Technical Report 0695

Final Report on Bioassessment in Nonperennial Streams - Report to the State Water Resources Control Board

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EXECUTIVE SUMMARY

Overview

Despite comprising large portions of stream length in coastal Southern California, nonperennial streams are often excluded from most monitoring programs because it is unclear if existing assessment tools can be used to accurately identify them and evaluate their condition. When they are sampled, it is unclear whether assessment tools developed for perennial systems produce scores that accurately reflect condition of non-perennial streams. To address this uncertainty, the Stormwater Monitoring Coalition directed a study in the San Diego region to evaluate the extent of nonperennial streams in the region, as well as the applicability of the Southern California Index of Biotic Integrity (IBI) for use in nonperennial streams. This study showed that, despite some limitations, available tools can be used to assess the health of at least some nonperennial streams.

Nonperennial streams are defined as streams that lack surface flow for at least several days per year in most years. This definition encompasses a large variety of streams, from ephemeral washes and headwaters that flow for only a few hours after rain events, to those with sustained flows lasting nearly all year (and even more than a year with adequate rainfall). The findings of this report may only apply to nonperennial streams that flow for sufficient duration to all establishment of benthic invertebrate communities (i.e. several weeks during the spring or summer months).

Extent of Nonperennial Streams

Based on ground-truthed field estimates from ambient monitoring programs, nonperennial streams comprise 59% of stream-length in the South Coast region of California and 73% of the streams in the San Diego region, which is substantially less than estimates from the National Hydrography Dataset (NHD) Plus (i.e., 81 and 85%, respectively). Nonperennial streams were found to be relatively extensive in open space and agricultural settings, whereas many urban streams appeared to have been perennialized. The majority of disagreements between field-based estimates and the NHD Plus were observed for streams in the urbanized coastal plain.

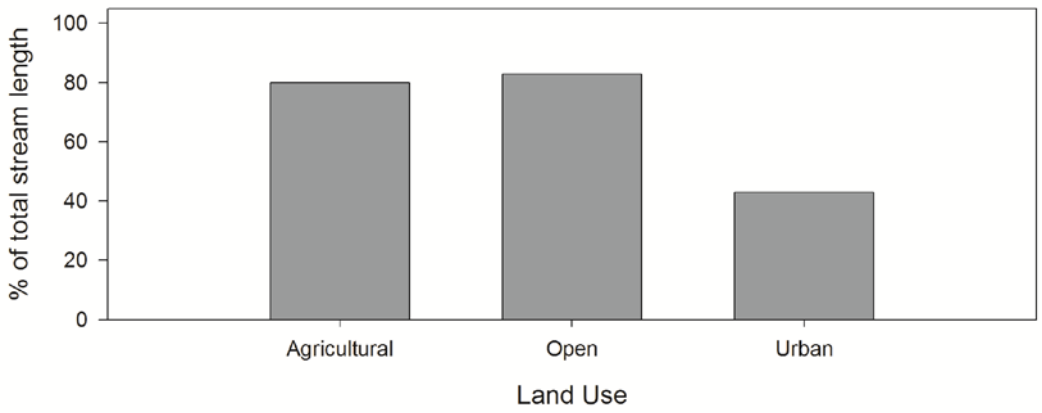

Figure E1. Extent of nonperennial stream length in Southern California.

Applicability of the Index of Biotic Integrity to Nonperennial Streams

Despite the effects of nonperennial flow on benthic community structure, the Southern California IBI can be used to assess the condition of nonperennial streams. Nonperennial streams support benthic macroinvertebrate communities that are distinct from those found in perennial streams. Many of the life history traits that macroinvertebrates use to survive in nonperennial streams (such as tolerance of low oxygen or high conductivity conditions, or rapid life-cycles) are similar to those used to survive in degraded streams. In the past, concerns have been raised that indices designed to identify degraded streams (such as the IBI) may give false indications of impairment at nonperennial streams under natural conditions. At sites included in this study, no such false indications were observed.

The IBI accurately assessed the condition of some nonperennial streams that had flow long enough to all establishment of benthic communities, as indicated by the comparability of IBI scores at minimally stressed perennial and nonperennial sites. That is, nonperennial flow alone did not preclude high IBI scores at low stress sites in this study, and all low-stress sites had scores well above the threshold for identifying streams in poor quality (i.e,. 39). Furthermore, IBI scores declined with increasing stress at nonperennial streams, indicating that the IBI can identify poor biological condition at nonperennial streams. However, future adjustments (e.g., changes in scoring thresholds or metrics) may be required to apply the IBI to the full diversity of nonperennial stream types, such as streams with short flow durations. Additional sampling at a large number (at least 50) of nonperennial reference sites is necessary to determine if such adjustments are needed.

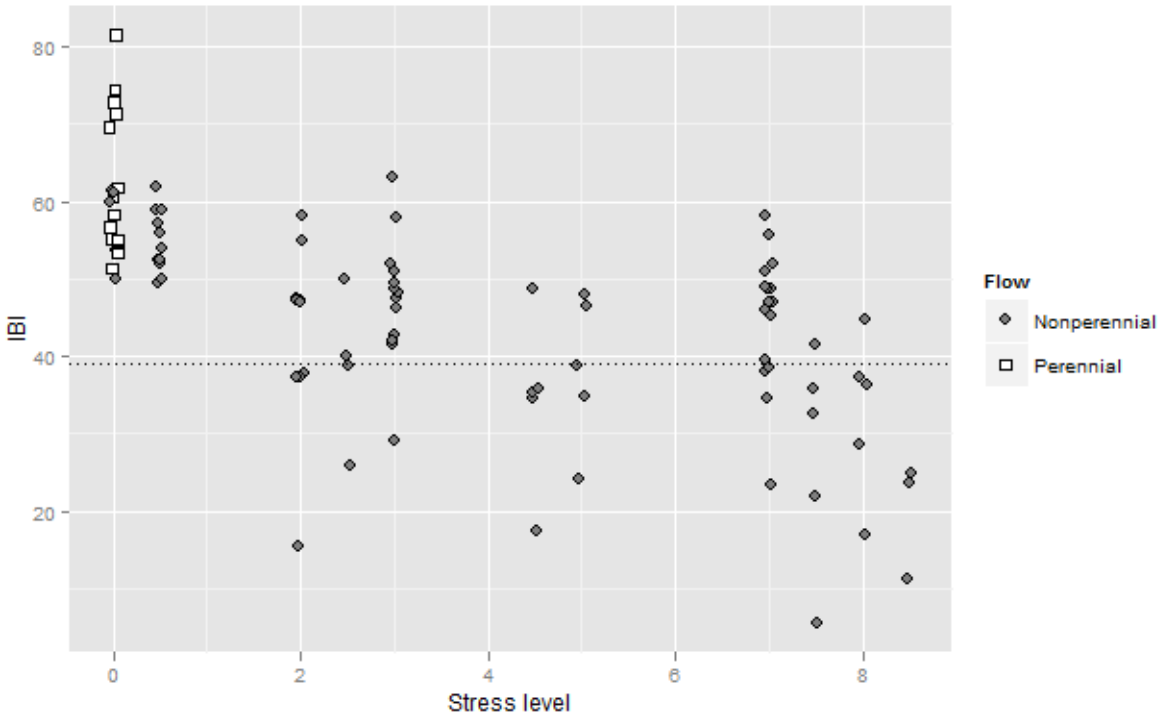

Figure E2. IBI scores declined with stress at nonperennial streams. Each point represents one sample. Gray circles represent nonperennial sites, and white squares represent perennial sites. The dashed line represents the threshold for identifying nonreference condition. Stress was quantified as the sum of evident (score 0.5) and major (score 1.0) stressors, identified by the California Rapid Assessment Method's Stressor Checklist (Collins et al 2008).

Sensitivity of the Index of Biotic Integrity to Changes in Flow

IBI scores were robust to declines in flow at minimally stressed sites. However, decreases in flow were associated with declines in IBI scores at moderately and highly stressed sites, suggesting that nonperennial streams can be particularly sensitive to flow modifications. Few other consistent trends with habitat or chemistry variables were observed, and instead reflected site- or year-specific phenomena, rather than a predictable environmental change that occurs during stream trying.

Conclusions and Recommendations

Although limited to a small number of sites, this study illustrates that nonperennial streams can be incorporated into routine bioassessment programs with little modification of current protocols, provided that surface flow persists for sufficient duration to allow establishment of benthic macroinvertebrate communities. Because existing bioassessment programs mandate several minimum flow conditions that are consistent with this requirement (e.g.., flow sustained at least 4 weeks since last storm, wetted width at

least 1 m for 50% of the reach; flow sufficient to operate a d-frame net), no adjustments to these protocols are justified. Furthermore, the large extent of nonperennial streams in the San Diego Region makes their inclusion more relevant if watershed managers are to truly understand the health of their watersheds.

The following considerations are recommended to improve the assessment and management of nonperennial streams:

1. Develop a flexible approach to characterize flow regimes at nonperennial sites.
    - An approach that can characterize the intra- and inter-annual variability in flow regimes has many applications to watershed management, and creates more useful maps for planning and survey design. This approach could lead to the development of a map or a rapid field assessment protocol that identifies the status of a stream reach along a flow gradient from perennial to nonperennial.
2. Include nonperennial streams that meet the minimum flow criteria in routine and ambient bioassessment programs, such as the Perennial Stream Assessment and compliance monitoring, using existing sampling protocols and assessment tools (such as the IBI).
    - Data from this study do not support modifying the IBI. In its current form, the IBI can correctly identify streams in reference condition, even for streams with nonperennial flow. Furthermore, the IBI responds to stress in an expected manner, indicating that it may be useful in evaluating degradation at nonperennial streams. Data from additional sites are needed to establish the general applicability of this finding beyond the limited sites sampled for this study.
3. Establish a program to monitor reference nonperennial sites that capture the full gradient of natural flow regimes under multiple climatic conditions.
    - Although California has initiated a robust program to monitor perennial reference streams (Ode and Schiff 2009), data from nonperennial reference streams are minimal, and only three minimally stressed sites were included in this study.
4. Include assessments of hydrologic disturbances when trying to identify possible causes of low IBI scores.

Nonperennial streams may be uniquely sensitive to altered hydrology, and as this study revealed, routine bioassessment protocols are inadequate to identify some hydrologic stressors. Routine deployment of water loggers or flow gages/meters may help detect hydrologic disturbance patterns. Channel erosion associated with hydromodification also has the potential to be used as an indicator of hydrologic disturbance.

Full Text

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/695_NonperennialStreamsSanDiego.pdf