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Fish & Macroinvertebrate Species Diversity in Restored and Unrestored Forks of Massies' Creek, Ohio

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Fish Species Diversity in Restored & Unrestored Forks of Massies' Creek, Ohio

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Background

In 2006 a project team consisting of the Sanitary Engineering Department of Greene County, Ohio, Greene County SWCD, private landowners, Malcom Pirnie consultants, and Ohio EPA implemented a stream restoration project along the North Fork of Massies Creek. The \$1.7 million project sought to reduce agricultural impacts along a 3.5 km (2.2 mile) stream segment. In particular this work addressed erosion, water quality, fertilizer runoff, drainage, and improvements in stream and riparian habitat. In November of 2009 the engineering phase of the project was substantially completed, with supplemental plantings done in spring 2010.

The goal of habitat improvement is of particular interest in this agriculturally intensive area of southeast Ohio. With this in mind we began stream quality, fish, macroinvertebrate, and bird surveys in 2011 at this site. In order to monitor progress we chose to compare the restored North Fork with an unrestored segment of the South Fork of Massie's Creek approximately 5 km away.

Objectives

1. We sought to *measure the effectiveness* of this restoration project with respect to the fish communities of restored and unrestored Forks of Massie's Creek.
2. We set out to *establish a baseline* from which we might compare future monitoring efforts
3. To begin monitoring *seasonal variations* in fish species composition.

Study Sites

We conducted this study at two locations located in Southwestern, Ohio :

- The studied section of the North Fork of Massies Creek had been restored to resemble a natural stream with increased sinuosity, stabilized stream banks, and numerous riffle and pool features.
- We compared the restored section with an unrestored section of the South Fork of Massies Creek that exhibited heavily channelization, extreme down cutting, low sinuosity, and high erosion.



Methods

Fish sampling

- At each site during September 2011, April 2012, and September 2012 we deployed 4 – 10 minnow traps placed at ~5 m increments.
- Traps were placed once a week for five weeks and collected the traps 1 – 3 days after deployment
- We identified each fish using the Ohio Division of Wildlife Stream Fishes of Ohio Field Guide.

Data analysis

- Shannon ($H = -\sum P_i(\ln P_i)$) and Simpson ($D = \frac{1}{\sum \frac{1}{n_i}}$) indices used for analysis of species evenness and dominance at both sites. Simpson values closer to 0 indicate a more diverse community. Whereas, Shannon values range from 0 – 8 (with 1.5 – 3 considered typical).
- We used the spring 2012 data set to calculate fish metrics from Karr's Index of Biotic Integrity (IBI) for fish species,

	Count		% Abundance	
	Restored	Unrestored	Restored	Unrestored
Intolerant spp.	98	12	0.37	0.02
Tolerant spp.	100	333	0.38	0.69
Omnivores	10	32	0.04	0.07
Carnivores	95	11	0.36	0.02

Results

Fish communities

Stream comparison

- During the spring 2011 and fall 2012 sample periods we caught 345 and 696 individual fish at the restored and unrestored streams. The Creek Chub was most abundant in both streams with 144 and 520 caught.
- Species richness was greater at the unrestored stream with 26 species as opposed to the 21 species identified in the restored stream.

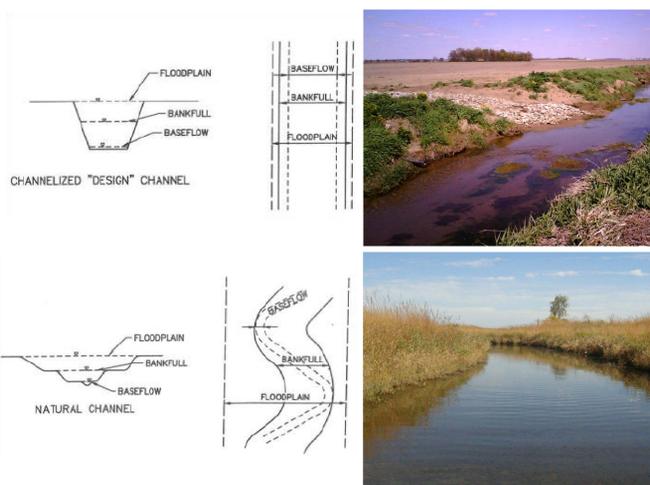
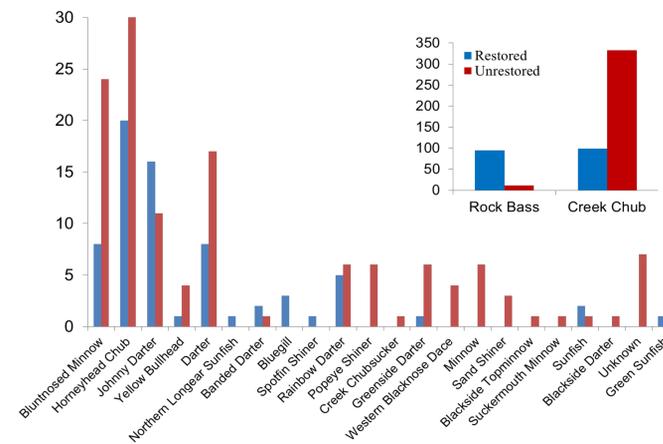
Seasonal differences

During fall 2011:

- We caught a total of 295 fish during the fall 72% (n = 213) of which were caught at the unrestored stream.
- Species dominance was greater (D = 0.85) and evenness was lower (H = 0.37) at the unrestored stream as compared to the restored stream (D = 0.43 and H = 1.05).

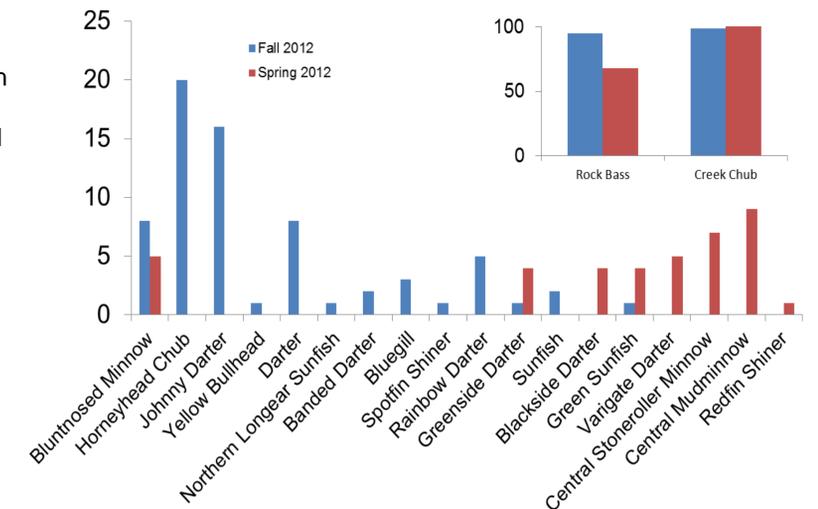
During spring 2012 (see figure below):

- We caught nearly 3x as many fish (n = 746) as compared to the fall with 483 and 263 in the unrestored and restored streams, respectively.
- Species dominance was greater (D = 0.49) and evenness was lower (H = 0.060) at the unrestored stream relative to the restored stream (D = 0.28 and H = 0.70).



During Fall 2012

- Due to a lack of rain in fall of 2012 the unrestored section of the creek was bone dry and thus unable to sample for the entirety of the season.
- We chose instead to sample only the restored section for direct comparison with the spring 2012 fish data.
- We caught a total of 229 fish at the restored site which was consistent with our spring 2012 catch of 263.
- Both species dominance and evenness was similar in the fall 2012 survey (D=.33, H=.66) relative to the spring 2012 survey (D=.28 and H=.70).



Implications

Fish communities

- Our study found species richness in these streams to be similar though the unrestored stream supported a community of tolerant species that made up 69% of the fish caught there during the spring as compared to the restored stream fish community which we found to have greater than 1/3 (37%) of the fish being intolerant species.
- Diversity varied by stream and season with the restored stream having lower reduced species richness and increased species evenness.
- Fish species diversity in the restored site varied little between the fall 2012 and spring 2012 surveys indicating that fish populations in the restored section may retain their diversity levels between fall and spring seasons.

Stream restoration

- These data and related investigations of stream chemistry, soil chemistry, and bird populations will serve well as a baseline with which to monitor future changes.

Acknowledgements

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