ASSESSMENTS FOR STORMWATER MONITORING AND MANAGEMENT

Eric Stein
Biology Departments
Southern California Coastal Water Research Project (SCCWRP)
Effects of Stormwater Runoff

Waterbody Impairments

Coliforms, Beach Closures and Pathogens
Stormwater Assessment is Complex
Monitoring and Assessment Framework

1. Conditions Monitoring and Assessment (M1)
   - Unsatisfactory conditions

2. Stressor Identification Monitoring (M2)

3. Source Identification Monitoring (M3)
   - Implement management actions

4. Performance Monitoring (M4)
   - Satisfactory conditions
Hydromodification
Bioobjectives
Water Quality
Wetland Policy
Sensitive Species
Toxicity
Nutrient Criteria
Don’t Freak Out!

- Coordination
- Integration
- Communication
Monitoring Philosophy

- Monitoring data should answer real questions
  - No data collection for data’s sake
  - Answered questions should result in management action

- Not enough $$ to answer all questions, so will need to prioritize the most important

- Provide regional context for site-specific monitoring
  - Identify mutual beneficial special studies
Need for Cooperative Monitoring

- Leverage resources, knowledge and experience
- Answer regional questions and fulfill mandates
- Provide relevant information that can be readily shared
- Provide a platform for more in-depth studies
- Standard tools and monitoring design
- Shared information management.
- Nested design to allow local intensification
Watershed Based Monitoring

- Start with watershed analysis
- Informs development of monitoring questions
- Priority locations
- Opportunities to leverage off existing programs
- Ability to monitor process indicators over time
Regional Monitoring Coalitions

- Ventura Co WPD
- Los Angeles Co DPW
- Los Angeles Co SD
- Orange County RDMD
- Riverside County FCD
- San Bernardino FCD
- San Diego Co DEH
- City of Long Beach
- City of Los Angeles CalTrans
- US EPA
- CA Dept. of Fish & Game
- SCCWRP
- San Diego RWQCB
- Santa Ana RWQCB
- Los Angeles RWQCB
- State Water Resources Control Board

Sources: USGS, ESRI, TANA, AND
Wet vs Dry Weather Monitoring

[Graph showing flow and total PAHs over time]
California’s Stream Ecological Indicators

- Instream Biology
  - California Stream Condition Index (CSCI)
  - Algal IBI

- Physical habitat
  - PHAB MMI
  - Hydromodification

- General stream condition
  - CRAM
Multiple Indicator Approach

- Benthic Inverts
- Stream Algae
- PHAB CRAM
- Chemistry
- Toxicity

Condition

Stress
Why use Biossessment?

Use species composition to measure overall ecological integrity

- Integrate effects of different stresses
  - ... But ... exact source of stress may be hard to identify

- Provide a measure of fluctuations of environmental conditions over time.

- Relatively inexpensive

- Direct measure of biological endpoint
Diverse Reference Network

Screened > 2400 candidate reference sites

Selected 586 sites

Objectives:

1. Reference pool represents CA stream diversity
2. Biological at reference sites is minimally influenced by stress
Reference Sites Cover Key Gradients

- Large sheds
- Shed size
- Arid sheds
- Temp
- Conductivity
- High cond. sheds
- Rainy sheds
- Rainfall
Converting Taxa to a “Score”
California Stream Condition Index (CSCI)

Part A: Ecological Structure Component (pMMI)
Part B: Taxonomic Loss Component (O/E)

BMI Species List from Sample

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayfly species 1</td>
<td>43</td>
</tr>
<tr>
<td>Mayfly species 2</td>
<td>12</td>
</tr>
<tr>
<td>Mayfly species 3</td>
<td>2</td>
</tr>
<tr>
<td>Beetle species 1</td>
<td>1</td>
</tr>
<tr>
<td>Beetle species 2</td>
<td>1</td>
</tr>
<tr>
<td>Midge genus 1</td>
<td>65</td>
</tr>
<tr>
<td>Midge species 1</td>
<td>3</td>
</tr>
<tr>
<td>Midge species 2</td>
<td>10</td>
</tr>
<tr>
<td>Midge species 2</td>
<td>3</td>
</tr>
<tr>
<td>Dragonfly species 1</td>
<td>2</td>
</tr>
<tr>
<td>Stonefly species 1</td>
<td>1</td>
</tr>
<tr>
<td>Stonefly species 2</td>
<td>14</td>
</tr>
<tr>
<td>Worm species 1</td>
<td>9</td>
</tr>
<tr>
<td>Worm species 2</td>
<td>2</td>
</tr>
</tbody>
</table>

Ecological Function Metrics

- # mayfly taxa
- # predator taxa
- % sediment tolerant taxa
- % non-insect taxa

Scores are adjusted to account for major natural gradients:
- Elevation
- Latitude
- Longitude
- Conductivity
- PPT, Temp
- Mineral Content

Species Loss Component

- E = 8 taxa
- O = 3 taxa

- Both components adjust for environmental setting
- CSCI is a simple average of the two scores
How does the CSCI Compare to Previous Indices?

- **Much better reference** data set
  - Bigger, broader, and more rigorously screened

- **More comprehensive** assessment of biological integrity

- **Statewide applicability**, without regionalization
  - Nearly all perennial wadeable streams can be assessed
  - Formal tests of applicability are possible

- **More lines of evidence** than most indices

- **Site-specific expectations** means that your site is held to appropriate standards
Benthic Algae IBIs

- Soft-bodied algae (& cyanobacteria)
- Diatoms
Why Add Algae to Bioassessment?

- Information complementary to bugs
  - Response to different stressors
  - Strongest responses evident over different ranges of disturbance

- Weight of evidence

- Potential for broader range/flexibility in interpretation of results
  - Applicability on different substrate types
Diagnostic Assessments

- Soft-bodied Diatoms

![Graph showing mean proportion of sites with nitrogen fixers recorded against nitrate concentration (mg/L). Triangles represent soft-bodied diatoms, and circles represent diatoms.](image-url)
Hydromodification Field Screening Tool

- Classify streams by:
  - Likely severity of response
  - Likely direction of response

- Decision trees
  - Clear endpoints – very high, high, medium, low

- Simple to apply field metrics
  - Does not rely on complex field measures

- Locally calibrated

- Rapid - < 1 day in office + 1 day in field
Field Indicators + Empirical Relationships

Form 3 Checklist 2: Grade Control

A  Grade control is present with spacing <50 m or 2/$S_v$ m
- No evidence of failure/ineffectiveness, e.g., no headcutting (>30 cm), no active mass wasting (analyst cannot say grade control sufficient if mass-wasting checklist indicates presence of bank failure), no exposed bridge pilings, no culvert/structures undermined
- Hard points in serviceable condition at decadal time scale, e.g., no apparent undermining, flanking, failing grout
- If geologic grade control, rock should be resistant igneous and/or metamorphic; For sedimentary/hardpan to be classified as grade control, it should be of demonstrable strength as indicated by field testing such as hammer tests/borings and/or inspected by appropriate stakeholder

B  Intermediate to A and C — artificial or geologic grade control present but spaced 2/$S_v$ m to 4/$S_v$ m or potential evidence of failure or hardpan of uncertain resistance

C  Grade control absent, spaced >100 m or >4/$S_v$ m, or clear evidence of ineffectiveness

GRADE CONTROL

A) Effective Grade Control
San Diego Creek: concrete embankment in good condition

B) Intermediate
Sillerado Canyon: ground riprap with some undermining at road crossing

C) Ineffective Grade Control
Borrego Canyon: ground riprap with substantial undermining
# Physical Habitat (PHAB) MMI

## Habitat Assessment Field Data Sheet

**Low Gradient Streams**

<table>
<thead>
<tr>
<th>Stream Name</th>
<th>Date</th>
<th>Time</th>
<th>AM/PM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Habitat Parameter</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Epilithal Substrate/Available Cover</td>
<td>Greater than 50% of substrate favorable for epilithal colonization and fish cover, mix of large, cobble, or boulders, good or excellent condition.</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>50 - 99% of habitat well suited for epilithal colonization potential, adequate habitat for colonization of populations; presence of additional substrate on the order of new woodland, but not yet prepared for colonization (mosses, liverworts, or ferns).</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Less than 50% stable habitat; lack of substrate or habitat is obvious; substrate unstable or lacking.</td>
<td>10</td>
</tr>
</tbody>
</table>

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<tr>
<th>Habit Parameter</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Post Substrate Characterization</td>
<td>Mixture of substrate materials, with gravel and fine sand prevalent; root mat and submerged vegetation common.</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Mixture of soft sand, mud, or clay; may be dominant; some root mat and submerged vegetation present.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>All mud or clay or sand bottom; little or no root mat; no submerged vegetation.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Hard or clay or boulders; no root mat or vegetation.</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Habit Parameter</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Post Variability</td>
<td>Even mix of large shallow, large deep, small shallow, small deep pools.</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Majority of pools very shallow.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Shallow pools much more prevalent than deep pools.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Majority of pools shallow, pools absent.</td>
<td>5</td>
</tr>
</tbody>
</table>
PHAB MMI Metrics

Condition Categories
- Riparian condition
- Substrate condition
- Productivity
- Channel equilibrium
- Riparian condition

Candidate Metrics
- Percent Presence of Macroalgae
- Percent Stable Banks
- Percent Fast Water of Reach
- Natural Shelter cover - SWAMP
- Mean Mid-Channel Shade
- Canopy cover
- Riparian Vegetation All 3 Layers
- CPOM Presence
- Particle Size Median (d50)
- Percent Substrate <2 mm

Index under development
California Rapid Assessment Method (CRAM)

Field-based, **rapid** tool to assess condition

- Applicable to all wetland types, including streams
- Based on readily observable field indicators
- Evaluates broad suite of conditions
- Validated with more intensive measures of condition
CRAM Attributes

CRAM recognizes four attributes of wetland condition:

- Landscape Context
- Hydrology
- Physical Structure
- Biotic Structure

- Each attribute is represented by 2-3 metrics, some of which have sub-metrics.
Emerging Indicators for Non-perennial Streams
What About Stress?

- Benthic Inverts
- Stream Algae
- PHAB CRAM
- Chemistry
- Toxicity
Risk Factors

Higher risk:
- Habitat degradation
- High nutrients

Lower risk
- Conventional toxicants

Analysis show correlation, not causation

Working on integrated assessment
Common Data Platforms

Benthic invertebrates, Algae, Chemistry, Toxicity

CRAM, Chemistry, Toxicity, + Project info
Nutrient Criteria

Water Quality

Bioobjectives

 Coordination
 Integration
 Communication

Sensitive Species

Toxicity

Wetland Policy

Nutrient Criteria

Hydromodification
Final Thoughts

- Questions drive monitoring

- True benefits will only be realized over the long-term
  - Need long-term implementation mechanisms

- Monitoring data contributes to new knowledge
  - Data must be made broadly available