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Article

The water quality of beargrass creek with regard to its crayfish population

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Abstract: As a type of small crustacean that can be found all over the world, though indispensably important, crayfish has received little attention on its conservation. In this research paper, I present results on the water quality of the three forks of Beargrass Creek of Kentucky, via pH, Dissolved Oxygen and water hardness, to discuss the effects that the three forks would have on its crayfish population. Due to the measuring difficult at the South fork, only the Middle fork and the Muddy fork were compared, and according to the data, Muddy fork is found to be a more ideal environment for crayfish to thrive, with higher Dissovled Oxygen and more optimal pH & water hardness.

Keywords: beargrass creek; middle fork; muddy fork; pH; dissolved oxygen; general hardness; water quality; crayfish; conservation

1. Introduction

Crayfish, a specimen of which is shown in **Figure 1**, are a very common type of crustacean that is eaten all over the world. There are some 150 crayfish species in North America, over 540 species worldwide.[1] They can be found in creeks and rivers in the US, from Michigan in the north to Florida in the south, and from the Americas to Eurasia. They are typically found in burrows near water or underneath rocks in creeks. As a creature that grows to no more than a foot in length, they usually feed on animal carcasses that they encounter or on aquatic plants [1].

Figure 1. Image of a typical crayfish.

However, due to pollution and over-exploitation of the natural environment, some species of crayfish are now in danger of going extinct. As a result, many recent studies have investigated the optimal living and breeding conditions of crayfish to figure out how to best save these species. For instance, a study done in 1997 shows that a pH between 7.5–8.5 is best for crayfish.1 Another article states that a water pH range from 6.5 to 8.5 and a total hardness/alkalinity range from 50 ppm to 250 ppm are the best water quality parameters for crayfish, 2 and yet another source claims that a pH of 6.5–8 and a general hardness of medium hard to very hard are the best water conditions for crayfish.3 Taken together, these reports indicate that the optimal water conditions for crayfish are medium hard or hard water with a slightly alkaline pH; however, none of these sources have shown the optimal dissolved oxygen in water for crayfish.

In this study, we attempted to measure the DO (dissolved oxygen), pH and water hardness levels at two different locations in the Beargrass Creek Watershed in Jefferson County, Kentucky—the Muddy fork and the Middle fork. Our goal was to determine which location might better support a crayfish population [2].

As shown in **Figure 2**, the Muddy Fork and the Middle Fork are two of the three forks of Beargrass Creek. Beargrass Creek is home to a species of crayfish known as the Louisville crayfish (Orconectes jeffersoni).

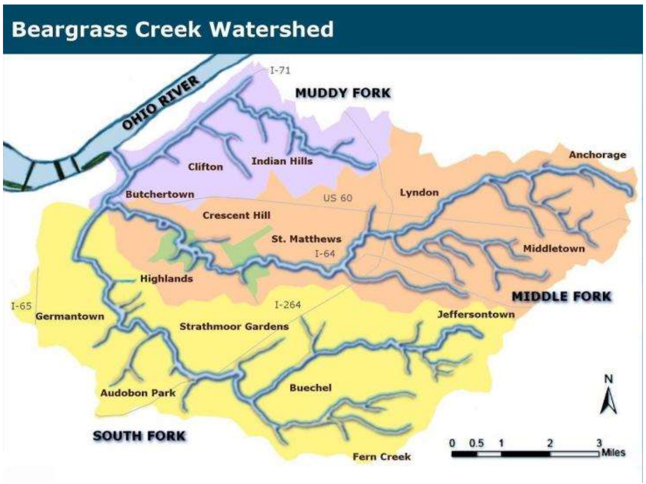

Figure 2. Map of the area around muddy fork and middle fork.

2. Methods

The pH of the Muddy and Middle fork were measured using Chlorine & pH Pocket Colorimeter II. Samples of water from these two forks were taken into a test tube, and the colorimeter was placed in, the pH readings were obtained.

Vials were be labelled with a piece of tape that said e.g., "pH Muddy Trial 1." The following method was employed:

1. Determine the GPS location of the collecting sites (Muddy Fork, South Fork, Middle Fork)

2. Collect sample 20 cm away from the bank, 10 cm deep in the water, collect 3 samples **Only collect moving water.

3a. Rinse test tube 3 times with water (point the collection container upstream).

3b. Fill the test tube to the 10 mL line with the water sample.

4. Put the probe of the colorimeter into the test tube.

5. Wait until the pH reading on the colorimeter hardly changes to record the result as pH.

6. Repeat steps 2–5 at South Fork and Middle Fork

The DO was measured using HQ30D Portable Dissolved Oxygen Meter.

Vials were labelled with a piece of tape that says e.g., "DO Muddy Trial 1." The following method was employed:

1. Determine the GPS location of the collecting sites (Muddy Fork, South Fork, Middle Fork)

2a. Rinse test tube 3 times with water

2b. Collect sample 20 cm away from the bank, 10 cm deep in the water, collect 3 samples

3. Submerge the small tube in the water sample, carefully remove the tube from the water sample, keeping the tube full to the top

4. Put the probe of the DO meter into the test tube.

5. Wait until the DO and temperature readings on the DO meter hardly change to record the result as ppm Dissolved Oxygen and °C water temperature.

6. Repeat steps 2–5 at South Fork and Middle Fork.

To measure general hardness, vials were labelled with a piece of tape that says eg. "GH Muddy Trial 1." The following method was employed:

1. Determine the GPS location of the collecting sites (Muddy Fork, South Fork, Middle Fork)

2a. Rinse test tube 3 times with water

2b. Collect sample 20 cm away from the bank, 10 cm deep in the water, collect 3 samples

3. Fill the test tube to the 10 mL line with the water sample

4. Dip a strip into water for 2 s and remove, gently shake off excess water

5. Hold the strip level, with pad side up, for 1 min

6. Compare the Total Hardness test pad to the color chart, estimate results if the color on the test pad reads between two color blocks

7. Repeat steps 2–6 at South Fork and Middle Fork

Eye protection was worn during experiments and hands were washed after performing experiments.

Dissolved oxygen and pH test samples can be disposed of by flushing down the drain with excess water. While in the field, reacted samples can be poured together into a waste container for later disposal.

3. Results and discussion

As seen in Graph 1 and **Table 1**, the DO concentration of the Muddy fork, which is 10.2 mg/L, is higher than that of the Middle fork with a concentration of 9.56 mg/L. This may be due to the lower water temperature of the Muddy fork than the Middle fork.

Table 1. Summary of the results collected at muddy fork and middle fork.

	Middle Fork	**Muddy Fork**
pH	7.87	8.03
Dissolved oxygen (mg/L)	9.56	10.2
General hardness (ppm)	38*	56

The difference in values between our measurements may have been due to the raining conditions during which we obtained these measurements. This may be because rain can have a lower pH than the creek water which could have lowered our pH readings of the Middle fork. See **Figure 3**.

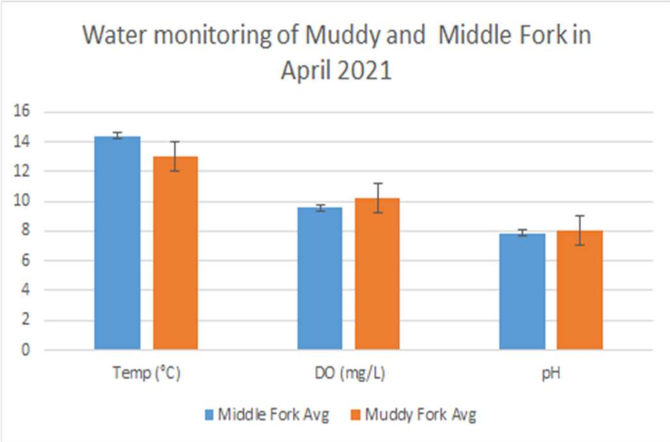

Figure 3. Graphical depiction of results collected at muddy and middle fork.

Only one measurement of general hardness was done for the Middle fork because of lacking water samples.

As a whole, we would expect the advanced measurement done using the HQ30D Portable Dissolved Oxygen Meter and the Chlorine & pH Pocket Colorimeter II to be more accurate because the use of advanced instruments avoids subjective errors; however this assumption was not directly tested. The water hardness reading was done by eye, where a comparison had to be made with colors, which can lead to errors. However, since the water hardness measurements are within margin of error, they still agreed with each other as a whole.

The pH values of both Muddy fork and Middle fork obtained are within the previously reported optimal pH ranges (7.5–8.5), but the water hardness concentrations were not similar. The water hardness of the Muddy fork is 56, which is within the optimal water hardness range (medium hard to hard), as opposed to the water hardness of the Middle fork, 38, which is classified as soft.

Overall, because our pH and water hardness measurements of the Muddy Fork were extremely similar to the optimal living conditions of crayfish measured in previous experiments, the Muddy Fork should be better for crayfish to live. See **Table 2**.

Table 2. Comparison of the results of previous experiments and my experiment at muddy fork.

	Muddy Fork	**Previous Experiments**
pH	8.03	7.5–8.5
General hardness (ppm)	56	50–200
Dissolved Oxygen (mg/L)	10.2	unknown

Based on qualitative observations, crayfish seemed to thrive more in the Muddy fork, which had a higher DO concentration and water hardness than the Middle fork [3].

4. Conclusions

Although it seems quite clear that the Muddy fork is a more optimal condition for crayfish to live in, there is a lot more work that has to be done in the future. This research paper only gives the prediction on the crayfish population of Muddy fork and Middle fork, we still need to find out whether our prediction is correct. Additionally, the sample site of Muddy fork is located in a naturally well-preserved area, whereas the sample site of Middle fork is located in the downtown area of Louisville where apartment buildings and factories surrounded the site; there was an obvious stinking odor around the sample site of Middle fork, whereas the sample site of Muddy fork didn't. As previously mentioned, due to measuring difficulty, we failed to obtain data from the South fork, so the water quality of the South fork is still unclear.

Conflict of interest: The authors declare no conflict of interest.

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