Technical Report 0639

Ecological Condition of Watersheds in Coastal Southern California: Progress Report of the Stormwater Monitoring Coalition's Stream Monitoring Program First Year (2009)

Prepared for the Stormwater Monitoring Coalition Bioassessment Workgroup

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EXECUTIVE SUMMARY

In 2009, the Stormwater Monitoring Coalition initiated a program to assess the condition of streams in southern California watersheds by sampling water chemistry, toxicity, physical habitat, and benthic macroinvertebrates. This program was designed to address three primary questions over a 5-year sampling cycle:

1. What is the condition of streams in southern California (across the region and in agricultural, open, or urban land use classes)?
2. What are the stressors that affect stream condition?
3. Are stream conditions getting better or worse over time?

In the first year of the program, a total of 134 sites were sampled in 15 watersheds in the coastal southern California region. This report summarizes the results of this sampling and represents the first time that the first two questions have been answered in a scientifically robust way for the entire region. The third question is based on temporal trends and requires multiple years of data before it can be fully addressed.

The sampling survey was designed to assess the condition of perennial, wadeable streams that are second-order or higher. First order streams and nonperennial streams were excluded to improve sampling success and because bioassessment tools have not yet been validated in nonperennial streams. Of more than 7,000 stream-km in the region, about 2,000 km were perennial, wadeable streams. Nonperennial streams were unevenly distributed among land-use classes, with perennial streams being more common in urban than in agricultural or undeveloped (open) streams.

Question 1: What is the condition of streams in Southern California?

Different indicators provided different insights into the health of streams in Southern California, but several indicators showed large differences in condition among the three land use classes (**Figure E1**). Biological indicators, which integrate other indicators of ecological health over time, showed that the majority of streams in the region had non-reference biological condition. The median Index of Biotic Integrity (IBI) score was 33 out of 100 maximum and 53% of stream-miles region-wide had scores $\leq$39, indicating widespread non-reference condition. In undeveloped watersheds, 90% of stream-miles were in reference condition. In contrast, only 35% of agricultural stream-miles were in reference condition. Urban streams were almost exclusively (98%) in non-reference condition (**Figures E1, E2**).

Water chemistry was evaluated by comparing chemical concentrations to numeric thresholds using numbers reported in scientific literature or in regulations. Many pollutants typically associated with stormwater (e.g., metals, pesticides) were rarely above thresholds. For example, copper was below threshold in 96% of stream-miles, and several metals (e.g., zinc) never exceeded thresholds. Pyrethroid pesticides were detected in 28% of stream-miles regionally, and these detections were more frequent in

agricultural and urban streams (39% and 38%, respectively) than undeveloped streams (16%). In contrast, nutrients were widespread; more than two-thirds of stream-miles had concentrations of nitrogen over 1 mg/L, and 42% had concentrations of phosphorus over 0.1 mg/L.

Furthermore, concentrations of nitrogen greater than 1.0 mg/L were observed in a large extent (i.e., 37%) of undeveloped stream-miles. Future reports will investigate the relationship between nutrient concentrations and biological impacts using algae indicators (**Figure E1**).

Toxicity to *Ceriodaphnia dubia* reproduction was observed in 47% of stream-miles in the region, although the distribution of sites with toxicity did not correspond with patterns observed for water chemistry or biological indicators. Undeveloped streams showed more pervasive toxicity (i.e., 63%) than agricultural (37%) or urban streams (32%). Toxicity to survival was observed in only 2% of stream-miles across the region, but was also more common in undeveloped streams than agricultural or urban streams (**Figure E1**).

Question 2: What are the stressors affecting stream condition?

Stressors related to biological condition were evaluated using two different analyses; relative risk and correlation. Although neither analysis proves causality, both identified a similar suite of water chemistry and physical habitat stressors associated with non-reference IBI scores. Three of the four highest risk stressors were related to physical habitat. For example, sandy substrate, low habitat complexity, and high human disturbance near the stream banks more than tripled the risk of observing non-reference biology, and low levels of riparian vegetation doubled the risk. Physical habitat assessments revealed that stressors were typically greater in urban and agricultural streams than those in open space. For example, metrics related to substrate size, riparian vegetation, primary productivity, habitat availability, and human disturbance all showed that stressors were higher in urban streams than open streams, and that agricultural streams were intermediate between the other two land-use classes. However, thresholds for physical habitat impairment have not been established, and the extent of streams with high quality habitat was not assessed. Among water chemistry constituents, nutrient concentrations (particularly total phosphorus) and major ions (e.g., chloride and sulfate) had relative risks ranging from 2 to 4. In contrast, metals and pyrethroids typically showed no or small increased risks.

Correlation analysis showed that several physical habitat and water chemistry stressors had wedge- or step-shaped relationships with IBI scores, suggesting that multiple stressors interact to limit biological condition. Many toxic pollutants (e.g., metals) showed weak associations with biological integrity, and sites that were toxic to *Ceriodaphnia* were no less likely to have reference biology than non-toxic sites.

Key Findings and Recommendations

- The first year of the SMC program was an effective collaboration that has begun to provide answers to two of three management questions.

  Recommendation: Continue the program to answer key questions, and modifying the design to improve statistical power.

- More than half of the streams in southern California are nonperennial, and therefore excluded from standard bioassessment protocols.

  Recommendation: Develop assessment tools (e.g., IBIs, maps) to include nonperennial streams in future surveys.

- Each indicator showed a different extent of streams in reference condition, but most showed that reference conditions were most widespread in undeveloped watersheds.

  Recommendation: Develop a framework for interpreting multiple indicators.

  - For biological indicators, reference conditions were rare (35%) in agricultural streams, and nearly absent (2%) from urban streams. High nutrient concentrations were widespread in urban (N: 83%; P: 82%) and agricultural streams (N: 78%, P: 54%) compared to open streams (N: 37%; P: 7%).

    Recommendation: Help the State Water Resources Control Board identify appropriate management goals for non-reference streams.

- Physical habitat, nutrient concentrations, and major ions appeared to be important stressors for biological condition, but cause-and-effect relationships were not examined. Major stressors for toxicity were not as clear, and need further investigation.

  Recommendation: Conduct site-specific stressor analyses at sites of interest.

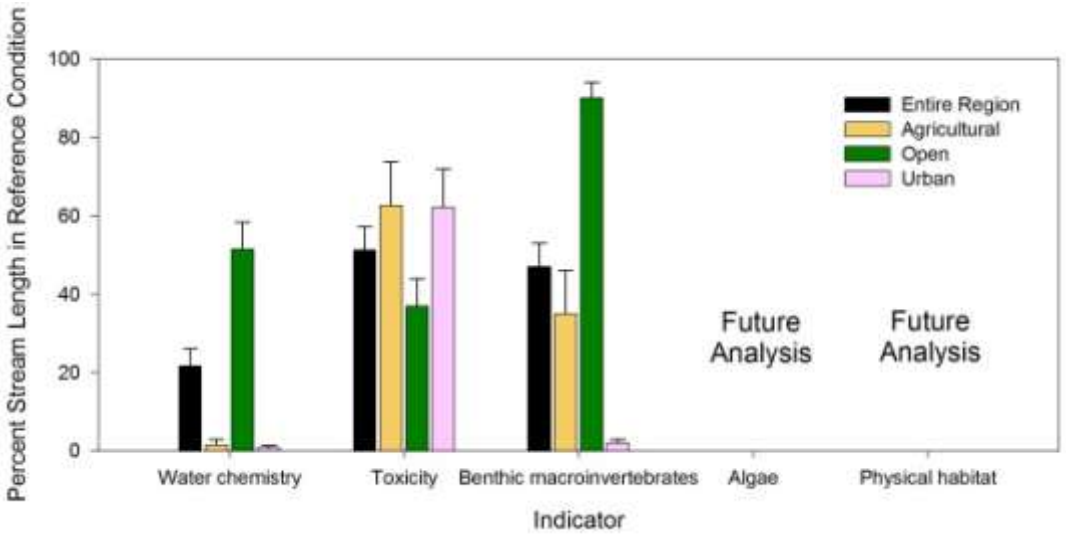

Figure E1. Percent of stream-length in reference condition by land use class and indicator. Reference was defined for each indicator as follows: No water chemistry analyte exceeding threshold; no evidence of toxicity to reproductive or survival endpoints; and index of biotic integrity scores over 39. Algae and physical habitat indicators were not assessed in this report.

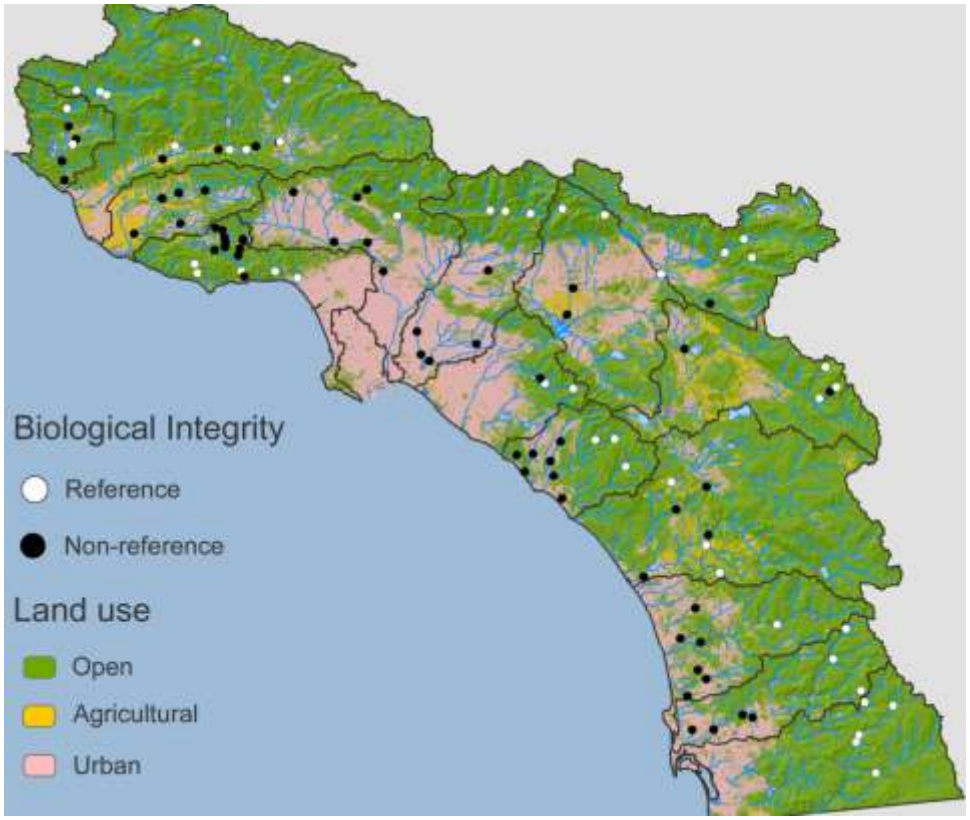

Figure E2. Biological integrity at sampled sites across the region. Sites in reference condition had Index of Biotic Integrity (IBI) scores ≥ 39.

Full Text

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/639_SMC_StreamsYear1.pdf