Manipulative Experiment to Examine the Effect of Sediment Covered Rocks versus Algae Covered Rocks on a Population of Macroinvertebrates in Rock Creek Stream

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Abstract:

In order to understand the negative effects of human activity, we studied the effect of sediment covered rocks versus algae covered rocks on a population of macroinvertebrates in Rock Creek. Sediment deposition is a natural process that impacts the feeding of macroinvertebrates and the quality of the habitat; substrate particle settles on algae covered rock and reduces its the nutritional quality. By collecting sediment and algae covered rocks, redistributing them to match a planned layout, and recording their populations, we were able to see the impacts of sediment on macroinvertebrates. Moreover, this allowed us to see the consequences of erosion in urbanized streams, which increases sedimentation and as a result, reduces the nutritional value of algae (a large source of food for macroinvertebrates). Our results supports the hypothesis in which there are less macroinvertebrates on sediment covered rocks than clean, algae covered rocks.

Introduction:

- The purpose of this experiment is to examine the effects of sediment deposition, the settlement of sediment and small rocks on surfaces, on macroinvertebrate populations by comparing the populations of macroinvertebrates on sediment covered rocks with minimal algae, and clean algae covered rocks.
- The research question is, "how does sediment on rocks affect the population of invertebrates?"
- Our hypothesis was that there will be less macroinvertebrates on the rocks with sediment compared to the rocks without sediment because sediment covers algae, which reduces the nutritional value of algae and macroinvertebrate fitness.
- We made our hypothesis based on the conclusion that sedimentation deposition decreases food supply of macroinvertebrates (Suren, 2005). Also, deposition of silt has shown to decrease survival of macroinvertebrates (Peeters et al., 2006)

Figure 1: Rock Creek, branching off from the Clackamas River, is part of the the Clackamas watershed.

Figure 2: Picture of where the rocks were placed. The red flags were used to mark where each rock was located.

Figure 3: Schematic of actual placement of rocks in stream.

Methods

Study site at Rock Creek Stream in the Clackamas Watershed

Experimental Design:

- Treatment = sediment covered rocks, control = algae covered rocks

Collected rocks covered with sediment in low velocity water and algae covered rocks with no sediment in the middle of stream (10 each)

- Measured vertical and horizontal axis of rocks in centimeters
- Marked treatment and control rocks with purple crayon (ex. T5)
- Because of time, only 7 treatment/control rocks were put in stream
- Two rows of 7 alternating treatment and control rocks 2 feet apart placed in stream (Figure 3)
  - Each rock 1 foot apart in rows and marked with red flags (Figure 5)
  - Placed in shallow area in the middle of stream
- Macroinvertebrate counts recorded on second day of experiment

Sample Processing

- Control and treatment rocks collected from stream after 5 days and placed on the side of the stream (preserved in field)
- Each rock was rinsed in tub with stream water and number macroinvertebrates from rock were counted and recorded with corresponding treatment/control number. (Figure 6)

Data Analysis

- Density of macroinvertebrates per square cm calculated with surface area of rock and corresponding population of macroinvertebrate

Figure 5: Marked locations of treatment and controls at Rock Creek.

Figure 6: In the picture, insects are washed into tub and counted. This is a step in our procedure.

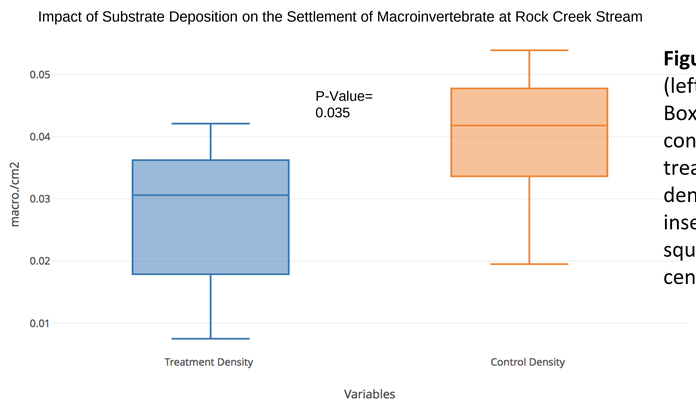

Figure 4: (left) Boxplot of control and treatment density of insects per square centimeter.

Data Table: Density of Macroinvertebrates per square centimeter

Treatment #	Surface Area (cm^2)	Density (macro./cm^2)	Control #	Surface Area (cm^2)	Density (macro./cm^2)
T1	468	0.036	C1	527	0.046
T2	356.5	0.042	C2	1078	0.020
T3	555	0.036	C3	391.5	0.049
T4	127.5	0.016	C4	573.5	0.042
T5	916.5	0.031	C5	693	0.036
T6	450	0.024	C6	297	0.054
T8	798	0.008	C8	396	0.033
Mean:	**524.5**	**0.028**		**565.1**	**0.040**

Figure 7: Data Table that compares the density of macroinvertebrates of rocks without sediment and rocks with sediment.

Results

- The control group (algae covered rocks) has a higher population density per cm^2 of macroinvertebrates than the treatment group (sediment covered rocks)
- Our results (P-value=0.035) can reject the null hypothesis because the P-value<0.05.
- Mean, Q1, and Q2 of insects control are higher than treatment
- The median, Q1 and Q2 of the control is also higher than the treatment
- The range of the treatment group is larger than the control group

Discussion

- Algae covered rocks (control) has a higher insect population density than sediment covered rocks (treatment)
- Sediment addition reduces macroinvertebrate population
  - Meaning that sediment = smaller population density
- Human activity has promoted erosion and sedimentation, which in turn causes substrate to be moved by currents (saltation). As a result, sedimentation decreases primary production and food quality (Peeters et al., 2006). Moreover, sediment degrades the teeth of macroinvertebrates and makes it less accessible. Ultimately, less food (algae) equates to less macroinvertebrates, which is why sediment covered rocks have a smaller population of stream invertebrates compared to algae covered rocks.
- By examining the negative impacts of sediment on macroinvertebrates, this allows us to become aware of the destruction caused by anthropological activity. Urbanized streams have suffered from heavy erosion/sedimentation and as a result, an increased sediment addition. Sedimentation has been a result of destructive land use, such as mining, forestry, agriculture, and urbanization. It is also found that invertebrates are very sensitive to sediments, and that this can contaminate food supplies and create an unhealthy habitat (Suren, 2005). By understanding these consequences, researchers are allowed to figure out ways to prevent this from happening further and understand why there is a population difference in sediment/algae covered rocks.

Experimental Flaws:

- We mixed up our schematic due to the inability to identify the treatment number. The crayon faded when we rinsed the rock, which caused us to arrange the rocks in the wrong schematic. Moreover, due to the time constraint, we ended up tossing rocks in the stream instead of in an organized, 1 foot by 2 foot arrangement.
- Only 7 trials instead of 10 (smaller sample size = less precise data)
- We were not experts on identifying macroinvertebrates, so our insect count might've been wrong. This was made clear when a college student counted more insects; that we missed when recording the population of one rock.
- It rained during the 5 day waiting period, which could have increased the current in the stream and affect populations.
- Limitations include: time constraint, sample size, human error (incorrect population count)
- I'd recommend future groups to work quickly, mark their treatment and controls CLEARLY, and research well to accurately identify the right number of macroinvertebrates.

Citations:

Peeters, Edwin T. H. M., Bart T. M. J. Brugmans, John A. J. Beijer, and Rob J. M. Franken. "Effect of Silt, Water and Periphyton Quality on Survival and Growth of the Mayfly Heptagenia Sulphurea." *Aquatic Ecology*40.3 (2006): 373-80. Web. 8 Mar. 2018.

Suren, Alastair M. "Effects of Deposited Sediment on Patch Selection by two Grazing Stream Invertebrates." *Hydrobiologia*549.1 (2005): 205-18. Web. 8 Mar. 2018.

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