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Does DNA barcoding improve performance of traditional stream bioassessment metrics?

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ABSTRACT

Benthic macroinvertebrate community composition is commonly used to assess the condition of streams and wetlands and help differentiate the effects of stressors between and among sites. DNA barcoding has been promoted as a way to increase taxonomic resolution, thereby increasing the sensitivity of existing bioassessment metrics. This hypothesis was tested by comparing the ability of several commonly used bioassessment metrics derived using traditional morphology and DNA barcoding to discern differences in stream condition. Six paired sites in southern California with relatively subtle impacts to habitat were assessed using standard bioassessment tools as well as DNA barcoding. At each site, two reaches were sampled: an upstream, (reference) reach and a downstream (impact) reach where the streambanks have been armored. For each sample, approximately 600 organisms were enumerated and identified based on morphological characteristics using a standardized taxonomic effort (generally to species, with midges to genus). mtDNA was then extracted from each individual and sequenced for the approximately 658 base pairs (bp) barcoding region of the cytochrome c oxidase subunit I (COI) gene. Although most (i.e., 91%) organisms yielded sequences >350 bp in length, high failure rates among all taxa collected from one stream required its exclusion from analysis. Results based on morphological identifications produced subtle differences in community composition, but no significant differences between armored and unarmored reaches using 16 commonly used metrics. In contrast, for 10 of the 16 metrics derived from DNA barcode identification, statistical power substantially increased; consequently, it was possible to discern differences between armored and unarmored reaches. These previously undetected differences were associated with the increased taxa richness for midges, mayflies, non-insects, caddisflies, and black flies that resulted from DNA barcoding. These results suggest that identifications based on DNA barcoding have the potential to improve power to detect minor changes in stream condition.

Full Text

http://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/2013AnnualReport/ar13_309_321.pdf