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MACROINVERTEBRATE LEAF SPECIES PREFERENCE: A COMPARATIVE STUDY

**ABSTRACT**

MACROINVERTEBRATE LEAF SPECIES PREFERANCE: A COMPARATIVE STUDY. Elizabeth Marilyn Yang Frantz. 536 South Summit St. Smithville, Ohio.

The purpose of this project was to find out which species of leaves macroinvertebrates prefer. The hypothesis was macroinvertebrates would prefer Sugar Maple leaves over eight other types of leaves. The Stroud Water Research Center, Avondale, Pennsylvania protocol for collecting macroinvertebrates was followed using twenty-seven leaf packs in Sugar Creek. Three data collection points were identified at the site, using nine bags at each site, one for each type of leaves, which were tied to concrete blocks and left to “soak” for seventeen days. The leaf packs were then collected and macroinvertebrates were then identified and counted. The data did not support the hypothesis at all three data collection points. Several factors affecting the data, during the seventeen days the leaf packs were in Sugar Creek, were high water, ice, and tangled lines. The data, however, showed there was minimal affect high water had on this research. Ice and tangled lines on the leaf packs probably resulted in significant loss of macroinvertebrates during the very difficult collection of the leaf packs for the first data set. The data showed macroinvertebrates had no preference to the nine leaf species. Macroinvertebrates seem to be opportunists and will live wherever there is shelter and food. Other relevant research can be done in the future such as finding water quality to help manage this important water resource used, and needed, every day.

**PURPOSE**

My brother and I were looking at leaf color this past fall before the leaves fell off the trees. We actually matched the color to a leaf color chart and entered this into a database. This really got me thinking more about leaves. I already knew some of the different leaves because I helped when it was time to rake them.

My brother really likes to go fishing. This got me thinking about what the fish eat. My Dad knew of a leaf pack experiment I could try to see what different animals (macroinvertebrates) lived in the water. This is how this idea came together.

In school we learn about cycles. This is like another cycle. The water needs to be clean in order to have macroinvertebrates living in the water, in order to be food for the fish, in order to be a good spot to go fishing, and in order to have clean fish to eat! Since there is a creek (Sugar Creek) by where I live, I decided to sample Sugar Creek to try to determine the health or quality of the water, which flows every day through Smithville.

**MY QUESTION**

Which type of leaves do macroinvertebrates that live in the water prefer?

**HYPOTHESIS**

I think the macroinvertebrates will prefer Sugar Maple, *Acer saccharum,* because the leaves are big and roundish and insects need hiding spots.

**CONTROL**

•Mass stayed the same (20 grams of leaves)

•Bags were the same

•Body of water (Sugar Creek)

•Same time in creek (17 Days)

•Invertebrate collection and identification (protocol)

**VARIABLE**

•Types of leaves (9 species used)

•Paw Paw (*Asimina triloba)*

*•*Silver Maple (*Acer saccharinum)*

•Pin Oak (*Auercus palustris*)

•Wild Cherry (*Prunus serotina)*

•Mulberry *(Morus alba*)

•Box Elder (*Acer negungo*)

•Sugar Maple (*Acer saccharum*)

•Hawthorn (*Crataequs pruinosa*)

•Persimmon (*Diospyros virginiana*)

**MATERIALS**

•Mesh bags

•Twenty grams of each leaf species

•Electronic balance

•Zip tie

•String

•Concrete block

•Small buckets

•Large bucket

•Sorting pan

•Macroinvertebrate identification cards

•Tree identification book

•Journal

•Magnifying glass

•Eye dropper

•Pencil

•Clip board

•Data sheets

•Calculator

**METHODS**

**PREPARATION**

1. Identify the nine different tree species.
2. Collect at least 60 grams of each leaf. Twenty grams of leaves for each of three leaf packs.
3. Twenty grams of leaves go into each mesh bag. The mesh bag is zip tied shut with an identification tag attached. The identification tag information includes, “Leaf Pack Experiment” and bag number.

**PLACING LEAF PACKS INTO THE CREEK**

1. Site identification included one slow moving section of Sugar Creek and two riffle (fast moving) sections of Sugar Creek.
2. The leaf packs were tied to the concrete blocks then carried (dragged) into Sugar Creek. The leaf Packs were left to “soak” for 17 days. We took the temperature of the water.

**COLLECTING THE LEAF PACKS**

1. Water temperature was taken.
2. Creek water was collected in a large bucket for use later.
3. When the leaf packs were collected after 17 days, they were immediately placed into small buckets with creek water so I wouldn’t lose many macroinvertebrates.

**SORTING THE LEAF PACKS**

1. When I got home, my Dad and I sorted out all of the macroinvertebrates from each bag (1-27). It took 3 days to do all of that (each day – 9 mesh bags, one for each species of tree).
2. I filled out the data recording sheets.
3. The macroinvertebrates were released back into Sugar Creek the same day.

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Data Collection Site

**RESULTS**

**MACROINVERTEBRATES FOUND**

•Mayflies (*Ephemeroptera*) 12

•Caddisflies (*Trichoptera*) 2

•Damselflies (*Zygoptera*) 152

•Beetle (*Coleoptera*) 1

•Midges (*Chironomidae*) 14

•Crane Flies (*Tipulidae*) 1

•Planarians (*Turbellaria*) 2

•Snails (*Gastropoda*) 3

•COMMON NAMES WILL BE USED THROUGHOUT THE REST OF THE RESULTS•

**FIRST GROUP OF NINE BAGS**

7 DEC 2019: BEGINNING WATER TEMPERATURE: -3.0 Cº (Closed canopy with Silver Maple, Elm, and Eastern Hemlock *Tsuga canadensis.* Creek clear, free flowing).

24 DEC 2019: ENDING WATER TEMPERATURE: 0.2 Cº (Much ice, especially on the leaf packs, which were also tangled and very difficult to separate and remove. Not many macroinvertebrates predicted, ultimately not many counted).

NOTE: Macroinvertebrates were in the larval stage unless noted differently.

BAG 1: Paw Paw. One caddisfly, one damselfly, two snails (adult). 4 (4)

BAG 2: Silver Maple. Seven damselflies. 7 (3)

BAG 3: Pin Oak. Three mayflies, six damselflies. 9 (2)

BAG 4: Wild Cherry. Three damselflies. 3 (5)

BAG 5: Mulberry. One mayfly, two damselflies, one midge. 4 (4)

BAG 6: Box Elder. Two damselflies, one dead millipede. 2 (6)

BAG 7: Sugar Maple. One non-insect (clam shell). 0 (7)

BAG 8: Hawthorn. Two mayflies, twenty-seven damselflies, two midges, one planarian. 32 (1)

BAG 9: Persimmon. Nothing. 0 (7)

The first test: Sugar Maple leaves came in last place (tied with Persimmon). Hawthorn got first place. Pin Oak got second place. Silver Maple got third place. Paw Paw and Mulberry tied for fourth place. Wild Cherry got fifth place. Box Elder got sixth place. Sugar Maple and Persimmon tied for last place in the first test.

**SECOND GROUP OF NINE BAGS**

8 DEC 2019: BEGINNING WATER TEMPERATURE: -0.8 Cº (Upstream from bridge. Riffle area. Closed canopy with Box Elder, Sycamore).

25 DEC 2019: ENDING WATER TEMPERATURE: 2.5 Cº (No ice, many shed skins found throughout the leaf packs).

BAG 10: Paw Paw. Nine damselflies, one beetle (adult), one midge. 11 (4)

BAG 11: Silver Maple. One mayfly, eight damselflies, one midge. 10 (5)

BAG 12: Pin Oak. Three mayflies, six damselflies. 9 (6)

BAG 13: Wild Cherry. Three damselflies. 3 (9)

BAG 14: Mulberry. One mayfly, sixteen damselflies, one midge. 18 (2)

BAG 15: Box Elder. One mayfly, ten damselflies, two midges, (one spider). 13 (3)

BAG 16: Sugar Maple. Six damselflies. 6 (7)

BAG 17: Hawthorn. One mayfly, twenty-four damselflies, two midges, one planarian. 28 (1)

BAG 18: Persimmon. Three damselflies, one midge. 4 (8)

The second test Sugar Maple got seventh place. Hawthorn got first place. Mulberry got second place. Box Elder got third place. Paw Paw got forth place. Silver Maple got fifth place. Pin Oak got sixth place. Sugar Maple got seventh place. Persimmon got eighth place. Wild Cherry got ninth place in the second test.

**THIRD GROUP OF NINE BAGS**

9DEC 2019: BEGINNING WATER TEMPATURE: 5.1 Cº. There were Sycamore, Silver Maple, Box Elder and White Oak trees.

26 DEC 2019: ENDING WATER TEMPATURE: 4.5Cº. There was no ice and the water was warmer than the other two days I took water temperature.

BAG 19: Paw Paw. Two mayflies, thirteen damselflies, three midges. 18 (4)

BAG 20: Silver Maple. One mayfly, twelve damselflies. 13 (7)

BAG 21: Pin Oak. Three mayflies, sixteen damselflies, one snail. 20 (2)

BAG 22: Wild Cherry. Fifteen damselflies, two midges. 17 (5)

BAG 23: Mulberry. One mayfly, sixteen damselflies, one midge, one crane fly. 19 (3)

BAG 24: Box Elder. One mayfly, twenty-seven damselflies, four midges, one planarian. 32 (1)

BAG 25: Sugar Maple. One caddisfly, thirteen damselflies. 14 (6)

BAG 26: Hawthorn. One mayfly, ten damselflies, one planarian. 12 (8)

BAG 27: Persimmon Two mayflies, five damselflies, one midge. 8 (9)

The third test Sugar Maple got in sixth place. Box Elder got first place. Pin Oak got in second place. Mulberry got third place. Paw Paw got forth place. Wild Cherry got fifth place. Sugar maple got sixth place. Silver Maple got seventh place. Hawthorn got eighth place. Persimmon got ninth place.

**SUMMARY TOTALS**

**PAW PAW:** Two mayflies, one caddisfly, twenty-one damselflies, one beetle, four midges, two snails.

TOTAL NUMBER OF MACROINVERTEBRATES: 31 (3)

AVERAGE NUMBER OF INVERTREBRATES: 10.3

**SILVER MAPLE:** 0ne mayfly, twelve damselflies.

TOTAL NUMBER OF MACROINVERTEBRATES: 13 (8)

AVERAGE NUMBER OF INVERTEBRATES: 4.3

**PIN OAK:** Three mayflies, sixteen damselflies, one snail.

TOTAL NUMBER OF MACROINVERTEBRATES: 20 (4)

AVERAGE NUMBER OF INVERTEBRATES: 6.6

**WILD CHERRY:** Fifteen damselflies, two midges.

TOTAL NUMBER OF MACROINVERTEBRATES: 17 (6)

AVERAGE NUMBER OF INVERTEBRATES: 5.6

**MULBERRY:** One mayfly, sixteen damselflies, one midge, one cranefly.

TOTAL NUMBER OF MACROINVERTEBRATES: 19 (5)

AVERAGE NUMBER OF INVERTEBRATES: 6.3

**BOX ELDER:** One mayfly, twenty-seven damselflies, four midges, one planarian.

TOTAL NUMBER OF MACROINVERTEBRATES: 33 (1)

AVERAGE NUMBER OF INVERTEBRATES: 11.0

**SUGAR MAPLE:** One caddisfly, thirteen damselflies.

TOTAL NUMBER OF MACROINVERTEBRATES: 14 (7)

AVERAGE NUMBER OF INVERTEBRATES: 4.6

**HAWTHORN:** Two mayflies, twenty-seven damselflies, two midges, one planarian.

TOTAL NUMBER OF MACROINVERTEBRATES: 32 (2)

AVERAGE NUMBER OF INVERTEBRATES: 10.6

**PERSIMON:** Two mayflies, five damselflies, one midge.

TOTAL NUMBER OF MACROINVERTEBRATES: 8 (9)

AVERAGE NUMBER OF INVERTEBRATES: 2.6

**TOTAL NUMBER OF MACROINVERTEBRATES: 187**

The leaf pack with the most macroinvertebrates is Box Elder.

The leaf pack with the least macroinvertebrates is Persimmon.

**BIOTIC INDEX**

Although not an official part of my experiment, I couldn’t help calculating the Biotic Index and EPT (see below). These are both ways to help determine the health of the water. The lower the number on the Biotic Index, the better.

Paw Paw: 6.4 (Fair)

Silver Maple: 6.7 (Poor)

Pin Oak: 6.5 (Fair)

Wild Cherry: 6.9 (Poor)

Mulberry: 6.7 (Poor)

Box Elder: 6.7 (Poor)

Sugar Maple: 6.5 (Fair)

Hawthorn: 6.6 (Poor)

Persimmon: 6.0 (Fair)

The cut-off between Fair and Poor is 6.5 to 6.6. All nine leaf-types are along this border. The overall Biotic Index is 6.5, just on the Fair side.

**EPT**

EPT measures water quality comparing mayflies (**E**phemeroptera), stoneflies (**P**lecoptera), and caddisflies (**T**richoptera) against all the other macroinvertebrates found. This is written as a percent. EPT macroinvertebrates are most sensitive to water quality and pollution. This time, the higher the percent, the better the water quality. The three EPT’s are added up then divided by the total number of macroinvertebrates to calculate percent as shown below.

Paw Paw: 9.7%

Silver Maple: 7.6%

Pin Oak: 15.0%

Wild Cherry: 0.0%

Mulberry: 5.0%

Box Elder: 3.0%

Sugar Maple: 7.1%

Hawthorn: 6.3%

Persimmon: 25.0%

Even though Persimmon has the highest EPT, 25.0% is still a very low indicator of water quality. The average EPT is 8.7%, which is pretty poor water quality.

**CONCLUSION**

The data I collected does not support my hypothesis. Sugar Maple did not have the most macroinvertebrates in any of the three tests. Sugar Maple came in seventh place of the nine species tested.

The data confirms there were fewer macroinvertebrates at the first site when compared to the second and third sites. While the first site was a little slower flowing water, I feel the reason for lack of macroinvertebrates was the leaf packs were covered in ice and the lines holding them to the concrete blocks became tangled, making it very difficult to remove the leaf packs easily from Sugar Creek.

Though it was not my hypothesis, I really thought that the non-native trees (Paw Paw and Persimmon) would not have as many macroinvertebrates as the native trees. Based on the data, there is no correlation between native and non-native leaf packs and the number of macroinvertebrates they may support. Paw Paw placed third, Persimmon placed ninth. Persimmon made sense to me; Paw Paw did not make sense to me.

Trees with smaller leaves (Box Elder and Hawthorn) had more macroinvertebrates than trees with larger leaves. I measured leaves by mass (according to protocol), not the total number of leaves. Therefore, trees with smaller leaves had more number of leaves, resulting in more surface area and ultimately more hiding places for macroinvertebrates.

**NEXT STEPS**

When doing this experiment, I ended up with more questions than answers!

Though it was not part of my experiment, the water quality data I calculated was interesting. It might be neat to sample other creeks to see if I can find a creek with better water quality than the one I tested. Plus, I would really like to find stonefly larvae as they look really cool and it indicates the best in water quality.

My Dad used to play in Sugar Creek and told stories about getting leeches stuck between his toes. But surprise! I never had any leeches show up in my leaf packs. I guess I could soak my feet in the water to see if any leeches want to drink my blood, but you can bet I will not be doing this experiment!

I only found one crane fly larvae. During the summertime there are crane flies all around our house, especially around our porch light at night. Do the crane flies really fly that far? If crane flies are so numerous as adults, I am curious why I only found one crane fly larvae in the creek.

Why are there only snails (7.0) in one out of twenty-seven leaf packs? They are pretty tolerant of poorer water quality yet I only found the two in one leaf pack.

Why were there a lot of damselflies in the creek? Damselflies (7.0) tolerate the same water quality as snails (7.0), but I found 152 damselflies and only two snails.

Finally, I would like to, one day, visit the Stroud Water Research Center in Avondale, Pennsylvania.

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