

Protocol for Monitoring Springs at Ozark National Scenic Riverways, Missouri. Heartland I&M Network

SOP 12: Data Analysis

Version 2.0 (05/17/2018)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0	5/17/2018	D.E. Bowles and L. W. Morrison	Exands and clarified types of analyses that should be used to evaluate data	Allows for more insightful analysis of data	2.0

Conclusions of ecological studies based on biological, chemical, and physical data are used by resource managers to better comprehend underlying system processes and develop environmental/management policies that best serve the resource. A critical component of any long-term monitoring protocol is a consistent and systematic approach to analyzing and reporting data. This information must describe the current condition, or status, of a community, and be robust enough to detect community changes through time. This, in turn, could have substantial ecological repercussions and should be an important consideration for investigators responsible for data interpretation. Therefore, every effort should be made to collect reliable data and use statistical analyses that are straightforward and will result in confident interpretations. This SOP describes the metrics to be calculated for invertebrate, fish, and aquatic vegetation data collected from springs at OZAR, and statistical analyses for interpreting those metrics.

I. Metrics and Estimated Variables for Analysis of Aquatic Vegetation

Summary indices and variables will provide information to park managers on the status of the target communities. As additional data are collected, trend analysis using time-series analysis or repeated measures may be used to detect temporal trends in vegetation community data. Control charts also will be used to evaluate data trends (see below) when appropriate.

For analysis, three sample plots (1 m² plots) are averaged for each transect. Once estimates for all parameters have been obtained for each transect, averages and a measure of variability (standard error of the mean) among transects are obtained for sampling reaches of individual springs.

The following metrics will be used to assess the aquatic vegetation communities of springs at OZAR.

Individual species abundances

Individual Species Frequency. Species frequency is calculated as the percentage of plots in which the species occurs for each transect and averaged across transects (n=6) to report mean species frequency for the spring reach.

Percent Foliar Cover: This metric serves as an estimate of abundance for each taxon. To calculate percent foliar cover, the cover class intervals are converted to median values to estimate percent cover for each taxon. Mean percent cover is then calculated as the species percent cover for each transect (n=3) and then averaged across all transects (n=6).

From these basic estimates of mean percent foliar cover and individual species frequency at each transect, the following metrics are calculated for the transect (1) **species relative cover**, (2) **species relative frequency**, and (3) **species importance value**. Relative frequency and relative cover are calculated using the following formulas:

$$\text{Species Relative Cover, species } i = \frac{\text{mean percent cover species } i}{\Sigma \text{ mean percent cover all species}}$$

$$\text{Species Relative Frequency, species } i = \frac{\text{percent occurrence species } i}{\Sigma \text{ percent occurrences all species}}$$

Where occurrence is the number of plots a species is present within a transect.

Species importance value (SIV) is an index derived from relative cover and relative frequency:

Species Importance Value, species i = (Species Relative Cover, species i + Species Relative Frequency, species i)/2*100

The importance value gives an overall estimate of the influence or importance of each plant species in the community.

Plant species richness, diversity and evenness

Species Richness. This metric is determined as the total number of plant species recorded per plot, averaged per transect (n=3), which are again averaged for the sampling reach (n=6). Species richness (S) is calculated with all species (native and exotic) included in the estimate.

Shannon Diversity Index (or Shannon-Weiner Index). This index assesses how the total number of individuals in a dataset are distributed among the number of species in the dataset. Typical index values range from 1.5 to 3.5 (Margalef 1972). The higher the value the greater the diversity, which in turn implies quality of stream condition. While any base may be used, the natural log (ln) is the most common.

It is calculated as:

$$H' = - \sum p_i(\ln(p_i))$$

where:

H = diversity value

p_i = proportion of taxon i in the dataset and derived from n_i/N , which is the abundance of taxon i divided by total taxa abundance

Species Distribution Evenness. This metric (E') is a measure of distribution of species within a community as compared to equal distribution and maximum diversity. It is also known as Shannon's Evenness Index. It is calculated as:

$$E' = H' / H_{\max},$$

where H' is the Shannon diversity index calculated in the above formula and $H_{\max}$ is the maximum possible diversity for a given number of species if all species are present in equal numbers ($\ln(\text{species richness})$).

Simpson's Index of Diversity. This metric estimates the likelihood that two randomly chosen individuals from a site will be different species and emphasizes common species. It is calculated using the complement of Simpson's original index of dominance:

$$D = \sum_{i=1}^k p_i^2$$

where: n_i is the number of observations from the sample in the i th of k (non-empty) categories, n is the sample size and $p_i = n_i/n$.

Effective Number of Species. Shannon and Simpson's diversity index values are converted into effective number of species for each community (H_e and D_e , respectively). This allows for both diversity measures to be compared directly to species richness of the sites (S) within and among sample years based on count of distinct species in the community. Shannon diversity index was converted into effective number of species (H_e) using the following formula:

$$H_e = e^{H'}$$

or

$$H_e = \exp^{H'}$$

where H' is the Shannon diversity index value.

Effective number of species based on Simpson's diversity index (D_e) is the inverse of the index value or:

$$D_e = 1/(1-D)$$

where D is the Simpson's diversity index value.

Dominance takes into account the species abundance and evenness of species distribution in the community. The degree of species dominance in the community is reflected by the degree to which $S > H_e > D_e$ when evenness (E') remains constant in a single community. The difference in number of species between the diversity measures reflects both how each metric considers uncommon species and how species diversity is partitioned within the community among years. If all species occurred in equal abundance in the community within and among sample years then $S = H_e = D_e$. Effective number of species for each diversity measure reflects the number of species found in a similar community when all species occur in equal density. For example, if $S = 100$ and D_e is equal to 20, then the community is dominated by 20 species and 80 species occur in low abundance. Such a community would be equivalent to a community with just 20 species all occurring in equal abundance.

I. Metrics and Estimated Variables for Analysis of Aquatic Invertebrates

Summary indices and variables will provide information to park managers on the status of the target communities. As additional data are collected, trend analysis using time-series analysis or repeated measures may be used to detect temporal trends in invertebrate community data. Control charts also will be used to evaluate data trends (see below) when appropriate.

For analysis, transects (one 0.25 m² sample per transect) are used as the unit of replication. Once estimates for all parameters have been obtained for each transect, averages and a measure of variability (standard deviation or standard error of the mean) among the five invertebrate transects are obtained for individual springs.

Multi-metrics

The following metrics will be used to assess the invertebrate communities of springs at OZAR.

Taxa Richness. This metric is a measure of the total number of genera or other designated taxonomic level of identification. Taxa richness generally increases with improving water quality, habitat diversity, or habitat suitability (Rabeni *et al.*, 1997). Calculate as the total number of genera or other designated taxonomic level of identification.

EPT Richness. This metric is a measure of the number of genera within the aquatic insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Members of these orders are generally considered pollution-sensitive organisms and a decrease in their total number may indicate impairment. Calculate as the total number of different genera within the aquatic insect orders Ephemeroptera, Plecoptera, and Trichoptera.

Shannon's Taxa Diversity Index. The formula for calculating this statistic is shown above, but with the distinction where p_i = relative abundance of each taxon, calculated as the proportion (decimal fraction) of individuals belonging to a given taxon (Resh and Jackson, 1993).

Taxa diversity generally decreases with declining water quality because of reductions in both richness and evenness.

Biotic Index (BI). The basis of the BI is that each taxon is assigned a pollution tolerance value related to its assumed or known tolerance of water quality degradation (Hilsenhoff, 1982, 1988). Tolerance values for taxa occurring at OZAR will follow Hilsenhoff (1982, 1988) and Lenat (1993) and are presented in Table 1 of this SOP. The BI increases with increasing impairment.

Calculate as:

$$BI = \sum (X_i T_i) / N$$

X_i = number of individuals within each genus

T_i = tolerance value of that species

N = total number of organisms in the sample

III. Metrics and Estimated Variables for Analysis of Fish Communities

Primary approaches to analyzing fish data from OZAR springs will include metric estimation/calculations with use of control charts and multivariate statistics. Biological metrics are commonly used by investigators at all levels (*e.g.*, private, state, tribal, and federal) to compare the condition of the biological community at multiple sites (Simon, 1999) or examine trends across time. Barbour *et al.* (1999) define a metric as a characteristic of the biota that changes in an expected direction with increased anthropogenic disturbance. Using these characteristics (Table 2) allows investigators to determine the importance of environmental conditions, clarify which habitat factors play a large role in shaping fish communities, and identify specific sources of impairment (Karr, 1981).

By combining multiple metrics (and results for those metrics) into a single index of biotic integrity (IBI), investigators can determine the overall quality of the fish community. An IBI can also be used to compare overall ecological conditions over time and among sites, providing the selected metrics are related to variables responsible for impairment (Karr, 1981; Barbour *et al.*, 1999; Simon, 1999). To assess fish community condition, the IBI developed for Ozark Highland streams by Dauwalter *et al.* (2003) will be evaluated for use at springs in OZAR.

Metrics

Species Richness. The number of species collected for the entire sample reach. Typically, species richness declines with increases in human disturbance.

Simpson's Diversity Index. This index uses both richness and abundance to calculate diversity of the fish community. This index is preferable to the Shannon diversity index and will be used

for data analysis because this index is independent of sample size. This index decreases with poor water quality and habitat conditions. Simpson's Diversity Index is calculated with the formula shown above.

Catch per Unit Effort. Catch per unit effort (CPUE) can be calculated as either Catch per Time or Catch per Area sampled. When using electrofishing gear to collect community data, CPUE is typically calculated as Catch per Time. We will use catch per minute to obtain relative abundance. Total CPUE will be calculated using the total number of fish collected at a reach. CPUE for each individual species will also be calculated at each reach.

Size Structure. Size structures of fish populations within the community can be indicative of a disturbance or resource problem. A community with primarily larger fish indicates that there is little recruitment to keep the community self-sustaining. A community with primarily smaller fish could indicate inadequate resources (*e.g.*, food resources) that limit growth. Average length and weight (and ranges) for each species at the reach will be calculated.

Percent Composition. Percent composition of each species will be calculated using count data and using biomass.

To calculate percent species composition using count data (C_i):

$$C_i = n_i / N_t * 100$$

n_i = number of individuals in species i

N_t = total number of individuals collected in reach

To calculate percent species composition using biomass :

First, calculate individual biomass for each species (B_i):

$$B_i = W_i N_i$$

W_i = average weight of fish species i

N_i = number of individuals of species i

Second, calculate biomass per area for each species (BPA_i) and total biomass per area (BPA_t):

$$BPA_i = B_i / A$$

$$BPA_t = \sum BPA_i$$

A = area of the sample reach

Lastly, calculate percent composition for each species based on biomass (BC_i)

$$BC_i = BPA_i / BPA_t * 100$$

I. Habitat and Water Quality Data

Summary statistics of habitat and water quality variables will provide information to park managers on the relative condition of the stream in relation to the aquatic plant, invertebrate and fish community metrics.

1. Because fish are sampled throughout the entire reach, in-stream habitat, fish cover, and bank measurements will be analyzed at the reach scale. For in-stream habitat, variables will be averaged across all 33 plots (3 plots per transect, 11 transects) within the reach. For presence of fish cover, percent occurrence of each cover type will be calculated across all transects (n=33 for those assessed at the plot and n= 22 for those assessed on left and right side of each transect). For bank measurements, averages will be calculated across transects for the right (n=11) and left (n=11) banks.
2. Categories for percentage class intervals are first converted to median values (0 = 0%, 1 = 5%, 2 = 25%, 3 = 57.5%, 4 = 87.5% for cover classes) to estimate percent coverage for each variable (i.e., Substrate Wentworth codes are converted to median millimeters).

III. Basic charts

The most basic information to provide to resource managers is a graph or chart plotting the point estimate of the respective variable over time. In general, graphs are the easiest way to communicate information to a non-technical audience. Thus, the first step in most analyses will be to plot the data and carefully examine the resulting graph. Visual examination of data is important; inferences should never be made based on test statistics alone (Anscombe 1973). The degree of uncertainty associated with the point estimate should also be included, if available. For statistical uncertainty (i.e., random sampling error), 95% confidence intervals should be used. (Any basic statistics text can be consulted for the steps in calculating confidence intervals.) If any other sources of error are documented and quantified (i.e., observer error, lack of precision in equipment, etc.), these could also be incorporated in such graphs as broader error bars.

If some threshold can be identified (e.g., a desired condition, a regulatory standard, etc.), this could be included and the product would be a type of control chart (see below). Any sort of relevant threshold that could be included would help to provide context to the graph. Outliers may become obvious at this stage, depending upon how the data are plotted. Outlier tests such as Grubbs or Rosner tests may be employed to determine whether an observation is a statistical outlier. Such outlier tests, however, determine only whether an observation is likely to have been generated from a normal distribution. Most field data from ecological studies are skewed, and do not resemble a normal distribution. Instead of using such tests, if any outliers are present, the data represented by the outliers should be verified for accuracy. If no errors in data collection or entry can be found, the data points probably represent important information and should not be discarded.

An example of a simple graph is included below. Note the basic components of an informative graph: appropriately labeled X and Y axes, including units of measurement; error bars reflecting uncertainty in the point estimate and a description in the legend of what the error bars represent; and a threshold (if available) and description in the legend of what the threshold represents. Obviously, other types of graphs are possible, depending upon the complexity of the data, but always should be constructed with ease of interpretation in mind.

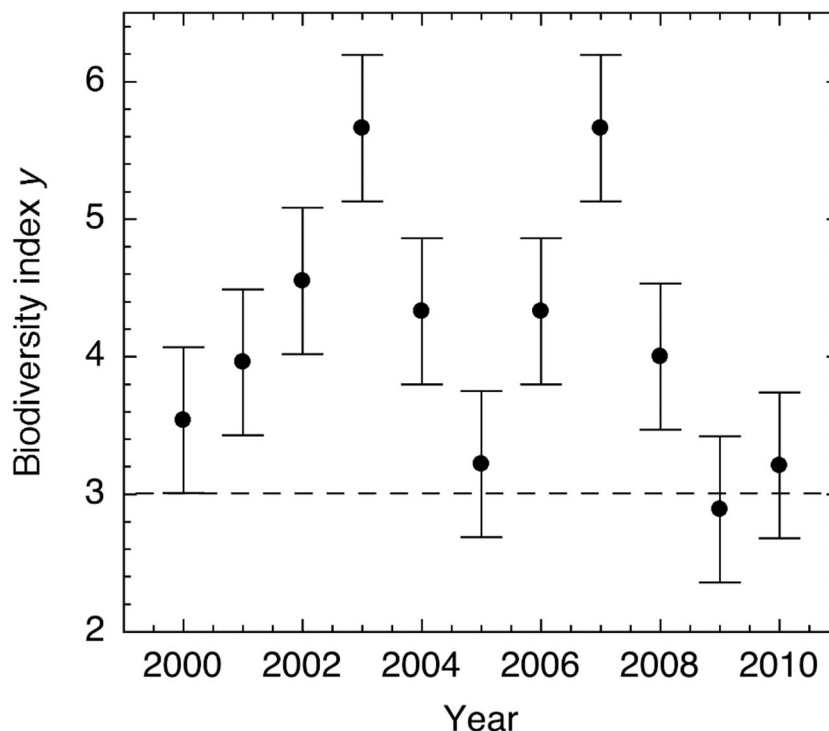


Figure 1. Biodiversity index y over time. Error bars represent 95% confidence intervals. The dashed line represents a threshold described in the literature as representing a depauperate community.

IV. Checking assumptions and remedial measures

Before conducting any analysis, the assumptions of the analysis should be evaluated. In general, parametric tests will have more restrictive assumptions than non-parametric tests. To assess normality of the data, normal probability plots, Skewness and Kurtosis statistics, or the Shapiro-Wilk test can be used (Shapiro Wilk 1965, D'Agostino et al. 1990, Kutner et al. 2005). Skewness and Kurtosis are descriptive statistics where a Skewness of 0 and a Kurtosis of 3 indicates normality of the data. The Shapiro-Wilk test provides a test statistic and *P*-value to determine normality. To test for homogeneity of variances, Bartlett's test, Levene's test, or Mauchly's test can be used (Bartlett 1937, Mauchly 1940, Levene 1960).

Graphical analysis of residuals can reveal nonlinearity of the regression function, nonconstancy of error variance, nonindependence of error terms, and autocorrelation (Kutner et al. 2005). A Durbin-Watson test can be employed to formally test for temporal autocorrelation (Savin and White 1977). The Durbin-Watson test provides a test statistic (*D*) between the values of 0 and 4.

A value of or near 2 indicates no autocorrelation; a value of or near 0 indicates positive autocorrelation, whereas a value of or near 4 indicates negative autocorrelation. To test for significance of the test statistic (D), Durbin-Watson tables listing lower and upper bounds (d_L and d_U) can be used. If D is less than d_L , then there is significant positive autocorrelation. If D is greater than d_U , then there is no significant autocorrelation. If D lies between d_L and d_U , the test is inconclusive. An inconclusive result does not mean there is no temporal autocorrelation, only that the test could not determine if autocorrelation exists, in principle because the sample size is too small (Kutner et al. 2005). The inconclusive range of the statistic grows wider as the sample size become smaller. (If a test for negative autocorrelation is required, the test statistic would be $4 - D$. If $4 - D$ is less than d_L , then there is significant negative autocorrelation, etc.)

Data transformations may be helpful prior to use of parametric tests that require normality and independence of the error terms (Kutner et al. 2005). Once the data are transformed, procedures to test for normality and autocorrelation should be re-examined. If significant autocorrelation exists, remedial measures include transformations such as the Cochrane-Orcutt procedure, the Hildreth-Lu procedure, and the First-Differences procedure (Kutner et al. 2005). None of these transformations is guaranteed to remove autocorrelation, however, and if significant autocorrelation is found, the best solution in most cases would be simply to apply the modified Mann-Kendall test.

V. Non-parametric Trend Analysis

Trend analysis looks for temporal or spatial changes in environmental monitoring parameters. Trend analysis may help identify trend and estimate rate of change, but it does not help determine cause, which must be assessed independently. Trend analysis can be accomplished using a parametric test (linear regression) or a non-parametric test (Mann-Kendall trend test). Prior to using either test, the data must be shown to meet the assumptions of the respective test (see below). Most of these tests are readily found in most commercial statistical software packages such as SAS, SPSS, and R.

Mann-Kendall test

A basic test for the existence of a monotonic trend in a data series is the Mann-Kendall test. It is a non-parametric analogue of parametric regression that does not require normality of the data or that the trend be linear (Mann 1945, Kendall 1975, Hirsch et al. 1982). If the model form specified in a regression equation were known to be correct (Y is linear with T) and the residuals were normal, then parametric regression would be optimal. If the actual situation departs, however, even to a small extent, then the Mann-Kendall test procedures will perform as well or better (Hirsch et. al. 1991, Helsel and Hirsch 2002).

The original Mann-Kendall test for trend is sensitive to serial correlation, however, with the probability that a significant trend will be detected (at a given alpha level) being substantially higher than the stated alpha. A modified seasonal test is available (Hirsch and Slack 1984), in which the probability of detecting a significant trend (at a given alpha level) is very close to the stated alpha even when serial correlation is present, given at least 10 years of data. (Seasonal data are not necessary to employ the test.) This modified test is less powerful than the original

test when data are independent, however. The modified version should be used in the presence of serial correlation.

Sen Slope (Kendall-Theil Robust Line)

This is a robust nonparametric test to determine if Y is linearly related to X. This test does not depend on normality of residuals and is not be strongly affected by outliers, in contrast to parametric regression. When residuals are normally distributed, parametric regression is slightly more efficient than the Sen Slope. When residuals depart from normality (are skewed or prone to outliers), then this nonparametric test can be much more efficient than parametric regression (Helsel and Hirsch 2002). The Sen Slope, however, is affected by serial correlation, in a similar manner as parametric regression.

The Sen Slope is the median annual slope of all possible pairs of values. It is expressed in the units of the variable, standardized to a year. For example, if a parameter is measured in each of 10 years, the slope is the difference between the endpoints of the fitted line divided by 10 (the number of years). Median annual slope is often compared to the median value of the variable as a measure of the magnitude of change. A statistically significant Kendall test with an annual trend of more than 1% of the median value is often considered meaningful (TimeTrends manual). Providing information on the magnitude of change is much more informative than merely determining statistical significance.

The Mann-Kendall test can be conducted in conjunction with the Sen Slope; the former determines whether a significant trend exists and the latter indicates the magnitude of the trend.

Implementation of non-parametric tests

TimeTrends software (<https://www.niwa.co.nz/freshwater/management-tools/water-quality-tools/analysis-of-water-quality-trends>) can be used to perform both the original and modified versions of the Mann-Kendall test as well as calculate the Sen Slope. Unless it has been determined that no serial correlation exists, or if <10 years of data are available, the original Mann-Kendall test can be employed. Otherwise, use the modified version.

VI. Parametric tests for trend

Parametric regression may be used with monitoring data. Linear regression is commonly employed, although other regression functions should be considered. Over longer time series, it is unlikely that a simple linear function will adequately fit the data (Bart and Beyer 2012, Johnson 2012). Thus the first step is to evaluate a graph of the data to visualize what trends may be apparent, and specify time periods of interest (if not the whole data series). In general, parametric regression attempts to fit a particular function to a data set (i.e., by drawing a line as close to all data points as possible). Numerous functions should be considered, including linear, exponential, polynomial, and breakpoint. (The “Curve Estimation” option of the “Regression” function in SPSS, for example, allows for simultaneous comparison of a number of different types of regression functions.) Decisions about model adequacy should not be made on the basis

of test statistics alone, however. A large R^2 or significant F-statistic does not guarantee that the data have been fitted well (e.g., Figure 2). The repeated measures linear regression model is also appropriate because the analysis allows for the significance of trends generated by the sequential sampling of plots to be tested (Lesica and Steele, 1996). The repeated measures linear regression model is based on differences in mean values among sample units (e.g., transects) between time periods.

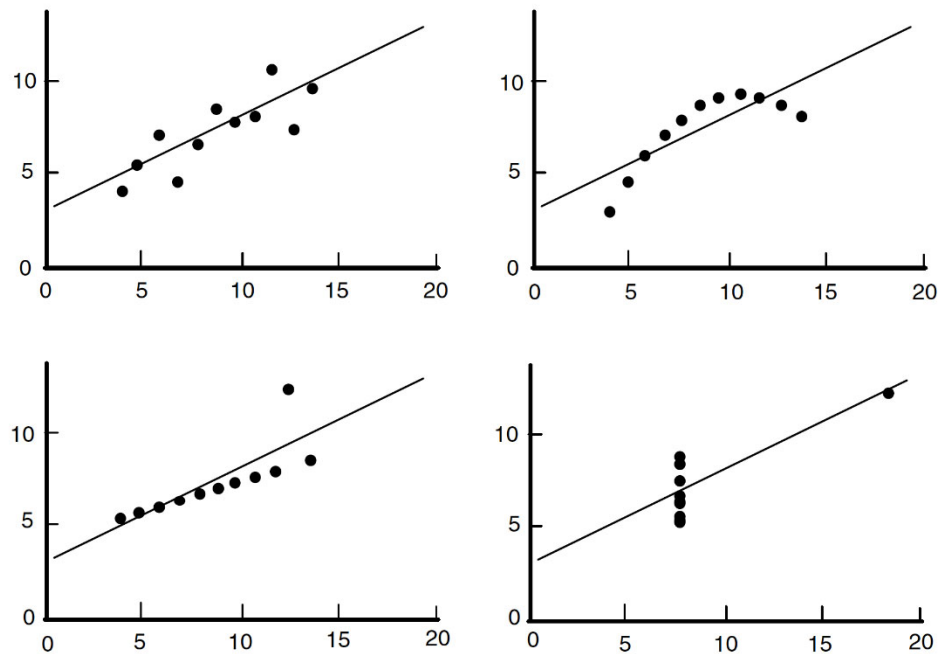


Figure 2. The data in the four graphs have exactly the same summary statistics and regression line (from Anscombe 1973).

The advantage of using an exponential model is that it describes change at a constant proportional rate, which provides a useful way of describing a trend. For example, if an exponential curve is fitted and the annual proportional rate of change (R) is 1.01, the variable of interest is interpreted as increasing at a rate of 1% per year. If R is 0.98, for example, the variable of interest is interpreted as decreasing at a rate of 2% per year. (Raise the base of the natural logarithm (e), which is equal to 2.71828 to the value of the slope parameter, b_1 , to find R [i.e., $e^{b_1} = R$].) Linear and polynomial curves do not change at a constant proportional rate so describing annual change is more difficult (Bart and Beyer 2012). Again, providing information on the magnitude of change is much more informative than merely determining ‘significance’.

True time series modeling (i.e., autoregressive integrated moving average [ARIMA] models) requires at least 50 but preferably > 100 observations (Box and Tiao 1975). Such models are complex and difficult to interpret. Thus, simpler approaches are encouraged, and ultimately necessary given the available sample sizes.

Parametric regression has numerous assumptions that are often not met with ecological data, and data transformations are often required. The four principal assumptions of linear regression, for example, are: (1) model form is correct (y is linearly related to x), (2) constant variance of residuals, (3) independence of errors, and (4) data are from a normal distribution. If all assumptions are not tested and met, results may be misleading. Serial correlation will violate the assumption of independent error terms. Outliers can cause serious problems because a fitted line may be pulled disproportionately toward an outlying observation. The use of parametric regression (including the relevant assumptions and potential transformations) is covered in many statistics texts (e.g., Kutner et al. 2005), and can be implemented with many different software applications.

If the Mann-Kendall test indicates no significant trend, the application of parametric regression is unlikely to provide any additional useful information. If the Mann-Kendall test does indicate a significant trend, and interest is on describing the parameters associated with the function of the relationship, then parametric regression may be warranted. Parametric regression (polynomial or breakpoint) may also be useful for a longer time series when the trend is obviously not constant over the entire data range.

VII. Multivariate Analyses

Ordination is a multivariate technique in which information from a large number of sites is represented as points in a two- or three-dimensional coordinate frame; similar sites are located near each other and dissimilar sites are farther away from each other. Ordination is useful in reducing the dimensionality of complex data sets and representing spatial or temporal relationships in a simplified visual context.

Numerous ordination methods exist, although many have assumptions that are not likely to be met with ecological data (i.e., multivariate normality), may be easily misinterpreted, or both (McCune and Grace 2002). Nonmetric multidimensional scaling (NMS; Kruskal 1964, Mather 1976) is a robust, non-parametric technique that does not have the restrictive assumptions of other methods. McCune and Grace (2002) describe it as “the most generally effective ordination method for ecological community data” and state that it “should be the method of choice” among ordination techniques.

NMS is an indirect gradient analysis approach that produces an ordination based on a distance or dissimilarity matrix. Unlike methods that attempt to maximise the variance or correspondence between objects in an ordination, NMS attempts to represent, as closely as possible, the pairwise dissimilarity between objects in a low-dimensional space. Any dissimilarity coefficient or distance measure may be used to build the distance matrix used as input. NMS makes few assumptions about the data.

NMS is a rank-based approach. This means that the original distance data is substituted with ranks. Thus, rather than object A being 2.1 units distant from object B and 4.4 units distant from object C, object C is the “first” most distant from object A while object B is the “second” most distant. While information about the magnitude of distances is lost, rank-based methods are generally more robust to data that do not have an identifiable distribution.

NMS orders sample units in ordination space so that their interpoint distances reflect the redundant pattern of covariation in the original data (Peck 2010). NMS analyses (and ordinations in general) are considered to be primarily exploratory and descriptive, rather than confirmatory (i.e., usually used to create hypotheses prior to more in-depth data collection), but can be useful to graphically display spatial or temporal patterns in two or three dimensions that are not evident from simple graphs. PC-ORD (McCune and Grace 2002, Peck 2010) is one software option to conduct NMS analyses.

Conducting a NMS analyses in PC-ORD (or any other software) is too complex and allows for too many options to provide a list of step-by-step instructions that would be suitable in all applications, although the following general guidelines could be followed: Prior to analyses, transformations or relativizations of data may be useful in increasing the resolution of any existing patterns. For example, transformations may be helpful when there exists a high degree of variation in abundance among species. Relativizations may be useful if habitat variables are measured in different units and on scales of different magnitudes. A general relativization by columns is often useful in such a case, with the value of p chosen for the relativization set as 1, which is appropriate for the Sørensen distance measure (McCune and Grace 2002). Before performing an NMS analyses, Chapter 9 in McCune and Grace (2002) should be studied.

An inherent danger of NMS analyses is that runs from different starting configurations may produce different results, resulting in unstable solutions. Thus, multiple runs should be conducted from different starting configurations to ensure that they converge on a stable solution. Preliminary solutions should be obtained using autopilot mode, on the “slow and thorough” setting. This procedure should be run at least three times, with different random number seeds, to determine the appropriate dimensionality and evaluate the consistency of results (Peck 2010). The Sørensen similarity is the recommended distance measure (McCune and Grace 2002). Conduct the final NMS run using 250 runs with real data, at the dimensionality determined by preliminary runs. Select the option to automatically rotate the axes to orthogonal principal axes; this eigenanalysis procedure is a rigid rotation designed to make the axes independent of each other (Peck 2010).

NMS can be used to calculate correlation coefficients of habitat variables with ordination axes, and overlay habitat vectors on the ordination graphs, producing joint plots. The squared correlation coefficients (i.e., coefficients of determination) express the amount of variation in position along an axis that is explained by a given habitat variable. Such correlations should primarily be used for descriptive purposes, and the use of P -values is discouraged in such cases because of lack of independence of ordination scores, and the effect of sample size on P -values (McCune and Grace 2002). Nevertheless, correlation coefficients can be interpreted in terms of P -values, although these must be calculated outside of PC-ORD.

The trajectory of each site may be plotted using the successional vector overlay option in PC-ORD. PerMANOVA, a distance-based nonparametric multivariate analysis of variance (Anderson 2001), may be used to determine significant differences among sites and years.

The stress score for a NMS solution should always be reported, which is an indicator of how misleading the solution could be. Lower stress scores are desired. Most ecological data sets have stress between 10 and 20, and values below 15 are usually considered satisfactory (McCune and Grace, 2002). The dimensionality and instability of the solution, as well as coefficients of determination (r^2), should also be reported. Because NMS is not based on partitioning of variance, the coefficients of determination do not represent variance explained by the ordination, but rather a comparison of how well the distances between points in ordination space represent distances in the original n -dimensional space, and the relative contribution of each axis (McCune and Grace 2002).

NMS is a powerful and complex analysis technique, with many options. The type and number of transformations or relativizations made will affect the results, as will the selection of distance measure and dimensionality. There are no absolutely right or wrong solutions, just more or less useful ones. McCune and Grace (2002) and Peck (2010) should be studied carefully before embarking on any NMS analysis.

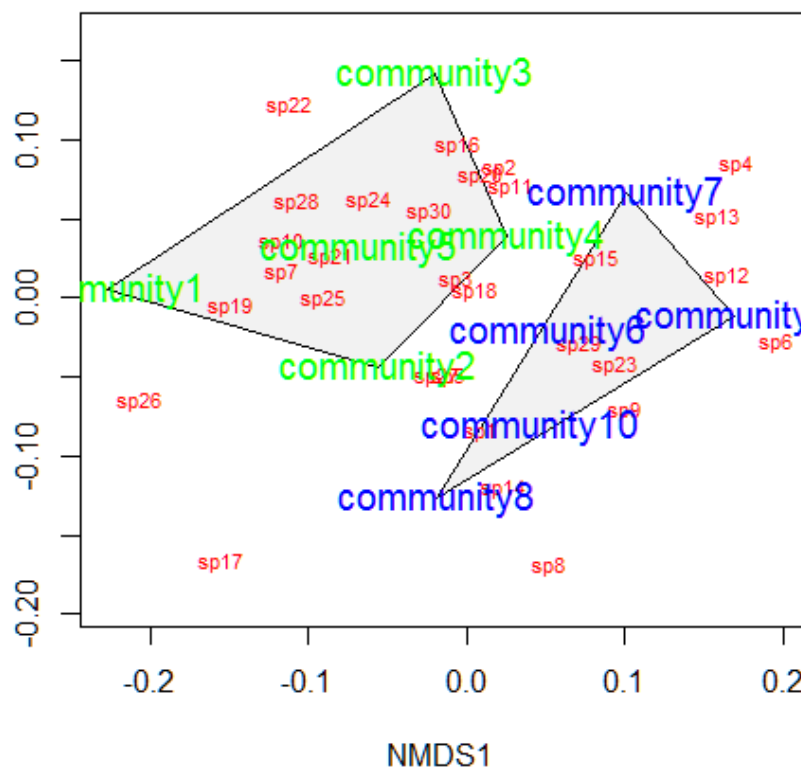


Figure 3. An example of an NMS analysis plot.

VIII. Control Charts

The construction and interpretation of control charts is covered in many texts focusing on quality control in industry (e.g., Beauregard et al., 1992; Gyrna, 2001; Montgomery, 2001). The application of control charts for ecological purposes is relatively straightforward. The use of control charts in environmental monitoring is discussed in texts by McBean and Rovers (1998) and Manly (2001), although not in as great detail as the texts referenced above focusing on industrial applications. Many different types of control charts could be constructed, depending

upon the type of information desired. For example, control charts can be used to evaluate variables or attributes (i.e., count or frequency data), and focus on measures of central tendency or dispersion, and in univariate or multivariate analyses.

Although some of the above-mentioned texts discuss the use of multivariate control charts (using the Hotelling T² statistic), this approach is only practical for a small number of variables, and assumes a multivariate normal distribution. In general, species abundances are not distributed as multivariate normal (Taylor, 1961), and traditional multivariate procedures are frequently not robust to violations of this assumption (Mardia, 1971; Olson, 1974). A new type of multivariate control chart recently has been described for use with complex ecological communities (Anderson and Thompson, 2004). A software application entitled ControlChart.exe is available for constructing these types of multivariate control charts (see Anderson and Thompson, 2004).

Most traditional control charts assume that observations come from a normal distribution, or that data can be transformed to normality. In industry, control limits are often set at a distance of 3 standard deviations on either side of the centerline (Wetherill and Brown, 1991; Beauregard et al., 1992; Montgomery, 2001). Thus, assuming a normal distribution centered at the centerline, the control limits would encompass 99.73 % of the distribution.

Control limits may be constructed so as to contain any desired proportion of the distribution (i.e., representing $[1-\alpha]$ confidence intervals for any α). In this case, choosing control limits is equivalent to specifying a critical region for testing the hypothesis that a specific observation is statistically different from the proposed centerline value (It is crucial that the centerline value is representative of the true population parameter). Control limits could also be based on probabilistic thresholds other than confidence intervals (e.g., McBean and Rovers, 1998).

If the observations cannot be assumed to come from a normal distribution, there are several options available beyond simple transformations of data. One option is to create subgroups of consecutive samples, and then use the subgroup averages, which will be approximately normally distributed in accordance with the central limit theorem (see Beauregard et al., 1992; Montgomery, 2001). It is possible to construct control charts based on other distributions (e.g., a Poisson distribution as in Atkinson et al., 2003), and construct analogous confidence limits, as long as the distributions are known. Distribution-free confidence limits may also be calculated, although these will usually be relatively wide and less sensitive to changes (Conover, 1999). Temporal autocorrelation will also affect the probabilistic interpretation of control limits based on standard deviations, and should be evaluated if such an interpretation is to be employed.

It is not absolutely necessary to use values from a statistical sampling process to determine centerlines and thresholds for action. It is possible to subjectively choose a centerline value as the desired state and set threshold limits to match the amount of variability with which one is comfortable for the variable of interest. It is crucial to realize that this approach has no statistical basis, and thus probabilities cannot be readily associated with the observations. This application also has a precedent in industry. Such charts, which plot observations without relevance to an underlying distribution, have been termed 'conformance charts'. Threshold values, which may be subjective, are termed 'action limits' (Beauregard et al., 1992). If taking this approach, one should be very familiar with the system in question, and preferably select values that are defensible based on the data.

Although control charts have potentially wide applicability, each application may be different. A generic process for control chart construction is provided below, although decisions will always have to be made and an analyst familiar with control charts should ideally be consulted.

If control limits are based on a statistical sampling process and interpreted in relation to the Type I error rate, this represents a type of statistical threshold, the conclusion regarding which may differ from that based on a trend test, such as the Mann-Kendall test or parametric regression. This is because one is testing different hypotheses (e.g., whether a threshold is crossed versus whether a trend exists). For example, a control limit representing a Type I error rate of 0.05 could be crossed, but no significant trend found ($P > 0.05$). An advantage of control charts is that a dramatic change that results in a control limit being crossed will be noticed immediately, whereas several sampling periods may be required before a trend-line becomes significant. Control charts provide complementary information to trend tests, and both may be used simultaneously, although one must realize the potential for confusion in the reader.

Steps in constructing a univariate control chart (Figure 4):

1. Determine the parameter of interest. *This may be the SCI, ORSIMI, any of the metrics or indices used to calculate the SCI, or practically any other variable that may be derived from this protocol.*
2. After several years of data are available, plot the values of the parameter of interest (on the y-axis) against time (on the x-axis).
3. Determined a “center-line” value for this parameter, which could represent a mean of the observations, a target value, or some other value. Determining an appropriate center-line contains inherent pitfalls, and an analyst who is familiar with control charts should be consulted.
4. Establish control limits around the center-line. It is possible that only an upper control limit, or only a lower control limit, or both will be necessary, depending upon the parameter of interest and management concerns. Control limits may be based on a probability distribution and thus allow one to make statistical inferences, or they may be based on target levels set by management. *If the parameter of interest is the SCI or BRICI, a lower control limit could be set at 14, indicating impairment of water quality.* Once again, determining appropriate control limits can be tricky, especially if statistical inferences are desired, and an analyst who is familiar with control charts should be consulted.
5. Continue to plot values of the parameter of interest over time as new data become available. If an observation exceeds the control limit(s), this is indicative of the potential need for management action, or a more focused study.

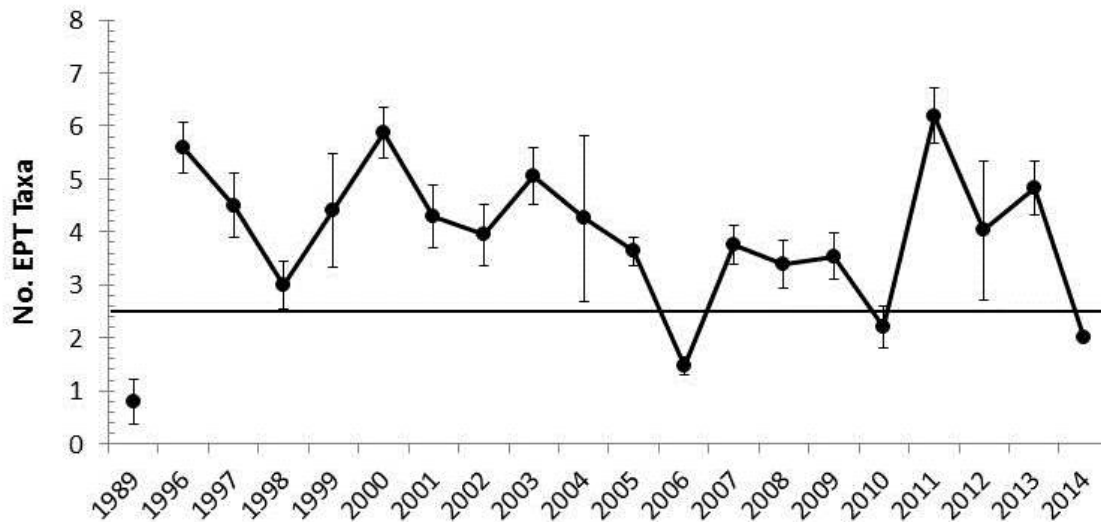


Figure 4. An example control chart. Dots are means and vertical bars are standard errors. The horizontal line represents the control limit corresponding to a Type I error rate of 0.05.

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Regional invertebrate taxa list with functional feeding groups and tolerance values

Phylum	Class	Order	Family	Genus/Species	TV	FFG
Annelida	Hirudinea				10	Ca, Pa, Pr
Annelida	Hirudinea	Branchiobdellida			6	C
Annelida	Hirudinea	Arhynchobdellida	Erpobdellidae		7.8	Pa
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		7	Pr
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	<i>Glossophonia complanata</i>		
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	<i>Helobdella triserialis</i>	8.9	
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	<i>Placobdella ornate</i>		
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	<i>Placobdella parasitica</i>	6.6	C
Annelida	Hirudinea	Rhynchobdellida	Piscicolidae			Pa
Annelida	Hirudinea	Rhynchobdellida	Piscicolidae	<i>Pisciola punctate</i>		Pa
Annelida	Oligochaeta				8	C
Annelida	Oligochaeta	Haplotaxida	Haplotaxidae	<i>Haplotaxis</i>		C
Annelida	Oligochaeta	Lumbricina	Lumbricidae		7.3	C
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	<i>Lumbriculus variegatus</i>	8	C
Annelida	Oligochaeta	Tubificida	Enchytraeidae		10	C
Annelida	Oligochaeta	Tubificida	Tubificidae		9.2	C
Annelida	Oligochaeta	Tubificida	Tubificidae	<i>Aulodrilus</i>	8	C
Annelida	Oligochaeta	Tubificida	Tubificidae	<i>Branchiura sowerbyi</i>	8.4	C
Annelida	Oligochaeta	Tubificida	Tubificidae	<i>Ilyodrilus templetoni</i>	9.4	C
Annelida	Oligochaeta	Tubificida	Tubificidae	<i>Limnodrilus</i>	9	C
Annelida	Oligochaeta	Tubificida	Tubificidae	<i>Potomothrix bavaricus</i>		C
Annelida	Oligochaeta	Tubificida	Tubificidae	<i>Quistadrilus multisetosus</i>	10	C
Annelida	Oligochaeta	Tubificida	Tubificidae	<i>Tubifex tubifex</i>	10	C
Arthropoda	Arachnoidea	Hydracarina		“Acarina”	5.7	Pa, Pr
Arthropoda	Crustacea	Amphipoda	Allocrangonyctidae	<i>Allocrangonyx</i>		C
Arthropoda	Crustacea	Amphipoda	Allocrangonyctidae	<i>Allocrangonyx hubrichtti</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Bactrurus</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Bactrurus brachycaudus</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Crangonyx</i>	8	C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Crangonyx forbesi</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Stygobromus</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Stygobromus albamensis albamensis</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Stygobromus onandagensis</i>		C

Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Stygobromus ozarkensis</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Stygonectes</i>		C
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	<i>Synurella</i>		C
Arthropoda	Crustacea	Amphipoda	Gammaridae	<i>Gammarus</i>	6.9	C
Arthropoda	Crustacea	Amphipoda	Gammaridae	<i>Gammarus fasciatus</i>	6.9	C
Arthropoda	Crustacea	Amphipoda	Gammaridae	<i>Gammarus minus</i>		C
Arthropoda	Crustacea	Amphipoda	Gammaridae	<i>Gammarus pseudolimnaeus</i>		C
Arthropoda	Crustacea	Amphipoda	Gammaridae	<i>Gammarus pulex</i>		C
Arthropoda	Crustacea	Amphipoda	Gammaridae	<i>Gammarus troglophilus</i>		C
Arthropoda	Crustacea	Amphipoda	Hyalellidae	<i>Hyalella azteca</i> Sassure	7.9	C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea (blind & unpigmented)</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea (epigean)</i>	8	C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea antricola</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea brevicauda</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea ancyla</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea dimorpha</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea foxi</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea fustis</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea salemensis</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea serrata</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Caecidotea stygia</i>		C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Lirceus garmani</i>	7.7	C
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Lirceus hoppinae</i>	7.7	C
Arthropoda	Crustacea	Isopoda	Cylistidae	<i>Cylisticus convexus</i>		C
Arthropoda	Crustacea	Isopoda	Porcellionidae	<i>Metroponorthus</i>		C
Arthropoda	Crustacea	Isopoda	Porcellionidae	<i>Porcellio</i>		C
Arthropoda	Crustacea	Isopoda	Trichoniscidae	<i>Caucasonethes</i>		C
Arthropoda	Crustacea	Isopoda	Trichoniscidae	<i>Miktoniscus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarellus puer</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarellus shufeldtii</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarus</i>	8.1	C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarus diogenes diogenes</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarus hubbsi</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarus hubrichti</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarus maculatus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Cambarus setosus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Fallicambarus fodiens</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Faxonella clypeata</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes</i>	2.7	C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes eupunctus</i>		C

Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes harrisonii</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes hylas</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes immunis</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes lancifer</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes longidigitus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes luteus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes macrus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes marchandi</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes medius</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes meeki</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes neglectus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes neglectus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes neglectus neglectus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes ozarkae</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes palmeri palmeri</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes peruncus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes punctimanus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes quadruncus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes rusticus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes virilis</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Orconectes williamsi</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Procambarus</i>	9.5	C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Procambarus acutus acutus</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Procambarus clarkii</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Procambarus gracilis</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Procambarus liberorum</i>		C
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Procambarus viaeveridus</i>		C
Arthropoda	Crustacea	Decapoda	Palaemonidae	<i>Palaemonetes kadiakensis</i>	6.7	C
Arthropoda	Insecta	Collembola	Entomobryidae			C
Arthropoda	Insecta	Collembola	Isotomidae			C
Arthropoda	Insecta	Collembola	Sminthuridae			C
Arthropoda	Insecta	Coleoptera	Dryopidae	<i>Helichus</i>	5.4	C, Sc
Arthropoda	Insecta	Coleoptera	Dryopidae	<i>Helichus basalis</i>	5.5	C, Sc
Arthropoda	Insecta	Coleoptera	Dryopidae	<i>Helichus fastigiatus</i>	5.5	C, Sc
Arthropoda	Insecta	Coleoptera	Dryopidae	<i>Helichus lithophilus</i>	5.5	C, Sc
Arthropoda	Insecta	Coleoptera	Dryopidae	<i>Helichus striatus</i>	4.6	C, Sc
Arthropoda	Insecta	Coleoptera	Dryopidae	<i>Acilius</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Agabus</i>	5	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Agabus amplus</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Brachyvatus</i>		Pr

Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Copelatus</i>	9.1	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Coptotomus interrogatus</i>	9	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Coptotomus</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Cybister</i>	4.6	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Desmopachria</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Dytiscus</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Graphoderus</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hoperius</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hydaticus</i>	5	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hydroporus</i>	8.9	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hydroporus niger</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hydroporus pulcher</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hydroporus undulates</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hydroporus vilis</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hydrovatus</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Hygrotus</i>	1.9	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Ilybius</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Laccophilus</i>	10	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Liodessus</i>		Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Oreodytes</i>	4.6	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Rhantus</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Thermonectus</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Uvarus</i>	4.6	Pr
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Ancyronyx variegata</i>	6.9	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Dubiraphia</i>	6.4	C
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Dubiraphia vittata</i>		C
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Gonielmis dietrichi</i>		C
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Heterelmis</i>		C
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Macronychus glabratus</i>	4.7	C
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Microcylloepus</i>	2.1	C
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Microcylloepus pusillus</i>		C
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Optioservus</i>	2.7	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Optioservus immunis</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Optioservus ozarkensis</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis</i>	5.4	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis beameri</i>	4.6	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis bicarinata</i>	5	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis cheryl</i>	5.5	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis convexula</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis crenata</i>	5.5	C, Sc

Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis decorata</i>	5.5	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis exigua</i>	5.5	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis exilis</i>	5	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis grossa</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis knobeli</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis lateralis</i>	4.6	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis lignicola</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis mera</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis sandersoni</i>	5.5	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis sexlineata</i>	6.4	C, Sc
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis xylonastis</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Gyrinidae	<i>Dineutus</i>	5.5	Pr
Arthropoda	Insecta	Coleoptera	Gyrinidae	<i>Gyretes</i>	3.7	Pr
Arthropoda	Insecta	Coleoptera	Gyrinidae	<i>Gyrinus</i>	6.3	Pr
Arthropoda	Insecta	Coleoptera	Halipilidae	<i>Halipilus</i>	5	
Arthropoda	Insecta	Coleoptera	Halipilidae	<i>Peltodytes</i>	8.5	He
Arthropoda	Insecta	Coleoptera	Helophoridae	<i>Helophorus</i>	7.9	Sh
Arthropoda	Insecta	Coleoptera	Heteroceridae	<i>Heterocerus</i>		
Arthropoda	Insecta	Coleoptera	Hydraenidae		6	C, Sc
Arthropoda	Insecta	Coleoptera	Hydraenidae	<i>Hydraena</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Hydraenidae	<i>Ochthebus</i>		C, Sc
Arthropoda	Insecta	Coleoptera	Hydrochidae		5	Sh
Arthropoda	Insecta	Coleoptera	Hydrochidae	<i>Hydrochus</i>	4.6	Sh
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Berosus</i>	8.6	He, C
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Chaetarthria</i>	5.5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Crenitis</i>		C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Cymbiodyta</i>	5.5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Dibolocelus</i>	5.5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Enochrus</i>	8.5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Helobata</i>		
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Helochares</i>	5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Helocombus</i>	5.5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Hydrobius</i>	5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Hydrochara</i>	6	C
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Hydrophilus</i>	4.6	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Laccobius</i>	8	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Paracymus</i>	7.3	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Sperchopsis</i>	6.5	C, Pr
Arthropoda	Insecta	Coleoptera	Hydrophilidae	<i>Tropisternus</i>	9.8	C, Pr
Arthropoda	Insecta	Coleoptera	Lutrochidae	<i>Lutrochus</i>	2.75	

Arthropoda	Insecta	Coleoptera	Lutrochidae	<i>Lutrochus laticeps</i>		
Arthropoda	Insecta	Coleoptera	Noteridae	<i>Hydrocanthus</i>	6.9	Pr
Arthropoda	Insecta	Coleoptera	Noteridae	<i>Suphisellus</i>		Pr
Arthropoda	Insecta	Coleoptera	Psephenidae	<i>Ectopria nervosa</i>	4.3	Sc
Arthropoda	Insecta	Coleoptera	Psephenidae	<i>Psephenus herricki</i>	2.5	Sc
Arthropoda	Insecta	Coleoptera	Salpingidae	<i>Cyphon</i>		Sh
Arthropoda	Insecta	Coleoptera	Scirtidae	<i>Prioocyphon</i>	5	Sh
Arthropoda	Insecta	Coleoptera	Scirtidae	<i>Scirtes</i>	5	Sh
Arthropoda	Insecta	Diptera	Athericidae	<i>Atherix</i>	2.1	Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae		6	C, Pr, Sc
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Bezzia</i>		Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Culicoides</i>		C, Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Mallochohelea</i>		Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Palpomyia</i>		C, Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Probezzia</i>	6	Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Serromyia</i>	6	Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Stilobezzia</i>	6	Pr
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Dasyhelea</i>	6	C, Sc
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Atrichopogon</i>	6	C
Arthropoda	Insecta	Diptera	Chaoboridae	<i>Chaoborus</i>	8.5	Pr
Arthropoda	Insecta	Diptera	Chaoboridae	<i>Eucorethea underwoodi</i>	6	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Acalcarella</i>		C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Apedilum</i>		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Axarus</i>	6	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Chironomus</i>	9.8	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cladopelma</i>	2.5	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cladotanytarsus</i>	3.7	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cladotanytarsus (Cladotanytarsus)</i>	3.7	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cladotanytarsus (Lenziella)</i>	5.5	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Constempellina</i>	4	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cryptochironomus</i>	7.4	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cryptotendipes</i>	6.1	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Demicryptochironomus</i>	2.1	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Dicrotendipes</i>	7.9	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Endochironomus</i>	7.5	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Endotribelos</i>		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Glyptotendipes</i>	8.5	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Goeldichironomus</i>	9	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Harnischia</i>	7.5	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Hyporhygma</i>		Sh

Arthropoda	Insecta	Diptera	Chironomidae	<i>Kiefferulus</i>	10	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Lauterborniella</i>	5.5	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Lipiniella</i>		C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Microchironomus</i>	8	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Micropsectra</i>	1.4	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Microtendipes</i>	6.2	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Nilothauma</i>	5.5	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Omisus</i>		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Pagastiella</i>	2.6	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Parachironomus</i>	9.2	C, Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Paracladopelma</i>	4.8	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Paralauterborniella</i>	8	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Paratanytarsus</i>	7.7	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Paratendipes</i>	5.3	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Phaenopsectra</i>	6.2	C, Sc
Arthropoda	Insecta	Diptera	Chironomidae	<i>Polypedilum</i>	7.4	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Pseudochironomus</i>	4.2	Co
Arthropoda	Insecta	Diptera	Chironomidae	<i>Rheotanytarsus</i>	6.4	Fi
Arthropoda	Insecta	Diptera	Chironomidae	<i>Robackia</i>	3.4	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Saetheria</i>	8.1	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Stelechomyia</i>	4.6	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Stempellina</i>	2	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Stempellinella</i>	5.3	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Stenochironomus</i>	6.4	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Stictochironomus</i>	6.7	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Sublettea</i>	1.7	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Tanytarsus</i>	6.7	C, F
Arthropoda	Insecta	Diptera	Chironomidae	<i>Thienemanniola</i>		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Tribelos</i>	6.6	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Xenochironomus</i>	7	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Zavreliella</i>	7	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Damesa</i>	7.7	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Potthastia</i>	4.7	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Pseudodiamesa</i>	4.6	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Sympotthastia</i>	5.7	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Syndiamesa</i>		C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Brillia</i>	5.2	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cardiocladius</i>	6.2	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Corynoneura</i>	6.2	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cricotopus bicintus</i>	8.7	C, Sh

Arthropoda	Insecta	Diptera	Chironomidae	<i>Cricotopus/Orthocladius</i>	6.5	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Diplocladius</i>	7.7	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Epoicocladius</i>	4	C, Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Eukiefferiella</i>	4	C, Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Heterotrissocladius</i>	5.4	C, Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Hydrobaenus</i>	9.6	C, Sc
Arthropoda	Insecta	Diptera	Chironomidae	<i>Krenosmittia</i>		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Lymnophyes</i>	8	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Mesocricotopus</i>		C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Mesosmittia</i>	7	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Nanocladius</i>	7.2	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Oliveridia</i>		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Orthocladius (Euorthocladius)</i>	6.3	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Orthocladius (Symposiocladius)</i>	5.4	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Parakiefferiella</i>	5.9	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Parametriocnemus</i>	3.7	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Paraphaenocladius</i>	4	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Parorthocladius</i>		C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Psectrocladius</i>	3.8	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Pseudorthocladius</i>		C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Pseudosmittia</i>	4	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Rheocricotopus</i>	7.3	C, Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Smittia</i>	4	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Synorthocladius</i>	4.7	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Thienemanniella</i>	6	
Arthropoda	Insecta	Diptera	Chironomidae	<i>Tvetenia</i>	4	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Xylotopus</i>	6.6	Sh
Arthropoda	Insecta	Diptera	Chironomidae	<i>Monodiamesa</i>	7	C
Arthropoda	Insecta	Diptera	Chironomidae	<i>Ablabesmyia</i>	6.4	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Clinotanytus</i>	9.1	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Coelotanytus</i>	6.2	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Djalmabatista</i>	6.4	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Krenopelopia</i>		Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Labrundinia</i>	5.3	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Larsia</i>	83	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Monopelopia</i>		Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Natarsia</i>	8	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Nilotanytus</i>	6	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Paramerina</i>	2.8	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Pentaneura</i>	4.6	Pr

Arthropoda	Insecta	Diptera	Chironomidae	<i>Procladius</i>	9.3	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Psectrotanypus</i>	10	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Tanypus</i>	9.6	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Thienemannimyia</i> grp.	6	Pr
Arthropoda	Insecta	Diptera	Chironomidae	<i>Zavrelymia</i>	9.3	Pr
Arthropoda	Insecta	Diptera	Culicidae	<i>Aedes</i>	5.5	Pr
Arthropoda	Insecta	Diptera	Culicidae	<i>Anopheles</i>	9.1	Fi
Arthropoda	Insecta	Diptera	Culicidae	<i>Culex</i>	10	Fi
Arthropoda	Insecta	Diptera	Culicidae	<i>Culiseta</i>	5.5	C, F
Arthropoda	Insecta	Diptera	Culicidae	<i>Mansonia</i>		C, F
Arthropoda	Insecta	Diptera	Dixidae	<i>Dixa</i>	2.8	C, Pr
Arthropoda	Insecta	Diptera	Dixidae	<i>Dixella</i>		C
Arthropoda	Insecta	Diptera	Dolichopodidae		9.7	Pr
Arthropoda	Insecta	Diptera	Empididae		6	C/Pr
Arthropoda	Insecta	Diptera	Empididae	<i>Chelifera</i>	6	Pr
Arthropoda	Insecta	Diptera	Empididae	<i>Clinocera</i>	6	Pr
Arthropoda	Insecta	Diptera	Empididae	<i>Hemerodromia</i>	6	C, Pr
Arthropoda	Insecta	Diptera	Empididae	<i>Neoplasta</i>	6	
Arthropoda	Insecta	Diptera	Empididae	<i>Rhamphomyia</i>		Pr
Arthropoda	Insecta	Diptera	Empididae	<i>Roederiodes</i>		Pr
Arthropoda	Insecta	Diptera	Ephydriidae		5.5	C, Sh
Arthropoda	Insecta	Diptera	Muscidae		6	Pr
Arthropoda	Insecta	Diptera	Phoridae	<i>Megaselia</i>	6	Pr
Arthropoda	Insecta	Diptera	Psychodidae	<i>Pericoma</i>	4	C
Arthropoda	Insecta	Diptera	Psychodidae	<i>Psychoda</i>	9.9	C
Arthropoda	Insecta	Diptera	Psychodidae	<i>Telmatoscopus</i>		C
Arthropoda	Insecta	Diptera	Scathophagidae			He, Sh
Arthropoda	Insecta	Diptera	Sciomyzidae			Pr
Arthropoda	Insecta	Diptera	Simuliidae		3.5	F
Arthropoda	Insecta	Diptera	Simuliidae	<i>Cnephia</i>	4	F
Arthropoda	Insecta	Diptera	Simuliidae	<i>Prosimulium</i>	2.6	F
Arthropoda	Insecta	Diptera	Simuliidae	<i>Simulium</i>	4.4	F
Arthropoda	Insecta	Diptera	Simuliidae	<i>Simulium luggeri</i>		F
Arthropoda	Insecta	Diptera	Simuliidae	<i>Simulium venustum</i>		F
Arthropoda	Insecta	Diptera	Simuliidae	<i>Stegapterna</i>	5	F
Arthropoda	Insecta	Diptera	Stratiomyidae		8	C, Sc
Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Allognosta</i>		
Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Caloparyphus</i>		C
Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Euparyphus</i>		C, Sc
Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Myxosargus</i>		C

Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Nemotelus</i>	7.3	C
Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Odontomyia</i>	7.3	C
Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Oxycera</i>		Sc
Arthropoda	Insecta	Diptera	Stratiomyidae	<i>Stratiomys</i>	7.3	C
Arthropoda	Insecta	Diptera	Syrphidae		8.25	C
Arthropoda	Insecta	Diptera	Tabanidae	<i>Chrysops</i>	7.3	Pr
Arthropoda	Insecta	Diptera	Tabanidae	<i>Hybomitra</i>		Pr
Arthropoda	Insecta	Diptera	Tabanidae	<i>Silvius</i>		Pr
Arthropoda	Insecta	Diptera	Tabanidae	<i>Tabanus</i>	9.7	Pr
Arthropoda	Insecta	Diptera	Tanyderidae	<i>Protoplasa fitchii</i>	3	
Arthropoda	Insecta	Diptera	Tipulidae	<i>Antocha</i>	4.6	C
Arthropoda	Insecta	Diptera	Tipulidae	<i>Cryptolabis</i>		
Arthropoda	Insecta	Diptera	Tipulidae	<i>Dactylolabis</i>	3.7	C, Sh
Arthropoda	Insecta	Diptera	Tipulidae	<i>Dicranota</i>	0	Pr
Arthropoda	Insecta	Diptera	Tipulidae	<i>Erioptera</i>	5.5	C
Arthropoda	Insecta	Diptera	Tipulidae	<i>Gonomyia</i>	5.5	C
Arthropoda	Insecta	Diptera	Tipulidae	<i>Holorusia</i>		Sh
Arthropoda	Insecta	Diptera	Tipulidae	<i>Hexatoma</i>	4.7	Pr
Arthropoda	Insecta	Diptera	Tipulidae	<i>Limnophila</i>	4.6	Pr
Arthropoda	Insecta	Diptera	Tipulidae	<i>Limonia</i>	10	Sh
Arthropoda	Insecta	Diptera	Tipulidae	<i>Lipsothrix</i>		Sh
Arthropoda	Insecta	Diptera	Tipulidae	<i>Molophilus</i>	4	
Arthropoda	Insecta	Diptera	Tipulidae	<i>Ormosia</i>	4.6	C
Arthropoda	Insecta	Diptera	Tipulidae	<i>Paradelphomyia</i>		
Arthropoda	Insecta	Diptera	Tipulidae	<i>Pedicia</i>	4.6	Pr
Arthropoda	Insecta	Diptera	Tipulidae	<i>Pilaria</i>	7	
Arthropoda	Insecta	Diptera	Tipulidae	<i>Prionocera</i>		Sh
Arthropoda	Insecta	Diptera	Tipulidae	<i>Pseudolimnophila</i>	7.3	C
Arthropoda	Insecta	Diptera	Tipulidae	<i>Rhabdomastix</i>		C
Arthropoda	Insecta	Diptera	Tipulidae	<i>Tipula</i>	7.7	C, Sh
Arthropoda	Insecta	Diptera	Thaumaleidae	<i>Thaumalea</i>		Sc
Arthropoda	Insecta	Ephemeroptera	Ameletidae	<i>Ameletus</i>	7	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ameletidae	<i>Ameletus lineatus</i>	2.1	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ameletidae	<i>Ameletus ludens</i>	0	C, Sc
Arthropoda	Insecta	Ephemeroptera	Baetidae		4	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Acentrella</i>	3.6	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Acerpenna</i>	3.7	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Apobaetis</i>	6	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Baetis</i>	6	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Barbaetis</i>		C

Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Callibaetis</i>	9.3	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Camelobaetis</i>	9.3	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Centroptilum</i>	6.3	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Centroptilum ozarkensum</i>		C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Cloeon</i>	7.4	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Diphetor</i>	5	
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Fallceon</i>	6	Pr
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Heterocloeon</i>	2	Sc
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Labiobaetis</i>	6	Pr
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Paracloeodes</i>	5	Sc
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Plauditus</i>	6	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Procloeon</i>	6.3	C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Pseudocentroptiloides</i>		C
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Pseudocloeon</i>	4.4	C
Arthropoda	Insecta	Ephemeroptera	Baetiscidae	<i>Baetisca gibbera</i>	1.4	C, Sc
Arthropoda	Insecta	Ephemeroptera	Baetiscidae	<i>Baetisca lacustris</i>	4	C, Sc
Arthropoda	Insecta	Ephemeroptera	Baetiscidae	<i>Baetisca obesa</i>	4	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Amercaenis</i>		F
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Brachycercus</i>	3.5	C
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis amica</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis anceps</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis hiliaris</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis latipennis</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis maccafferti</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis punctata</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis tardata</i>	7.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Attenella attenuata</i>	1	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	1.7	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella argo</i>		C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella aurivillii</i>	0	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella catawba</i>	4	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella dorothea</i>	1	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella excrucians</i>	2	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella invaria</i>	2.2	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella needhami</i>	0	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Ephemerella subvaria</i>	1	C, Sc
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	3	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Eurylophella aestiva</i>	5	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Eurylophella bicolor</i>	5.1	C

Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Eurylophella enoensis</i>	5	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Eurylophella funeralis</i>	2.3	Sh
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Eurylophella macdunnoughi</i>		C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Eurylophella versimilis</i>	0.3	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	1.9	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Serratella deficiens</i>	2.7	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Serratella frisoni</i>		C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Serratella serratoides</i>	1.5	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Serratella sordida</i>	2	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Timpanoga</i>	2	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Timpanoga lita</i>	0	C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Timpanoga provonshali</i>		C
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	<i>Timpanoga simplex</i>	3.9	C
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Ephemera</i>	2.2	C, Pr
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Ephemera guttulata</i>	2	C, Pr
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Ephemera simulans</i>	3.7	C, Pr
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Ephemera traversae</i>		C, Pr
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Ephemera varia</i>		C, Pr
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Hexagenia</i>	4.7	C
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Hexagenia atrocaudata</i>	3.7	C
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Hexagenia bilineata</i>	3.7	C
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Hexagenia limbata</i>	4.6	C
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	<i>Hexagenia rigida</i>	5.5	C
Arthropoda	Insecta	Ephemeroptera	Heptageniidae		4	C, Sc, Pr
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Anepeorus</i>		Pr
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Epeorus</i>	1.2	C
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	2.8	C, Sc
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Leucrocuta</i>	0	C, Sc
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Mccaffertium</i>	4	C, Sc
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Macdunnoa</i>	4.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Nixe</i>	2	C, Sc
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Rhithrogena</i>	0.4	C
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	7.1	C
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Stenonema</i>	3.4	C, Sc
Arthropoda	Insecta	Ephemeroptera	Isonychidae	<i>Isonychia</i>	3.8	F
Arthropoda	Insecta	Ephemeroptera	Isonychidae	<i>Isonychia bicolor</i>	2	F
Arthropoda	Insecta	Ephemeroptera	Isonychidae	<i>Isonychia rufa</i>	3.7	F
Arthropoda	Insecta	Ephemeroptera	Isonychidae	<i>Isonychia sayi</i>		F
Arthropoda	Insecta	Ephemeroptera	Isonychidae	<i>Isonychia sicca</i>	3.7	F
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	<i>Choroterpes</i>	2	C, Sc

Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	<i>Habrophlebiodes</i>	6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	<i>Leptophlebia</i>	6.4	C
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	<i>Neochoroterpes</i>		C, Sc
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	<i>Paraleptophlebia</i>	1.2	C, Sh
Arthropoda	Insecta	Ephemeroptera	Neoephemeridae	<i>Neoephemera</i>		C
Arthropoda	Insecta	Ephemeroptera	Palingeniidae	<i>Pentagenia vittigera</i>	6.4	C
Arthropoda	Insecta	Ephemeroptera	Polymitarcyidae	<i>Ephoron</i>	4.6	C
Arthropoda	Insecta	Ephemeroptera	Polymitarcyidae	<i>Ephoron album</i>	4.6	C
Arthropoda	Insecta	Ephemeroptera	Polymitarcyidae	<i>Ephoron leukon</i>	1.5	C
Arthropoda	Insecta	Ephemeroptera	Polymitarcyidae	<i>Tortopus primus</i>	5.5	C
Arthropoda	Insecta	Ephemeroptera	Potamanthidae		4	F
Arthropoda	Insecta	Ephemeroptera	Potamanthidae	<i>Anthopotamus</i>	4	F
Arthropoda	Insecta	Ephemeroptera	Pseudironidae	<i>Pseudiron centralis</i>	5	Pr
Arthropoda	Insecta	Ephemeroptera	Siphonuridae	<i>Siphonurus</i>	2.6	C, Sc
Arthropoda	Insecta	Ephemeroptera	Tricorythidae	<i>Tricorythodes</i>	5.4	C
Arthropoda	Insecta	Hemiptera	Belostomatidae	<i>Belostoma</i>	9.8	Pr
Arthropoda	Insecta	Hemiptera	Belostomatidae	<i>Lethocerus</i>	4.6	Pr
Arthropoda	Insecta	Hemiptera	Corixidae	<i>Corisella</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Corixidae	<i>Hesperocorixa</i>	5	Mp
Arthropoda	Insecta	Hemiptera	Corixidae	<i>Palmarcorixa</i>	5.5	
Arthropoda	Insecta	Hemiptera	Corixidae	<i>Sigara</i>	4.6	Mp, C
Arthropoda	Insecta	Hemiptera	Corixidae	<i>Trichocorixa</i>	5.5	C, Pr
Arthropoda	Insecta	Hemiptera	Gelastocoridae	<i>Gelastocoris</i>	7.3	Pr
Arthropoda	Insecta	Hemiptera	Gerridae	<i>Aquarius</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Gerridae	<i>Gerris</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Gerridae	<i>Metrobates</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Gerridae	<i>Rheumatobates</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Gerridae	<i>Trepobates</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Hebridae	<i>Hebrus</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Hebridae	<i>Merragata</i>	7.3	Pr
Arthropoda	Insecta	Hemiptera	Hydrometridae	<i>Hydrometra</i>	7.3	Pr
Arthropoda	Insecta	Hemiptera	Mesoveliidae	<i>Mesovelia</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Naucoridae	<i>Pelocoris</i>		Pr
Arthropoda	Insecta	Hemiptera	Nepidae	<i>Nepa</i>	4.6	Pr
Arthropoda	Insecta	Hemiptera	Nepidae	<i>Ranatra</i>	7.5	Pr
Arthropoda	Insecta	Hemiptera	Nepidae	<i>Ranatra fusca</i>	7.3	Pr
Arthropoda	Insecta	Hemiptera	Nepidae	<i>Ranatra kirkaldyi</i>	5.5	Pr
Arthropoda	Insecta	Hemiptera	Nepidae	<i>Ranatra nigra</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Notonectidae	<i>Buenoa</i>	5.5	Pr
Arthropoda	Insecta	Hemiptera	Notonectidae	<i>Notonecta</i>	5.5	Pr

Arthropoda	Insecta	Hemiptera	Pleidae	<i>Neoplea</i>	5.5	Pr
Arthropoda	Insecta	Hemiptera	Saldidae	<i>Micracanthia</i>	5.5	Pr
Arthropoda	Insecta	Hemiptera	Saldidae	<i>Pentacora</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Saldidae	<i>Saldula</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Veliidae	<i>Microvelia</i>	6.4	Pr
Arthropoda	Insecta	Hemiptera	Veliidae	<i>Platyvelia</i>		Pr
Arthropoda	Insecta	Hemiptera	Veliidae	<i>Rhagovelia</i>	7.3	Pr
Arthropoda	Insecta	Hemiptera	Veliidae	<i>Steinovelia</i>		Pr
Arthropoda	Insecta	Lepidoptera	Crambidae		5	He
Arthropoda	Insecta	Lepidoptera	Crambidae	<i>Parapoynx</i>	5	He
Arthropoda	Insecta	Lepidoptera	Crambidae	<i>Petrophila</i>	1.8	He, Sc
Arthropoda	Insecta	Lepidoptera	Crambidae	<i>Nymphula</i>	7	He
Arthropoda	Insecta	Lepidoptera	Cossidae			He
Arthropoda	Insecta	Lepidoptera	Nepticulidae	<i>Nepticula</i>		He
Arthropoda	Insecta	Lepidoptera	Noctuidae	<i>Bellura</i>		He
Arthropoda	Insecta	Lepidoptera	Noctuidae	<i>Simyra</i>		He
Arthropoda	Insecta	Lepidoptera	Pyrilidae		5	He
Arthropoda	Insecta	Lepidoptera	Totidae	<i>Archips</i>		Sh
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Chauliodes</i>	4	Pr
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Chauliodes pectinicornis</i>	4	Pr
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Chauliodes rastricornis</i>	4	Pr
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Corydalus</i>	5.6	Pr
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Corydalus cornutus</i>	5.6	Pr
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Nigronia fasciatus</i>	6.2	Pr
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Nigronia serricornis</i>	5.5	Pr
Arthropoda	Insecta	Megaloptera	Sialidae	<i>Sialis</i>	7.5	Pr
Arthropoda	Insecta	Megaloptera	Sialidae	<i>Sialis velata</i>		Pr
Arthropoda	Insecta	Neuroptera	Sisyridae	<i>Climacia</i>	6.5	Pr
Arthropoda	Insecta	Neuroptera	Sisyridae	<i>Sisyra</i>		Pr
Arthropoda	Insecta	Neuroptera	Sisyridae	<i>Sisyra vicaria</i>		Pr
Arthropoda	Insecta	Odonata	Aeshnidae		6.4	Pr
Arthropoda	Insecta	Odonata	Aeshnidae	<i>Aeshna</i>	6.4	Pr
Arthropoda	Insecta	Odonata	Aeshnidae	<i>Anax</i>	6.4	Pr
Arthropoda	Insecta	Odonata	Aeshnidae	<i>Basiaeschna janata</i>	7.7	Pr
Arthropoda	Insecta	Odonata	Aeshnidae	<i>Boyeria</i>	6.3	Pr
Arthropoda	Insecta	Odonata	Aeshnidae	<i>Epiaschna heros</i>	3.7	Pr
Arthropoda	Insecta	Odonata	Aeshnidae	<i>Nasiaeschna pentacantha</i>	8	Pr
Arthropoda	Insecta	Odonata	Calopterygidae		5	Pr
Arthropoda	Insecta	Odonata	Calopterygidae	<i>Calopteryx</i>	8.3	Pr
Arthropoda	Insecta	Odonata	Calopterygidae	<i>Hetaerina</i>	6.2	Pr

Arthropoda	Insecta	Odonata	Coenagrionidae		9	Pr
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Amphiagrion</i>	2.8	Pr
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Argia</i>	8.7	Pr
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Chromagrion</i>		Pr
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Enallagma</i>	9	Pr
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Ischnura</i>	9.4	Pr
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Nehalennia</i>		Pr
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Telebasis</i>		Pr
Arthropoda	Insecta	Odonata	Cordulegastridae	<i>Cordulegaster</i>	6.1	Pr
Arthropoda	Insecta	Odonata	Gomphidae		7	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Arigomphus</i>	6.4	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Dromogomphus</i>	6.3	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Erpetogomphus</i>	5.5	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Gomphus</i>	6.2	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Hagenius brevistylus</i>	4	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Lanthus parvulus</i>	2.7	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Lanthus vernalis</i>	2.7	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Ophiogomphus</i>	6.2	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Progomphus obscurus</i>	8.7	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Stylogomphus albistylus</i>	4.8	Pr
Arthropoda	Insecta	Odonata	Gomphidae	<i>Stylurus</i>	4	Pr
Arthropoda	Insecta	Odonata	Lestidae	<i>Archilestes</i>	6.4	Pr
Arthropoda	Insecta	Odonata	Lestidae	<i>Lestes</i>	6.4	Pr
Arthropoda	Insecta	Odonata	Libellulidae		9	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Epithea</i>	5.5	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Epithea</i>	8.5	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Helocordulia</i>		Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Neurocordulia</i>	4	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Somatochlora</i>	8.9	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Brachymesia</i>		Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Celithemis</i>	3.7	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Dythemis</i>	3.7	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Erythemis</i>	7.7	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Erythrodiplax</i>		Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Leucorrhinia</i>	6.4	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Libellula</i>	9.8	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Orthemis ferruginea</i>	4.6	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Pachydiplax longipennis</i>	9.6	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Pantala</i>	6.4	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Perithemis</i>	10	Pr

Arthropoda	Insecta	Odonata	Libellulidae	<i>Plathemis</i>	10	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Sympetrum</i>	7.3	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Tramea</i>		Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Didymops</i>	5.5	Pr
Arthropoda	Insecta	Odonata	Libellulidae	<i>Macromia</i>	6.7	Pr
Arthropoda	Insecta	Odonata	Petaluridae	<i>Tachopteryx thoreyi</i>	3.7	Pr
Arthropoda	Insecta	Plecoptera	Capniidae		1	Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia</i>	2.8	Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocania forbesi</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia granulata</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia jeanae</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia malverna</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia mohri</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia mystica</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia oribata</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia ozarkana</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia peltoides</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocania pygmaea</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia rickeri</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia sandersoni</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia smithi</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia vivipara</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Allocapnia warreni</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Nemocapnia carolina</i>		Sh
Arthropoda	Insecta	Plecoptera	Capniidae	<i>Paracapnia angulata</i>	0.2	Sh
Arthropoda	Insecta	Plecoptera	Chloroperlidae		1	Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Alloperla</i>	1.4	Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Alloperla caddo</i>		Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Alloperla caudate</i>		Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Alloperla hamata</i>		Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Alloperla leonarda</i>		Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Alloperla ouachita</i>		Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Haploperla</i>	1.4	C, Pr
Arthropoda	Insecta	Plecoptera	Chloroperlidae	<i>Haploperla brevis</i>	1.3	C, Pr
Arthropoda	Insecta	Plecoptera	Leuctridae		0	Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Leuctra</i>	0.7	Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Leuctra paleo</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Leuctra rickeri</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Leuctra tenuis</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Zealeuctra</i>	0	Sh

Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Zealeuctra Cherokee</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Zealuctra claasseni</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Zealuctra fraxina</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Zealuctra narfi</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Zealuctra warreni</i>		Sh
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Zealuctra wachita</i>		Sh
Arthropoda	Insecta	Plecoptera	Nemouridae		2	Sh
Arthropoda	Insecta	Plecoptera	Nemouridae	<i>Amphinemura</i>	3.4	Sh
Arthropoda	Insecta	Plecoptera	Nemouridae	<i>Amphinemura delosa</i>		Sh
Arthropoda	Insecta	Plecoptera	Nemouridae	<i>Amphinemura nigrutta</i>		Sh
Arthropoda	Insecta	Plecoptera	Nemouridae	<i>Prostoia</i>	6.1	Sc, Sh
Arthropoda	Insecta	Plecoptera	Nemouridae	<i>Prostoia completa</i>	6.1	Sc, Sh
Arthropoda	Insecta	Plecoptera	Nemouridae	<i>Prostoia similes</i>	6.1	Sc, Sh
Arthropoda	Insecta	Plecoptera	Nemouridae	<i>Shipsa rotunda</i>	0.3	Sc, Sh
Arthropoda	Insecta	Plecoptera	Perlidae		1	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria</i>	1.4	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria abnormis</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria evoluta</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria filicis</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria internata</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria mela</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria ozarkensis</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria perplexa</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Agnentina capitata</i>	1.4	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Agnentina flavescens</i>	0	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Attaneuria ruralis</i>	2.75	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Neoperla</i>	1.6	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Neoperla carlsoni</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Neoperla catharae</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Neoperla choctaw</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Neoperla falayah</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Neoperla harpi</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Neoperla osage</i>		Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Paragnetina</i>	1.8	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Paragnetina kansensis</i>	2	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Paragnetina media</i>	1	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlesta</i>	0	C, Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlesta baumanni</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlesta browni</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlesta cinctipes</i>		C, Pr

Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlesta decipiens</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlesta fusca</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlesta shubata</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlinella drymo</i>	0	Pr
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Perlinella ephyre</i>	0	Pr
Arthropoda	Insecta	Plecoptera	Perlodidae		2	Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Clioperla clio</i>	4.8	Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Helopicus nalatus</i>	5.75	Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Hydroperla</i>	2.75	Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Hydroperla crosbyi</i>	3.7	Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Hydroperla fugitans</i>	2.75	Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla</i>	2	C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla bilineata</i>	5.5	C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla buski</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla couthatta</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla decepta</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla dicala</i>	2.2	C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla mohri</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla namata</i>	1.8	C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla mohri</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla signata</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Perlodidae	<i>Isoperla szczytkoi</i>		C, Pr
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	<i>Pteronarcys pictetii</i>	1.7	Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae		2	Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Strophopteryx</i>	2.5	Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Strophopteryx arkansae</i>		Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Strophopteryx cucullata</i>		Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Strophopteryx fasciata</i>	3	Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	6.3	C, Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx burksi</i>	5.8	C, Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx lita</i>		C, Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx lonicera</i>	2	C, Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx maura</i>		C, Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx metequi</i>	1.4	C, Sh
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx parvula</i>	2	C, SH
Arthropoda	Insecta	Trichoptera	Brachycentridae	<i>Brachycentrus</i>	2.2	F
Arthropoda	Insecta	Trichoptera	Brachycentridae	<i>Brachycentrus americanus</i>	1	F
Arthropoda	Insecta	Trichoptera	Brachycentridae	<i>Brachycentrus lateralis</i>	0.4	F
Arthropoda	Insecta	Trichoptera	Brachycentridae	<i>Brachycentrus numerosus</i>	1.8	F
Arthropoda	Insecta	Trichoptera	Brachycentridae	<i>Brachycentrus occidentalis</i>	1	F

Arthropoda	Insecta	Trichoptera	Brachycentridae	<i>Micrasema</i>	0.6	Sh
Arthropoda	Insecta	Trichoptera	Glossosomatidae	<i>Agapetus</i>	0	C, Sc
Arthropoda	Insecta	Trichoptera	Glossosomatidae	<i>Agapetus illini</i>	0	C, Sc
Arthropoda	Insecta	Trichoptera	Glossosomatidae	<i>Glossosoma</i>	1.5	C, Sc
Arthropoda	Insecta	Trichoptera	Glossosomatidae	<i>Protoptila</i>	2.8	Sc
Arthropoda	Insecta	Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	0	Sc
Arthropoda	Insecta	Trichoptera	Hydropsychidae		4	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	1.4	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Ceratopsyche morosa</i> grp	2.95	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Ceratopsyche piatrix</i>		F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Ceratopsyche slosonae</i>	0	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	6.6	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Diplectrona</i>	2.2	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	4	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Macrostemum</i>	3.6	F
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Potamyia flava</i>	5	F
Arthropoda	Insecta	Trichoptera	Hydroptilidae		4	C, He, Sc
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Agraylea</i>	8	He, Sc
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Dibusa angata</i>	3	Sc
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Hydroptila</i>	6.2	He, Sc
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Ithytrichia</i>	4	Sc
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Leucotrichia</i>	4.3	C, Sc
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Neotrichia</i>	2	Sc
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Ochrotrichia</i>	6.4	C, He
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Orthotrichia</i>	7.2	C, He
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Oxyethira</i>	3	C, He
Arthropoda	Insecta	Trichoptera	Hydroptilidae	<i>Stactobiella</i>	2.75	Sh
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	<i>Lepidostoma</i>	1	Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae		4	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Ceraclea</i>	2.3	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Leptocerus americanus</i>	4.6	Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Mystacides</i>	3.5	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Nectopsyche</i>	4.1	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Nectopsyche albida</i>	5.5	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Nectopsyche candida</i>	3.8	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Nectopsyche diarina</i>	5.5	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Nectopsyche exquisita</i>	4.2	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Nectopsyche pavidia</i>	4.2	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Nectopsyche spiloma</i>	4.6	C, Sh
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Oecetis</i>	5.7	He, Pr

Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Setodes</i>	0.9	C, Pr
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Triaenodes</i>	3.7	Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae		4	Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Frenesia</i>	0	Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Hesperophylax</i>	3	He, Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Hydatophylax</i>	2.3	C, Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Ironoquia</i>	7.3	C, Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Leptophylax</i>		He, Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Limnephilus</i>	2.75	He, Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Platycentropus</i>	4	Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Pseudostenophylax</i>	0	C, Sh
Arthropoda	Insecta	Trichoptera	Limnephilidae	<i>Pycnopsyche</i>	2.3	C, Sh
Arthropoda	Insecta	Trichoptera	Molannidae	<i>Molanna</i>	3.9	C, Sh
Arthropoda	Insecta	Trichoptera	Odontoceridae	<i>Marilia</i>	0	Sh
Arthropoda	Insecta	Trichoptera	Odontoceridae	<i>Psilotreta</i>	0	C, Sc
Arthropoda	Insecta	Trichoptera	Philopotamidae		3	F
Arthropoda	Insecta	Trichoptera	Philopotamidae	<i>Chimarra</i>	2.8	F
Arthropoda	Insecta	Trichoptera	Philopotamidae	<i>Dolophilodes</i>	1	F
Arthropoda	Insecta	Trichoptera	Philopotamidae	<i>Wormaldia</i>	0.4	F
Arthropoda	Insecta	Trichoptera	Phryganeidae	<i>Agrypnia</i>	4.6	Sh
Arthropoda	Insecta	Trichoptera	Phryganeidae	<i>Banksiola</i>		Sh
Arthropoda	Insecta	Trichoptera	Phryganeidae	<i>Phryganea</i>	4.6	Sh, Pr
Arthropoda	Insecta	Trichoptera	Phryganeidae	<i>Ptilostomis</i>	6.7	Sh, Pr
Arthropoda	Insecta	Trichoptera	Polycentropodidae		6	C, Pr, Sh
Arthropoda	Insecta	Trichoptera	Polycentropodidae	<i>Cernotina</i>	4.6	Pr
Arthropoda	Insecta	Trichoptera	Polycentropodidae	<i>Cynellus fraternus</i>	7.4	F
Arthropoda	Insecta	Trichoptera	Polycentropodidae	<i>Neureclipsis</i>	4.4	F, Sh
Arthropoda	Insecta	Trichoptera	Polycentropodidae	<i>Paranyctiophylax</i>	0.9	C, Pr
Arthropoda	Insecta	Trichoptera	Polycentropodidae	<i>Phylocentropus</i>	5.6	F
Arthropoda	Insecta	Trichoptera	Polycentropodidae	<i>Polycentropus</i>	3.5	C, Pr
Arthropoda	Insecta	Trichoptera	Psychomyiidae	<i>Lype diversa</i>	4.3	Sc
Arthropoda	Insecta	Trichoptera	Psychomyiidae	<i>Paduniella neartica</i>	0	C, Sc
Arthropoda	Insecta	Trichoptera	Psychomyiidae	<i>Psychomyia flavida</i>	3.3	C, Sc
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	0.8	Pr
Arthropoda	Insecta	Trichoptera	Uenoidae	<i>Neophylax</i>	1.6	Sc
Arthropoda	Insecta	Trichoptera	Uenoidae	<i>Neophylax concinnus</i>	1.6	Sc
Arthropoda	Insecta	Trichoptera	Uenoidae	<i>Neophylax fusca</i>	1.6	Sc
Mollusca	Bivalvia	Unionida	Unionidae		0	F
Mollusca	Bivalvia	Cardiida	Dreissenidae	<i>Dreissena polymorpha</i>	8	F
Mollusca	Bivalvia	Veneroidea	Corbiculidae	<i>Corbicula</i>	6.3	F

Mollusca	Bivalvia	Veneroidea	Sphaeriidae	<i>Pisidium</i>	6.8	F
Mollusca	Bivalvia	Veneroidea	Sphaeriidae	<i>Sphaerium/Musculium</i>	7.7	F
Mollusca	Gastropoda	Limnophila	Ancylidae	<i>Ferrissia</i>	6.9	Sc
Mollusca	Gastropoda	Limnophila	Ancylidae	<i>Laevapex</i>	7.3	Sc
Mollusca	Gastropoda	Limnophila	Ancylidae	<i>Rhodaemea</i>		Sc
Mollusca	Gastropoda	Limnophila	Lymnaeidae	<i>Lymnaea</i>	6	Sc
Mollusca	Gastropoda	Limnophila	Lymnaeidae	<i>Pseudosuccinea</i>	7.2	Sc
Mollusca	Gastropoda	Limnophila	Lymnaeidae	<i>Pseudosuccinea columella</i>		Sc
Mollusca	Gastropoda	Limnophila	Physidae	<i>Physa/Physella</i>	9.1	Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Carychium exile</i>		Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Gyraulus</i>	8	Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Helisoma</i>	6.5	Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Menetus</i>	8.4	Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Menetus sampsoni</i>		Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Planorbella</i>		Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Planorbula</i>		Sc
Mollusca	Gastropoda	Limnophila	Planorbidae	<i>Promenetus</i>		Sc
Mollusca	Gastropoda	Limnophila	Pomatiopsidae	<i>Pomatiopsis lapidaria</i>		Sc
Mollusca	Gastropoda	Limnophila	Hydrobiidae			Sc
Mollusca	Gastropoda	Limnophila	Hydrobiidae	<i>Fontigens aldrichi</i>		Sc
Mollusca	Gastropoda	Limnophila	Pleuroceridae	<i>Elimia</i>	2.5	Sc
Mollusca	Gastropoda	Mesogastropoda	Pleuroceridae	<i>Goniobasis</i>		Sc
Mollusca	Gastropoda	Mesogastropoda	Pleuroceridae	<i>Leptoxis</i>	1.6	Sc
Mollusca	Gastropoda	Mesogastropoda	Pleuroceridae	<i>Lithasia</i>		Sc
Mollusca	Gastropoda	Mesogastropoda	Pleuroceridae	<i>Pleurocera</i>	6	Sc
Mollusca	Gastropoda	Mesogastropoda	Valvatidae	<i>Valvata</i>	8	Sc
Mollusca	Gastropoda	Mesogastropoda	Viviparidae	<i>Campeloma</i>	6.7	Sc
Mollusca	Gastropoda	Mesogastropoda	Viviparidae	<i>Cipangopaludina</i>		Sc
Mollusca	Gastropoda	Mesogastropoda	Viviparidae	<i>Lioplax</i>		Sc
Mollusca	Gastropoda	Mesogastropoda	Viviparidae	<i>Viviparus</i>	6	Sc
Nematoda					5	C/Pa
Nematomorpha			Chordodidae		5	Pa
Nematomorpha			Gordiidae		5	Pa
Platyhelminthes		Tricladida	Dendrocoelidae	<i>Macrocotyla grandulosa</i>		C, Pr
Platyhelminthes		Tricladida	Planariidae	<i>Dugesia</i>	7.5	C, Pr

Table 2. Fish species classifications by tolerance, trophic status, habitat, spawning, and substrate preferences.

Common name	Scientific name	Tolerance	Habitat preference				Spawning preference				Substrate Preference					Trophic status				
			Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vegetation	Herbivore	Planktivore	Detritivore	Invertivore	Carnivore
American brook lamprey (ammocoete)	<i>Lampetra appendix</i>	Unk		X		X								X		X				
American brook lamprey adult	<i>Lampetra appendix</i>	I	X					X		X	X	X	X							
American eel	<i>Anguilla rostrata</i>	M-T		X		X													X	X
Arkansas saddled darter	<i>Etheostoma euzonum</i>	Unk	X								X	X								
Banded darter	<i>Etheostoma zonale</i>	I	X				X					X							X	
Banded sculpin	<i>Cottus carolinae</i>	M	X						X		X	X							X	
Bigeye chub	<i>Hybopsis amblops</i>	I-M		X	X		X					X	X						X	
Bigeye shiner	<i>Notropis boops</i>	I		X			X				X								X	
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>	M		X	X	X	X							X					X	
Black buffalo	<i>Ictiobus niger</i>	M-I		X		X	X													
Black bullhead	<i>Ameiurus melas</i>	M-T		X		X			X				X	X					X	X
Black crappie	<i>Pomoxis nigromaculatus</i>	M		X		X			X				X	X	X				X	X
Black redhorse	<i>Moxostoma duquesnei</i>	I			X		X			X	X	X	X						X	

Habitat preference																					Spawning preference					Substrate Preference				Trophic status				
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore														
Blackside darter	<i>Percina maculata</i>	M		X			X			X		X	X							X														
Blackspotted topminnow	<i>Fundulus olivaceus</i>	M		X		X	X					X	X			X				X														
Blacktail shiner	<i>Cyprinella venusta</i>	Unk			X			X					X							X														
Bleeding shiner	<i>Luxilus zonatus</i>	Unk									X									X														
Bluegill	<i>Lepomis macrochirus</i>	M-T		X					X						X					X														
Blue sucker	<i>Cycleptus elongatus</i>	I			X		X			X		X	X			X				X														
Bluntnose minnow	<i>Pimephales notatus</i>	T		X		X			X			X	X	X				X																
Brindled madtom	<i>Noturus miurus</i>	I-M		X					X			X	X	X						X														
Brook silverside	<i>Labidesthes sicculus</i>	M-I		X			X										X			X														
Brown trout	<i>Salmo trutta</i>	M-I		X				X		X	X									X														
Carmine shiner	<i>Notropis percobromus</i>	I		X	X			X			X	X				X		X	X															
Central stoneroller	<i>Campostoma anomalum</i>	M-T	X	X	X			X		X	X					X																		
Chain pickerel	<i>Esox niger</i>	M		X			X								X					X														

		Habitat preference				Spawning preference				Substrate Preference				Trophic status						
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore
Checkered madtom	<i>Noturus flavater</i>	Unk																		
Chestnut lamprey adult	<i>Ichthyomyzon castaneus</i>	M			X			X			X	X								X
Common carp	<i>Cyprinus carpio</i>	T		X			X								X			X	X	
Creek chub	<i>Semotilus atromaculatus</i>	T		X				X			X		X						X	X
Creek chubsucker	<i>Erimyzon oblongus</i>	M-T-I		X			X			X		X	X		X				X	
Current darter (traits from orangethroat darter)	<i>Etheostoma uniporum</i>	M		X	X			X				X							X	
Cypress darter	<i>Etheostoma proeliare</i>	M		X		X		X						X	X				X	
Duskystripe shiner	<i>Luxilus pilsbryi</i>	Unk		X	X						X								X	
Emerald shiner	<i>Notropis atherinoides</i>	M		X	X		X						X				X			
Fantail darter	<i>Etheostoma flabellare</i>	M	X						X		X	X							X	
Fathead minnow	<i>Pimephales promelas</i>	T		X					X				X	X				X	X	
Flathead catfish	<i>Pylodictis olivaris</i>	M		X					X										X	X
Flier	<i>Centrarchus macropterus</i>	M		X		X			X					X					X	
			Habitat preference				Spawning preference									Trophic status				

Substrate Preference																				
Common name	Scientific name	Tolerance	Riffle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore
Freckled madtom	<i>Noturus nocturnus</i>	M-I	X		X				X			X	X						X	
Freshwater drum	<i>Aplodinotus grunniens</i>	M		X		X	X												X	X
Goldfish	<i>Carassius auratus</i>	T		X		X	X							X	X	X			X	
Gilt darter	<i>Percina evides</i>	I	X				X				X								X	
Gizzard shad	<i>Dorosoma cepedianum</i>	M-T		X	X		X									X				
Golden redhorse	<i>Moxostoma erythrurum</i>	M-I		X			X			X									X	
Golden shiner	<i>Notemigonus crysoleucas</i>	T		X		X	X									X			X	
Goldeye	<i>Hiodon alosoides</i>	I		X		X	X												X	
Gravel chub	<i>Erimystax x-punctatus</i>	M-I	X		X		X					X				X				
Green sunfish	<i>Lepomis cyanellus</i>	T-M		X		X			X						X				X	X
Greenside darter	<i>Etheostoma blennioides</i>	M-I	X					X			X								X	
Highfin carpsucker	<i>Carpionodes velifer</i>	I-M		X		X	X			X		X	X					X		

Habitat preference																					Spawning preference				Substrate Preference				Trophic status				
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore													
Horneyhead chub	<i>Nocomis biguttatus</i>	I-M	X	X				X			X	X				X			X														
Johnny darter	<i>Etheostoma nigrum</i>	M		X					X				X	X					X														
Lake chubsucker	<i>Erimyzon sucetta</i>	M		X		X	X						X	X		X			X														
Largemouth bass	<i>Micropterus salmoides</i>	M-T		X		X			X				X	X	X				X	X													
Largescale stoneroller	<i>Campostoma oligolepis</i>	M	X		X			X		X	X					X																	
Least brook lamprey adult	<i>Lampetra aepyptera</i>	M-I	X					X				X	X																				
Least brook lamprey ammocoete	<i>Lampetra aepyptera</i>	Unk		X		X								X		X																	
Logperch	<i>Percina caprodes</i>	M					X					X	X																				
Longear sunfish	<i>Lepomis megalotis</i>	I-M		X					X		X		X		X				X														
Longnose gar	<i>Lepisosteus osseus</i>	M		X		X	X								X					X													
Mississippi silvery minnow	<i>Hybognathus nuchalis</i>	M-I		X		X	X						X					X															
Mooneye	<i>Hiodon tergisus</i>	I		X		X	X												X														
Mountain madtom	<i>Noturus eleutherus</i>	I	X		X				X		X	X							X														
Habitat preference			Spawning preference				Trophic status																										

Substrate Preference																				
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore
Mud darter	<i>Etheostoma asprigene</i>	M			X				X			X	X						X	
Northern hog sucker	<i>Hypentelium nigricans</i>	I-M	X		X		X				X	X				X			X	
Northern studfish	<i>Fundulus catenatus</i>	I				X	X						X						X	
Orangespotted sunfish	<i>Lepomis humilis</i>	M		X					X						X				X	
Orangethroat darter	<i>Etheostoma spectabile</i>	M		X	X			X				X							X	
Ozark bass	<i>Ambloplites constellatus</i>	Unk		X					X		X								X	X
Ozark chub	<i>Erimystax harryi</i>	I		X	X		X				X	X								
Ozark madtom	<i>Noturus albater</i>	Unk	X	X							X								X	
Ozark minnow	<i>Notropis nubilus</i>	I		X		X		X			X	X				X				
Ozark sculpin	<i>Cottus hypselurus</i>	Unk	X									X			X				X	
Ozark shiner	<i>Notropis ozarcanus</i>	Unk		X	X						X		X						X	
Paddlefish	<i>Polyodon spathula</i>	I			X		X			X							X		X	

Habitat preference																				Spawning preference				Substrate Preference				Trophic status				
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore												
Pealip redhorse	<i>Moxostoma pisolabrum</i>	M	X	X	X		X			X		X								X												
Pirate perch	<i>Aphredoderus sayanus</i>	M		X		X			X					X	X				X	X												
Pugnose minnow	<i>Opsopoeodus emiliae</i>	I				X			X						X		X	X														
Quillback	<i>Carpiodes cyprinus</i>	M-T		X		X	X			X		X	X					X	X													
Rainbow darter	<i>Etheostoma caeruleum</i>	M-I	X	X				X			X	X							X													
Rainbow trout	<i>Oncorhynchus mykiss</i>	M-I	X	X				X		X		X							X	X												
Redear sunfish	<i>Lepomis microlophus</i>	M		X		X			X				X	X					X													
Redfin pickerel	<i>Esox americanus</i>	M		X			X								X				X	X												
Redfin shiner	<i>Lythrurus umbratilis</i>	M-T		X				X						X																		
Redspotted sunfish	<i>Lepomis miniatus</i>	Unk		X					X				X	X					X													
Ribbon shiner	<i>Lythrurus fumeus</i>	M																														
River carpsucker	<i>Carpiodes carpio</i>	M		X		X	X						X	X			X	X														

Habitat preference																					Spawning preference				Substrate Preference				Trophic status				
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore													
River redhorse	<i>Moxostoma carinatum</i>	I		X	X			X			X	X							X														
Sauger	<i>Sander canadensis</i>	M		X	X	X	X			X		X	X	X					X	X													
Shadow bass	<i>Ambloplites ariommmus</i>	Unk		X					X			X	X	X					X	X													
Shortnose gar	<i>Lepisosteus platostomus</i>	M		X			X													X													
Shovelnose sturgeon	<i>Scaphirhyncus platorynchus</i>	M			X		X					X	X						X														
Silver redhorse	<i>Moxostoma anisurum</i>	M		X			X			X									X														
Skipjack herring	<i>Alosa chrysochloris</i>	M			X		X			X		X	X				X																
Slender madtom	<i>Noturus exilis</i>	I	X	X	X				X			X						X	X														
Smallmouth bass	<i>Micropterus dolomieu</i>	M-I		X	X				X			X							X	X													
Smallmouth buffalo	<i>Ictiobus bubalus</i>	M-I		X	X	X	X									X			X														
Southern cavefish	<i>Typhlichthys subterraneus</i>	Unk																															
Southern redbelly dace	<i>Phoxinus erythrogaster</i>	M-I		X			X					X					X																

Habitat preference																				Spawning preference				Substrate Preference				Trophic status				
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore												
Speckled darter	<i>Etheostoma stigmaeum</i>	Unk		X	X			X				X	X																			
Spotted bass	<i>Micropterus punctulatus</i>	M		X	X				X			X							X	X												
Spotted gar	<i>Lepisosteus oculatus</i>	M		X		X	X													X												
Spotted sucker	<i>Minytrema melanops</i>	M-I		X			X						X	X					X													
Stargarzing darter	<i>Percina uranidea</i>	I			X							X							X													
Steelcolor shiner	<i>Cyprinella whipplei</i>	M-I		X	X			X			X		X						X													
Stippled darter	<i>Etheostoma punctulatum</i>	Unk		X							X								X													
Striped shiner	<i>Luxilus chrysocephalus</i>	M-T		X		X		X				X	X						X													
Suckermouth minnow	<i>Phenacobius mirabilis</i>	M	X		X		X			X	X	X	X						X													
Tadpole madtom	<i>Noturus gyrinus</i>	M-I		X		X			X		X			X			X		X													
Telescope shiner	<i>Notropis telescopus</i>	Unk		X	X						X								X													
Threadfin shad	<i>Dorosoma petenense</i>	M					X										X															

		Habitat preference				Spawning preference				Substrate Preference				Trophic status						
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore
Walleye	<i>Sander vitreus</i>	M		X	X	X	X			X									X	X
Warmouth	<i>Lepomis gulosus</i>	M		X		X			X					X	X			X		X
Wedgespot shiner	<i>Notropis greeniei</i>	Unk		X	X						X	X	X							
Weed shiner	<i>Notropis texanus</i>	I		X	X		X						X		X			X		
Western mosquitofish	<i>Gambusia affinis</i>	M-T				X													X	
White bass	<i>Morone chrysops</i>	M-T		X			X			X								X		X
White crappie	<i>Pomoxis annularis</i>	M-T		X		X			X				X	X				X		X
White sucker	<i>Catostomus commersoni</i>	T	X	X			X			X	X	X				X		X		
Whitetail shiner	<i>Cyprinella galuctura</i>	Unk			X			X			X								X	
Yellow bullhead	<i>Ameiurus natalis</i>	T-M		X		X			X				X	X	X				X	X
Yellow perch	<i>Perca flavescens</i>	M		X		X	X								X				X	X

Habitat preference				Spawning preference				Substrate Preference				Trophic status								
Common name	Scientific name	Tolerance	Rifle	Pool	Run	Backwater	Broadcaster	Simple nester	Complex nester	Migratory	Cobble/rubble (rocky)	Gravel	Sand	Mud (silt, clay, detritus)	Vege-tation	Herbivore	Plank-tivore	Detrit-ivore	Invert-ivore	Carnivore
Yoke darter	<i>Etheostoma juliae</i>	Unk	X								X								X	
* Tolerance: I = Intolerant, M = Moderately Tolerant, T = Tolerant, Unk = Unknown.																				