Changes in Benthic Assemblages Below Forest Clear Cuts

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Benthic assemblages failed to show long-term changes associated with upstream clearcuts. High natural variability in the system may explain this lack of changes.

INTRODUCTION

Attempts to determine the effects of logging activity on benthic populations have sometimes yielded confusing and contradictory results. Some studies have shown general decreases in standing crops and numbers below logging areas, whereas others have shown increased numbers (1 - 7) or increases in some components of the benthic community and decreases in others following logging (8-11).

The purpose of this study was to characterize the benthic insect assemblages downstream from logged and unlogged areas in southeastern Oklahoma.

METHODS

The study sites were located in southern LeFlore County, Oklahoma. A single site was located on Little Cow Creek, a tributary of the Mountain Fork River, near the town of Zafra in T1N R27E. Two sites were located on Upper Little River northeast of the community of Octavia in T1N, R23E. Site 1 was located in Section 1 and site 2 in Section 12. Another site was located on Big Eagle Creek (a tributary of the Mountain Fork River) north of the community of Octavia in T1N, R24E, Section 1. Little Cow Creek (an unlogged site) was used as a reference for logged sites on Big Eagle Creek and Upper Little River. Each of these streams was a third-order stream with similar soil type, substrate size, and other stream characteristics.

Quarterly samples were collected from riffles at each site with a Circular Depletion Sampler (12). Each sample was composed of three subsamples each of 2 min duration. Samples were initially placed in 10% formalin, then preserved in 70% alcohol. Organisms were generally identified to genus. Density and diversity values were based on population estimates (13) rather than on the actual number of organisms captured. Analysis of variance of rankings (14) was used to test for differences between population densities.

Diversity was calculated for each site using the Shannon-Weaver Index (15). Comparisons of diversity values were made on both a yearly and seasonal basis.

RESULTS

Significant annual (1981 and 1982) differences in total density occurred between the benthic assemblages in the reference site and both Upper Little River #1 and Big Eagle Creek #2 (Table 1). Values for ULR #2 were not significantly different from those at the reference site in either year. Significant seasonal (spring and summer) differences in total density also occurred between assemblages at the reference site and ULR #1 and BEC #2 in 1981 (Table 1). In 1982, the spring assemblage from ULR #1 was significantly different and that from BEC #2 was nearly significantly different from that at the reference site; also the winter assemblages on ULR #1 and BEC #2 were significantly different from that of the reference site. Assemblages during other seasons did not differ significantly from those at the reference site.

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TABLE 1. Seasonal mean density at each sample site.

Site	Mean	Spring	Summer	Fall	Winter
		Density/M^2			
1981					
LCC#1	3805	3310	4364	2174	5557
BEC#2	2476*	957*	2651*	4229	2068
ULR#1	2331*	990*	706*	1758	5871
ULR#2	4476	2435	2806	4842	7821
1982					
LCC#1	3630	2531	9058	788	3866
BEC#2	2431*	2196	8022	1032	1268*
ULR#1	1761*	1578*	-	1635	1985*
ULR#2	2675	1601	4335	1550	3571

LCC = Little Cow Creek
ULR = Upper Little River
BEC = Big Eagle Creek
* Significantly different from LCC#1

TABLE 2. Seasonal mean density at each sample site.

Site	Mean	Spring	Summer	Fall	Winter
1981					
LCC#1	3.11	3.32	3.24	3.10	2.82
BEC#2	2.89	3.37	2.89	2.01	3.28
ULR#1	2.44	3.15	2.89	1.42	2.27
ULR#2	3.12	3.16	3.44	2.81	3.07
1982					
LCC#1	3.50	3.83	3.09	3.06	3.46
BEC#2	3.36	3.72	2.64	3.33	3.25
ULR#1	3.01	3.64	-	2.53	2.53
ULR#2	3.63	4.18	3.15	3.69	3.23

LCC = Little Cow Creek
ULR = Upper Little River
BEC = Big Eagle Creek

Diversity was higher at the reference site than at ULR #1 and BEC #2 during both 1981 and 1982 (Table 2). Conversely, diversity was lower at the reference site than at ULR #2 during both years. There was no obvious difference in diversity between assemblages at the reference site and those at ULR #1 and ULR #2 in either spring, although values were consistently higher in 1982 than in 1981. Diversity values during the other seasons were variable, but they appeared to be more consistent at the reference site and ULR #2 than at BEC #2 and ULR #1.

There were no statistical differences in the numbers of taxa (Table 3) present at any of the sites during either year. However, the presence of large variations in the data between seasons would require very large differences in order to attain statistical significance.

TABLE 3. Number of taxa present at each of the sample sites during 1981 and 1982.

Site	Mean	Spring	Summer	Fall	Winter
		Number of Taxa			
1981					
LCC#1	49	52	45	48	51
BEC#2	36	33	37	35	38
ULR#1	32	33	26	29	39
ULR#2	44	42	41	46	48
1982					
LCC#1	36	45	32	24	44
BEC#2	31	41	31	21	29
ULR#1	32	40	-	23	34
ULR#2	39	48	33	31	44

LCC = Little Cow Creek
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DISCUSSION

During both years Upper Little River #1 and Big Eagle Creek #2 had lower annual densities and diversity of organisms than did the reference site. Both of these sites are located below areas of logging activity and in 1981 extensive road construction also occurred above these sites. A new clearcut was created upstream from ULR #1 in 1981 and approximately 100 m of the stream was channelized between the summer and fall of that year. A clearcut was also created upstream from BEC #2 late in 1982. The lower density and diversity of organisms at BEC #2 relative to the reference site could have resulted from silvicultural activity and that on ULR #1 from a combination of silviculture and channelization (16). Similar changes have been attributed to logging impacts by other authors (1, 4-6).

Although there does appear to be some evidence in the annual data for logginginduced changes below clearcuts, only about two-thirds of the seasonal observations show lower density and diversity in these sites than in the reference site. It is possible that natural variability could explain many of these differences. However if random variability were entirely responsible, we might not expect the lowest diversity on ULR #1 to correspond so closely with the timing of the second clearcut and channelization at that location. These data and those of another study (17) failed to reveal any dramatic long-term changes in the benthic populations. One might suspect that in a system, such as this one, that is naturally subjected to alternating periods of flash floods and droughts, that resistance to the kinds of conditions associated with clearcutting would be high and recovery would be rapid.

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