Comparison of Stream Fish Diversity and Habitat Quality across Restored Reaches at East Fork Indian Creek, Menifee Co, KY

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NSF-Research Experiences for Undergraduates, Disturbance Ecology in Central Appalachia 2018

Introduction

Fish are an important component to freshwater ecosystems. Besides from being a common food source for many organisms, they mineralize nitrogen and phosphorus that are essential for primary production.[1] As organisms that are continuously exposed to changing water conditions, fish also serve as biological indicators. Therefore, their abundance and diversity can provide information to researchers about the quality of the water.

Freshwater fish are most threatened by anthropogenic disturbances that alter water flow and cause stream fragmentation.[2] An example of these disturbances are dams. Dams isolate downstream populations of fish by creating too high of gradients that make it difficult for small fish to migrate upstream. Obstructions to migration reduce gene flow and diversity, which can increase local extinctions. Nevertheless, research is looking towards restoration projects that limit these modifications to freshwater ecosystems. An example is cross-vanes.

Cross-vanes are U-shaped structures made with large rocks or boulders that direct energy towards the center of the channel. This provides width/depth stability of the stream, reduces bank erosion, provides habitat cover, and reduces excessive sediment transport.[3] All of these are supposed to increase the habitat quality for fish and other aquatic life.

[1] European Commission 2007
[2] Liermann, Nilsson, Robertson, and NG 2012
[3] Rosgen 2001

Photo: Cross-vane at East Fork Indian Creek

In 2015-2016, concrete low head dams and plank crossings were removed at East Fork Indian Creek (EFIC.) In addition, double inverted cross-vanes were installed to restore a section of EFIC to improve the habitat for aquatic organisms. specifically for the Emerald Darter (*Etheostoma baileyi*) and the Frecklebelly Darter (*E. stictogaster*), that are two fish species of state concern. The purpose of this study was to compare fish diversity and habitat quality across restored reaches to an unrestored section to discover what impact these cross-vanes were having to the area.

Methods

Surveying was conducted from May to July 2018 at EFIC in Menifee County, Kentucky (Lat: 37.894159 N, Long: -83.646977 W). Fish were sampled in 100-m reaches in the restored and unrestored section. The restored section included six cross-vanes, which were sampled both upstream and downstream (12 reaches). In addition, an upstream and downstream reach were sampled in

the unrestored section to be used as a control (2 reaches). Three-pass depletion was conducted using a backpack electroshocker and a mesh dipnet in a zig-zag pattern to cover the whole habitat. Fish were held in buckets containing an aeration system and were identified and enumerated. They were then put in a mesh enclosure immersed in the stream where they remained until the third pass was completed to avoid catching the same individuals.

Data Analysis

A rapid bioassessment protocol (RBP) was used at each of the six cross-vanes and the control to evaluate the habitat and water quality of all reaches. The RBP score is objective and is determined by 10 parameters that include vegetative cover, sediment deposition, and velocity/depth regime. The higher the score, the greater the habitat quality is for fish.

A Kentucky Index of Biotic Integrity (KIBI) was used to assess stream health using fish as a biological indicator. The KIBI uses twelve equally weighted metrics including catchment area, total number of individuals, and native species richness. East Fork Indian Creek was used with the mountain criteria with a scale of zero meaning very poor, to greater than 71 meaning excellent.

The Simpson's Diversity Index (SDI) was calculated for each upstream and downstream reach. It accounts for species richness and evenness with an index of zero to one. The higher the index, the higher the diversity. A single factor ANOVA was also used to examine if upstream or downstream was a significant factor in the KIBI score and the SDI.

Results

There was no significant difference in upstream and downstream KIBI scores (727.14 ± 3.78 and 77.14 ± 2.66 respectively df=1, F=1.17, p=0.30). Additionally, there was no difference in SDI upstream and downstream (0.849 ± 0.016 and 0.854 ± 0.017 respectively, df=1, F=0.046, p=0.83).

The RBP was highest in the control where there was no cross-vane (Figure).

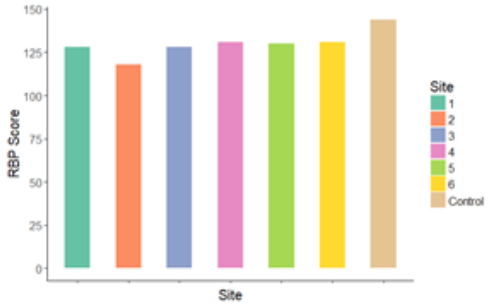

Figure: RBP scores of the 6 cross-vanes and unrestored section (control)

Conclusions

There were no significant differences in diversity and habitat quality across the restored section and unrestored section. This suggests that cross-vanes are not negatively influencing stream fish communities. Although the RBP score was slightly higher in the control than in the cross-vane sites, this could be a result of the cross-vanes only being installed a few years ago. This may not be a sufficient amount of time to score the cross-vanes because the vegetation is still growing after the construction work necessary to install these structures.

In the future, diversity and RBP should be measured again because restoration monitoring needs to be examined long term to truly understand the impact. There was no data taken before the restoration project and so this data can be used for comparison to determine if cross-vanes are best for stream management at East Fork Indian Creek.

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.