What are the Humidity, Precipitation, and Temperature Conditions Associated with Active Mosquito Season?

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Abstract

This environmental research study was conducted by Shumate Middle School students: Bayle Buvia (Sixth Grade), Muhammed Muheisen (Sixth Grade), Sophia Payne (Sixth Grade), and Alyvia Roll (Sixth Grade). In our study, we are trying to figure out what are the average humidity, precipitation, and daily temperature values associated with activite mosquito season during 2017 and 2018 on the Shumate Middle School campus in Gibraltar, Michigan (United States of America). All data utilized in this study was collected by our automated weather system - Gibraltar School District WeatherSTEM. This study is the first phase of our research as we are investigating data. Again, this report will focus on three environmental parameters (humidity, precipitation, and temperature). During the next phase of our research, we will begin using the GLOBE Observer app to start collecting mosquito counts on our campus via the Mosquito Habitat Mapper. Please see our environmental data collected in this study.

Research Question

We are active members of the GLOBE Mission Mosquito campaign. For this project, our research question is, *"What are the average humidity, precipitation, and temperature parameters associated with active mosquito season in Gibraltar, Michigan (United States of America)?"*

Introduction

Mosquitoes are very deadly insects. They are considered to be the world's most dangerous animal as they kill more humans than any other animal by spreading various dangerous diseases (D. Janney, personal communication, March 14, 2019). Due to climate change and globalization, mosquito-borne diseases are spreading in Michigan. According to by Strachan, the spread of mosquito borne diseases are increasing across the entire United States of America. The GLOBE *"Mission Mosquito"* campaign is asking people around the world to help us find out when active mosquito season begins.

Hypothesis:

If mosquitos thrive in warm temperatures and a certain amount of precipitation to reproduce, our team believes that the humidity, precipitation, and temperature parameters associated with active mosquito season to be:

- Humidity - The average humidity level will range between 50 and 60 percent during the active mosquito period. This estimate is based on what our group knows about humidity during this time of year.
- Precipitation - The average precipitation value will range between 0.76 mm - 2.54 mm. This estimate is based on what our group knows about the amount of precipitation in Gibraltar, Michigan during the active mosquito time period.
- Temperature - The average temperature value will range between 15.5 - 21.1 degrees Celsius. This estimate is based on what our group knows about weather during this time of year.

GLOBE BADGES

We would like to apply for the following GLOBE International Virtual Science Symposium Badges:

- **Collaborator** - For this project, we connected with Ms. Dorian Janney (NASA and The GLOBE Program) when we had questions and/or needed assistance with our project. We held several webinars via Zoom with Ms. Janney.
- **Make an Impact** - Our data will be shared with the GLOBE Mission Mosquito campaign. This campaign is trying to find out when active mosquito season begins and ends around the world. Additionally, we hope to share our results with WeatherSTEM and the City of Gibraltar.

Ms. Dorian Janney
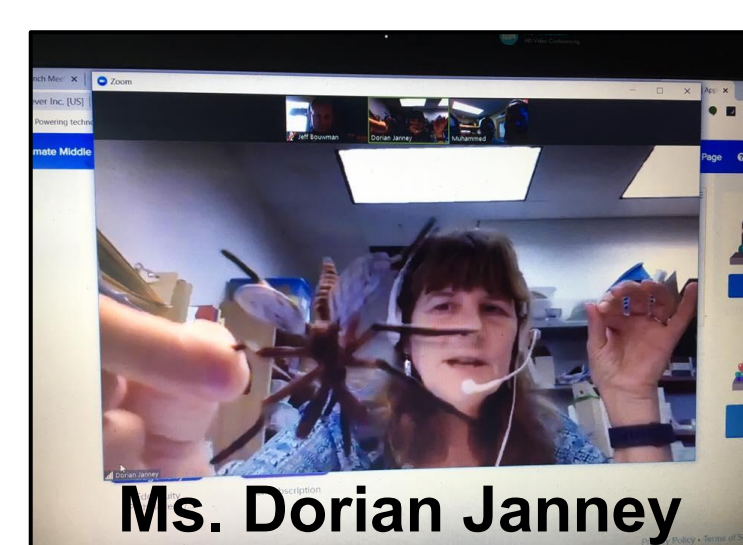
Research Methods

GLOBE Study Sites:

Shumate Middle School - Latitude 42.085501, Longitude -83.21121, Elevation 176.7m
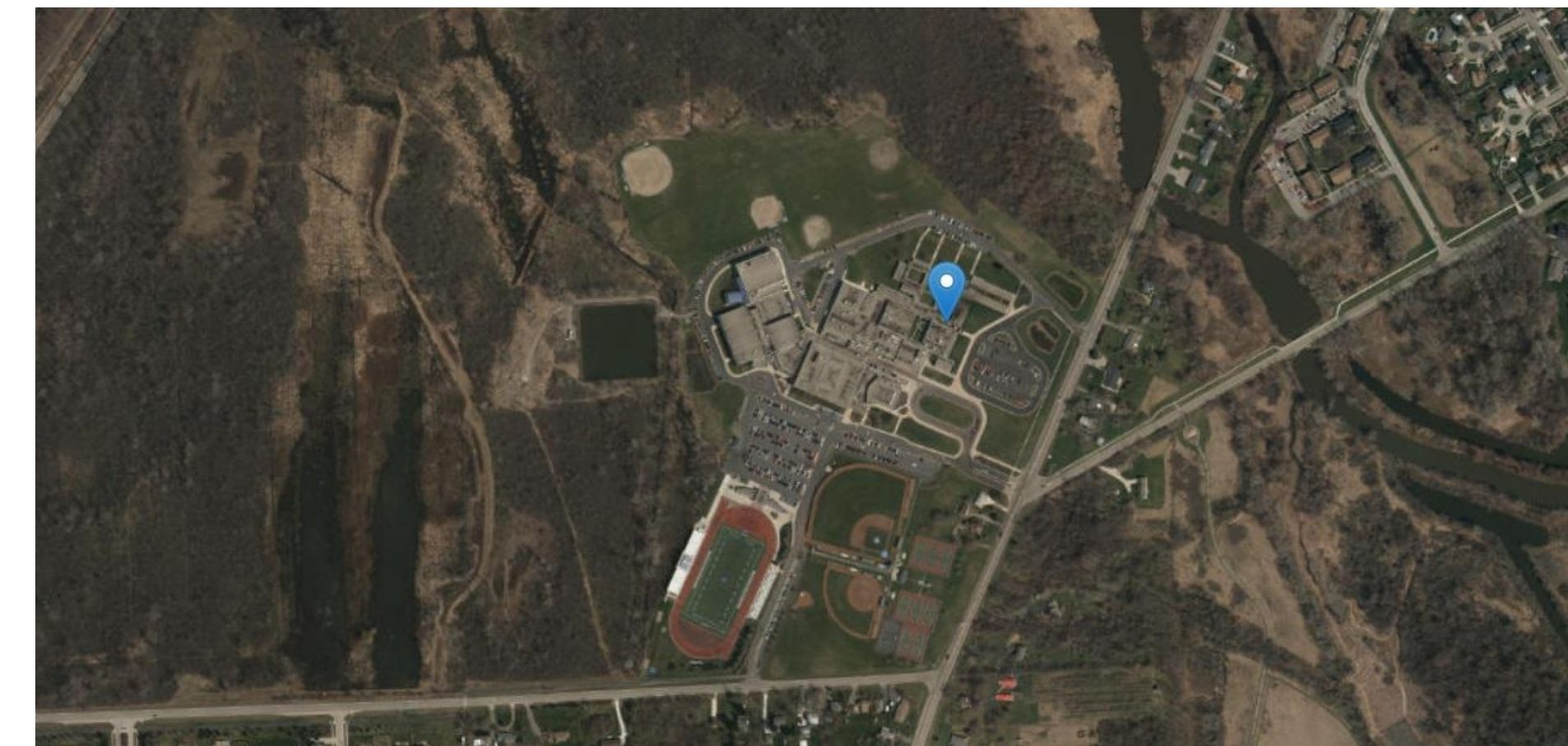
Gibraltar School District WeatherSTEM - *Latitude 42.085203, Longitude -83.210939, Elevation 167m*

GLOBE Protocols Utilized in this Study:

- **Atmosphere:**
  - Air Temperature (Automated System - WeatherSTEM)
    - *Humidity and Precipitation data also retrieved.*
- **Study Site:**
  - Shumate Middle School
  - Gibraltar School District WeatherSTEM
    - Please see GLOBE Study Site and aerial images below.
- **Time Frame:**
  - 2017 Season - Friday, April 21, 2017 - Friday, September 15, 2017
  - 2018 Season - Saturday, April 21, 2018 - Saturday, September 15, 2018

Materials:

For Analyzing Ideal Mosquito Breeding Conditions: (Phase One)
- Gibraltar School District WeatherSTEM Station - Utilized the Data Mining system to find local data.
- Chromebook - Used to locate data, create charts and graphs, and to communicate.
- Google Spreadsheet - Utilized to store data and create data tables and graphs.

For Conducting Mosquito Habitat Observations: (Phase Two)
- **iPad** - GLOBE observer, mosquito and larva counts.
- **Small Bucket** - Observing and collecting water samples.
- **Chromebook** - Research, webinars, and Google Spreadsheet.
- **GLOBE Observer App** - Mosquito Habitat Mapper and Land Cover tools.

Methods:

For Analyzing Ideal Mosquito Breeding Conditions: (Phase One)
- Go to the WeatherSTEM website and select the Data option at the top of the website. Next select Data Mining in the drop down box.
- Select the sensors and date(s) you'd like to research.
- Select the output for your data (CSV, table, graph, etc.).
- Click Submit and Download.
- Your data is ready for analysis.

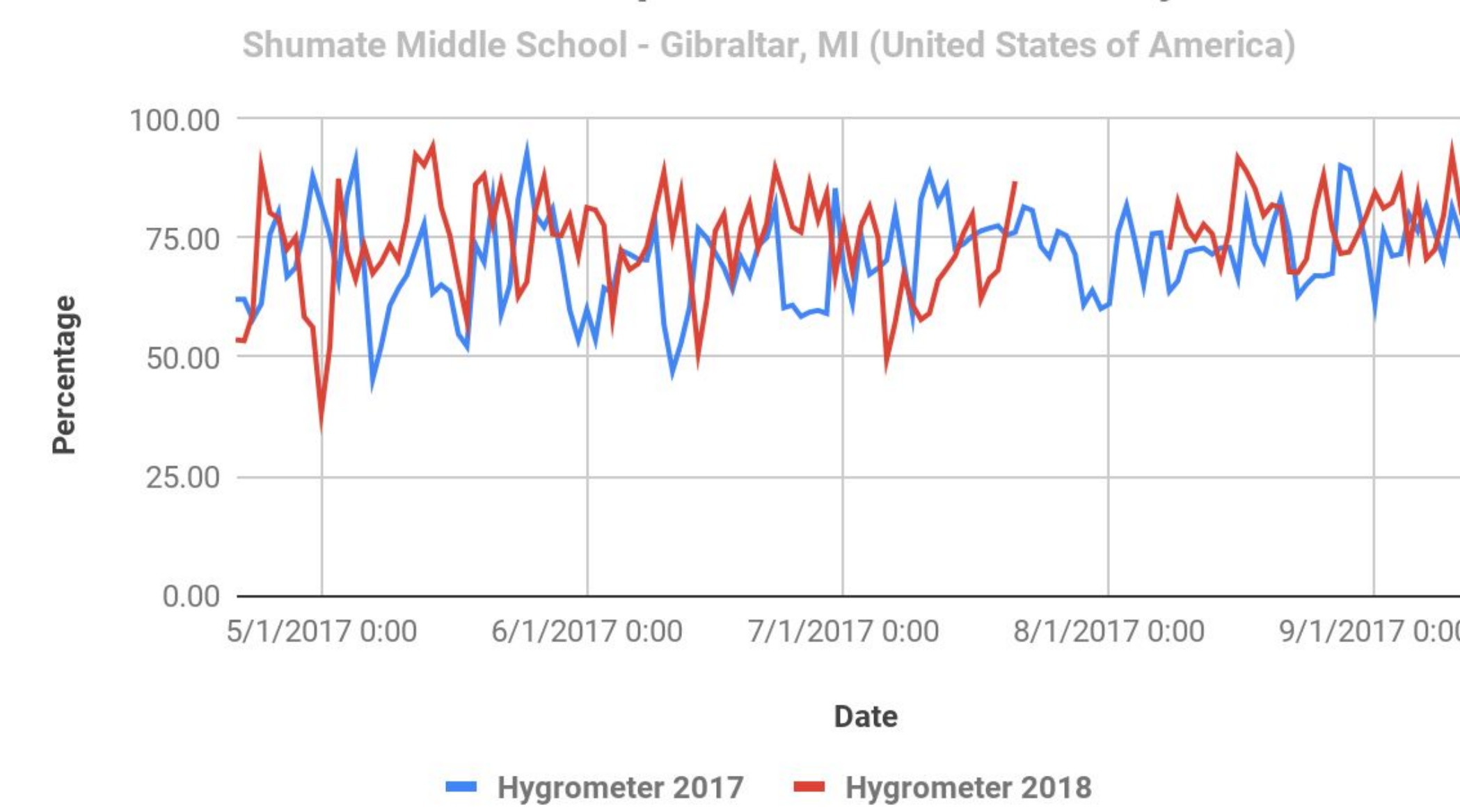*Step-by-Step Mosquito and Larva Counts: (Phase Two)*
- Collect a water sample from a pond, ditch, puddle, etc.
  - Make sure the sample is in a clear container so you can observe.
- Count and identify the mosquito larvae in the clear container.
- Use the GLOBE Observer Mosquito Habitat Mapper to take the mosquito count.
  - Follow the instructions (prompts) on the app.
  - Submit once all required data has been entered.
- After the observation is finished, dump the water down the drain.

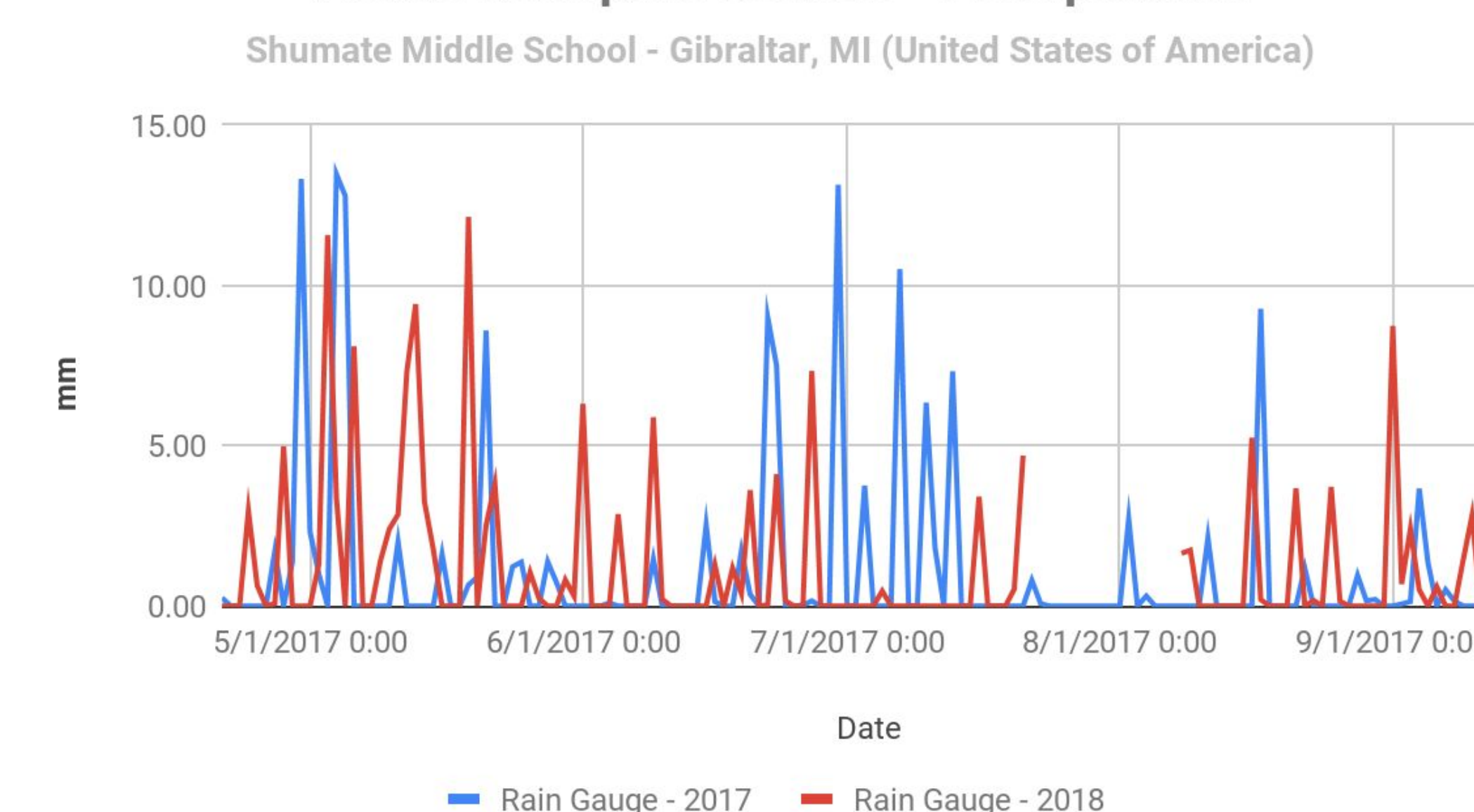*Step-by-Step Mosquito Land Cover (Phase Two)*
- Travel outside with the iPad (GLOBE Observer app installed).
- Select a study site.
- Use the GLOBE Observer Land Cover to take a land cover measurement.
  - Follow the instructions (prompts) on the app.
  - Submit once all required data has been entered.
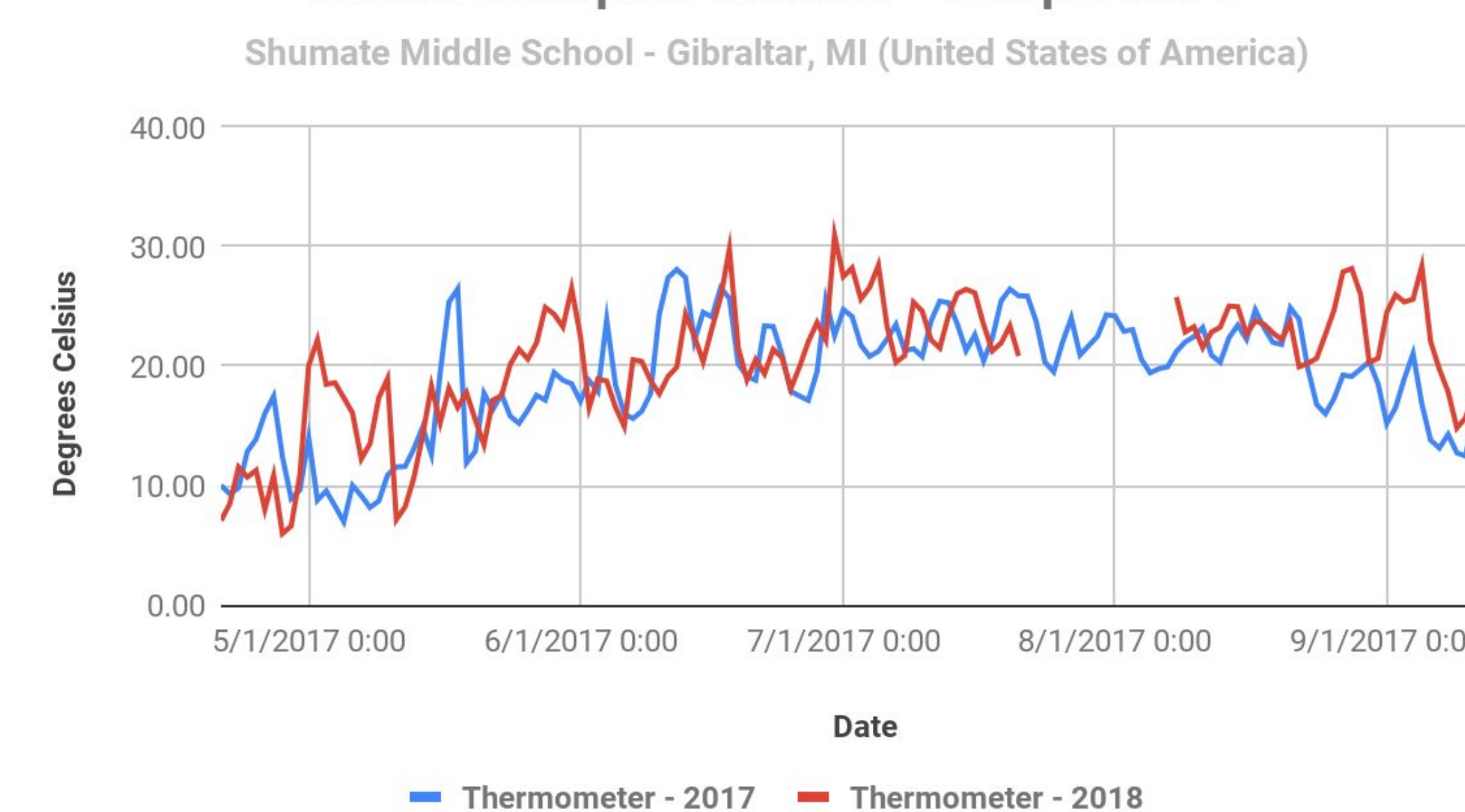- Travel back to the classroom and put away tools.

Results

Active Mosquito Season - Humidity
Shumate Middle School - Gibraltar, MI (United States of America)

Active Mosquito Season - Precipitation
Shumate Middle School - Gibraltar, MI (United States of America)

Active Mosquito Season - Temperature
Shumate Middle School - Gibraltar, MI (United States of America)

Humidity Analysis - Per Gibraltar School District WeatherSTEM, the average humidity during active mosquito season was 71.32% in 2017 and 75.16% in 2018. The maximum humidity was 92.71% in 2017 and 94.20% in 2018. The minimum humidity was 45.44% in 2017 and 38.29% in 2018.

Precipitation Analysis - Per Gibraltar School District WeatherSTEM, the average precipitation value during active mosquito season was 1.04 mm in 2017 and 1.21 mm in 2018. The maximum amount of precipitation was 13.47 mm in 2017 and 12.14 mm in 2018. The minimum value for both years was 0.00 mm, and this was observed on many occasions.

Temperature Analysis - Per Gibraltar School District WeatherSTEM, average temperature during active mosquito season was 19.00 degrees Celsius in 2017 and 20.27 degrees Celsius in 2018. The maximum temperature was 28.09 degrees Celsius in 2017 and 30.93 degrees Celsius in 2018. A minimum temperature of 6.97 degrees Celsius was recorded in 2017, and a minimum temperature of 5.99 degrees Celsius was recorded in 2018.

Discussion

Mosquitoes are very dangerous because they can spread many dangerous diseases. Based on our data, our understanding about when mosquitoes can begin to become active, and the data we have collected over the past two years, we are almost certain that we will start noticing mosquitoes towards the end of April here in our area. This is because mosquitos thrive in hot weather, and temperatures need to be at least 10 degrees Celsius for several weeks for them to begin laying eggs. They prefer temperatures to be around 27 degrees Celsius to be active and complete their four-stage life cycle. Adult mosquitoes can hibernate over the winter, and then will start laying their eggs when it gets to be warm enough and there is some standing water. We want to try to find out exactly when mosquitoes begin to be active here, and now we have done research and also have evidence from last two years study to guide us. At this point, we do not have any local comparison to compare our data to. We were unable to find a school collecting average humidity, precipitation, and temperature data that is close to Shumate Middle School.

We will continue with our research over the rest of the school year and throughout the summer. This will help us continue to research many things that we want to find out about mosquitoes here in our area. We will make several mosquito traps and place them around the school, as this will help us know that if when mosquitoes begin to breed and go through their life cycle. If we find mosquito larvae in the month of April or May, then that will be the designated month of the beginning of active mosquito season. We will also talk to the health administration and do more research to get a better answer to when is mosquito season. We will continue to monitor mosquito traps at our homes during the summer to see when we find the most larvae and to try to see what kind of larvae we find. We will have a head start on our research for the next IVSS!

Conclusions

In conclusion, we discovered that our hypothesis was partially correct. First, we believed that the average humidity would range between 50 and 60 percent during the active mosquito periods. Instead, the average humidity percentages were over 70 percent during both 2017 and 2018. In regards to precipitation, this part of our hypothesis was correct. We believed that the average amount of precipitation would range between 0.76 mm - 2.54 mm. The average precipitation value was 1.04 mm in 2017 and 1.21 mm in 2018. Again, this part of our hypothesis was correct. Finally, in regards to temperature, we believed that the average temperature would range between 15.5 degrees Celsius through 21.1 degrees Celsius. Again, we were correct in regards to this part of our hypothesis. The average temperature was 19.00 degrees Celsius in 2017 and 20.27 degrees Celsius in 2018. These values fell within the range defined in our hypothesis. By knowing what these environmental conditions should be, after looking at our data for the past two years, we can better predict exactly when we should begin to find mosquito larvae here in Gibraltar, MI.

Bibliography

Strachan, Jessica. (2018). Increase in Mosquito - Borne Diseases Hitting Michigan.. Patch. Retrieved from:
https://patch.com/michigan/detroit/increase-mosquito-borne-diseases-hitting-michigan