ALBANY PINE BUSH PRESERVE HABITAT WATCH

SPECIES RESPONSES TO TEMPERATURE

OVERVIEW

Albany Pine Bush Preserve Commission Educators have prepared this document as a resource for teachers. Here, we present a phenomenon and related materials available through the Albany Pine Bush Preserve website and relate them to a specific learning standard. Teachers are welcome to use these materials for objectives not encompassed by the learning standard listed and are encouraged to contact the Albany Pine Bush Preserve Commission with questions, ideas, and feedback.

NYS NEXT GENERATION SCIENCE LEARNING STANDARD

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

CORE IDEA

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

BACKGROUND

THE DATA

Since 2015, middle school students have been coming to a site at the Albany Pine Bush Preserve to collect environmental data. Most of the data are from the months of September, October, and November. Each class of middle school students is broken into four small groups when they arrive at the site and the groups rotate through the data collection stations. This means the data at each station is collected four times over the course of approximately two hours, typically in the morning. Among the measurements taken are the temperature of the pond at the site and the numbers of different species of aquatic macroinvertebrates observed in the pond. These are the data we will be referring to in this document.

TEMPERATURE DATA

The temperature data are in degrees Fahrenheit. Students collected this data by reading the temperature from a floating thermometer placed near the edge of the pond.

AQUATIC MACROINVERTEBRATE DATA

To collect these data, each student in the group (usually 6-8) uses a small net to stir up sediment at the edge of the pond and collect one net full of material from the water. The samples taken from the pond by the students are distributed as evenly as possible across three trays. Next, the students and a trained adult do a timed survey of each tray. For each tray, the students help the trained adult spot the organisms, the adult tells the students what the organisms are, and they try to count the number of each organism. Each tray is searched for just two minutes. A student note taker records the data.

THE SITE

The location of the field site where the data are collected is a piece of property adjacent to the Rapp Road Landfill. On this property is a small pond. The soil is sandy and the canopy is relatively open, such that the pond is not very shaded by trees or other vegetation. It is not known how deep the pond is.

ASSIGNMENT OPTION 1

Examine the graphs provided (empirical evidence) to make the following argument: changes to a physical component of an ecosystem affect populations.

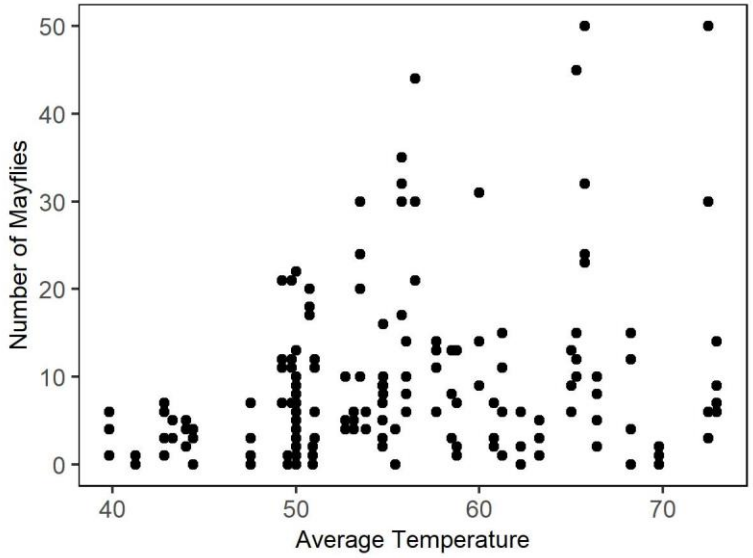
Graph of mayflies observed vs temperature

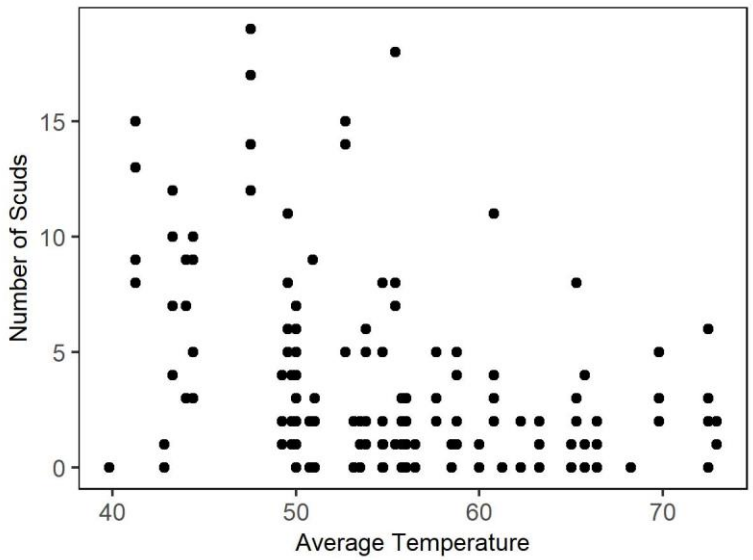
Graph of scuds observed vs temperature

THE DATA REPRESENTED IN THE GRAPHS INCLUDES:

- Records from September, October, and November since 2015
- Records of two commonly observed invertebrate species, mayflies and scuds.

GRAPHS





OBSERVATIONS

- As temperatures increase, the numbers of mayflies observed by students tends to increase.
- As temperatures increase, the numbers of scuds observed by students tends to decrease.
- Different types of animals may respond in opposite ways to the same environmental change.

- The relationships between temperature and each of these animals are not completely clear; there is a lot of variability.

DISCUSSION TOPICS

- Observing fewer individuals of a species does not necessarily mean there are fewer individuals of that species in the pond.
    - Samples were taken from the edge of the pond, and the edge does not represent the entire pond. How might the edge be different from the center of the pond?
    - The changes in observed abundance of an animal could indicate that the actual number of individuals in the pond has changed in response to temperature. Alternatively, it could mean temperature affects animals' behaviors, making them more or less likely to be collected, even though the total numbers of animals in the pond remains the same.
- Although it appears there is a pattern in the data, there is also a lot of variability.
    - This variability could be due to mistakes on the part of the people collecting the data, called measurement error, or it could be due to strange events (e.g. unexpected changes in weather or food availability) that disrupted the expected relationships between the organisms and the temperature. "Noisy" datasets with a lot of variation are very common in ecological systems, because there are many uncontrolled variables. As the years go on and we collect more and more data, relationships between species and temperature should become more clear.
- Since all of these measurements were taken in the fall and temperatures tend to drop as the fall season goes on, maybe what we are observing is seasonal change.
    - This is a possibility, and we may not observe the same relationships between organisms and temperature at all times of year. However, temperature is likely to be the thing that is driving the seasonal change in the populations of organisms. How might we investigate questions about temperature and seasonal change further?

ARGUMENT

- Scuds and mayflies were sampled during the fall for many years from the edge of a pond. Water temperature was also recorded for each survey. Overall, fewer mayflies were observed when temperatures were low than when temperatures were high. The opposite relationship was observed for scuds. This is an example of how changes in temperature can affect the size (number of individuals) or behavior of animal populations within an ecosystem.

ASSIGNMENT OPTION 2

Graph a summarized data set and use the graphs to make arguments and observations similar to those in assignment option 1.

Download summarized data

THE DATASET INCLUDES:

- Records from September, October, and November
- Records of two commonly observed invertebrate species, mayflies and scuds.

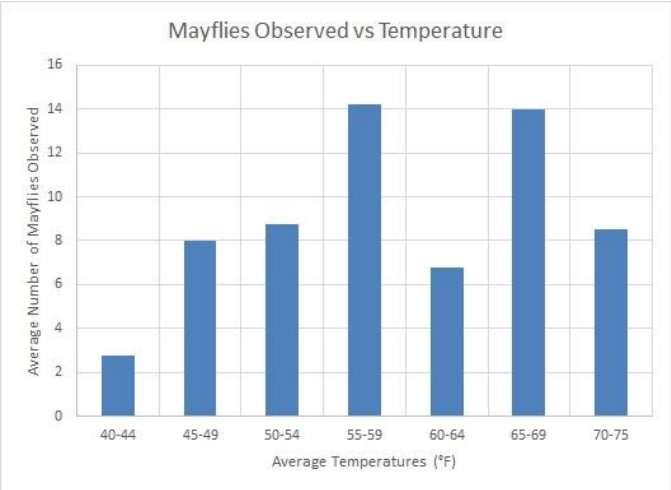
HOW THE ORIGINAL DATA ARE SUMMARIZED IN THE DATASET PROVIDED

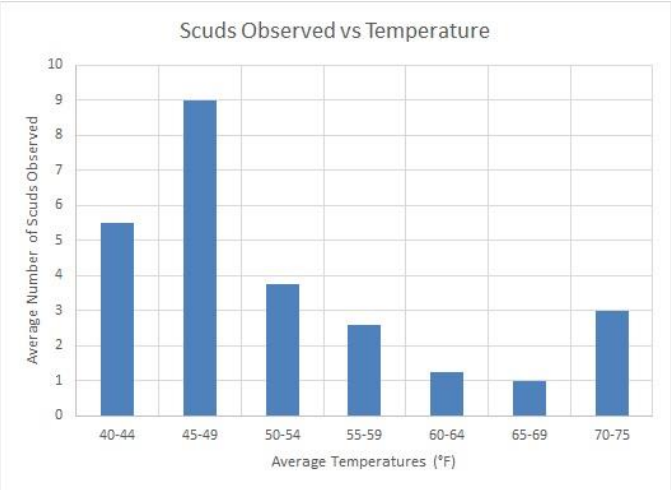
- The original dataset has four temperature readings for each day (one reading taken by each student group).
    - These temperature readings were averaged for each day and rounded to the nearest whole number.
- The original dataset has four different values for each aquatic macroinvertebrate for each day (one for each student group).
    - Even if we are only looking at two species, this is a lot of data. In order to reduce the amount of data students would need to graph, all of the observations of mayflies made on days where the average temperatures were 40°F–44°F were grouped together and averaged. This yielded a value for the average number of mayflies observed at temperatures within this range. The same was done for all of the observations of mayflies made on days when the average temperatures were 45°F–49°F, 50°F–54°F, and so on. The numbers of scuds were summarized in the same way.

ASSIGNMENT FOR STUDENTS

USE THE DATASET PROVIDED TO CREATE TWO BAR GRAPHS

These are examples of the graphs students could make using the provided dataset.





OBSERVATIONS

- As temperatures increase, the numbers of mayflies observed by students tends to increase.
- As temperatures increase, the numbers of scuds observed by students tends to decrease.
- Different types of animals may respond in opposite ways to the same environmental change.
- As temperature increases, the dependent variables show overall trends, but the change from one data point (bar) to the next does not always match the overall trend.

DISCUSSION TOPICS

- Observing fewer individuals of a species does not necessarily mean there are fewer individuals of that species in the pond.
    - Samples were taken from the edge of the pond, and the edge does not represent the entire pond. How might the edge be different from the center of the pond?
    - The changes in observed abundance of an animal could indicate that the actual number of individuals in the pond has changed in response to temperature. Alternatively, it could mean temperature affects animals' behaviors, making them more or less likely to be collected, even though the total numbers of animals in the pond remains the same.
- There is not a simple or direct relationship between temperature and either of these two types of animals. The trend is that with higher temperatures we observe more mayflies and fewer scuds, the change from one data point (bar) to the next does not always match the overall trends, however.
    - Data collected from natural environments are often "noisy". For example, if all other variables could be perfectly controlled, it's possible that we would be able to very accurately predict a change in one variable, say plant growth, based on another variable, say amount of light. In nature, however, uncontrolled variables (e.g. temperature and availability of nutrients in the soil) might also affect growth, causing the relationship between growth and light to be less clear. There are many uncontrolled and unknown variables in our study pond that could be influencing the numbers of animals observed. What are some examples?
    - As the years go on and we collect more and more data, the true relationships between species and temperature should become more clear.
- Since all of these measurements were taken in the fall and temperatures tend to drop as the fall season goes on, maybe what we are observing is seasonal change.

- This is a possibility, and we may not observe the same relationships between organisms and temperature at all times of year. However, temperature is likely to be the thing that is driving the seasonal change in the populations of organisms. How might we investigate questions about temperature and seasonal change further?

ARGUMENT

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APPENDIX A

AQUATIC MACROINVERTEBRATES OBSERVED IN THE STUDY POND

INSECT MACROINVERTEBRATES (ORGANIZED BY ORDER)

COLEOPTERA (BEETLES)

1. Crawling water beetle (adults)
2. Predaceous diving beetle (adults)
3. Water scavenger beetle (adults)
4. Unidentified beetle species (larvae and adults)

DIPTERA (FLIES)

5. Midge (larvae, aka bloodworm)
6. Mosquitos (larvae)

EPHEMEROPTERA (MAYFLIES)

7. Mayflies (nymphs)

HEMIPTERA (TRUE BUGS)

8. Backswimmer (nymphs and adults)
9. Creeping water bug (adults)
10. Giant water bug (adults)
11. Pygmy backswimmer (adults)
12. Water boatmen (nymphs and adults)
13. Water strider (adults)
14. Water scorpion (adults)

ODONATA (DRAGONFLIES AND DAMSELFLIES)

15. Damselflies (nymphs)
16. Dragonflies (nymphs)

TRICOPTERA

17. Caddisfly (larvae)

NON-INSECT MACROINVERTEBRATES

18. Daphnia (aka water fleas)
19. Fingernail clams
20. Flatworms
21. Leeches
22. Scuds
23. Snails
24. Sowbugs
25. Unidentified worms
26. Water mites