Habitat heterogeneity and fish communities relative to debris dams in East Fork Indian Creek, Menifee County, KY

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NSF-Research Experiences for Undergraduates, Disturbance Ecology in Central Appalachia 2019

Introduction

Large woody debris in streams has major effects on stream ecosystems, altering stream properties such as habitat heterogeneity, organic matter retention, and pool size. Many organisms rely on large wood debris for survival, including aquatic macroinvertebrates, fish, and turtles. Other organisms, such as herons and raccoons, rely on this for easier access to food [1].

One way large wood can be structured in a stream is as woody accumulations or debris dams. These dams form when a large branch or tree falls perpendicular to the stream's flow. Over time this obstruction accumulates smaller branches and leaf litter and significantly blocks stream flow. While these types of dams have been shown to support higher macroinvertebrate abundances and diversities[2], effects of debris dams on fish communities remains poorly understood. To fill this gap, we assessed how debris dams affect habitat heterogeneity, fish community diversity, fish communities upstream and downstream of debris jams, and biomass in East Fork Indian Creek (EFIC), Menifee County, Kentucky.

Methods

Sampling occurred at six sites along EFIC, which consisted of three debris dams and three unobstructed controls. Locations that contained a pool with immediate upstream and downstream riffles were selected as controls to ensure habitat similarity among all sites. Each dam was divided into two 30-meter reaches, upstream and downstream, with debris dams or center pools designated as the centerpoint. All measurements were taken from each reach independently.

Example of a debris dam on East Fork Indian Creek.

Three transects were established perpendicular to the stream every 10 meters in each 30-meter reach. Wetted stream width (m) was recorded at each transect using a meter tape. Water temperature (°C) was measured at the midpoint of each transect using a YSI probe. Microhabitat variables were measured at 10 equidistant points along each transect and included stream depth (cm), water velocity (m/s), dominant substrate, and canopy cover. Substrate was ranked based on a modified Wentworth scale ranging from silt (1) to boulder substrate (5). Fish were sampled with a backpack electrofisher once at each site using a single pass. Each fish was identified to species, and total length (mm) and mass (g) were recorded.

Data Analysis

Habitat data were analyzed using an additive rank approach. A larger rank meant greater difference in means and, overall, more

heterogeneous environment. Rank values were compared using a Wilcoxon rank sum test in RStudio.

Fish communities were analyzed by calculating both the Simpson's index and percent similarity for every site. Simpson's index values were converted to the effective number of species so they could be compared with a Wilcoxon rank sum test. Percent similarity values indicated how similar or different fish communities upstream and downstream of a debris dam or center pool were. These values were compared with a Wilcoxon rank sum test. Fish biomass was compared by calculating total fish mass for each site and comparing debris dams to controls using a Wilcoxon rank sum test.

Results

Results showed that debris dams did not significantly affect any response variable. Habitat heterogeneity (P=0.4), effective number of species (P=0.7), percent similarity (P=0.5), nor biomass (P=0.2) were altered by the presence of log jams.

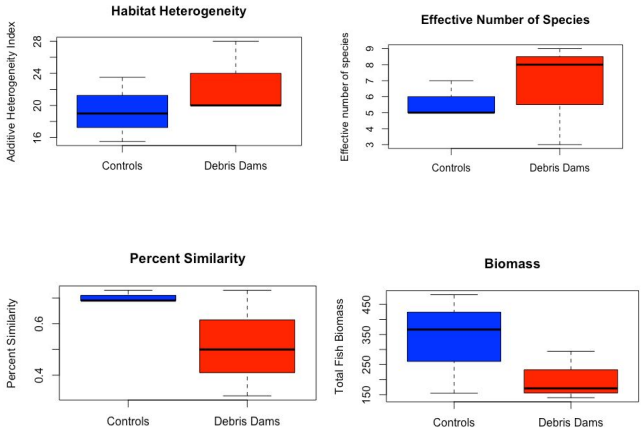

Figure: Box plots showing the results of the study. None of the response variables were altered by the presence of log jams (all P>0.05).

Conclusions

The results of this study indicate that debris dams had no significant influence on habitat or fish communities in EFIC. These results could most likely be due to the characteristics of EFIC. A previous study found that the inputs of large wood had less of an effect on high gradient streams with larger substrate [3]. EFIC and many of the streams around it are considered high gradient streams and there were many large boulders present at both the control sites and along many other pools and riffles. Perhaps the presence of large substrate lessens the impact debris dams have on this high gradient stream as well. These results may also be due to the stream order of EFIC. This stream is a larger, third order stream which may hinder the influence of debris dams on fish diversity. A study done involving beaver dams found that they increase fish species richness in headwater streams, but had little effect in downstream areas [4]. Perhaps debris dams act similarly.

Taken together these results suggest that debris dams have little effect on habitat heterogeneity and fish communities in EFIC. This has been one of the first studies to assess how fish are affected by these types of obstructions. This may also aid ongoing restoration efforts being done by the Kentucky Department of Fish and Wildlife Resources and the United States Forest Service.

References

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The study was conducted as part of the NSF Research Experience for Undergraduates and Research Experience for Teachers program: Disturbance Ecology in Central Appalachia — a ten-week summer research program hosted by Eastern Kentucky University.

Funded by the National Science Foundation, DIB 1559980.