Developing the Technical Foundation for Statewide Biological Objectives

Kenneth Schiff
Southern California Coastal Water Research Project

www.sccwrp.org
Our Guiding Principles

- The state should have biological objectives for all waterbody types
- The state should use multiple indicators for biological objectives
- The state should develop biological objectives with numeric endpoints
- There should be statewide consistency with regional flexibility
A Number Of Scoring Tools Currently Exist in California

- Regional Index of Biotic Integrity
- Statewide predictive models
  - Observed over expected (O/E)
- Each has their issues that limits their regulatory application
  - old, incomplete, and/or not comparable
Steps For Developing a New O/E Tool

• Reference condition
  - Sets biological expectation

• Calibrating and validating the predictive model
  - How good can we estimate “E”

• Establishing thresholds
  - When is “O” different from “E”
Defining Reference Condition

- NOT based on biology

- Compiled more than a dozen large-scale data sets
  - Over 1,700 sites statewide

- Compiled more than 1,200 metrics of disturbance
  - Landscape scale (GIS data)
  - Site scale (local data)

- Identify screening levels for each metric
  - Balance between sufficient representation without allowing impacts (Type I vs. Type II errors)
Our Final Scenario

615 Sites based on 10 metric cutoffs

- % Landscape disturbance
- % Urban
- % Agriculture
- % Development
- Roads (# and density)
- Mines
- Dams
- Nutrients
- Canals/pipelines
O/E Index Development Process

Data Preparation

- Reference Dataset (490 sites with BMI data)
- Calibration Sites
- Validation Sites
- Test Dataset (~1200 sites ~50% probability sites)
- Supplemental Data (replicates, site revisits)

Model Development

- Cluster Sites (based on biological similarity)
- Create Best Discriminant Functions Model
- Calculate Predictor Suite
- Calculate Index Scores For All Samples (with all indices)

Model Testing

- Calculate Performance Relative to other Indices
- Conduct additional testing
- Revise as needed
- PILOT STUDY

PILOT STUDY
The New O/E Model

- Based on 5 physical factors, predicts what species should be present at a site (=E)
  - elevation, precipitation, temperature, watershed area, geology (conductivity)

- Measure what species actually occur at that site (=O)

- The ratio represents the O/E score
  - Range from 0 to 1, 1 being best
Sources of variation in O/E scores

A = sampling error

B = A + temporal variation

C = B + model error

(after Hawkins et al. 2010)
Scoring Tool Performance Measures

1. **Applicability** – the extent of the stream population that can be scored accurately with the index

2. **Precision** – variability of scores for sites considered to be in similar condition (e.g., reference sites)

3. **Accuracy** – proximity of score to “true” condition

4. **Responsiveness** – ability to discriminate impaired sites and sensitivity to gradients of stress

5. **Repeatability** – similarity of scores for repeated measurements
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Threshold Setting Is Not Straightforward

- It's not completely a technical exercise
  - There are two basic approaches

- Based on statistical distributions

- Based on ecosystem function

- Either way needs to incorporate uncertainty
California O/E Reference Site Distribution

2 SD = 0.68
Our Next Steps

- Final model refinement
- Threshold setting
  - Exception classes?
- Causal Assessment
  - What do you fix when you’re out of compliance?