**Using Macroinvertebrates to assess Biotic Health**

**Background:**

Streams and rivers are highly prized in Montana for their recreational and agricultural value. Rafting, kayaking and fishing all require clean flowing water. However, historic mining activity (mining before the 1960’s) has challenged Montanans to reclaim rivers and streams. **Acid mine drainage** has polluted many of Montana’s favorite trout fisheries including the famous Blackfoot River. Mining activity exposes mineralized bedrock material and can lead to a decrease in pH with an increase in heavy-metal concentrations. Arsenic, cadmium, lead and zinc are artificially high in many Montana rivers and have lead to destruction of viable fisheries.

Living in the 21st century, we may think hi-tech solutions are needed to solve the water problems in Montana but, ironically, several low-tech solutions are proving to be very effective. Many of Montana’s rivers and streams are being reclaimed using settling ponds and artificial wetlands. We have also found that **biological monitoring** or **bioassessment** (using biological organisms to assess stream health) is often better at identifying stream problems than alternative hi-tech gadgets. Hi-tech probes are usually restricted to measuring one factor (e.g. pH or conductivity) over a short period of time. Biological organisms must live in the stream environment their entire life and deal with all of the interacting chemical components. For example, **macroinvertebrates** (stream invertebrates larger than 1000 microns) have been used to assess the recovery efforts of many rivers (McGuire 1999). Together, biological monitoring and **bioremediation** are cleaning up most of Montana’s polluted streams and rivers.

**Field Procedure:**

1. Each team will use a Hess sampler to obtain macroinvertebrate samples on Ten Mile Creek at 3 locations. Operation of the sampler will be demonstrated but generally consists of randomly selecting a sampling point, placing the net at a 45o angle in the stream channel, and then stirring up about 0.5 m2 of the substrate directly upstream from the net to allow the invertebrates to drift into the sampler.
2. Either spread the net out on the shore or pour the sample into an insect tray or white enamel pan and separate the invertebrates from other debris. Count the total number of macroinvertebrates in each sample and record the results in your field notebook. Using the key provided, separate the invertebrates into 3 groups: 1) PETs which include stonefly nymphs (Plecoptera), mayfly nymphs (Ephemeroptera), and caddisfly larvae (Tricoptera), 2) fly larvae (Diptera), and 3) all other invertebrates. Count and record the number of invertebrates in each category. Repeat the sampling protocol for at least 3 samples before the end of the lab period.

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| **Category** | **Sample 1** | **Sample 2** | **Sample 3** |
| PET’s |  |  |  |
| Diptera |  |  |  |
| Other Invertebrates |  |  |  |
| Total Invertebrates |  |  |  |
| PET/PETD ratio |  |  |  |

1. Sum the total number of macroinvertebrates for each sample. Then, obtain data from the other lab groups. With 4 lab groups, there should be a total of 12 samples. You can use the “Total Invertebrates” for an assessment of sedimentation. Streams with more fine sediment have fewer macroinvertebrates and, consequently, fewer fish. Use EXCEL and provided tutorials to calculate descriptive statistics for Total Invertebrates including confidence intervals using data from all 12 samples.
2. Calculate the ratio PET/PET+Diptera (i.e. sum all the PET and Diptera together and divide into the number of PET’s). Because PET’s are more sensitive to chemicals than diptera and other invertebrates, the PET/PETD ratio will tell you what the chemical load is for a stream. Use EXCEL and provided tutorials to calculate descriptive statistics for the ratio including confidence intervals using all 12 samples.
3. In a subsequent lab period, complete steps 1-4 at either Prickly Pear Creek or Seven Mile Creek or both. Create a table comparing the descriptive statistics for each of your sites. Note any differences between creeks.
4. Use EXCEL and provided tutorials to calculate inferential test statistics to test for differences between the creeks. After testing parametric assumptions (see tutorials), use either a t-Test (to compare 2 creeks) or an ANOVA (for 3 or more creeks).