PARTIAL CUTTING IMPACTS ON MACROINVERTEBRATES IN EPHEMERAL STREAMS IN SOUTHERN NY

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Abstract

Macroinvertebrate sampling was used to biomonitor ephemeral stream water quality in partially harvested (Feb 2002) and reference watersheds in the Catskill Mt. Region of southern NY. Streams were sampled with a Surber sampler in May and June of 2001 (pre-harvest) and 2002 (post-harvest). Macroinvertebrates were hand sorted in the field, placed in 70% alcohol, and returned to the lab for identification to genus. The macroinvertebrates collected were distributed across 7 orders and 26 families. Faunal community structure varied greatly between years within the reference sites. A variety of indices were computed from the sample data: index of biotic integrity, Hilsenhoff improved biotic index, family level biotic index, North Carolina biotic index, functional feeding groups, and Shannon H and Simpson D diversity indices. These indices provided no evidence that a partial harvest negatively impacted water quality. Diversity may have been reduced following harvesting, but the high variability precluded a definitive conclusion.

Introduction

Benthic macroinvertebrates are being utilized as a tool to assess surface water quality (Bailey et al. 2001). Ease of collection and identification are important advantages relative to other organisms (i.e. algae). The combination of limited mobility, short life spans, and differential tolerance to a variety of pollutants makes macroinvertebrates potentially attractive as indicators of local, recent conditions (Davis et al. 2001). Most of the macroinvertebrate sampling has been done in perennial streams. Caruso (2002) is one of the few to examine benthic macroinvertebrate communities during extreme low flow conditions resulting from severe drought. He found reduced number of sensitive taxa and reduced diversity, although the magnitude of the differences was small and did not differ statistically from the pre-drought period. The purpose of this study was to examine the effects of a partial cut on aquatic macroinvertebrate populations in small ephemeral streams in southern New York using a variety of biotic indices.

Methods

Two adjacent paired watersheds were selected at Frost Valley located along the west branch of the Neversink River in the Catskill Mountains of Ulster County, New York (41°59' N; 74°31' W). Sixty percent of the basal area was harvested in a heavy improvement thinning from the lower 6 ha portion of 10 ha Frost Valley site A during February – May 2002. Adjacent site G served as an untreated reference. An untreated reference site was located at Ninham. During 2002, we added one additional reference site at Ward Pound Ridge.

Macroinvertebrates were sampled at each of the 4 sites: May – June 2001, and May – June 2002, with the exception of Ward Pound Ridge which was not sampled in 2001. Sampling was prevented in July and August by lack of water. Streams were partitioned into either erosional (sediment being eroded from stream bed) or depositional (sediment being deposited into streambed) sections. Each stream section was assigned a number and 6 erosional and 6 depositional sections were randomly selected at each sampling date. A Surber sampler (30.5 cm x 30.5 cm with mesh size 0.363 mm) was placed in the substrate. Sediment was disturbed to a depth of 10 cm forcing dislodged material into the water column passing through the net. Material was washed into a plastic tray and hand sorted in the field under 5-10x magnification. Macroinvertebrates were preserved in 70% ethyl

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alcohol and returned to the lab for identification to genus. Macroinvertebrate data were utilized to compute the following indices: IBI, index of biotic integrity (Fore et al. 1994); BI, Hilsenhoff improved biotic index (Hilsenhoff 1987); FBI, family level biotic index (Hilsenhoff 1988); NCBI, North Carolina biotic index (Lenat 1993); FFG, functional feeding groups (Merritt and Cummins 1996); and Shannon H and Simpson D diversity indices (Magurran 1998).

Results and Discussion

A total of 477 macroinvertebrates distributed across 7 orders and 26 families were collected from the sampled streams in 2002 (Table 1). The streams dried up in July and August, restricting sampling to May and June of each year. There was considerable variation in faunal communities between years even within the reference sites.

Table 1.- Summary of macroinvertebrates collected from sample streams during May-August 2002. Numbers in parentheses indicate percentage of organisms in dominant family.

	Frost Valley A	Frost Valley B	Ninham	Ward Pound Ridge
Number	225	58	69	125
Dominant	*Simuliidae* (72%)	*Chironomidae* (29%)	*Isonychiidae* (20%)	*Isonychiidae* (22%)
Taxa	*Prosimulium*	*Chironomus*	*Isonchia*	*Isonchia*

Comparison of the indices between ephemeral streams in treated and harvested watersheds indicated no detectable effects of the harvest on macroinvertebrate communities (Table 2). All sampled streams, even in the harvest treatment, were classified as “fair” in 2001 using the IBI. The BI and FBI indices indicated a slight reduction in quality from 2001 to 2002 for Frost Valley streams in both harvested and reference watersheds while the BI for Ninham increased from “good” to “excellent”. These two indices were designed to detect organic pollution which causes reduced dissolved oxygen levels. All streams were rated “excellent” by the NCBI. Although the FSBI exhibited the greatest change between harvested and reference streams at Frost Valley, the magnitude of the difference between years for Ninham was opposite in sign compared to the Frost Valley reference watershed. Consequently, the results are inconclusive. The poor performance of this index is partially due to the fact that only 3-4% of the organisms collected could be assigned tolerance values.

There were no consistent changes in the proportion of functional feeding groups attributed to harvesting. In theory, disturbances can have large impacts on invertebrate community structure. Variation in FFG between years was high for both treated and reference watersheds at Frost Valley.

Simpson and Shannon diversity indices both decreased from 2001 to 2002 in the harvested watershed and increased in the untreated Frost Valley watershed; there was very little change at Ninham.

Conclusions

Biomonitoring of macroinvertebrates in ephemeral streams in southern NY over a 2-year period provided no evidence that a partial harvest negatively impacted water quality. Harvesting may have reduced diversity the first year following harvest, however, the high degree of variability for these ephemeral streams limits the strength of this observation. In order to understand more fully the potential utility of macroinvertebrate monitoring for ephemeral stream water quality, the number of streams and the duration of the monitoring period must be increased.

Table 2.- Summary of indices computed from macroinvertebrate data[1].

Index2	FV Harvested		FV Reference		Ninham		WPR
	2001	2002	2001	2002	2001	2002	2002
IBI	21 Fair	19 Fair	16 Fair	27 Good	20 Fair	27 Good	30 Good
BI	4.32 V Good	5.05 Good	3.4 Excel	4.6 Good	4.8 Good	3.48 Excel	2.3 Excel
FBI	4.5 Good	5.02 Fair	3.82 V Good	4.48 Good	3.09 Excel	3.03 Excel	1.97 Excel
NCBI	2.383 Excel	3.011 Excel	2.906 Excel	3.936 Excel	3.9 Excel	3.297 Excel	4.036 Excel
FSBI	3.08	4.10	4.29	3.60	2.68	3.25	4.20
Diff = 2002-2001	1.02		-0.79		0.57		NC
FFG3							
Predators %	28	2	4	31			
Collectors %	36	74	6	45	NC	NC	NC
Shredders %	36	24	90	24			
Simpson D	5.95	1.88	2.31	5.55	8.29	7.3	9.35
Shannon H	0.85	0.55	0.57	0.88	1.03	0.95	1.1

[1]FV indicates Frost Valley. WPR indicates Ward Pound Ridge, NC = not computed.
Index abbreviations detailed in Methods.
[2]Interpretation of index listed below raw score (Excel is short for excellent).
[3]Functional feeding groups listed as percentage of organisms identified as predators, collectors, and shredders.

Literature Cited

Bailey, R.C., R.H. Norris, and T.B. Reynoldson. 2001. **Taxonomic resolution of benthic macroinvertebrate communities in bioassessment.** The North American Benthological Society 20: 280-286

Caruso, B.S. 2002. **Temporal and spatial patterns of extreme low flows and effects on stream ecosystems in Otaga, New Zealand.** Journal of Hydrology 257: 115-133.

Fore, L.S., J.R. Karr, and L.L. Conquest. 1994. **Statistical properties of an index of biotic integrity used to evaluate water resources.** Canadian Journal of Fisheries and Aquatic Science 51: 1077-1087.

Davis, J.C., G.W. Minshall, C.T. Robinson, and P. Landres. 2001. **Monitoring wilderness stream ecosystems.** USDA Rocky Mountain Research Station, General Technical Report RMRS-GTR-70.

Hilsenhoff, W.L. 1988. **Rapid field assessment of organic pollution with family-level biotic index.** Journal of North American Benthol. Soc. 7: 65-68

Hilsenhoff, W.L. 1987. **An improved biotic index of organic stream pollution.** The Great Lakes Entomologist 20: 31-39

Lenat, D.R. 1993. **A biotic index for the southeastern United States: derivation and list of tolerance values, with criteria for assigning water-quality ratings.** Journal of North American Benthol. Soc. 12: 279-290.

Magurran, A.E. 1988. **Ecological Diversity and its Measurements.** Princeton University Press, Princeton, NJ. pp.179

Merritt, R.W. and K.W. Cummins. 1996. **Aquatic Insects of North America 3rd edition.** Kendall/Hunt Publishing Company, Iowa. pp. 862