DOI

AMPHIPOD TRANSPLANT STUDY

Peyton Goodrich, Jocelyn Santos, Elizabeth Bailey, and Alexis Benner

ABSTRACT

In this report, our research team conducted a transplant study to investigate the potential impact of water quality and the accumulation of pollutants on the survivorship of *Gammarus minus.* Given the sensitivity of this particular amphipod species to changes in the quality of water within its habitat, we hypothesized that heavy residential land use and traffic might lead to differential water quality in different sections of the Muddy Run stream, thereby affecting the survivorship of the amphipods. Specifically, ninety amphipods were transplanted in three different locations, with thirty remaining in their harvest location of Petersburg Spring and the other sixty being divided among two sites in Muddy Run, one directly outside the East Houses bridge and one the near Weis Markets parking lot. It was expected that the East Houses location would have higher pollution levels and thus lower survivorship due to heavier residential use and foot traffic. Over the course of two consecutive weeks, the survivorship of amphipods at each site was monitored by visiting once a week and counting the number of alive versus dead individuals. Our results revealed unexpected findings, with higher mortality observed among the amphipods at the Weis Parking site, contrary to our initial hypothesis. Despite this discrepancy, our study provides valuable insights into the complex interplay between water quality and the survivorship of amphipods in Muddy Run stream.

Key words: amphipods, survivorship, transplant study, water quality

INTRODUCTION

Amphipods; small, elongated crustaceans within the order *Amphipoda,* are common in many aquatic ecosystems, including but not limited to springs, rivers, and lakes. The order *Amphipoda* contains many different families and genera of crustacean, but this study focuses specifically on the species *Gammurus minus.* Evidence exists to suggest that *Gammurus minus* is highly sensitive to changes in water quality, including dissolved oxygen, with a preference for high oxygen levels (Wetzel, 2001), and water temperature, with a preference for cold water (Wetzel, 2001). Previous studies have also shown that *Gammurus minus* is sensitive to the presence of several pollutants, and that survivorship can be heavily influenced by even the smallest levels of pollution (Lieb and Carline, 2000). As such, the presence or absence of *Gammarus minus* in a body of water can provide important information about water quality and ecosystem health. With this in mind, the objective of this study was to examine the survivorship of transplanted amphipods in three different locations: Petersburg Spring, a branch of Muddy Run directly outside of East Houses, and a branch of Muddy Run further downstream, near Weis. Specifically, our research team aimed to determine which location had the highest survivorship rate, and whether that survivorship was influenced by the accumulation of pollutants.

QUESTION

Does water quality in different locations of Muddy Run affect survivorship of transplanted amphipods?

DOI

HYPOTHESIS

Null Hypothesis: Survivorship will not differ between sites.
Alternate Hypothesis: Survivorship will be lower at the East location due to point-source pollution from heavy residential use.

MATERIALS AND METHODS

To investigate the potential impact of water quality on the survivorship of amphipods in Muddy Run stream, we conducted a transplant experiment that involved multiple steps. First, we visited three different locations, namely Petersburg Spring (control), East Bridge, and Weis Parking, and conducted basic water quality tests using a YSI multiparameter probe. Next, we collected a total of ninety amphipods from Petersburg Spring and distributed them into transplant containers. These amphipods were then divided into three groups, with thirty amphipods in each group: Petersburg, East, and Weis.

Over the course of two weeks, we returned to each group to count the survivorship of the amphipods. During each visit, we recorded the number of dead and alive amphipods in each group. After completing the data collection, we analyzed the survivorship of the amphipods in relation to the water quality data we had collected earlier. Specifically, we compared the survivorship rates of the amphipods at the different locations and correlated them with the corresponding water quality measurements to explore the potential effects of environmental factors on the survivorship of amphipods.

TIMELINE

- Week 1: collect the amphipods, distribute them to each stream, do water quality testing at each stream
- Week 2: first survivorship test
- Week 3: second survivorship test
- Week 4: analyze results

MATERIALS

- YSI multiparameter water quality probe (1)
- Transplant containers (90)
- Rubber bands (90)
- Nets (4)
- Buckets (3)
- Pipettes (4)
- Tray (1)

FIELD SITE

- Petersburg Spring, which served as a control group habitat, is a relatively warm and neutral spring where the amphipods for the transplant study were collected.
- Muddy Run, East, is a relatively warm and neutral spring beneath a heavily trafficked area that is known for large amounts of pollutants and debris.
- Muddy Run, Weis, is the coolest and most basic spring, residing next to a grocery store parking lot and partially shaded by an overpass.

Figure 1.

Bucket of transplant containers at the Petersburg spring.

Figure 2 was taken at the Petersburg spring.

Figure 3 was taken at Muddy Run (East).

Figure 4 shows a general representation of where we put transplants throughout Muddy Run. The blue line gives an approximate area of where Muddy Run runs and the yellow circles are approximately where we put our transplants.

Date	Amphipods Alive	Amphipods Dead	Amphipods Missing

3/28/23	30	0	0
4/4/23	21	0	9
4/11/23	19	0	2
TOTAL	19	0	11

Table 1 shows the survivorship of amphipods over the course of two weeks at Petersburg. On the date of 3/28/23, we put 30 amphipods into the spring, and after two weeks nineteen survived, eleven went missing, and none died.

Date	**Amphipods Alive**	**Amphipods Dead**	**Amphipods Missing**
3/28/23	30	0	0
4/4/23	15	5	10
4/11/23	5	3	7
TOTAL	5	8	17

Table 2 shows the survivorship of amphipods over the course of two weeks at Muddy Run (East). On the date of 3/28/23, we put 30 amphipods into the spring, and after two weeks five survived, eight died, and seventeen went missing.

Date	Amphipods Alive	Amphipods Dead	Amphipods Missing
3/28/23	30	0	0
4/4/23	20	8	2
4/11/23	10	4	6
TOTAL	10	12	8

Table 3 shows the survivorship of amphipods over the course of two weeks at Muddy Run (Weis). On the date of 3/28/23, we put 30 amphipods into the spring, and after two weeks ten survived, twelve died, and eight went missing.

After Two Weeks

Alive	Dead + MIA
19	11
5	25
10	22

Table 4. A contingency table with results from a two- week transplant study

Results						
	Dead+MIA	Alive				***Row Totals***
Petersburg	11 (18.67) [3.15]	19 (11.33) [5.19]				30
Muddy Run East	25 (18.67) [2.15]	5 (11.33) [3.54]				30
Muddy Run Wise	20 (18.67) [0.10]	10 (11.33) [0.16]				30
Column Totals	56	34				**90 (Grand Total)**

Figure 2. A contingency table with results for the two-week transplant study

Site	ph	Water Temp	DO (mg/L)	Conductivity	Barometric Pressure
Petersburg S|	7.2	10.4C°	13.65 mg/L	147.7 SPC	746.7 mmHG
East Bridge	7.6	10.6C°	19.27 mg/L	375.7 SPC	746.8 mmHG
Weis Parking	8	9.9C°	21.63 mg/L	429.3 SPC	747.6 mmHG

Figure 3. Results of water quality test

RESULTS

Our study began with thirty alive amphipods at each site, all extracted from Petersburg spring. After the first week, each container was checked and the amphipod inside was placed in one of three categories: Alive, Dead, or Missing in Action (MIA). If the amphipod inside was alive, it was returned to the stream for a second week of study. As shown in the contingency table above, after two weeks, nineteen amphipods remained alive in the control group at Petersburg Spring; five remained alive in the East Bridge location, and ten remained alive in the Weis Parking location. In order to calculate our results with greater significance, the dead and missing-in-action amphipods were combined. In Petersburg, eleven amphipods were dead or missing; ar the East Bridge location, twenty-five were dead or missing; finally, at the Weis Parking location, twenty were dead or missing. When these results were analyzed, it was found that the East location had the lowest survivorship, with Petersburg having the highest. However, Petersburg only served as a control group. Of the two variable locations, Weis parking had the highest survivorship. For this data set, we conducted a chi-square test, and with that test, we received a statistic of 14.2752, after running this test, we received a p-value of .000795, which results in our data being significant.

DISCUSSION

After conducting this experiment, our results tell us that amphipods had higher survivorship in Petersburg, that was because this spring meets the ideal condition best suited for amphipods to live in such as low water temperature of 10.4 C° primary neutral pH levels of 7.4, etc. When collecting water quality samples, we noticed that the temperature in muddy run, the east location was 7.6 compared to the Weis location having a more basic pH 8. The temperature between the two muddy run locations showed us that in the east section, the more populated area has a temperature more closely like Petersburg of 10.6 C°, unlike the Weis location, its temperature was 9.9 C°. It is important that springs have plentily of oxygen for aquatic life to survive, in Petersburg the amount of dissolved oxygen of 13.65 mg/L, and both the east and Weis had higher levels of dissolved oxygen, the highest one coming from Weis being at 21.63 mg/L and east having dissolved oxygen at 19.27 mg/L. By measuring the barometric pressure, we are able to predict the short-term changes in the weather, which plays a factor in springs when harsh weathers occur, different things can enter the springs such as sticks, dirt, and plant fertilizer that can change the water quality in springs, and with these drastic changes, this can cause the aquatic life living inside of the springs do not have high survivorship in the spring. As mentioned in the paper, our hypothesis was that survivorship will be lower in the East location in the muddy run due to the point source of pollution and being a high residential area, by performing this transplant study, we were able to prove that our hypothesis was correct, in springs with both higher temperature and pH will lessen the survivorship of amphipods. What had through this two-week study was that three of the amphipods that remained in the

control group, in the Petersburg spring, we happened to accidentally insert pairs of amphipods in the transplant containers, and during our second round of data collection, three of the remaining nineteen amphipods happen to had given birth, unfortunately, it only occurred in the control setting, we are not for certain that it was human error that causes them to give birth but it was still an interesting find to make during this study.

LITERATURE CITED

Wetzel, Robert. 2001. "Benthic Animals and Fish Communities." *Amphipod - an Overview* |

ScienceDirect Topics. Website accessed April 2023. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/amphipod#:~:text=Amphipods%20have%20high%20oxygen%20requirements,concentrations%20(Franke%2C%201977). "Amphipod." *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., website accessed April 2023. https://www.britannica.com/animal/amphipod.

Lieb, David A., and Robert F. Carline. "Effects of Urban Runoff from a Detention Pond on Water Quality, Temperature and Caged Gammarus Minus (Say) (Amphipoda) in a Headwater Stream Hydrobiologia." *SpringerLink*, Kluwer Academic Publishers, Dec. 2002.

Lawrence, Lisa. "Amphipods." *BRIDGE Ocean Education,* website accessed April 2023.http://masweb.vims.edu/bridge/datatip.cfm?Bridge_Location=archive0202.html#:~:text=An%20amphipod%20is%20a%20small,good%20species%20for%20pollution%20experiments.