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MEMORANDUM

DATE: June 20, 2011

TO: Deb Lester, Jo Wilhelm, King Co.

FROM: Leska S. Fore, Statistical Design

RE: Effect of natural features on B-IBI and recommendations for the 2011 sampling design

Objective

Evaluate the influence of elevation, watershed area, and stream channel slope (gradient) on B-IBI values in Puget Sound streams. Determine which attributes of sample sites should be included in the 2011 sampling design.

Analysis & Results

The primary driver for B-IBI is percent urban (P_Urban) development. P_Urban values were highly correlated with B-IBI when measured in a 1 km buffer or the entire watershed. The following series of figures show B-IBI plotted against P_Urban (1 km buffer) for different values of elevation, watershed area, and slope. Data are shown as a multi-plot figure with one panel for different values of the physical feature and as a single plot with data from all values overlaid. The purpose of the figures is to illustrate where the relationship between B-IBI and urban development is consistent and where B-IBI may be influenced by natural features.

Data

B-IBI data were taken from the Puget Sound Stream Benthos Database. Data from replicate samples were combined for each site-visit. Individuals were subsampled to a 500 count before calculating B-IBI. For sites with multiple visits in different years, only the most recent visit was included (N = 968). Physical data were derived from GIS layers (P. Leinenbach, EPA)

Elevation

- B-IBI declined consistently as urbanization increased for all elevations (Figure 1).
- Slopes of the regression lines for B-IBI vs. P_Urban were similar for all elevations with the exception of sites with elevation < 25 m.
- More sites at the lowest elevation (<25 m) had lower B-IBI values than expected based on low urban development. Some of these site had <500 individuals and several were in Clallam Co.

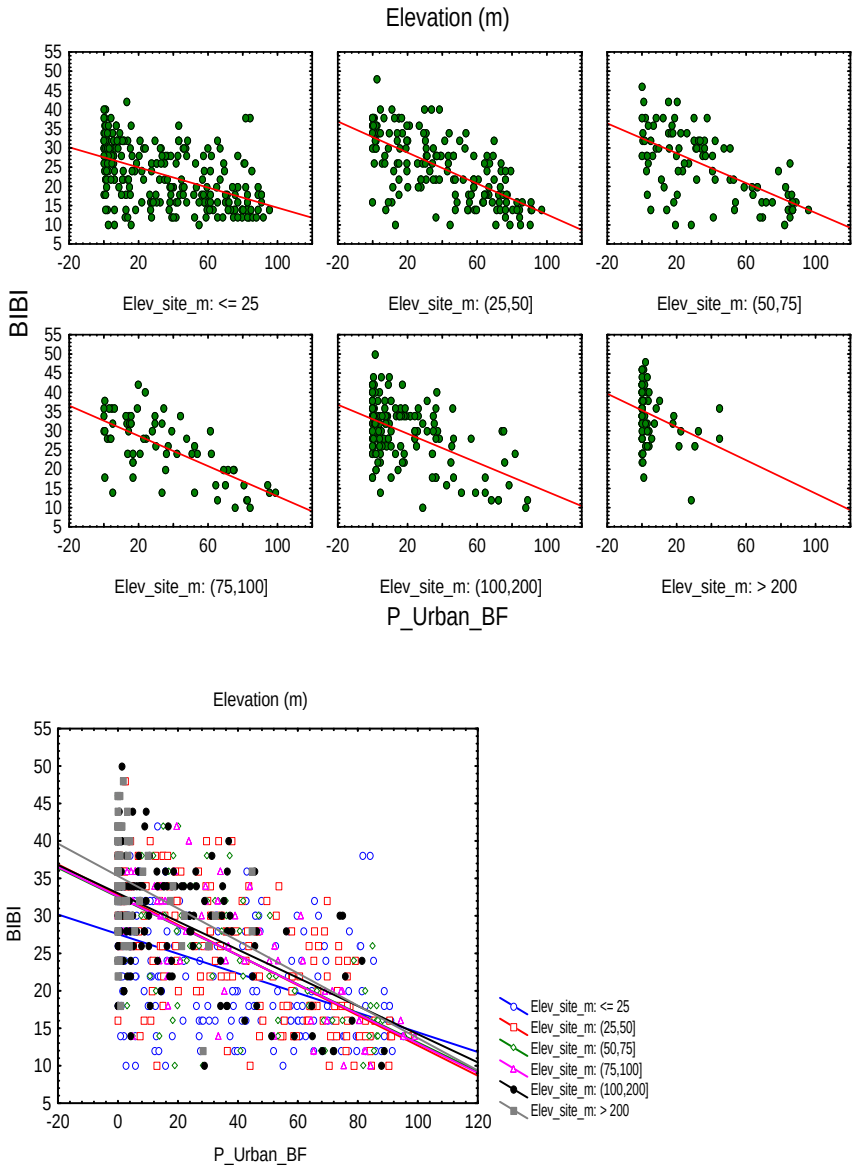

Figure 1. B-IBI declines as urbanization increases. Rates of decline (as indicated by regression line) were similar across elevation categories. Lowest elevation sites showed a tendency toward lower B-IBI values in areas with low urban development. (Note: the two figures represent the same data. Upper panel has data separate for each category of elevation, lower panel has data overlaid for all categories of elevation.)

Channel slope (gradient)

- B-IBI declined consistently as urbanization increased for all channel slopes (Figure 2).
- Slopes of the regression lines for B-IBI vs. P_Urban were similar for all channel slopes with the exception of sites in the steepest category (>20%).
- Sites in the steepest channels showed greater decline in B-IBI values as urban development increased. The difference in regression lines was relatively small for this category and could be because there were very few sites with high urban development, which is to be expected for steep terrain.

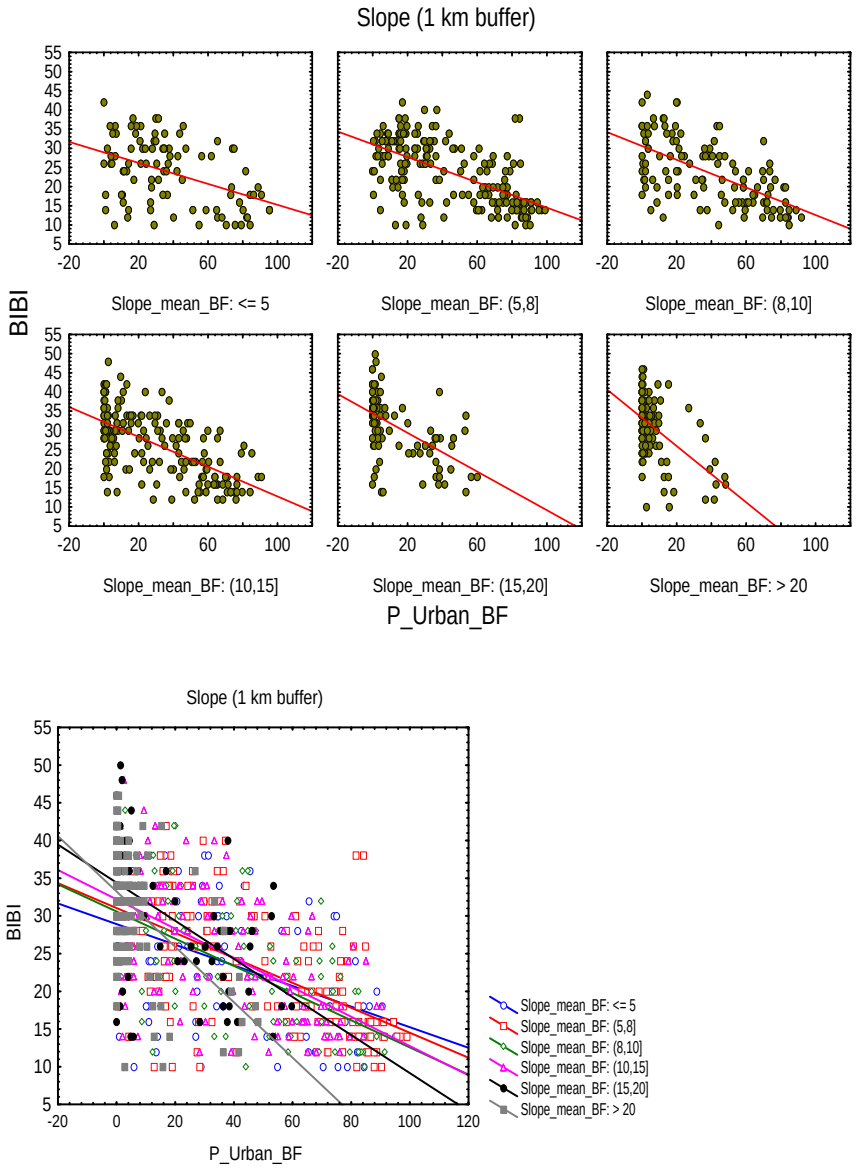

Figure 2. B-IBI declines as urbanization increases. Rates of decline (as indicated by regression line) were similar across categories of channel slope. Steepest channels showed a tendency toward a more rapid decline in B-IBI values as urbanization increases.

Watershed area

- B-IBI declined consistently as urbanization increased for all watershed sizes (Figure 2).
- Slopes of the regression lines for B-IBI vs. P_Urban were similar for watershed sizes with the exception of sites in the largest category (> 5000 hectares [50 km^2 or ~19 mi^2]).
- Sites with the largest watersheds showed a lower correlation between B-IBI and P_Urban. B-IBI could be measuring other sources of degradation not captured by P_Urban within 1 km of the site or B-IBI may be less sensitive in streams draining the largest watersheds.

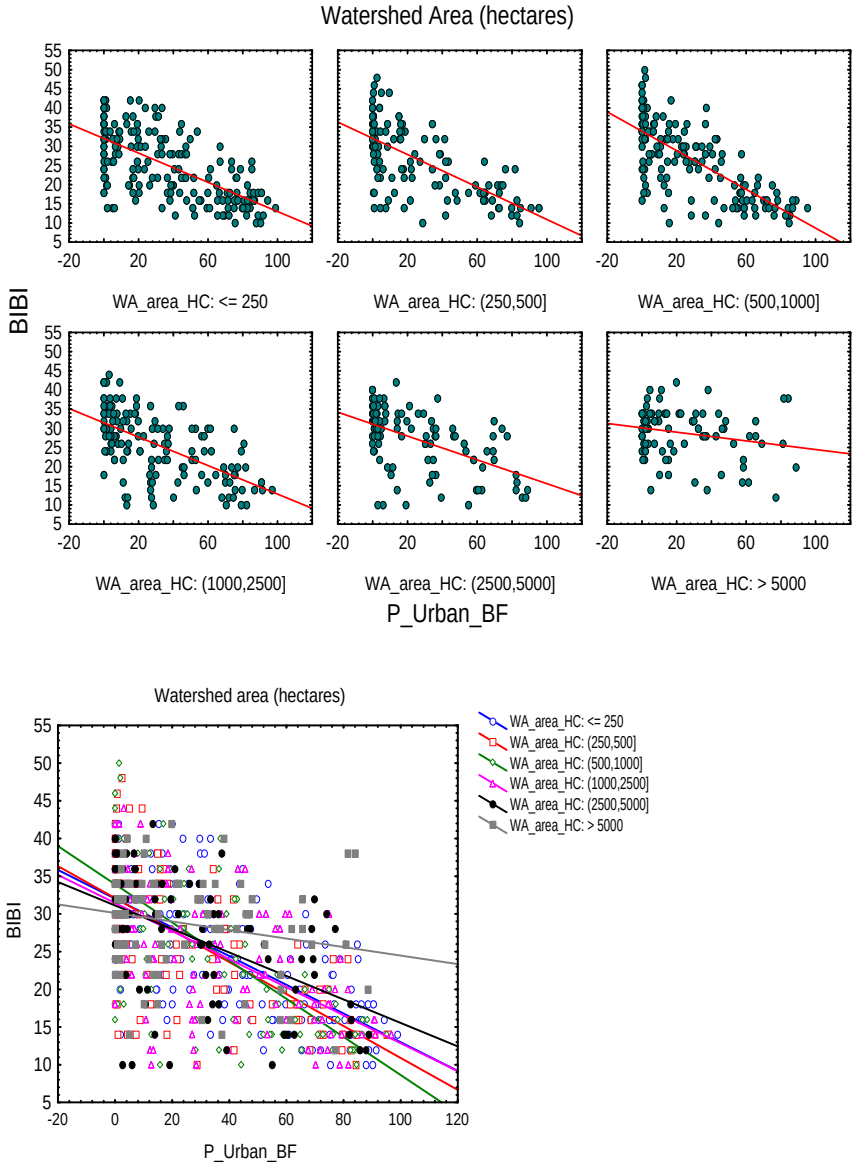

Figure 3. B-IBI declines as urbanization increases. Rates of decline (as indicated by regression line) were similar across categories of watershed area. Association between B-IBI and P_Urban was not as strong for sites in the largest watersheds (>5000 hectares).

Recommendations for 2011 sampling

- Percent urbanization is the primary driver of B-IBI values. Consequently, sites should be selected to represent a range of intensity of urban development.
- Low elevation sites with minimal disturbance should be included in the design to determine if low B-IBI values at these sites are due to natural differences. If so, expectations for metric scores may need to be modified.
- Channel slope and watershed area do not have a consistent influence on B-IBI values. The sampling design does not need to address these factors.
- Sites from watersheds greater than 50 km^2 (N = 90 sites) should be further evaluated with existing data to determine if other types of disturbance are contributing to lower than expected B-IBI values and to determine if invertebrate samples have more taxa than expected for a given level of disturbance result in higher than expected B-IBI values.
- Select sites according to the table below. Select more sites from the extremes of urban development to anchor the comparison of the sampling methods. Supplement with a few low elevation sites with low urban development. Select more sites as time permits to insure a good representation from local jurisdictions and tribes and to include a variety of elevations and watershed sizes.

Percent urban	< 1%	1-10%	10-40%	40-70%	>70%
Number of sites	7	5	5	5	7
Number of sites with elevation < 25 m	3	3			