code	Source	State	Latitude	Longitud	Year	No. TAXA	HBI	EPT	DOMTAX
Trail Creek	TL	43	ID	45.52	113.47	93	17	3.40	13	57.40
Snyder Creek	SY	43	OR	42.45	120.10	93	23	4.73	1	52.20
Basin Creek	BN	43	ID	44.50	113.25	93	11	4.87	4	52.20
Burnt Creek	BT	43	ID	44.09	113.38	93	16	4.58	8	50.00
Honey Creek	HY	43	OR	42.40	120.10	92+93	31	5.17	12	48.70
Twelve Mile Creek	12	43	OR	42.35	120.10	92+93	33	4.67	15	48.00
Camas Creek	CA	43	OR	42.30	120.10	92+93	33	4.48	15	45.60
Parsnip Creek	PP	43	OR	42.45	120.30	93	29	5.40	6	41.20
Deep Creek	DP	43	OR	42.10	120.05	90-'93	30	4.49	14	40.53
Lake Creek	LK	43	ID	44.06	114.13	93	28	4.63	15	37.80
Haynes Creek	HY	43	ID	45.00	113.42	93	25	4.13	14	35.70
Bridge Creek	BG	43	OR	43.05	121.10	92+93	2	3.91	15	35.50
Buck Creek	BK	34	ID	42.00	115.42	90	21	4.19	10	2.00
Bayhorse Creek	BY	43	ID	44.23	114.16	93	22	4.11	12	31.40
Herd Creek	HD	43	ID	44.07	114.16	93	22	3.95	13	30.70
Road Creek	RD	43	ID	44	113	93	21	3.93	10	30.20
Cow Creek	CO	43	ID	44.55	113.32	93	25	3.40	15	30.00
Morgan Creek	MG	43	ID	44	113	93	28	3.92	15	25.15
Little Hat Creek	LH	43	ID	44.47	114.03	93	21	4.93	9	23.60
Ecoregion Average							**25**	**4.76**	**10**	**37.38**

Note: Sources are identified by their numbers within the bibliography.

Bibliography

1. Anderson, T. M., and N. H. Anderson. 1995. The insect fauna of spring habitats in semi-arid rangelands in Central Oregon. Journal of the Kansas Entomological Society **(in press)**.

2. Canton, S. P., and J. W. Chadwick. 1988. Variability in benthic invertebrate density estimates from stream samples. Journal of Freshwater Ecology 4:291-297.

3. Carlson, J. Y. 1989. Effects of forest management on fish habitat and macroinvertebrates in northeastern Oregon streams. MS Thesis. Oregon State University.

4. Carlson, J. Y., C. W. Andrus, and H. A Froehlich. 1990. Woody debris, channel features, and macroinvertebrates of streams with logged and undisturbed riparian timber in Northeastern Oregon., USA Canadian Journal of Fisheries and Aquatic Sciences 47:1103-1111.

5. Caton, L. 1993. Biological monitoring report and evaluation of EPA's rapid bioassessment benthic protocol for Three Governor's Watershed Enhancement Board restoration projects in the John Day River Basin. Oregon Department of Environmental Quality, Laboratory Division, Biological Monitoring Section.

6. Clark W. 1989. Rock Creek Rural Clean Water Program comprehensive water quality monitoring annual report 1988. Idaho Department of Health and Welfare.

7. Cushing, C. E., and W. L. Gaines. 1989. Thoughts on recolonization of endorheic cold desert spring-streams. Journal of the North American Benthological Society 8:277-287.

8. Dorband, W. R 1980. Benthic macroinvertebrate communities in the Lower Snake River Reservoir system. Ph.D. Dissertation. University of Idaho.

9. Elliot, J. M. 1981. Some methods for the statistical analysis of samples of benthic invertebrates. Volume 25. Scientific Publications of the Freshwater Biological Association.

10. Environmental Protection Agency. 1994. Macroinvertebrate communities - Oregon ecoregion data. 1984 EPA Data Set.

11. Furnish, J. 1989. An analysis of habitat, aquatic macroinvertebrate and trout survey data from the Trout Creek Mountains of Southeastern Oregon. Bureau of Land Management Report, Vale District, June 1989.

12. ---. 1990. An analysis of habitat, aquatic macroinvertebrate and trout survey data from Burns, Prineville, Lakeview, & Vale Districts, Eastern Oregon. Bureau of Land Management Report, October 1990.

13. Gaines, W. L. 1987. Secondary production of benthic insects in three cold-desert streams. Pacific Northwest Laboratory, U.S. Department of Energy contract # DE-AC06-76RLO.

14. Gaines, W. L., C. E. Cushing, and S. D. Smith. 1992. Secondary production estimates of benthic insects in three cold desert streams. Great Basin Naturalist **52(1)**: 1 l-24.

15. Gilpin, B. R 1975. Benthic community dynamics in relation to sedimentary rehabilitation on tributaires of the South fork of the Salmon River. Ph.D. Dissertation. University of Idaho.

16. Griffith, J. S., R. K. Fuller, and D. A. Andrews. 1985. Initial recovery by aquatic invertebrates of a portion of the Big Lost River, Idaho, after a three-year dewatering. Journal of the Idaho Academy of Science **21**:30-40.

17. Hafele, R. 1990. Cottonwood creek stream monitoring assessment summary 1988 through 1989. U.S. Bureau of Land Management, Vale District.

18. Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist **20**:3 l-39.

19. Hoiland, W. K., and F. W. Rabe. 1992. Effects of increasing zinc levels and habitat degradation on macroinvertebrate communities in three North Idaho streams. Journal of Freshwater Ecology **7(4)**:373-380.

20. Li, H. W., G. A. Lamberti, T. N. Pearsons, C. K. Tait, J. L. Li, and J. C. Buckhouse. 1994. Cumulative effects of riparian disturbances along High Desert trout streams of the John Day Basin, Oregon. Transactions of the American Fisheries Society 123:627-640.

21. Li, J. L., A. Herlihy, P. Kaufman, W. Gerth, and S. Gregory. In prep. Macroinvertebrate sampling protocols developed from intensive surveys of western Oregon. .

22. Ludwig, J. A, and J. F. Reynolds. 1988. Statistical Ecology. John Wiley & Sons, New York.

23. Magurran, A E. 1988. Ecological diversity and its measurement. Princeton University Press, Princeton, NJ.

24. Mangum, F. 1975. Anaylsis of Macroinvertebrate samples from ten Rocky Mountain streams. Ph.D. Dissertation. Brigham Young University.

25. Mangum, F. Aquatic ecosystem inventory: macroinvertebrate analysis. U.S. Forest Service National Aquatic Ecosystem Monitoring Center.

26. McIntosh., B. 1992. Historical changes in anadromous fish habitat in the Upper Grand Ronde, Oregon, 1941-1990. MS Thesis. Oregon State University, Corvallis.

27. Merritt, R W., and K. W. Cummins, editors. 1987. An Introduction to the Aquatic Insects, 2nd Edition. Kendall/Hunt, Dubuque.

28. Minshall, G. W. 1981. Structure and temporal variations of the benthic macroinvertebrate community inhabiting Mink Creek Idaho, U.S.A., a third Order Rocky Mountain stream. Journal of Freshwater Ecology 1: 13-50.

29. Omernik, J. M., and A L. Gallant. 1986. Ecoregions of the Pacific Northwest (with map), EPA/600/3-86/033. Environmental Protection Agency, Corvallis.

30. Oregon Natural Heritage Program. 1993. Rare, Threatened and Endangered Plants and Animals of Oregon. Oregon Natural Heritage Program, Portland, OR

3 1. Paine, R J. 1966. Food web complexity and species diversity. American Naturalist 100:850-860.

32. Plotnikoff, R W. 1992. Timber/fish/wildlife ecoregion bioassessment pilot project. Washington State Department of Ecology, Ecology publication # 92-63.

33. Preston, F. W. 1948. The commoness, and rarity, of species. Ecology 29:254-283.

34. Robinson, C. T., and G. W. Minshall. 1991. Biological metric development for the assessment of nonpoint pollution in the Snake River Ecoregion of Southern Idaho. Idaho Snake River Ecoregion Final Report. Department of Biological Sciences, Idaho State University.

3 5. Robinson, C. T., G. W. Minshall, and S. R Rushforth. 1990. Seasonal colonization dynamics of macroinvertebrates in an Idaho stream: Journal of the North American Benthological Society 9(3):240-248.

36. Rosenberg, D. M., and V. H. Resh. 1993. Freshwater biomonitoring and benthic macroinvertebrates. Chapman and Hall, New York.

37. Shepard, R 1984. The logseries distribution and Mountford's similarity index as a basis for the study of stream benthic community structure. Freshwater Biology 14:53-71.

38. Tait, C. and J. L. Li. 1994. Macroinvertebrates fron Deardorfand Camp Creek. Unpublished data.

39. Tait, C. K., J. L. Li, G. A Lamberti, T. N. Pearsons, and H. W. Li. 1994. Relationships between riparian cover and the community structure of high desert streams. Journal of the North American Benthological Society 13:45-56.

40. Vinson, M. 1994. Bureau of Land Management Aquatic Ecosystem Laboratory, Utah State University. Logan Utah.

4 1. Wenatchee National Forest. 1993. Gold Creek Macroinvertebrate Study -1993. Naches Ranger District, Wenatchee National Forest.

42. Whittier, T. R, R M. Hughes, and D. P. Larsen. 1988. Correspondence between ecoregions and spatial patterns in stream ecosystems in Oregon. Canadian Journal of Fisheries and Aquatic Sciences 45: 1264-1278.

43. Wisseman, R W. 1992a. Benthic invertebrate biomonitoring: Bureau of Land Management, Klamath Falls Resource Area. Aquatic Biology Associates, Corvallis, Oregon.

44. ---. 1992b. Benthic Invertebrate Biomonitoring: Deschutes National Forest. Aquatic Biology Associates, Corvallis, Oregon.

Appendix A. 1. Life history characteristics of taxa within the Eastern Cascade ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Coleoptera								
Oreodytes	LL	A	x	S/MB	PC	1	x	x
Eubrianax	0	E	x	CG	SP	x	x	x
Cleptelmis	0	E	CB	CG	CL/SP	x	x	x
Optioservus	0	A	DS	CG	SP/CL	2	x	x
Zaitzevia	0	E	CB	CG	SP/CL	x	x	x
Hydaticus	LL	D	SP	S/D/MB	PC	x	x	x
Heterlimnius	0	E	CB	CG	CUSP	x	x	x
Crustacea								
Copepoda	x	x	x	x	x'	x	x	x
Ostracoda	x	x	x	x	x	x	x	x
Daphnia	x	x	x	x	x	· x	x	x
Bosmina	x	x	x	x	x	x	x	x
Diptera								
Dicranota	LL	D	DS	SW/BW	EN	x	x	x
Simulium	LL	E	x	CG	CL/FL	1-2	x	x
Prosimulium	0	E	x	CG	CL/FL	1	x	x
Glutops	0	D	x	SW/BW	PC	x	x	x
Antocha	0	E	WD	CG	CL	x	x	x
Hemerodromia	0	D	DS	SW/BW	EN/CL	x	x	x
Pericoma	LL	D	M/DS	B W	CL	x	x	x
Chelifera	0	D	x	SW/BW	EN	x	x	x
Ceratopogonidae	LL	D	P	SW/BW	CL	x	x	x
Maruina	0	E	x	CG	SP/CL	x	x	x
Hexatoma	LL	A	DS	BW/SW/CG	EN	x	x	x
Chironomidae	LL	A	Z	BW	CL/FL	1-4	x	x
Ephemeroptera								
Serratella	0	E	x	CG	CL	x	x	x
Ephemerella	LL	A	Z	CG	CL	1-2	x	U
Ironodes	0	x	x	CG	SP/CL	x	F/CD	U
Tricorythodes	0	D	SA/CB	SW/CG	CL	x	x	M
Ameletus	0	A	Z	S/CG	CL	1	x	U
Pseudocloeon	0	E	x	S/CG	SP/CL	x	F	U
Caudatella	0	A	x	CG	CUSP	x	x	x

Appendix A. 1. Life history characteristics of **taxa** within the Eastern Cascade **ecoregion**. **(Code** definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Baetis	LL	A	Z	CG/MB	CUSP	1-3	x	U
Cinygmula	'0	E	*RC*	*CG*	SP/CL	x	x	x
Caenis	0	D	x	SW	CUSP	2-3	S	U
Attenella	0	E	x	*CG*	CL	x	x	x
Epeorus	0	E	x	*CG*	SP/CL	1	F/CD	x
Rhithrogena	0	E	x	*CG*	CL/SP	1	x	U
Paraleptophlebia	0	E	x	S/CG/SW	CLJSH	1	F	x
Drunella	x	x	x	CG/SW	SP	x	x	x
Gastropoda								
Fluminicola	x	x	x	x	x	x	x	x
Gyraulus	x	x	x	x	x	2	x	x
Planorbula	x	x	x	x	x	2-3	x	x
Mites								
Hydracarina	x	x	x	x	x	x	x	x
Acari	x	x	x	x	x	2	x	x
Odonata								
Argia	LL	D	DS	CG/SW	EN	2	x	x
Plecoptera								
Capniidae	*0*	A	x	CG/SW	SH	1	x	x
Hesperoperla	LL	E	x	x	EN	x	x	S
Doroneuria	LL	E	x	x	x	x	x	S
Pteronarcys	0	A	x	CG/SW	SH	x	F	U
Soliperla	0	A	x	x	x	x	x	x
Sweltsa	0	E	x	x	EN	x	x	S
Skwala	LL	E	x	x	EN	x	S	U
Setvena	LL	E	x	x	EN	x	x	x
Amphinemura	0	A	x	x	SH/CL	1	x	U
Malenka	LL	A	x	x	x	x	CL/CD	x
Isoperla	0	A	x	CG/SW	EN	1-2	x	U
Megarcys	0	E	CB	CG	EN	x	F/CL/CD	U
Zapada	0	E	x	SW	SH	x	CD	S
Yoraperla	0	A	x	x	SH	x	x	x
Pelecypoda								
Pisidillm	x	x	x	x	x	1-3	x	x

Appendix A. 1. Life history characteristics of **taxa** within the Eastern Cascade ecoregion. (Code definitions follow table)

Taxa	**Lotic/Lentic**	**Flow Type**	**Habitat**	**Motivation**	**Feeding**	**Tolerance**	**Water**	**Voltinism**
Sphaeriidae	x	x	x	x	x	1-3	x	x
Trichoptera								
Micrasema	0	E	**SP**	**CG/SW**	**SH/CL**	x	CD/CL	x
Neothremma	0	E	RC	CG	**SP/CL**	x	**x**	x
Rhyacophila	0	E	x	CG	EN	1	**CL/CD/F**	x
Hydropsyche	0	E	**x**	CG	**CL/FL**	1-3	x	**x**
Hydroptila	0	A	**Z**	CG	PC	1-2	**x**	**U**
Ochrotrichia	E	D	x	CG	PC	x	**S**	x
Parapsyche	0	E	x	CG	**CL/FL**	x	F/CD	x
Oxyethira	LL	**x**	x	MB	**PC/CL**	**x**	**S**	**x**
Glossosoma	0	**E**	x	CG	CUSP	**1-2**	CD/F	**M**
Ecclisomyia	0	E	x	CG	CUSP	**x**	CD/CL	**x**
Cheumatopsyche	0	E	x	CG	**CL/FL**	**2-3**	**WM**	**S**
Agapetus	0	E	**x**	CG	**SP/CL**	**1**	**S**	U
Dolophilodes	0	E	**SP**	CG	**CL/FL**	x	**x**	x
Wormaldia	0	E	x	CG	**CL/FL**	x	**x**	x
Other								
Turbellaria	x	x	x	x	x	x	x	**M**
Oligochaeta	x	x	x	x	x	x	x	x
Nematoda	x	**x**	x	x	x	x	x	x
Hydra	x	**A**	x	x	x	x	x	x
Planariidae	x	x	x	x	x	x	x	x
Collembolla	x	x	x	x	x	x	x	**x**

Symbol Key:

L= **lentic**	E= erosional	**RC=** rock	CG= clinger	CL= collector	1 **=least** tolerant	CD= cold	U= univoltine
O= lotic	D= depositional	**DS=** sediments	MB= climber	FL= filterer	**4=most** tolerant	CL= clear	**S=** semivoltine
LL= both	A= both	CB= cobble	BW= burrower	**SP=** scraper		**WM= warm**	M= multivoltine
		SA= sand	SW= sprawler	**SH=** shredder		F= fast	
		WD= woody debris	**S=** swimmer	EN= engulfer		**S=** slow	
		SP= plants		PC= piercer			
		Z= all					
		M= margins					

Appendix A.2. Life history characteristics of **taxa** within the Columbia Plateau ecoregion. (Code definitions follow table)

Taxa	**Lotic/Lentic**	**Flow Type**	**Habitat**	**Motivation**	**Feeding**	**Tolerance**	**Water**	**Voltinism**
Coleoptera								
Dubiraphia	LL	E	**SP**	**CG/MB**	CUSP	**2**	**x**	x
Coptotomus	LL	D	**SP**	**S/D/MB**	PC	**x**	**x**	x
Zaitzevia	0	E	CB	CG	**SP/CL**	**x**	**x**	x
Helophorus	LL	E	**M**	**MB**	SH	**2**	**x**	x
Optioservus	0	A	DS	CG	**SP/CL**	**2**	**x**	x
Ordobrevia	0	E	CB	CG	**SP/CL**	**x**	**x**	x
Heterlimnius	0	E	CB	CG	CUSP	**x**	**x**	x
Crustacea								
Ostracoda	x	x	x	**x**	x	x	x	x
Hyallela	x	x	x	**x**	x	2	x	x
Diptera								
Limonia	LL	D	**M/DS**	**BW/SW**	SH	x	**x**	x
Antocha	0	E	**WD**	CG	CL	x	**x**	x
Hemerodromia	0	D	DS	**SW/BW**	EN/CL	**x**	**x**	x
Simulium	LL	E	**x**	CG	**CL/FL**	**1-2**	**x**	x
Chironomidae	LL	A	**Z**	BW	**CL/FL**	**1-4**	**x**	x
Caloparyphus	E	**x**	P	SW	C L	x	**x**	x
Chelifera	0	**D**	x	**SW/BW**	EN	x	**x**	x
Muscidae	LL	A	**x**	SW	**EN/PC**	x	**x**	x
Dicranota	LL	D	**DS**	**SW/BW**	EN	x	**x**	x
Ephemeroptera								
Serratella	0	E	x	CG	CL	x	**x**	x
Paraleptophlebia	0	E	**x**	**S/CG/SW**	**CL/SH**	1	**F**	**x**
Ameletus	0	A	**Z**	**S/CG**	CL	1	**x**	**U**
Caenis	0	D	**x**	SW	CUSP	2-3	**S**	U
Tricorythodes	0	D	**SA/CB**	**SW/CG**	CL	x	**x**	**M**
Epeorus	0	E	**x**	CG	**SP/CL**	1	**F/CD**	**x**
Ephemerella	LL	A	**Z**	CG	CL	**1-2**	x	**U**
Rhithrogena	0	E	x	CG	CUSP	**1**	**x**	U
Heptagenia	0	E	**x**	CG	**SP/CL**	2-3	**F**	**x**
Baetis	LL	A	**Z**	**CG/MB**	CUSP	1-3	x	**U**
Gastropoda								
Lymnaea	x	x	x	**x**	x	2-3	x	x
Leptidoptera								

Appendix A.2. Life history characteristics of **taxa** within the Columbia Plateau ecoregion. (Code definitions follow table)

Taxa	**Lotic/Lentic**	**Flow Type**	**Habitat**	**Motivation**	**Feeding**	**Tolerance**	**Water**	**Voltinism**
Petrophila	LL	E	x	CG	**SP**	x	x	x
Mites								
Hydracarina	x	x	x	x	x	x	x	x
Megaloptera								
Sialis	LL	E	D S	**BW/MB/CG**	EN	1-3	x	x
Odonata								
Ophiogomphus	0	A	SA	, BW	EN	x	CD/CL	x
Argia	LL	D	DS	**CG/SW**	EN	*2*	x	x
Plecoptera								
Hesperoperla	LL	**E**	**x**	**x**	EN	x	**x**	**S**
Zapada	0	E	**x**	**SW**	SH	x	**CD**	**S**
Skwala	LL	E	**x**	x	EN	x	**S**	U
Malenka	LL	A	**x**	**x**	**x**	**x**	**CL/CD**	**x**
Isoperla	0	A	**x**	**CG/SW**	**EN**	**1-2**	x	**U**
Trichoptera								
Glossosoma	0	E	x	C G	**CL/SP**	1-2	CD/F	**M**
Hydropsyche	0	E	**x**	CG	CLJFL	1-3	**x**	**x**
Brachycentrus	0	E	**SP/WD**	CG	**FL/SP**	1-2	**F**	**U**
Cheumatopsyche	0 .	E	**x**	CG	**CL/FL**	*2-3*	**WM**	**S**
Hydroptila	0	A	**Z**	CG	PC	**1-2**	**x**	U
Parapsyche	0	E	x	CG	**CL/FL**	x	**F/CD**	**x**
Lepidostoma	**O**	A	x	**MB/SW/CG**	SH	x	CD/S	**U**
Other								
Planariidae	x	x	x	x	x	x	x	x
Oligochaeta	x	x	x	x	x	x	x	x

Symbol Key:

L= **lentic**	E= erosional	**RC=** rock	CG= clinger	CL= collector	**1=least** tolerant	CD= cold	**U=** univoltine
O= lotic	D= depositional	**DS=** sediments	MB= climber	FL= filter	**4=most** tolerant	CL= clear	**S=** semivoltine
LL= both	A= both	CB= cobble	BW= burrower	**SP=** scraper		**WM=** warm	**M=** multivoltine
		SA= sand	**SW=** sprawler	**SH=** shredder		F= fast	
		WD= **woody** debris	**S=** swimmer	EN= **engulfer**		**S=** slow	
		SP= plants		PC= piercer			
		Z= all					
		M= margins					

Appendix A.3. Life history characteristics of taxa within the Northern Rockies ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Coleoptera								
Optioservus	0	A	DS	CG	SP/CL	2	x	x
Ordobrevia	0	E	CB	CG	SP/CL	x	x	x
Oreodytes	LL	A	x	S/MB	PC	1	x	x
Haliplus	E	x	P	MB	PUSH	23	x	x
Lara	0	E	WD	CG/BW	SH	x	x	x
Heterlimnius	0	E	CB	CG	CUSP	x	x	x
Microcylloepus	0	A	x	CG/BW/MB	SH	1	x	x
Zaitzevia	0	E	CB	CG	SP/CL	x	x	x
Diptera								
Muscidae	LL	A	x	SW	EN/PC	x	x	x
Tabanus	LL	D	x	SW/BW	PC	1-3	x	x
Empididae	0	D	DS	SW/BW	EN	x	x	x
Atherix	0	A	x	SW/BW	PC	1	x	x
Simulium	LL	E	x	CG	CL/FL	1-2	x	x
Hexatoma	LL	A	DS	BW/SW/CG	EN	x	x	x
Chelifera	0	D	x	SW/BW	EN	x	x	x
Caloparyphus	E	x	P	SW	CL	x	x	x
Chironomidae	LL	A	Z	BW	CL/FL	1-4	x	x
Antocha .	0	E	WD	CG	CL	x	x	x
Ephemeroptera								
Serratella	0	E	x	CG'	CL	x	x	x
Heptagenia	0	E	x	CG	SP/CL	2-3	F	x
Paraleptophlebia	0	E	x	S/CG/SW	CL/SH	1	F	x
Cinygmula	0	E	RC	CG	SP/CL	x	x	x
Rhithrogena	0	E	x	CG	CUSP	1	x	U
Pseudocloeon	0	E	x	S/CG	SP/CL	x	F	U
Baetis	LL	A	Z	CG/MB	CL/SP	1-3	x	U
Ephemerella	LL	A	Z	CG	CL	1-2	x	U
Epeorus	0	E	x	CG	SP/CL	1	F/CD	x
Drunella	x	x	x	CG/SW	SP	x	x	x
Gastropoda								
Fluminicola	x	x	x	x	x	x	x	x
Mites								

Appendix A.3. Life history characteristics of **taxa** within the Northern Rockies ecoregion. '(Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Lebertia	x	x	x	x	x	x	x	x
Hydracarina	x	x	x	x	x	x	x	x
. *Odonata*								
Argia	LL	D	DS	**CG/SW**	EN	2	x	x
Plecoptera								
Paraperla	*HY*	**x**	x	**x**	**x**	x	HY	**S**
Pteronarcys	*0*	**A**	x	**CG/SW**	**SH**	x	F	U
Hesperoperla	LL	**E**	x	x	EN	x	x	**S**
Doroneuria	LL	E	x	x	**x**	x	**x**	**S**
Skwala	LL	E	x	x	**EN**	x	**S**	U
Suwallia	0	E	x	x	EN	x	x	x
Yoraperla	0	A	x	**x**	. **SH**	x	**x**	**x**
Zapada	0	E	x	**SW**	SH	x	**CD**	**S**
Malenka	LL	A	x	**x**	**x**	x	**CL/CD**	**x**
Kogotus	0	E	**x**	**CG**	**EN**	x	**x**	**U**
Megarcys	0	E	**CB**	CG	EN	x	**F/CL/CD**	U
Isogenoides	0	A	x	x	EN	x	**x**	U
Pelecypoda								
Sphaeriidae	x	x	x	x	x	1-3	x	x
Pisidium	x	x	x	x	x	1-3	x	x
Trichoptera								
Lepidostoma	*0*	A	x	MB/S**W/CG**	SH	x	CD/S	U
Rhyacophila	0	E	**x**	CG	EN	**1**	**CL/CD/F**	**x**
Brachycentrus	0	E	**P/WD**	CG	**FL/SP**	1-2	F	**U**
Wormaldia	0	E	x	CG	**CL/FL**	x	**x**	**x**
Agapetus	0	E	**x**	CG	**SP/CL**	1	**S**	**U**
Hydroptila	0	A	**Z**	CG	PC	**1-2**	**x**	U
Arctopsyche	0	E	x	CG	**CL/FL**	x	**F/CD/CL**	**S**
Hydropsyche	0	E	x	CG	**CL/FL**	1-3	**x**	x
Apatania	0	E	**x**	**CG/MB/SW**	**SP/CL**	1	**CD/CL**	x
Neotrichia	0	E	**RC**	CG	**SP**	**x**	F	**x**
Glossosoma	0	E	x	**CG**	CUSP	**1-2**	**CD/F**	**M**
Neophylax	0	E	**x**	CG	**SP**	x	F	x
Neothremma	0	E	**RC**	CG	**SP/CL**	x	x	x

Appendix A.3. Life history characteristics of taxa within the Northern Rockies ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Helicopsyche	LL	A	x	CG	SP	x	WM./CD	x
Chimarra	0	E	x	CG	CL/FL	1	WM/F	U
Cheumatopsyche	0	E	x	C G	CL/FL	2-3	WM	S
Micrasema	0	E	SP	CG/SW	SH/CL	x	CD/CL	x
Other								
Turbellaria	x	x	x	x	x	x	x	M
Planariidae	x	x	x	x	x	x	x	x
Nematoda	x	x	x	x	x	x	x	x
Oligochaeta	x	x	x	x	x	x	x	x

Symbol Key:

L= lentic	E= erosional	RC= rock	CG= clinger	CL= collector	1=least tolerant	CD= cold	U= univoltine
o= lotic	D= depositional	DS= sediments	MB= climber	FL= filterer	4=most tolerant	CL= clear	S= semivoltine
LL= both	A= both	CB= cobble	BW= burrower	SP= scraper		wM= warm	M= multivoltin
		SA= sand	SW= sprawler	SH= shredder		F= fast	
		WD= woody debris	S= swimmer	EN= engulfer		S= slow	
		SP= plants		PC= piercer			
		Z= all					
		M= margins					

Appendix A.4. Life history characteristics of taxa within the Blue Mountains ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Coleoptera								
Narpus	0	E	BC	CG	SH	x	x	x
Optioservus	0	A	DS	CG	SP/CL	2	x	x
Ordobrevia	0	E	CB	CG	SP/CL	x	x	x
Heterlimnius	0	E	CB	CG	CUSP	x	x	x
Hydaticus	LL	D	SP	S/D/MB	PC	x	x	x
Hydroporus	LL	D	SP	S/MB	PC	x	x	x
Psephenidae	LL	E	x	CG	SP	x	x	x
Zaitzevia	0	E	CB	CG	SP/CL	x	x	x
Crustacea								
Ostracoda	x	x	x	x	x	x	x	x
Diptera								
Antocha	0	E	WD	*CG*	CL	x	x	x
Pericoma	LL	D	M/DS	BW	CL	x	x	x
Empididae	0	D	DS	SW/BW	EN	x	x	x
Simulium	LL	E	x	CG	CL/FL	1-2	x	x
Ceratopogonidae	LL	D	SP	SW/BW	CL	x	x	x
Chironomidae	LL	A	Z	BW	CL/FL	1-4	x	x
Prosimulium	0	E	x	CG	CL/FL	1	x	x
Oerodytes	x	x	x	x	x	x	x	x
Ephemeroptera								
Heptagenia	0	E	x	CG	SP/CL	2-3	F	x
Rhithrogena	0	E	x	CG	CUSP	1	x	U
Paraleptophlebia	0	E	x	S/CG/SW	CL/SH	1	F	x
Leptophlebia	0	E	x	S/CG/SW	CL	2	S	U
Serratella	0	E	x	CG	CL	x	x	x
Epeorus	0	E	x	CG	SP/CL	1	F/CD	x
Callibaetis	E	x	x	S/MB	CL	3	x	x
Cinygmula	0	E	RC	CG	SP/CL	x	x	x
Drunella	x	x	x	CG/SW	SP	x	x	x
Baetis	LL	A	Z	CG/MB	CL/SP	1-3	x	U
Ameletus	0	A	Z	S/CG	CL	1	x	U
Ephemerella	LL	A	Z	CG	CL	1-2	x	U
Hemiptera								

Appendix A.4. Life history characteristics of taxa within the Blue Mountains ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Graptocorixa	E	x	x	S	PC	x	x	x
Gerris	LL	D	x	SK	PC	x	x	x
Corisella	E	D	x	S	PC	x	K	x
Mites								
Hydracarina	x	x	x	x	x	x	x	x
Odonata								
Argia	LL	D	DS	CG/SW	EN	2	x	x
Plecoptera								
Yoraperla	*0*	A	x	x	SH	x	x	x
Zapada	0	E	x	SW	SH	x	CD	S
Calineuria	0	E	x	CG	EN	x	x	S
Pteronarcella	0	A	x	CG/SW	SH	x	F	U
Skwala	LL	E	x	x	EN	x	S	u
Visoka	LL	A	x	x	x	x	F/CD/CL	S
Sweltsa	0	E	x	x	EN	x	x	S
Hesperoperla	LL	E	x	x	EN	x	x	S
Malenka	LL	A	x	x	x	x	CL/CD	x
Doroneuria	LL	E	x	x	x	x	x	S
Megarcys	0	E	CB	CG	EN	x	F/CL/CD	U
Pelecypoda								
Pisidium	x	x	x	x	x	1-3	x	x
Trichoptera								
Rhyacophila	*0*	E	x	CG	EN	1	CL/CD/F	x
Wormaldia	0	E	x	C G	CL/FL	x	x	x
Ecclisomyia	0	E	x	CG	CUSP	x	CD/CL	x
Glossosoma	0	'E	x	CG	CL/SP	1-2	CD/F	M
Hydropsyche	0	E	x	CG	CL/FL	1-3	x	x
Arctopsyche	0	E	x	CG	CL/FL	x	F/CD/CL	S
Brachycentrus	0	E	SP/WD	CG	FL/SP	1-2	F	U
Dolophilodes	0	E	SP	CG	CL/FL	x	x	x
Ochrotrichia	E	D	x	CG	PC	x	S	x
Parapsyche	0	E	x	CG	CL/FL	x	F/CD	x
Neophylax	0	E	x	CG	SP	x	F	x
Lepidostoma	0	A	x	MB/SW/CG	SH	x	CD/S	U

Appendix A.4. Life history characteristics of taxa within the Blue Mountains ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Micrasema	*0*	E	SP	CG/SW	SH/CL	x	CD/CL	x
Other								
Oligochaeta	x	x	x	x	x	x	x	x
Collembolla	x	x	x	x	H/D	x	x	x

Symbol Key:

L= lentic	E= erosional	RC= rock	CG= clinger	CL= collector	1=least tolerant	CD= cold	U= univoltine
o= lotic	D= depositional	DS= sediments	MB= climber	FL= filterer	4=most tolerant	CL= clear	S= semivoltine
LL= both	A= both	CB= cobble	BW= burrower	SP= scraper		wM= warm	M= multivoltine
		SA= sand	SW= sprawler	SH= shredder		F= fast	
		WD= woody debris	S= swimmer	EN= engulfer		S= slow	
		SP= plants		PC= piercer			
		Z= all					
		M= margins					

Appendix A.5. Life history characteristics of taxa within the High Desert ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Coleoptera								
Gyrinus	x	x	S	S/D	EN	x	x	x
Peltodytes	LL	x	SP	MB/CG	PUSH	x	x	x
Brychius	x	E	x	CG	SP/PC	2	x	x
Oreodytes	LL	A	x	S/MB	PC	1	x	x
Haliplus	E	x	P	MB	PUSH	2-3	x	x
Dubiraphia	0	E	SP	CG/MB	CUSP	2	x	x
Deronectes	LL	E	SP	S/MB	PC	x	x	x
Eubrianax	0	E	x	CG	SP	x	x	x
Carabidae	0	x	RC	CG	EN	x	x	x
Psephenidae	0	E	x	CG	SP	x	x	x
Optioservus	0	A	DS	CG	SP/CL	2	x	x
Hydroporus	0	D	SP	S/MB	PC	x	x	x
Zaitzevia	0	E	CB	CG	SP/CL	x	x	x
Laccophilus	0	D	SP	S/D/MB	PC	3	x	x
Tropistemus	0	D	x	MB	EN	3	x	x
Rhizelmis	x	E	x	CG	SP/CL	x	x	x
Heterlimnius	O	E	CB	CG	CUSP	x	x	x
Crustacea								
Copepoda	LL	x	x	x	x	x	x	x
Daphnia	LL	x	x	x	x	x	x	x
Ostracoda	0	x	x	x	x	x	x	x
Hyallela	LL	x	x	x	x	2	x	x
Gammarus	LL	x	x	x	x	1-2	x	x
Diptera								
Dixa	0	D	DS	S/MB	CL	x	x	x
Dicranota	LL	D	DS	SW/BW	EN	x	x	x
Pericoma	0	D	M/DS	BW	CL	x	x	x
Hexatoma	LL	A	DS	BW/SW/CG	EN	x	x	x
Hemerodromia	0	D	DS	SW/BW	EN/CL	x	x	x
Oerodytes	LL	x	x	x	x	x	x	x
Empididae	x	D	DS	SW/BW	EN	x	x	x
Muscidae	LL	A	x	SW	EN/PC	x	x	x
Simulium	0	E	x	CG	CUFL	1-2	x	x

Appendix **A.5.** Life history characteristics of **taxa** within the High Desert ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Antocha	0	E	**WD**	C G	CL	**x**	**x**	**x**
Prosimulium	0	E	**x**	CG	CUFL	1	**x**	**x**
Atherix	LL	A	**x**	**SW/BW**	PC	**1**	**x**	**x**
Atrichopogon	LL	E	**M/WD/AM**	**SW/CG**	CL	**x**	**x**	**x**
Bezzia	LL	HS	**AM**	BW	EN	**3**	**x**	**x**
Rhabdomastix	**x**	D	SA	BW	EN/CL	**x**	**CL**	**x**
Ceratopogonidae	**x**	D	**SP**	**SW/BW**	CL	**x**	**x**	**x**
Chironomidae	**O**	A	z	BW	CUFL	**1-4**	**x**	**x**
Ephemeroptera								
Ameletus	0	A	z	**S/CG**	CL.	1	**x**	U
Cinygmula	0	E	RC	CG	**SP/CL**	**x**	**x**	**x**
Caenis	**x**	D	**x**	SW	CUSP	**2-3**	**S**	**U**
Leurocuta	**O**	A	**x**	CG	SPICL	**x**	**S/WM**	**x**
Leptohyphes	LL	D	**WD/CB**	CG	**x**	**x**	**S**	
Baetis	LL	A	Z	**CG/MB**	**CL/SP**	**1-3**	**x**	4
Rhithrogena	0	E	**x**	CG	CUSP	1	**x**	U
Heptagenia	**x**	E	**x**	CG	SPICL	*2-3*	**F**	**x**
Serratella	**O**	E	**x**	CG	CL	**x**	**x**	**x**
Ephemerella	0	A	**Z**	CG	CL	**1-2**	**x**	**U**
Centroptilum	LL	A	Z	**S/CG**	CUSP	*2*	**x**	U
Drunella	0	**x**	**x**	**CG/SW**	**SP**	**x**	**x**	**x**
Epeorus	0	**E**	**x**	CG	**SP/CL**	1	**F/CD**	x
Callibaetis	**x**	**x**	**x**	**S/MB**	CL	*3*	**x**	**x**
Paraleptophlehia	**LL**	**E**	**x**	**S/CG/SW**	CUSH	1	**F**	**x**
Tricorythodes	0	D	**SA/CB**	**SW/CG**	CL	**x**	**x**	**M**
Pseudocloeon	**x**	E	**x**	**S/CG**	SPICL	**x**	**F**	U
Gastropoda								
Physa	0	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Fossaria	LL	**x**	**x**	**x**	**x**	**2**	**x**	**x**
Physella	0	**x**	**x**	**x**	**x**	*2-3*	**x**	**x**
Gyraulus	0	**x**	**x**	**x**	**x**	*2*	**x**	**x**
Psychoglypha	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Hemiptera								
Corisella	**x**	D	**x**	**S**	PC	**x**	K	**x**

Appendix A.5. Life history characteristics of taxa within the High Desert ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Naucoridae	0	E	x	CG/S	PC	x	x	x
Gerris	0	D	x	SK	PC	x	x	x
Hesperocorixa	LL	D	x	S/MB	PC	3	. x	x
Notonecta	LL	D	x	S/MB	PC	2	x	x
Lepidoptera								
Petrophila	LL	E	x	CG	SP	x	x	x
Mites								
Hydracarina	0	x	x	x	x	x	x	x
Megaloptera								
Sialis	LL	E	DS	BW/MB/CG	EN	1-3	x	x
Odonata								
Argia	E	D	DS	CG/SW	EN	2	x	x
Ophiogomphus	LL	A	SA	BW	EN	x	CD/CL	x
Zoniagrion	0	D	SP	MB	EN	x	x	x
Plecoptera								
Beloneuria	0	E	x	x	x	x	x	x
Hesperoperla	0	E	x	x	EN	x	x	S
Doroneuria	0	E	x	x	x	x	x	S
Cascadoperla	x	A	x	CG/SW	x	x	x	x
Claassenia	LL	E	x	CG	x	x	B/S	S
Pteronarcys	LL	A	x	CG/SW	SH	x	F	U
Calineuria	x	E	x	CG	EN	x	x	S
Capniidae	x	A	x	CG/SW	SH	1	x	x
Alloperla	O	E	x	x	x	x	x	x
Isoperla	0	A	x	CG/SW	EN	i-2	x	U
Megarcys	LL	E	CB	CG	EN	x	F/CL/CD	U
Zapada	LL	E	x	SW	SH	x	CD	S
Malenka	LL	A	x	x	x	x	CUCD	x
Yugus	0	E	x	x	EN	x	x	x
Suwallia	0	E	x	x	EN	x	x	x
Skwala	0	E	x	x	EN	x	S	U
Amphinemura	x	A	x	x	SH/CL	1	x	U
Sweltsa	O	E	x	x	EN	x	x	S
Pelecypoda								

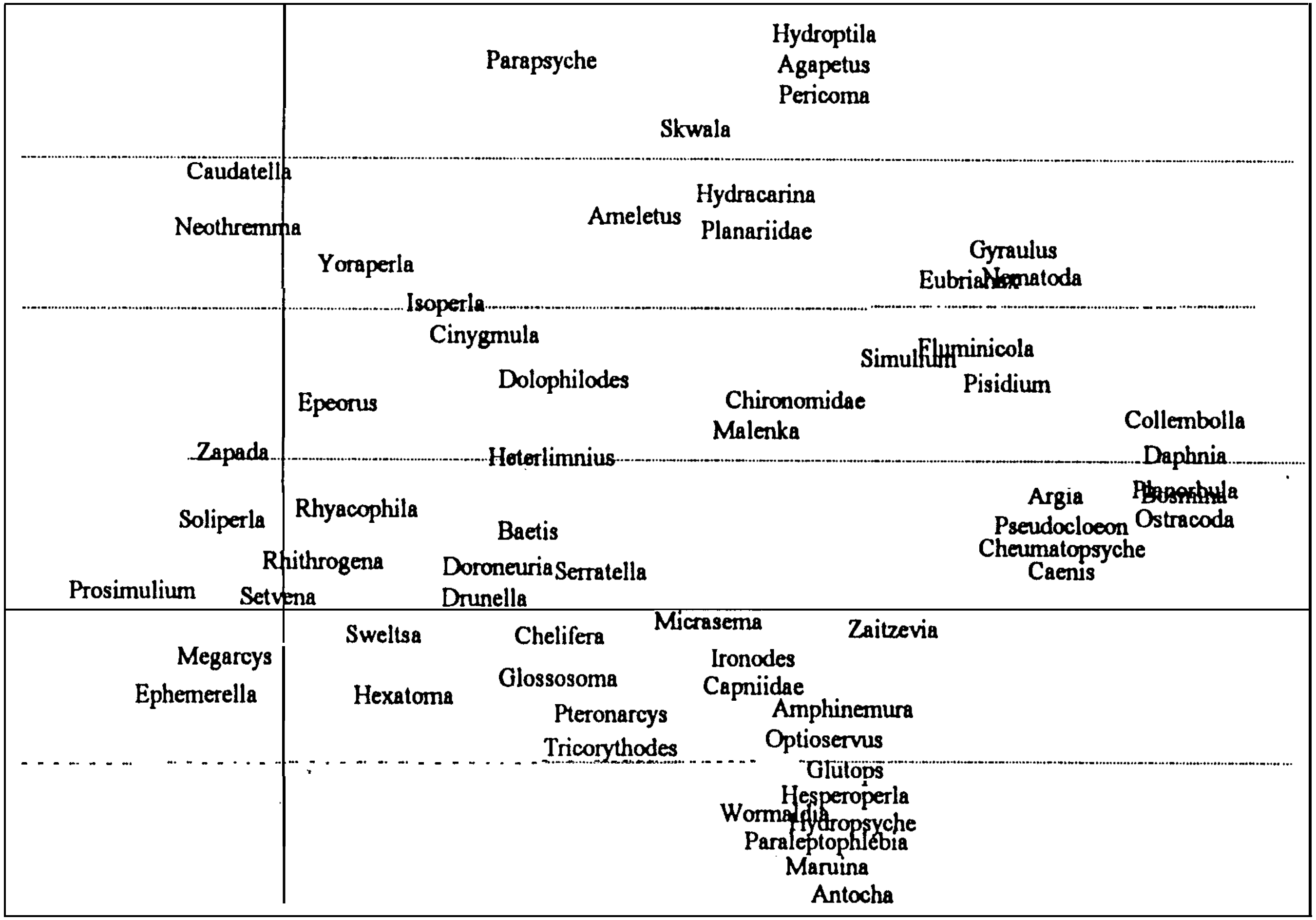
Appendix A.5. Life history characteristics of **taxa** within the High Desert ecoregion. (Code definitions follow table)

Taxa	Lotic/Lentic	Flow Type	Habitat	Motivation	Feeding	Tolerance	Water	Voltinism
Pisidium	E	x	x	x	x	1-3	x	x
Sphaeriidae	0	x	x	x	x	**1-3**	x	x
Trichoptera								
Neothremma	**x**	E	**RC**	CG	**SP/CL**	x		x
Neophylax	**LL**	E	x	CG	**SP**	**x**	5	x
Hydropsyche	LL	E	x	CG	**CL/FL**	**1-3**		x
Heliwpsyche	0	A	x	CG	**SP**	x	W & D	x
Apatania	0	E	**x**	**CG/MB/SW**	**SP/CL**	**1**	CD/CL	**x**
Amiocentrus	LL	E	**P**	**CG/MB**	C L	x	B	**U**
Lepidostoma	0	A	x	**MB/SW/CG**	SH	x	CD/S	U
Leucotrichia	0	E	**x**	CG	FL/CUSP	x	F	x
Micrasema	0	E	**SP**	**CG/SW**	**SH/CL**	x	CD/CL	x
Wormaldia	0	E	**x**	CG	**CL/FL**	**x**	x	**x**
Hydroptila	0	A	**Z**	CG	PC	**1-2**	**x**	**U**
Arctopsyche	E	E	**x**	CG	CL/FL	x	**F/CD/CL**	**S**
Ceraclea	**x**	A	**DS**	**SW/MB**	CUSH	x	**G/S**	x
Grensia	**O**	D	x	SW	**x**	x	**x**	x
Parapsyche	0	E	x	CG	**CL/FL**	**x**	**F/CD**	**x**
Glossosoma	**x**	E	x	CG	CUSP	**1-2**	CD/F	**M**
Dicosmoecus	**LL**	E	**x**	SW	**SH/SP**	**x**	**x**	U
Brachycentrus	**x**	E	**SP/WD**	CG	**FL/SP**	**1-2**	**F**	U
Gumaga	**E**	E	x	SW	SH	x	**WM/CD/F**	x
Rhyacophila	**x**	E	x	CG	EN	**1**	**CL/CD/F**	x
Cheumatopsyche	**O**	E	x	CG	**CL/FL**	2-3	**WM**	**S**
Oxyethira	0	x	x	MB	**PC/CL**	x	**S**	x
Other								
Planariidae	0	x	**x**	**x**	**x**	**x**	**x**	x
Oligochaeta	0	x	**x**	**x**	**x**	**x**	**x**	x
Nematoda	LL	x	**x**	**x**	**x**	**x**	**x**	**x**
Turbellaria	0	x	**x**	**x**	**x**	**x**	**x**	**M**

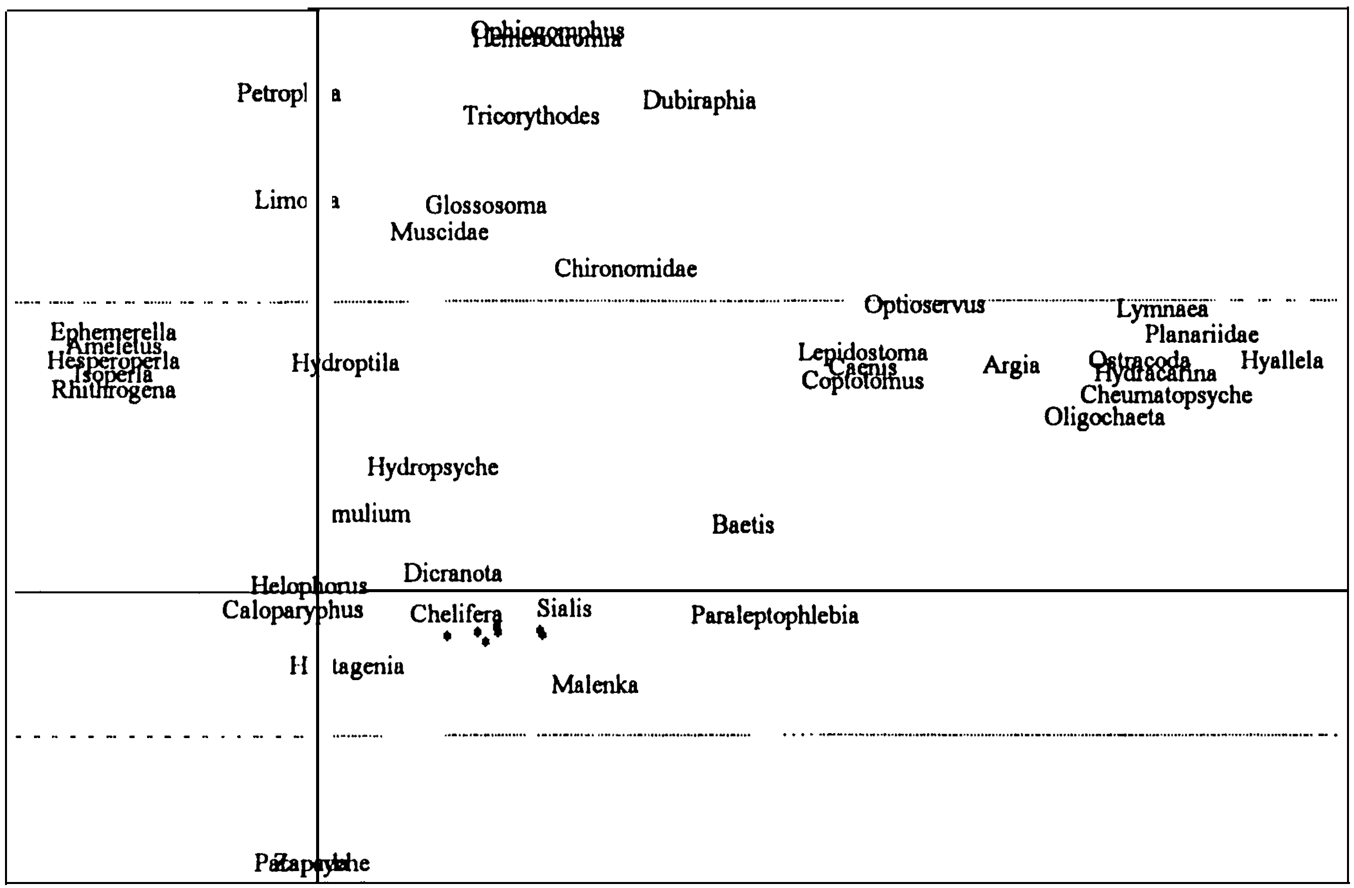
Appendix AS. Life history characteristics of **taxa** within the High Desert ecoregion. (Code definitions follow table)

Taxa	**Lotic/Lentic**	**Flow Type**	**Habitat**	**Motivation**	**Feeding**	**Tolerance**	**Water**	**Voltinism**
	Symbol Key:							
	L= **lentic**	E= erosional	RC= rock	**CG=** clinger	CL= collector	l=least tolerant	CD= cold	U= univoltine
	o= **lotic**	D= depositional	**DS=** sediments	MB= climber	FL= filterer	**4=most** tolerant	CL= clear	**S=** semivoltine
	LL=both .	A=both	CB= cobble	BW= burrower	**SP=** scraper		WM= warm	M= multivoltine
			SA= sand	SW= sprawler	**SH=** shredder		F= fast	
			WD= woody debris	**S=** swimmer	EN= **engulfer**		**S=** slow	
			SP= plants		PC= piercer			
			z= all					
			M= margins					

Appendix B. 1. **DECORANA** analysis plot of **taxa from** ecoregion six (Eastern Cascades).

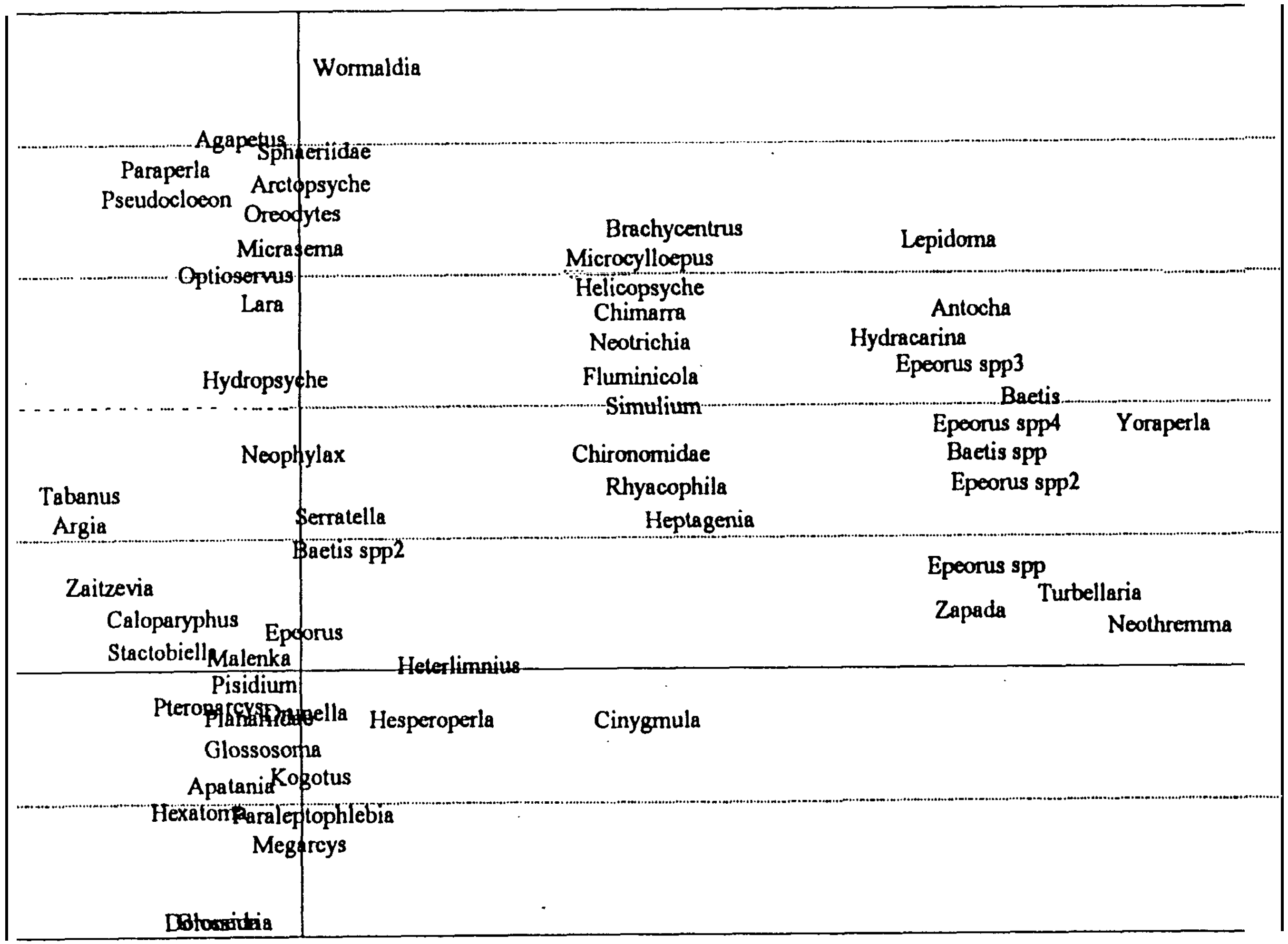


Appendix B.2. DECORANA analysis plot of taxa from ecoregion seven (Columbia Plateau).

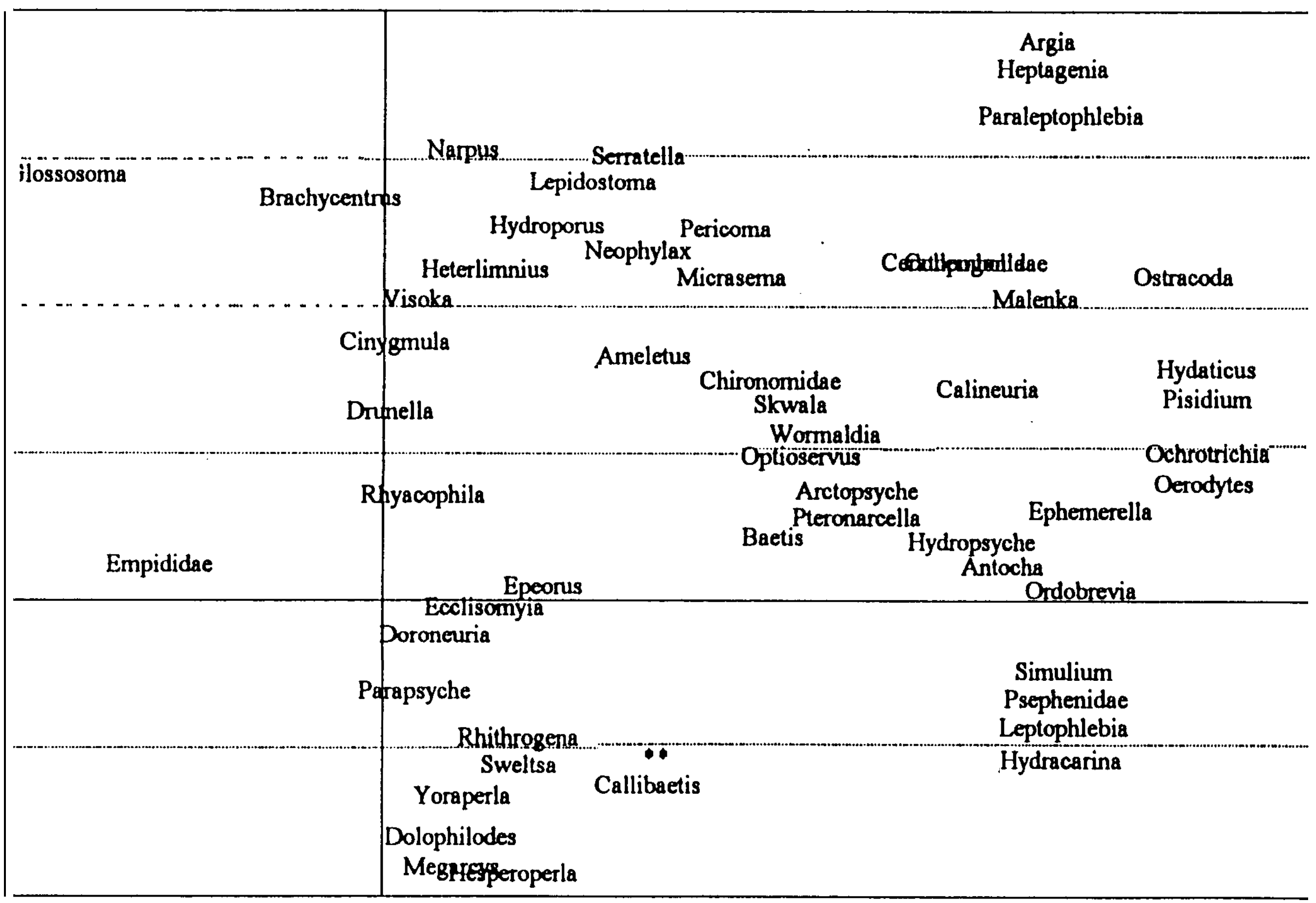


• = Antocha, Brachycentrus, Epeorus, Heterlimnius, Ordobrevia, Serratella, Skwala, Tipula, Zaitzevia

Appendix B.3. 'DECORANA analysis plot of taxa from ecoregion eight (Northern Rockies).

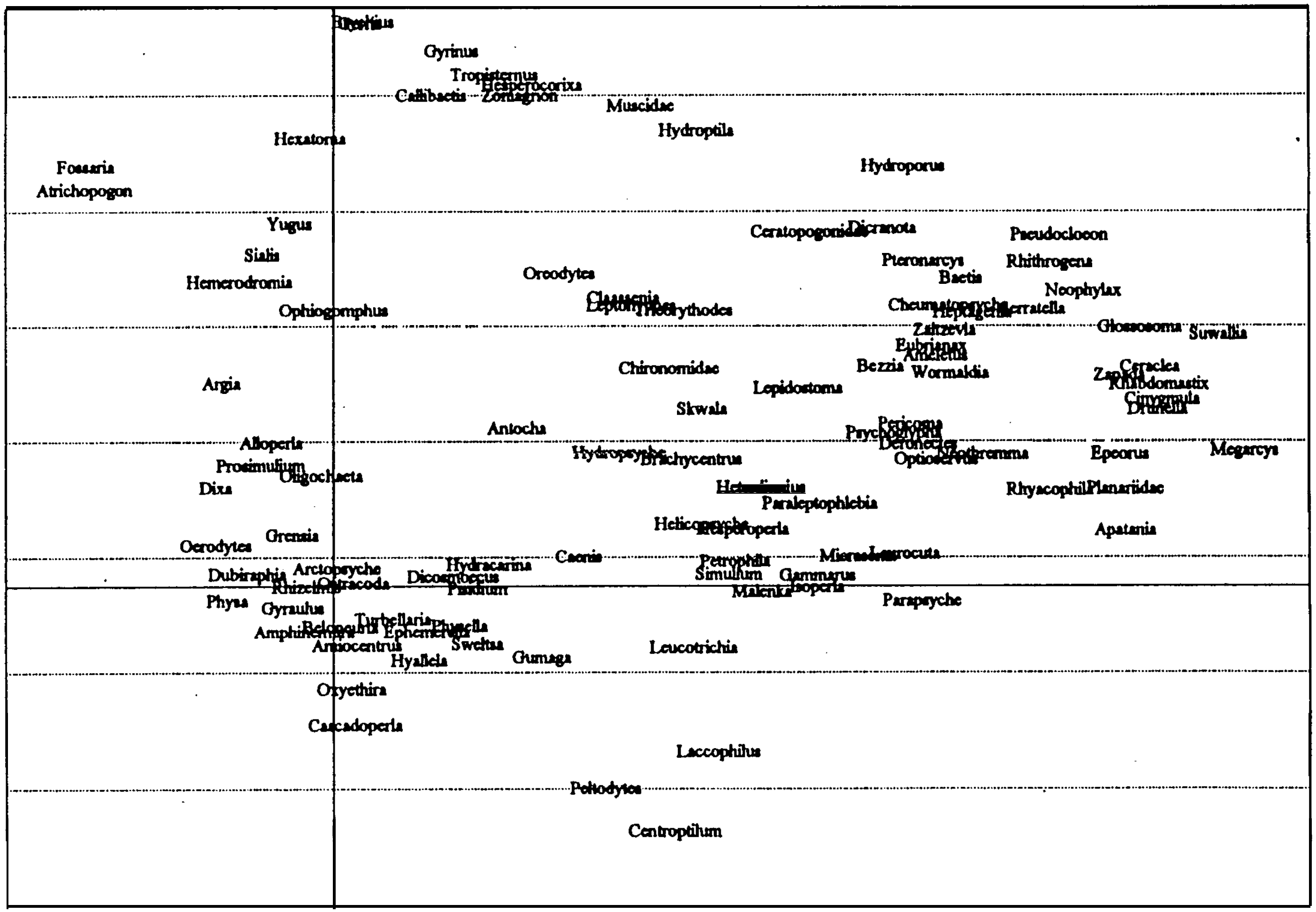


Appendix B.4. DECORANA analysis plot of **taxa from** ecoregion nine (Blue Mountains).



* = Corisella, Gerris, Graptocorixa, Prosimulium

Appendix **B.5. DECORANA** analysis plot of **taxa from** ecoregion ten (High Desert).



Follow-up Report to the Interior Columbia River Basin Ecosystem Task Force:
Relating aquatic macroinvertebrate information to landuse data

Judith L. Li and Kristopher Wright
Department of Fisheries and WildlifeOregon State University

General patterns across the breadth of the Inner Columbia River Basin (ICRB) were surprisingly interpretable for stream macroinvertebrate assemblages characterized from an array of information sources (Li et al 1995). Using 4 to 5 general invertebrate metrics we classified assemblages into five general groups: riverine, low diversity from flashy systems, low diversity from high desert or disturbed systems, moderate diversity from good habitat conditions, and high diversity from cool habitats (Table 1). However our previous assessment was based primarily on invertebate metrics such as taxa richness, abundance and proportion of Ephemeroptera, Plecoptera and Trichoptera (EPT), and correlations with specific landuses were vague. The purpose of this supplement is to examine these generalities relative to elevation and available information about landuse, particularly road density, timber harvest, and grazing activities. This report focuses on systems where information was most readily available; some Ecological Research Units (ERU's) and streams within ERU's were excluded. However sufficient data was available to test how well pattern could be discerned using our previous work and management data on the same streams.

We obtained stream elevation and road density data from the ICRB task force, and landuse data from scientists within appropriate regions. Rob Plotnikoff provided both reports (Plotnikoff 1992) and personal commentary on streams from eastern Washington (Ecological Resource Units), Wayne Elmore and Ellie Sipple supplied descriptions of restoration and landuse from Prineville BLM district streams (in ERU) and Dave Hohler obtained descriptions for previous streams in the Deschutes National Forest. In addition Dave obtained more recent macroinvertebrate data to test utility of our mutltivariate analysis for management.

MACROINVERTEBRATES AND ROAD DENSITIES

We were not able to detect a trend between road densities and assemblage characteristics (Figure 1). If there was a relevant correlation we might expect disturbed streams to be associated with high density roads, or high diversity assemblages with low road densities. Instead, assemblages characterized as low diversity from disturbed systems occurred in highest numbers where no roads were reported, and in most other road density categories (Figure 2). At the other end of the disturbance spectrum, high diversity assemblages, which we judged to be from coolwater sites, were associated from a wide range of road densities as well, with a few more in high or extremely high road densities (Figure 1).

One explanation for some of the discrepancy between road densities and invertebrate assemblages was provided by Dave Hohler regarding Deschutes Forest streams that occurred in ERU's 2 and 3 according to ICRB designations. In that forest there are many unused forestry roads that receive little traffic and may be stable'enough to preclude significant erosion. In these situations Dave believed there possibly could be high density roads in the same Hydrologic Unit (HUC) as coolwater streams with healthy invertebrate communities.

We believe the lack of correlation between assemblage characteristics and road densities was due in part to data collections at very different scales. Whereas road density data was collected at HUC scales that are relatively broad, invertebrate samples are site-specific to a point or reach in a stream. Though invertebrates may be very sensitive to disturbances resulting from roads such as sedimentation and increased solar radiation, these assemblages may reflect riparian or streambank conditions relatively immediate to the stream. If roads are dense but somewhat distant from the stream there may not be stream disturbances that result in changes within invertebrate communities. On the other hand composited information for invertebrates, representing long stream extents, may better represent assemblages comparable to road densities at the same scale. The metrics used for our analysis were those most readily calculated from available information, representing very general assemblage characteristics; perhaps more finely tuned metrics in concert with finer scale resolution on road data would detect the effects of road density more appropriately.

MACROINVERTEBRATES, ELEVATION, AND LANDUSE

Though the range in stream elevations was wide there was a tendency for streams at higher elevations to be in either moderate or high diversity conditions (Figure 3). These associations were constrained by where streams occurred within any particular ERU (Figure 4). For example all the streams in ERU's 3 (representing 6 streams) and 9 (with 8 streams) were at elevations greater than 1500 feet; ERU 7 was represented only by Spring Creek, that was at 750 feet elevation.

We examined the correspondence between elevation, land use and assemblage characteristics by looking at gradients for, particular ecoregions; within each ecoregion (Omemink) were several ERU's designated by the ICRB. For the Eastern Cascades streams (ERU's 2 and 3) where we added landuse data to metrics in the original database, the comparison between the PCA axis and elevation revealed a cluster around 1500 feet elevation (including Fall, Tumalo, Cultus and Bridge Creeks) and a lower elevation group about 1000 feet (including Brush and Candle Creeks) along the first PCA axis (Figure 5). This gradient of decreasing elevations followed a trend of increasing taxa richness and increasing proportion of Ephemeroptera, Trichoptera and Plecoptera (EPT or mayflies, stoneflies and caddisflies). Landuse information was interpretable along this gradient as well. Candle, Jack, Jefferson and Brush Creeks were associated with wilderness areas (Table 1). In this lower elevation group only Jack Creek was not associated with wilderness, but like many of the other streams in this group it received spring-fed water. Most of the higher elevation streams were depicted as moderate diversity assemblages, except Tumalo and Fall Creeks. Elevation as general categories were useful cues to assemblage characterisitics, but landuse also influenced how streams clustered in the analysis. The highest elevation streams, Soda Creek (165 1 feet) and Bridge Creek (1560 feet), had both undergone at least light grazing and 50% of the flow was diverted from Soda Creek. The PCA clustering was able to distinguish between these streams and high diversity assemblages of Jack, Candle and Canyon, as well as Fall and Tumalo Creeks.

Among the streams of the Columbia Plateau (ERU's 5, 6, 7 and part of 2) for which we obtained further landuse data, three elevational groups clustered out when the first PCA axis was compared to elevation (Figure 6). The analysis was limited to a small number of streams, though data points include samples at different dates. The two lower elevation streams (Douglas, and Crab Creeks) had low diversity macroinvertebrate assemblages. This PCA axis was best explained by EPT, which increased with higher elevation, and by the proportion of the most dominant taxon; which tended to decrease along the same gradient. The manner in which these streams spread along the first PCA axis was'explained in part by land use. On the far right of the axis, Naneum Creek had a deciduous riparian canopy and was considered a reference stream (R. Plotnikoff). North Fork Asotin Creek, another reference stream, had restricted access, with semi-annual grazing; likewise, Cummings Creek was described as having light forestry and infrequent grazing. At the other extreme of the axis, Douglas and Crab Creeks were subjected to continual agricultural use: dryland wheat at Douglas Creek, and irrigation return flow at Crab Creek.

In ecoregion 9, the Blue Mountains (including ERU's 5,6 and 13), elevation did not correspond to either the first or second PCA axis (Figure 7 and 8). However landuse data from Wayne Elmore and from our studies of the John Day River basin (Li et al 1994) tend to support groupings derived from the PCA analysis. Five streams in the moderate diversity group (Table 1) for which we have further information are in various stages of restoration: these are Bridge, Camp (in the Crooked River drainage), Camp (in the Middle Fork John Day River drainage), Deardorf Creeks and South Fork Crooked River. In addition Service Creek has a healthy riparian zone protected from grazing. We obtained information for four streams in the low diversity, disturbed cluster; of these three had readily identifiable disturbances. Committee Creek has been heavily grazed, and its watershed has been clearcut. Alder Creek also is heavily grazed, and becomes intermittent in some years. Bear Creek had a large sediment dump in 1987. West Fork Camp Creek in the Crooked River watershed has been restored recently and we could not determine why its assemblages were degraded: Though clustering by PCA provided logcial stream groupings according to landuse we did not detect correspondence to elevation as in other ecoregions.

INCREASING THE DATABASE

As we were assembling information on stream conditions we also obtained information for 21 additional sites in the Eastern Cascades (in ERU's 2 and 3). These collections were made and analyzed by Bob Wisseman, who also generated data for this ecoregion which we reported previously. These collections were ideal for considering how new information could be examined in the context of our previous analysis. Our approach was to use the same general metrics as before, and to combine these stream assemblages with previous streams in a PCA analysis (Figure 9).

The resulting analysis is displayed using capital letters for the original streams and lower case letters for the new ones. Obviously the new streams fell within the general range of the original streams. The first axis was best explained by taxa richness (0.937) and EPT (0.913, with both variables increasing from left to right. This was similar to the analysis of the original streams. We suggest that assemblages within a region can be assessed by comparing how they fit within the original clusters and matrix. For example, Abbot Creek has the highest taxa richness and EPT for the region; this may be a new standard for the area. Two other sites show high diversity: on the Metolius River and Roaring Creek. At the other extreme Big Marsh Creek and one Deschutes River site are characterized as low diversity in comparison to other streams in the region..

Another way to evaluate how stream assemblages compare within a region is to examine them within the context of physical condition or landuse. The high diversity, high elevation streams (Fall River, Jefferson and Tumalo Creeks) remained separate from other streams as in our previous analysis. If any of the added streams had been characterized readily as high elevation, the hypothesis drawn from our analysis would be that assemblage characteristics would be similar to the high elevation cluster; variation from this expectation would warrant explanation.

The diversity and abundance of stream macroinvertebrates provide great potential for detecting pattern in a stream. At the same time we are faced with the dilemma of interpreting the meaning of differences between assemblages. The objective of understanding landscape-scale patterns from these tiny creatures, patchily distributed in a stream, increases the difficulty of interpretation. Our study has shown that multivariate analysis of assemblage metrics can suggest gradients comparable to physical gradients such as elevation. However the analysis is restricted to the quality and compatability of physical data. For much of our analysis we were dependent on physical data not necessarily collected at precisely the same location or at the same time as the invertebrates. This was particularly true for road densities. With sufficient physical data we can more readily detect how invertebrates respond. Given the patterns that are emerging from even this preliminary analysis, future efforts to document physical factors including riparian'condition, landuse, and road density at the time of collections will greatly enhance our ability to understand how stream biota respond to landuse. In addition studies designed to examine particular gradients or contrasts in landuse also will increase our understanding.

SUMMARY

In this survey of available Inner Columbia Basin invertebrate data, patterns of assemblage characteristics corresponded well with elevation in the Eastern Cascades (ERU's 2 and 3) and Columbia Plateau (ERU's 5,6,7 and part of 2). Landuse patterns associated with wilderness, intact riparian zones, grazing, and timber harvest, were useful in explaining trends associated with elevation and invertebrate metrics. Though elevation was not a useful explanatory factor in the Blue Mountain streams (ERU's 5,6 and 13), landuse information related to riparian condition and grazing corresponded well to metric trends. Road densities calculated by HUC (Hydrologic Units) did not correspond to trends observed with multiple metrics. This may be a problem in varying scales for data collection and analysis. Our test of the multivariate approach using added invertebrate information from the Deschutes National Forest demonstrated that the original cluster was sufficiently robust to provide a context for the new information. We expect that

increased resolution and coordination of stream surveys, in combination with work conducted to compare gradients of specific landuse or physical factors. will increase our ability to interpret the trends in aquatic communities as represented by macroinvertebrates.

REFERENCES

Li, H. W., G.A. Lamberti, T.N. Pearsons, C.K. Tait, J.L. Li, and J.C. Buckhouse. 1994. Cumulative effects of riparian disturbances alon High Desert trout streams of the John Day Basin, Oregon. Transactions of the American Fisheries Society 123:627-640.

Li, J.L., K. Wright and J. Furnish 1995. A survey of Eastside Ecosystem benthic invertebrates. Sumitted to the Eastside Ecosystem Management Project. March 1, 1995.

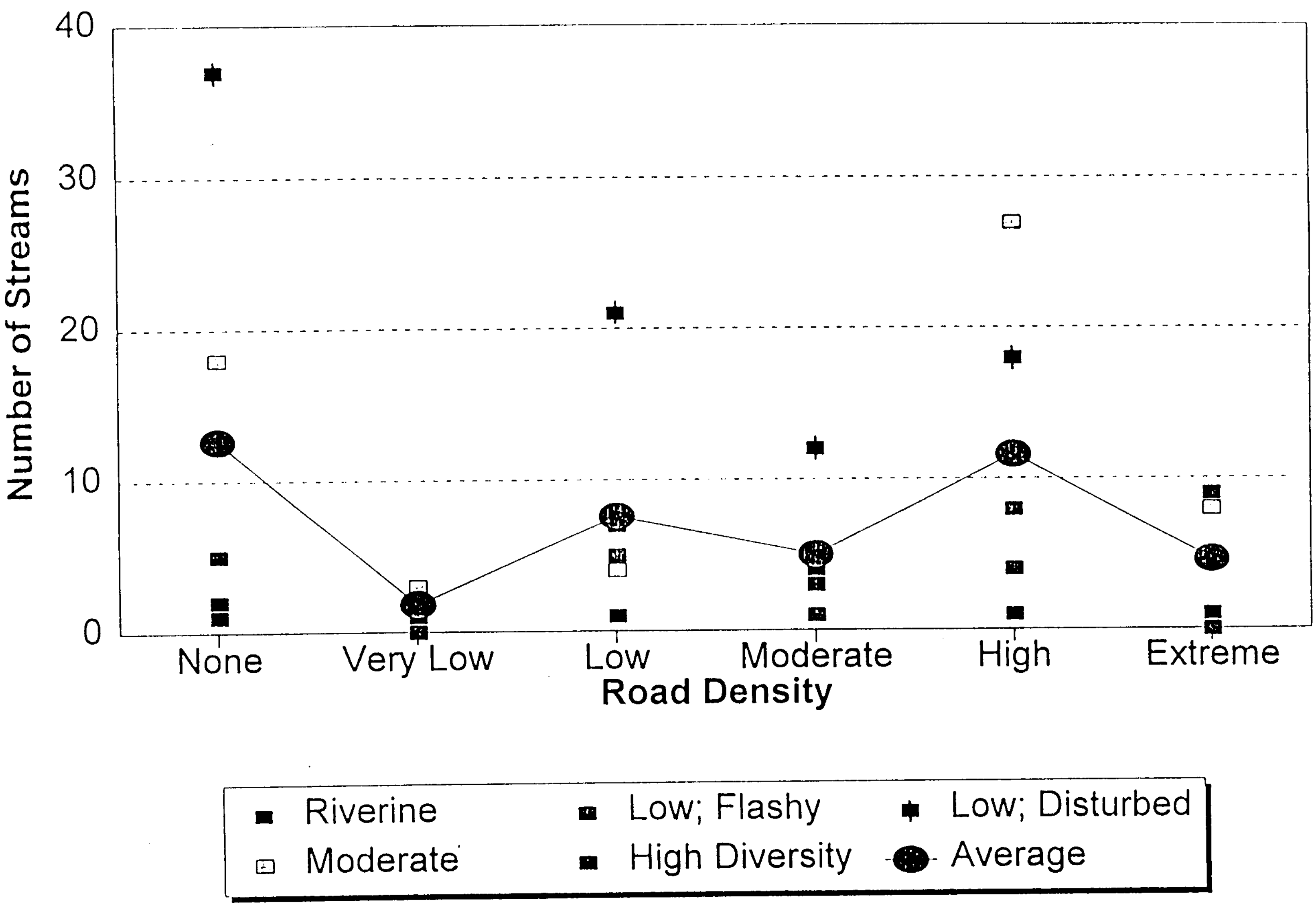
Plotnikoff, R. W. 1992. Timber/fish/wildlife ecoregion bioassessment pilot project. Washington State Department of Ecology, Ecology publication #92-63.

Table 1.

REORGANIZED ASSEMBLAGE CLASSIFICATIONS

REGION	TAXA	TOTAL	HBI	EPT/C	EPT	DOMTAX
RIVERINE						
COLUMBIA PLATEAU	6	49			2	70.1
LOW DIVERSITY,FLASHY						
EASTERN CASCADES	22	8422	4.88	2.33	8	67.79
COLUMBIA PLATEAU	23	5892			8	53.2
LOW DIVERSITY,HIGH DESERT OR DISTURBED						
BLUE MOUNTAINS	23	4688		2.4	8	45.0
COLUMBIA PLATEAU	22	1879			11	43.8
NORTHERN ROCKIES	20	1404	4.13		11	39.1
HIGH DESERT	25		4.76		10	37.4
COLUMBIA PLATEAU	31	7968			12	33.7
MODERATE DIVERSITY, GOOD HABITAT						
EASTERN CASCADES	38	4433	3.85	3.92	17	36.3
NORTHERN ROCKIES	38	17790	4.57		21	32.8
BLUE MOUNTAINS	42	4314		5.35	23	29.0
BLUE MOUNTAINS	41	5850		9.1	22	28.4
HIGH DIVERSITY, COOL HABITAT						
EASTERN CASCADES	38	3915	1.9	20.3	24	27.8
COLUMBIA PLATEAU	32	652			21	24.2
EASTERN CASCADES	54	10561	3.77	2.12	26	23.5
BLUE MOUNTAINS	59	5941		3.44	30	18.2

Figure 1. **Eastside Road Densities**
Sorted by Stream Qualities



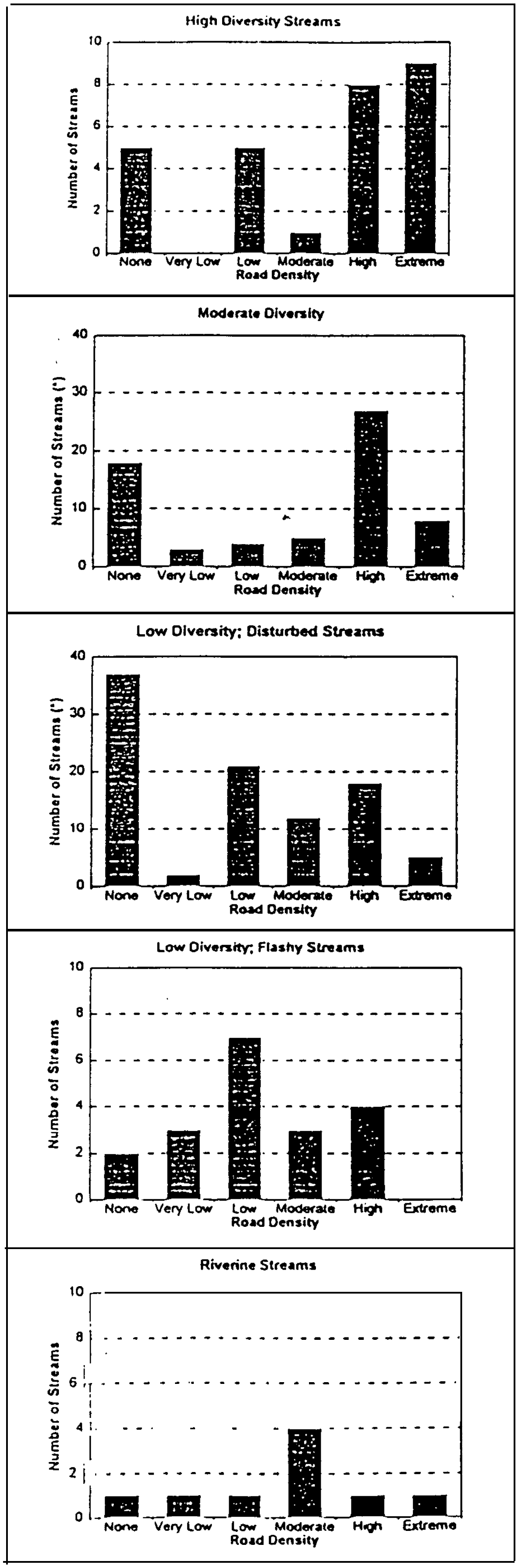
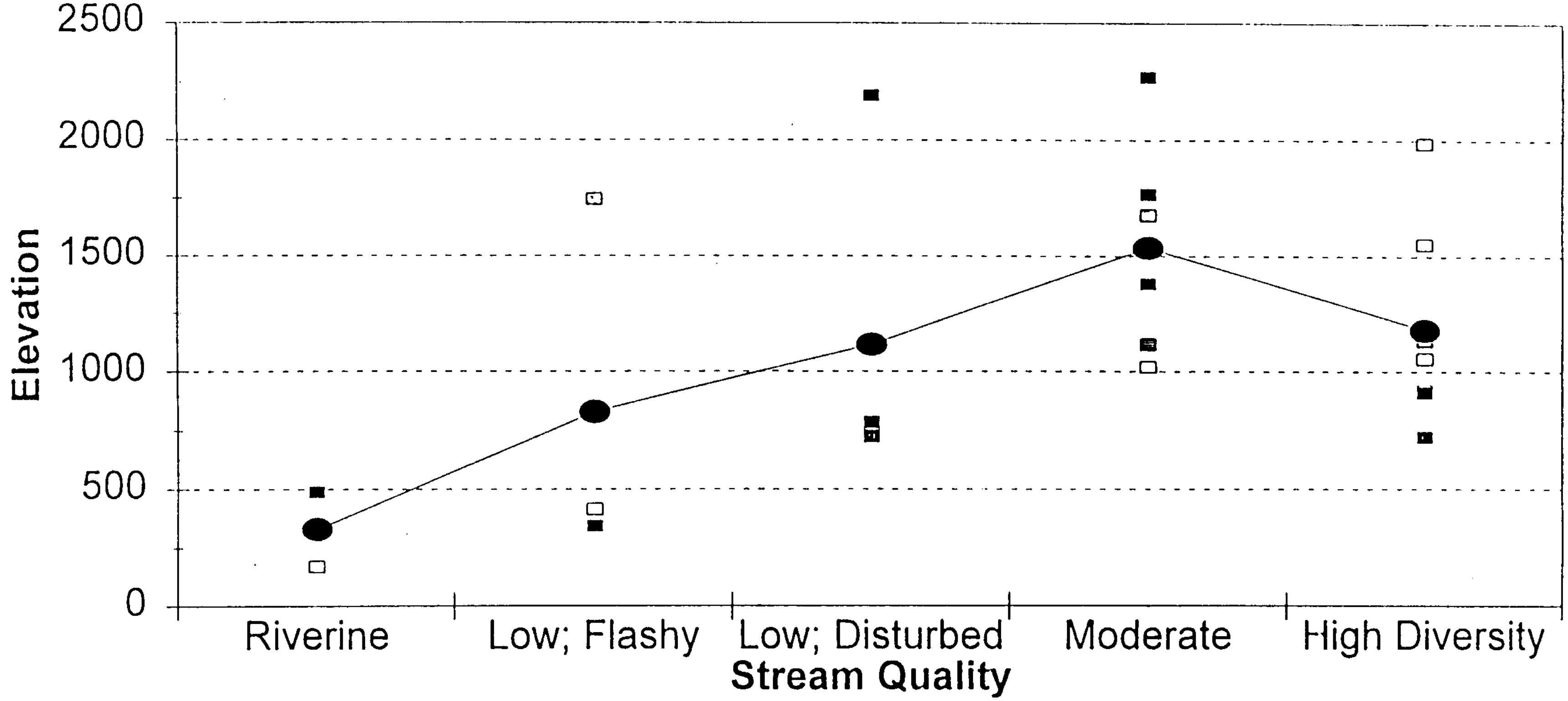


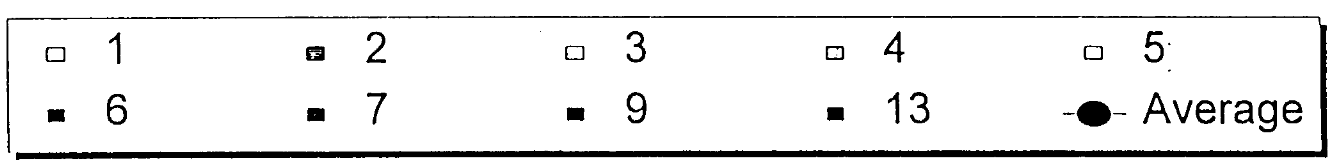
Figure 2. Number of streams at each road density for each classification of invertebrate div'ersity (according to PCA clusters).

Figure 3. **Eastside Columbia Basin E.R.U.s**

Elevations for Stream Qualities



LEGEND:
Each number represents an ERU.



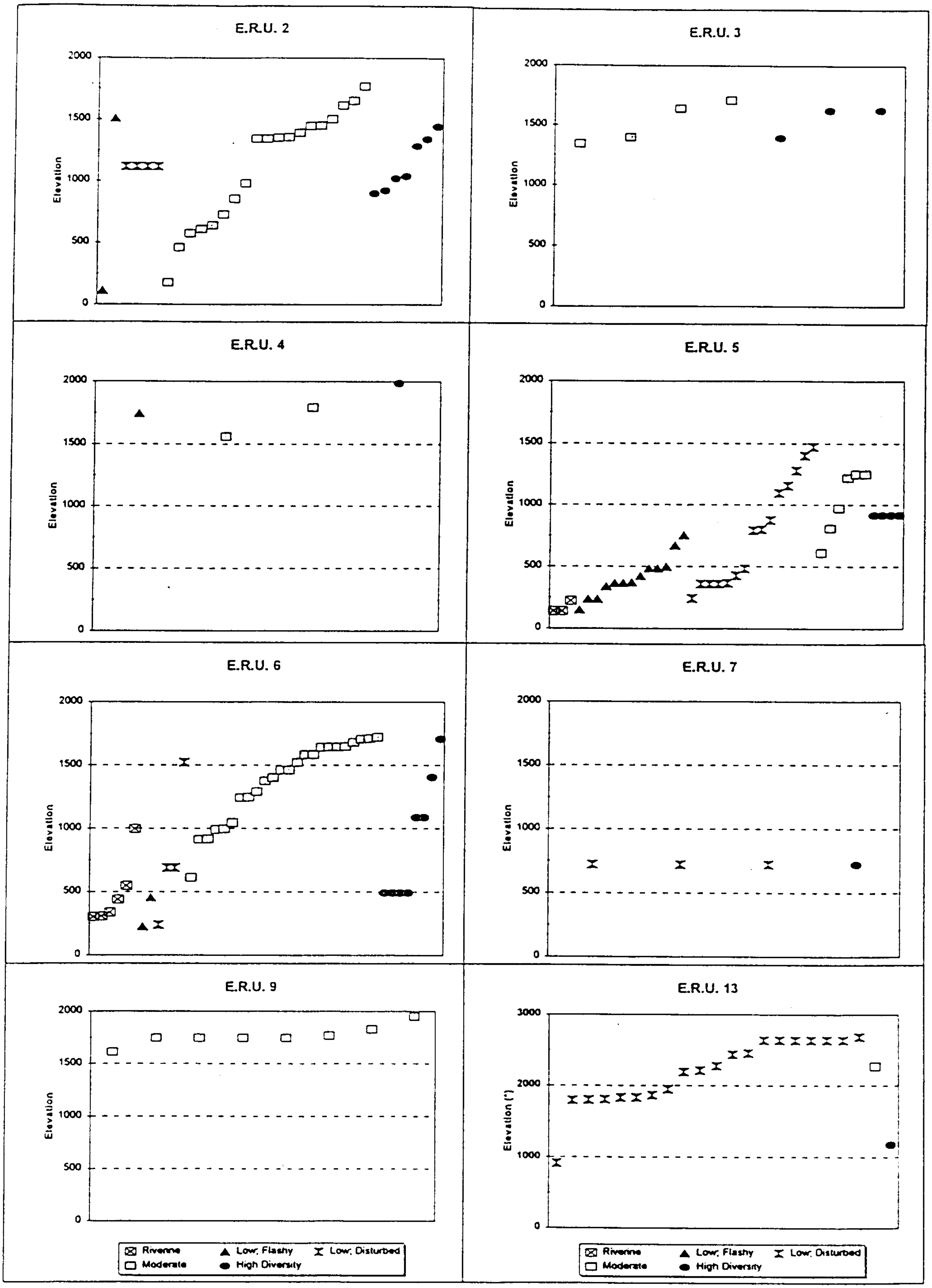


Figure 4. Elevations of all study streams by ERU's. Symbols denote different PCA diversity clusters.

Figure 5. ECOREGION 6 PCA VS ELEVATION

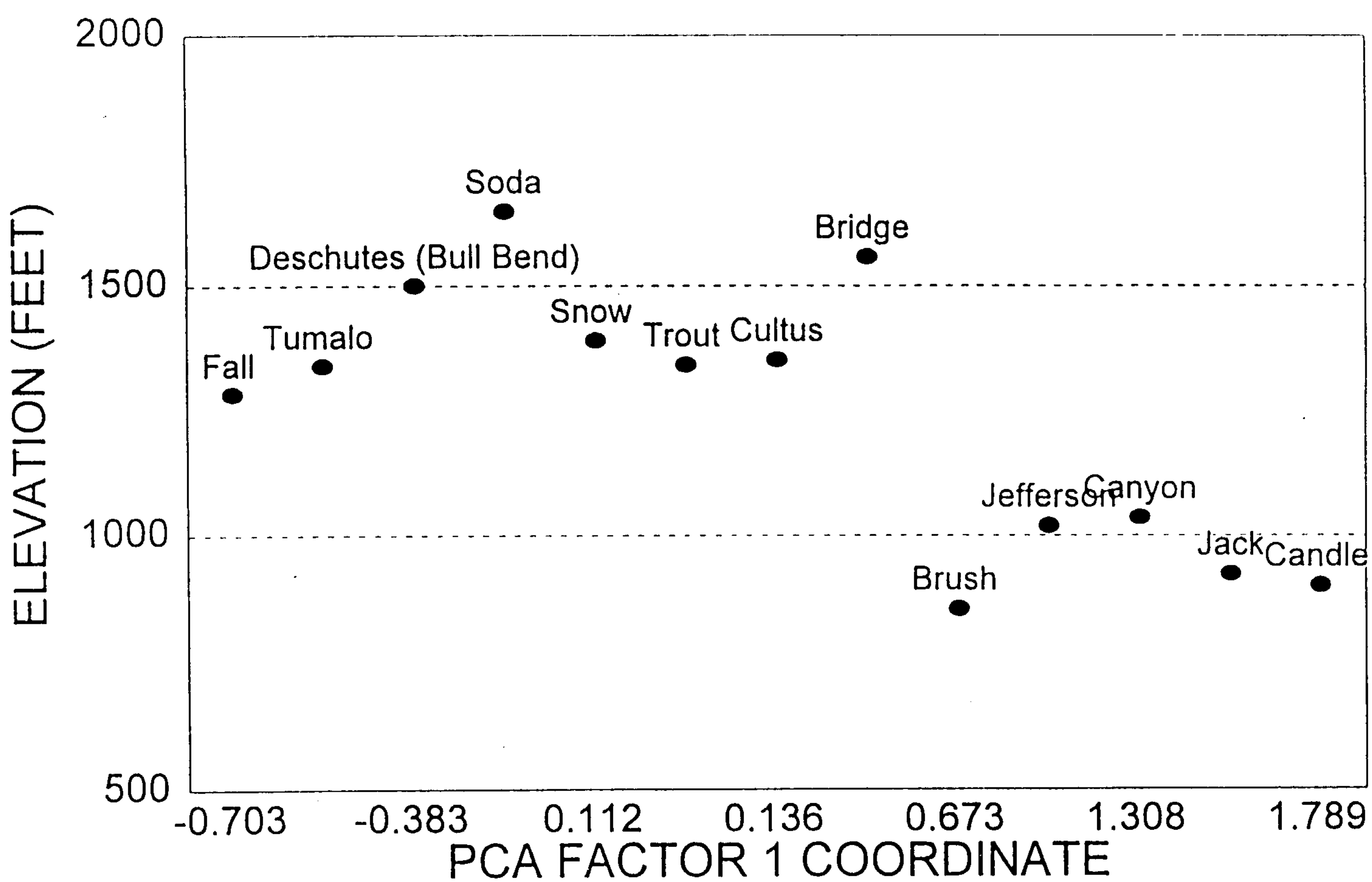


Figure 6. **ECOREGION 7 PCA VS ELEVATION**

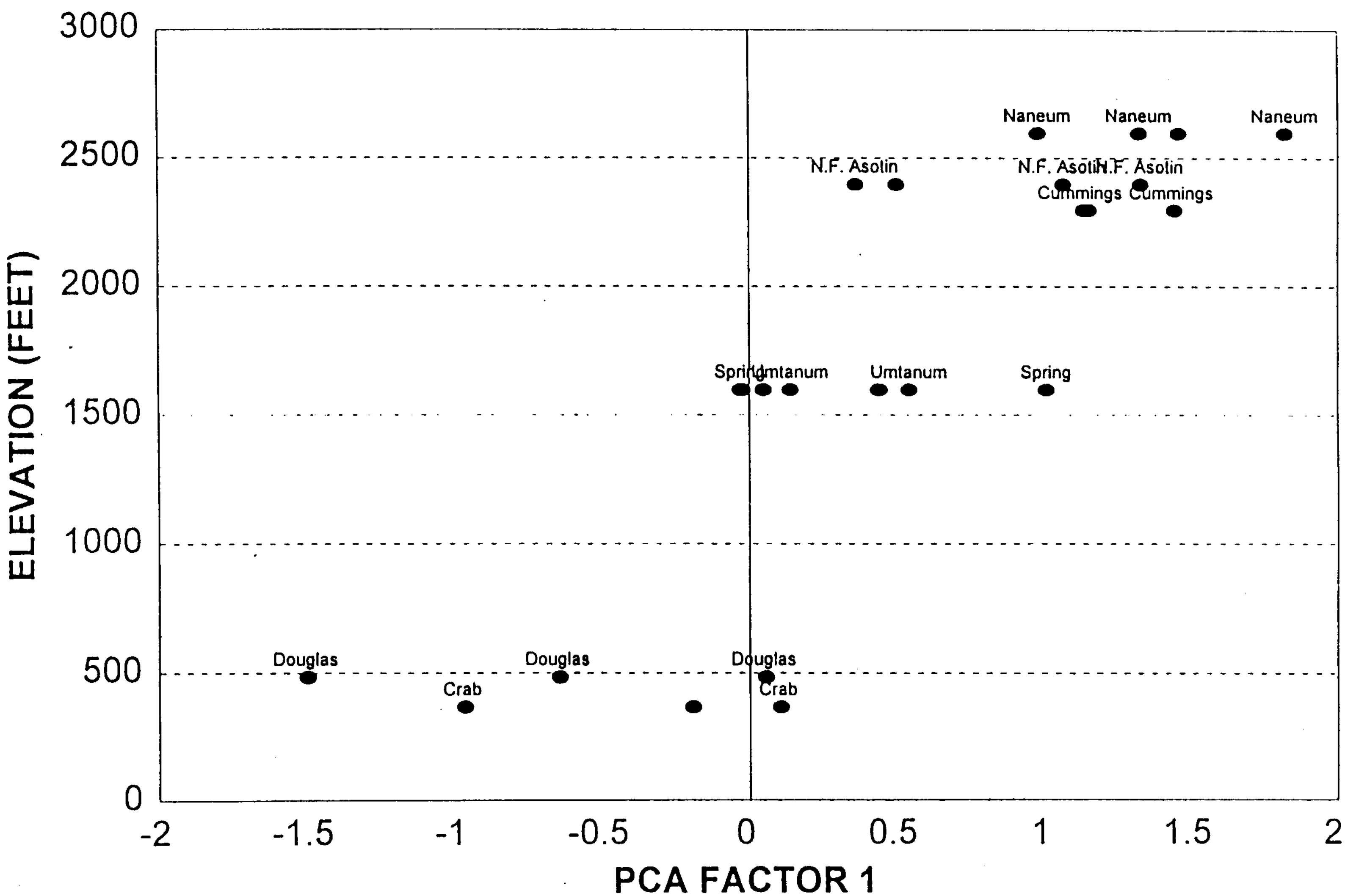


Figure 7. **Ecoregion 9 Elevation vs PCA**

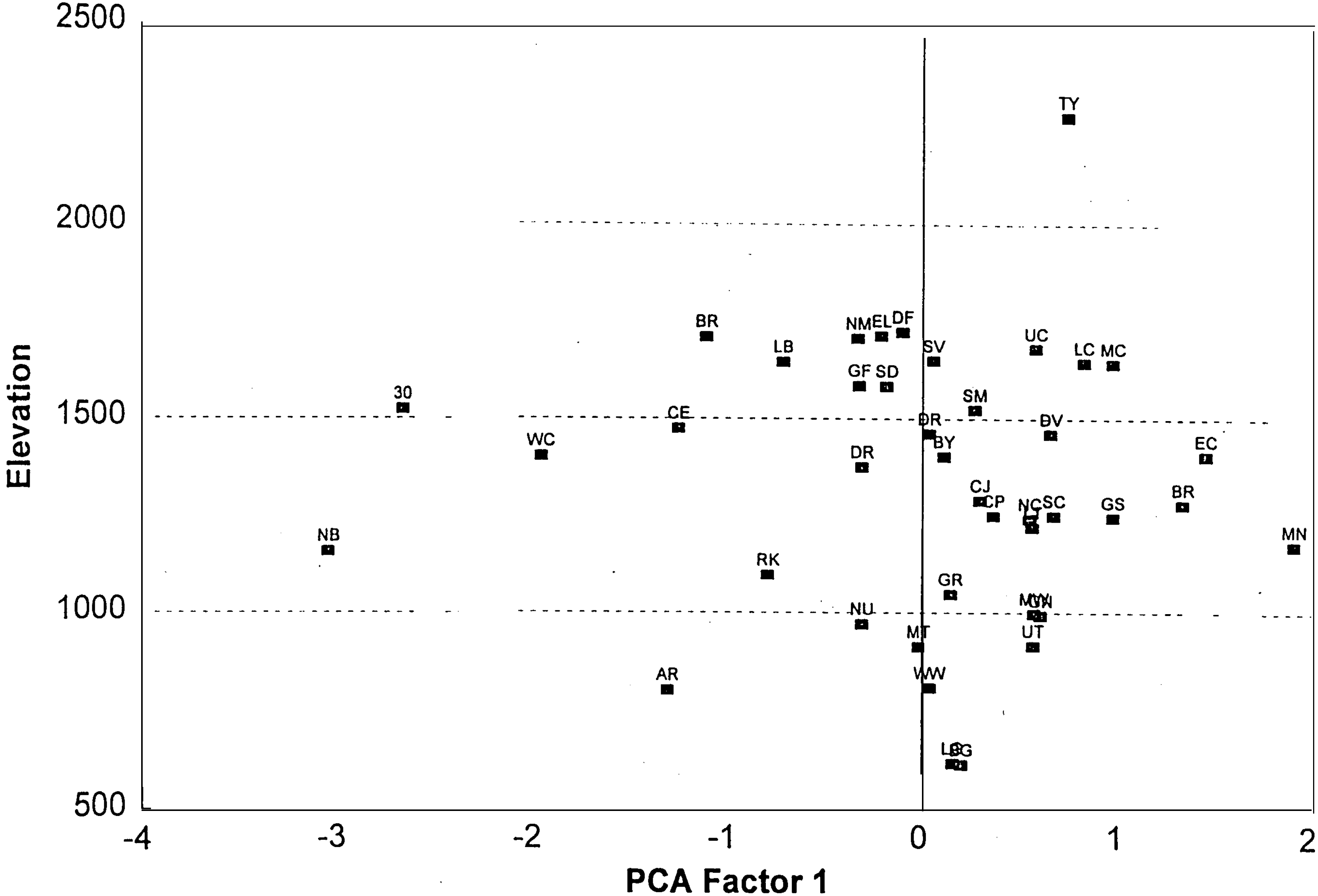


Figure 8. **Ecoregion 9 Elevation vs PCA**

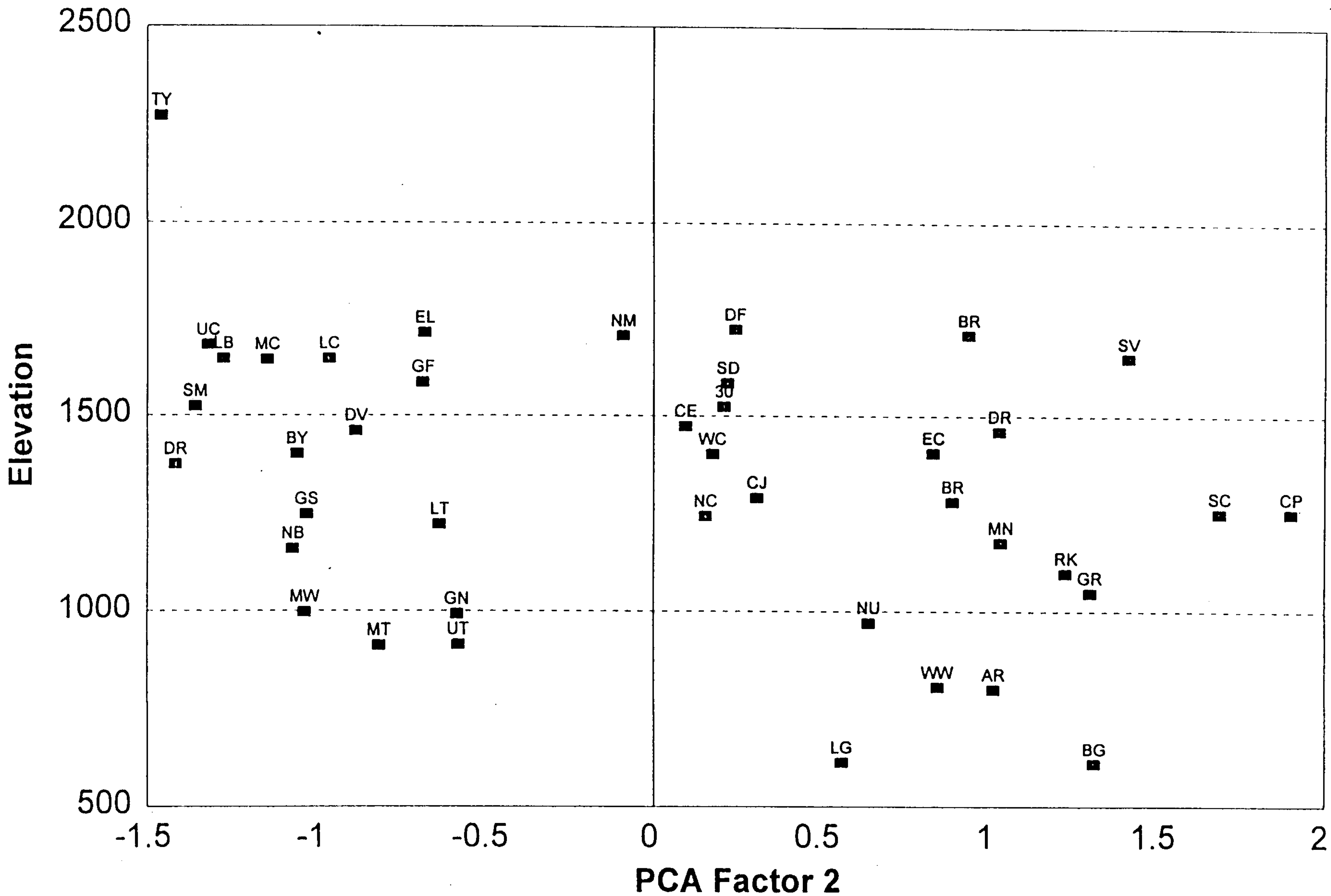
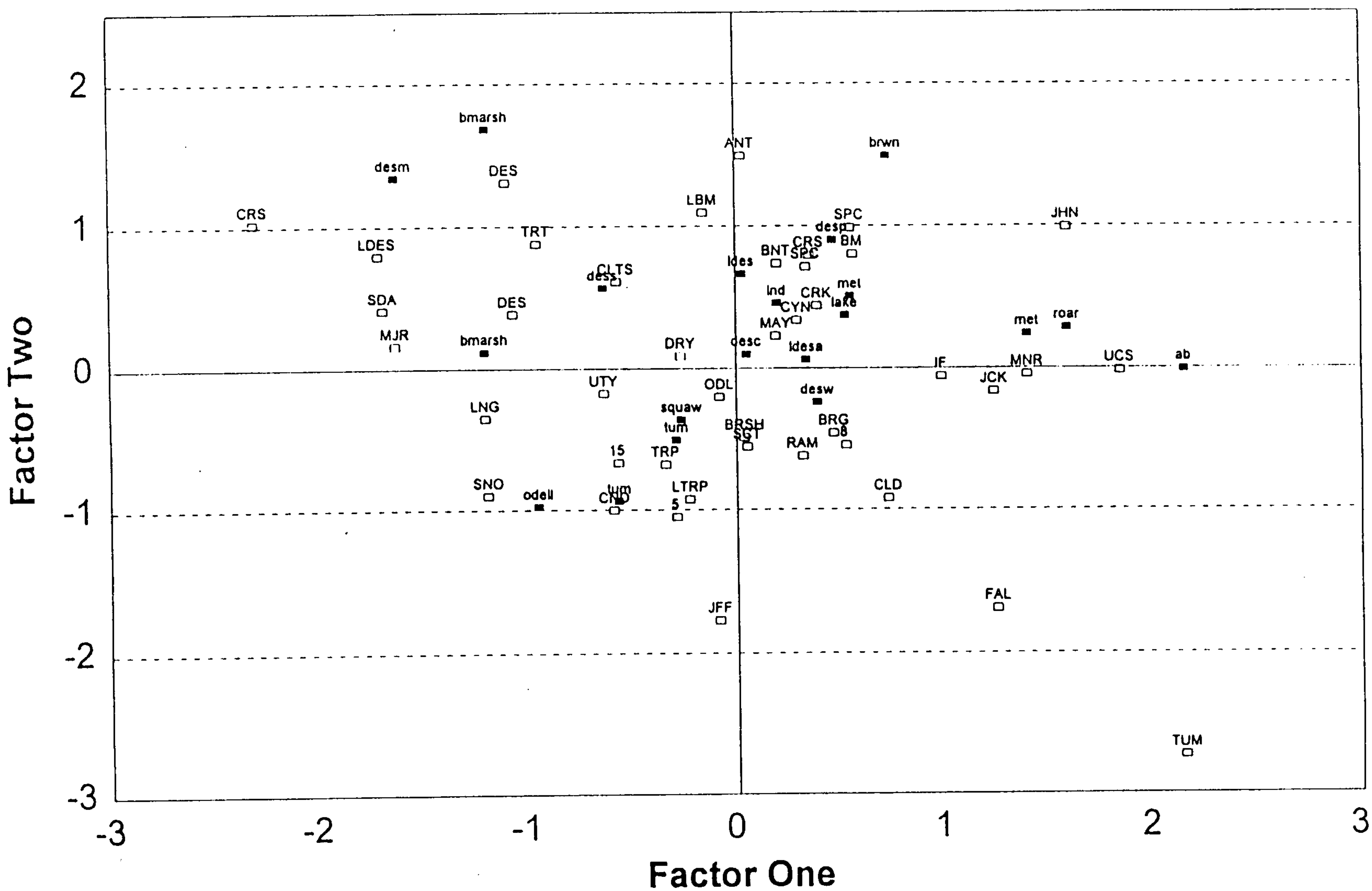


Figure 9. **PCA for the all Eco 6 streams (+HBI)**

This analysis uses Hilsenhof's Biotic Index as one of the assemblage metrics. Streams with filled squares and lower case are new additions.



Metric and predicted response		Eastern Oregon	SW Oregon	Puget Sound	Tennessee Valley	Japan
Taxa richness & composition						
Total number of taxa	Decrease	X	X	X	X	X
Ephemeroptera taxa	Decrease		X	X	X	X
Plecoptera taxa	Decrease	X	X	X	X	
Trichoptera taxa	Decrease	X	X	X	X	X
Long-lived taxa	Decrease	X	X	X	0	
Dipteran taxa	Decrease					
Chironomid taxa	Increase	0		0		
Tolerant / intolerant						
% Tolerant	Increase		X	X	X	X
% Sediment tolerant	Increase	X	X	0	0	
% Planaria & amphipods	Increase			X		
% Oligochaetes	Increase				X	X
% Chironomids	Increase					
Intolerant taxa	Decrease	X	X	X	X	X
Sediment intolerant taxa	Decrease	X	X	0	0	
%Very tolerant	Increase					X
% "Legless" organisms						X
Feeding ecology						
% Predator	Decrease	X		X	X	
% Scraper	Increase	X			X	
% Gatherer		X				
% Filterer					X	
% Omnivore	Increase				X	
% Shredder	Decrease					
% Mud burrower	Increase					X
Clinger taxa richness	Decrease					X
Population attributes						
Abundance	Decrease				X	X
% Dominance	Increase		X		X	

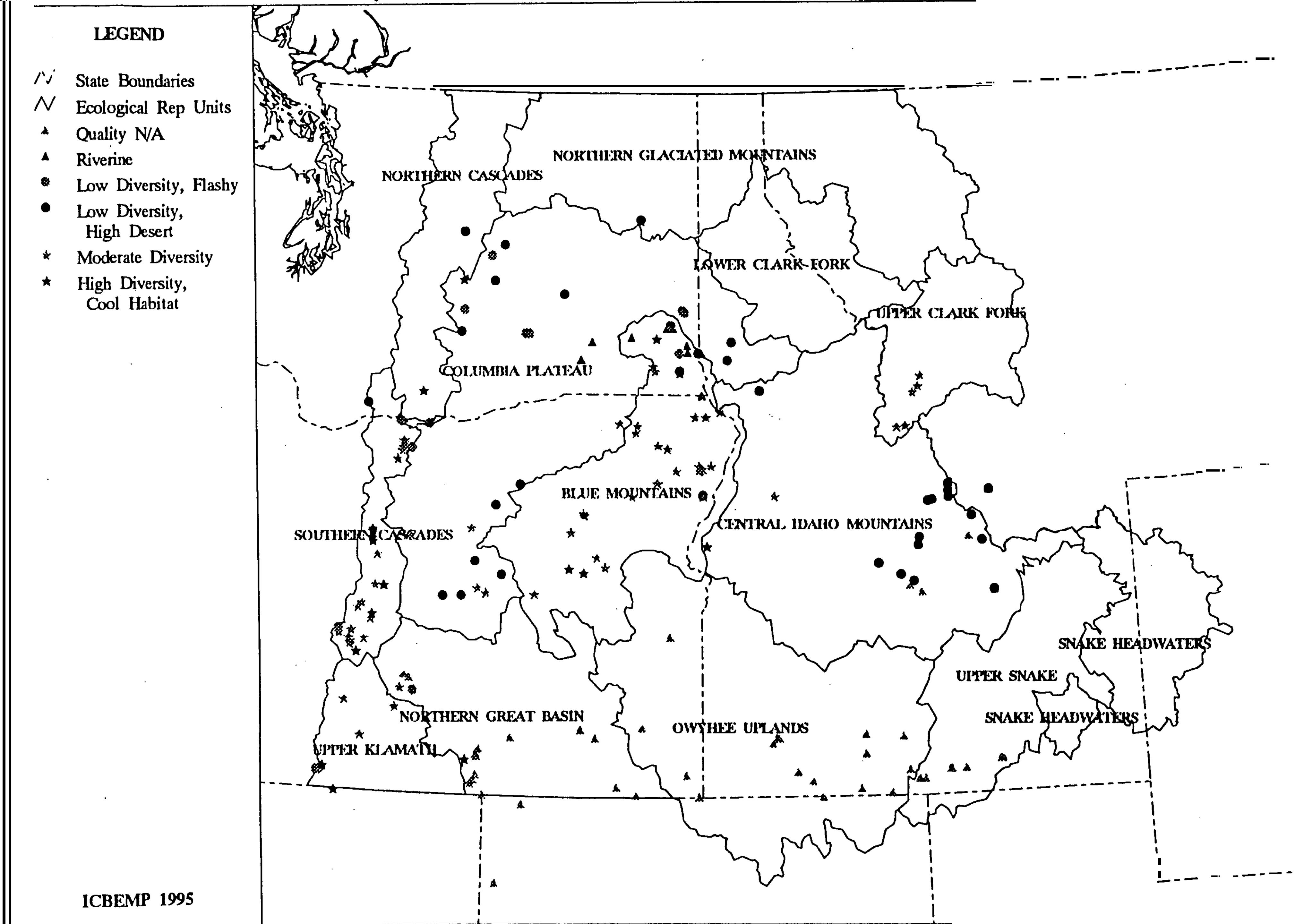
FOR: TRACY NOEL

Benthic Invertebrates - reselections and classifications

```
Quality N/A
: 52 of 219 selected.    ecoregion = 10

Riverine
: 9 of 219 selected.     ecoregion = 7 and quality = 'Large River'

Low Diversity, Flashy
: 5 of 219 selected.     ecoregion = 6 and quality = 'Lowest'
: 19 of 219 selected.    ecoregion = 7 and quality = 'Flashy' and latitude > 0

Low Diversity, High Desert
: 7 of 219 selected.     ecoregion = 9 and quality = 'Low'
: 22 of 219 selected.    ecoregion = 7 and quality cn 'Average'
: 27 of 219 selected.    ecoregion = 7 and quality = 'Disturbed'
: 47 of 219 selected.    ecoregion = 8 and quality = 'Disturbed'

Moderate Diversity
: 26 of 219 selected.    ecoregion = 6 and quality cn 'Average'
: 41 of 219 selected.    ecoregion = 9 and quality cn 'Average'
: 57 of 219 selected.    ecoregion = 9 and quality cn 'Good'
: 65 of 219 selected.    ecoregion = 8 and quality cn 'High'

High Diversity, Cool Habitat
: 13 of 219 selected.    ecoregion = 7 and quality cn 'Best'
: 16 of 219 selected.    ecoregion = 6 and quality cn 'High'
: 24 of 219 selected.    ecoregion = 6 and quality cn 'Good'
: 27 of 219 selected.    ecoregion = 9 and quality cn 'Best'
```

Benthic Invertebrates

Source: "A Survey of Eastside Ecosystem Benthic Invertebrates" J. Li, K. Wright, and J. Furnish 1995.



Benthic Invertebrates

Source: "A Survey of Eastside Ecosystem Benthic Invertebrates" J. Li, K. Wright, and J. Furnish 1995.