Benthic Index of Biotic Integrity (B-IBI) for San Francisco Bay Area Creeks

Project Update

Chris Sommers

EOA, Inc.

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Background

- **Biological Integrity**
  - The condition of the biological components of a waterbody. The integrity condition is generally based on a comparison to a reference which is a relatively undisturbed system and represents the best quality to be expected.

- **Approaches**
  - Multivariate - Overall biological condition is estimated by comparing the observed (O) biological community with the community expected (E) based on key environmental variables (e.g., Rivpaks Model)

  - Multmetric - an array of metrics that individually provide information on each biological parameter and, when integrated, function as an overall indicator of biological condition (e.g., Index of Biotic Integrity).

Project Rationale and Scope

Rationale

- Assessment of biological condition needed in Bay Area Creeks
- No reference conditions developed for Bay Area
- IBIs have been developed for Northern and Southern California
- Identified as a BAMBI priority project in 2004

Scope

- Collect and compile existing benthic data from freshwater creeks
- Develop a common format for regional data management
- Develop reference conditions
- Develop an easy to use interpretive tool
  - Provisional B-IBI(s) for San Francisco Bay Area Creeks
- Make data readily available

Project Team and Funding Sources

Project Team

- Chris Sommers – Project Manager
- Terri Fashing, William Lin and RB Staff – Database
- Paul Randall and Matt Cover – GIS and Statistical Analysis
- BAMBI Participants and CDFG – Technical Oversight

Funding

- Bay Area Municipal Stormwater Programs
- SFB Water Board (in-kind support)

Project Status Update

Task 1 & 2

1. Compile Existing BMI Data from Participating Agencies/Organizations that Meet Acceptability Criteria
2. Modify the California Ecological Data Application System (CalEDAS) Database to Accommodate Bay Area BMI Data

- **Acceptability Criteria**
  - CSBP (Field and STE)
  - Professional level entomologist
  - Taxa lists available
  - Data organized and manageable

- **Status**
  - Nearly all data from 1998-2005 translated into Cal EDAS format
    - ~300 Sites and 400+ data points
    - Marin and Sonoma to be completed
    - Data Sources (Municipal Stormwater Programs and SWAMP)
  - Cal EDAS modification not needed

- **Next Steps**
  - Uploading files into Cal EDAS to be completed in February/March
  - Recommend data submittal process and develop data format for future data management
    - Paul Randall – Data Management (Later Today)

Next Steps
Task 3 - Reference Condition Development

- *General Theory*
  - Reference sites are sections of streams that represent the desired state of stream health for a region of interest.
  - Since natural stream communities vary both spatially and temporally, it is natural that measures of biotic integrity also should be expected to vary.
  - Once candidate reference reaches have been identified, these are used to characterize the range of biotic conditions expected for minimally disturbed sites.
  - Deviation from this range can then be used as an indication that test sites may be impacted.

Task 3 (Continued)

- Many definitions of the term “reference condition” ranging from the pristine, undisturbed state of a stream, to merely the “best available” or “best attainable” conditions in a region.
- Practical considerations limit our ability to find minimally disturbed sites, most reference condition approaches seek to identify a compromise, the “least disturbed condition” in region.
- In some regions, particularly those that have been severely impacted by human activity, it is necessary to select sites that represent the “best attainable” condition given best management practices in a manipulated ecosystem.

Task 3 – Step 1

- Create comparable datasets through Monte Carlo simulation
  - Randomly select 500 of 900 organisms per site
- Generate metrics (~60) for each site
- Compile existing GIS data sets necessary to screen site for reference conditions
- Disturbance variables at four spatial scales
  1. Watershed area upstream of site (watershed region)
  2. 5-km radius upstream of site (local region)
  3. 120-m riparian zone of all creeks in watershed region
  4. 120-m riparian zone within local region
- GIS Coverages Needed
  - Land cover (urban, agriculture, open space/forest)
  - Human activity (population, road density)
  - Creeks (Blue Lines)
  - Elevations

Task 3 – Step 2

- Eliminate sites from the reference pool based on qualities not attributable to a reference site (subjective)
- Further eliminate site based on reach-scale conditions (local knowledge – Need Assistance)
  - Bank Erosion
  - Sedimentation
  - Evidence of Mining
  - Dams
- Share reference site locations with BAMBI participants and get feedback
- Randomly divide the reference and test sets into:
  - Development set (used to screen metrics)
  - Validation set (independent evaluation of IBI performance)

Task 4 – Screen and Select Metrics

- Identify which metrics are most closely related to biological integrity
- Looking for metrics with:
  - Strong dose-response relationships with disturbance gradients
  - Good discrimination between reference and non-reference sites
  - High signal to noise ratios
  - High level of repeatability
  - Independence of measurement (non-redundancy)
- Two-step process
  1. Examine responsiveness of metrics in test set to watershed and local scale disturbance values
  2. Determine lack of correlation with other responsive metrics (i.e., avoid redundancy)
- Outcome – Provisional metrics selected

Task 5 – Develop Scoring Ranges

- Metric Scoring Ranges
  - 0-10 scale (reference and test sites)
  - Test Sites Scoring
    - ≥ 80th percentile of reference site score= 10
    - ≤ 10th percentile of reference site score = 0
    - 1-9 equally divided
- Evaluate whether metric scores are significantly different due to natural conditions
  - Ecoregion
  - Flow Regimes (i.e., Ephemeral vs. Perennial)
  - High vs. Low Elevation
  - High vs. Low Gradient
  - Potential Outcome - May need multiple IBI scoring systems

Task 6 – Test, Refine and Build B-IBI

- Metric scores as a result of chance or are they repeatable?
  - Compare development set with validation set
  - Significantly different?
    - Yes, refine IBI
    - No, assemble IBI
- IBI Assembly
  - Sum metric scores for each site and adjust to 100 point system

Tentative Schedule

Task	Completion Date
Task 1 & 2 (Data Compilation)	February 2006
Task 3 (Reference Conditions)	June 2006
Task 4 & 5 (Metric Selection & Scoring)	July 2006
Task 6 (Test, Refine and Build IBI)	September 2006

Draft B-IBI(s) out for review in September/October 2006