

Drones are an Effective Way to Identify Mosquito Breeding Habitats

Abstract

Identifying potential mosquito breeding habitats using drones was inspired by the GLOBE Mission Mosquito Campaign. The research team learned about it from the GLOBE website at the beginning of September 2018. The immediate goal was to figure out ways to identify mosquito breeding habitats. After doing some background investigation, it was decided to try to use drones to locate these sites. The research question is “How effective are drones in identifying potential mosquito breeding habitats surrounding schools in Medford, NJ?” This research project has two parts. This report only contains Part One. In Part One, the first step was to locate the Medford schools using latitude and longitude coordinates. Coordinates chosen had to be around the school buildings, as well as some of the surrounding area. Some of the schools had small ponds or playgrounds that could collect water, and the drones had to take pictures of them as well as the buildings that had flat roofs. The main reason surrounding areas were included in the drone images was because of a GLOBE webinar stating that mosquito breeding sites are affected by the surrounding area more than scientists originally thought. The next step in collecting data was to meet up with a professional drone operator to take the images. The images were analyzed and potential breeding sites were identified. This concluded Part One. In Part Two, the research teams will create mosquito traps, collect mosquito larvae and identify species. The final step of the entire research project will be to inform the Medford Board of Education of the research findings and encourage them to take action to prevent the breeding sites from reappearing, in an attempt to lessen the mosquito population. With the first part of the research experiment it was confirmed that drones are very effective in identifying possible mosquito breeding habitats.

Key Words

Mosquitoes, Drones, GLOBE research, IVSS, Mission Mosquito Campaign

Research Question

“How effective are drones in identifying potential mosquito breeding habitats surrounding schools in Medford, New Jersey?”

The point of the research question is to see if drones are helpful in identifying breeding sites. They should make it much easier since it is faster flying drones over large spaces and looking at images, than walking around on foot looking for things. Also, more precise and “to scale” images of the breeding sites are visible. Drones may be a key tool in future student and citizen science, including the Mission Mosquito campaign.

Introduction

Mosquitoes are among the most dangerous creatures on earth. This is because of the deadly diseases that they are vectors for, such as Zika and West Nile Virus. Mosquitoes, such as the *Culex* and *Aedes* genus, thrive in Medford’s wetlands environment, and they can be dangerous to all people living here¹. As part of the GLOBE’s Mission Mosquito program² research, drones were used to identify mosquito breeding sites around schools in the Medford Township Public Schools District. The research team’s reason for doing this is two-fold. First is to educate the community about mosquitoes and the second is to try to decrease the mosquito population in Medford. The research team had the opportunity to share information about mosquitoes in NJ during a webinar with GLOBE³. The importance of this is that there are many diseases and even deaths caused by mosquitoes and people need to be aware of this situation. There were 44 cases and three deaths caused by West Nile Virus in New Jersey in 2018. In all, by informing the people in the community and encouraging them to eliminate breeding grounds, it can help prevent mosquito-borne diseases and decrease their population.

Research Methods

When the team started research, the first thing done was to learn about mosquitoes. The GLOBE site was used to see why looking for mosquitoes is so important. The overall point of the Mission Mosquito Campaign is that there are so many people dying and getting diseases from mosquitoes, but it’s difficult to get rid of these pests unless you can identify breeding habitats.

The main goal is to have people find and eliminate mosquito breeding habitats to help people's health around the world.

After researching about mosquitoes, in general and mosquitoes in NJ, specifically, each team member downloaded the Globe Observer app for cell phones and took mosquito observations from the ditches and swamps around the school. Larvae were not counted though because it was winter and there weren't any larvae to identify. Since it was winter more research on how to continue to take data was taken. Surprisingly, the team learned that some mosquitos are still alive in the winter time; they are just hibernating.

Team Advisor, Mrs. Gorman, suggested looking at the most effective ways to quickly identify breeding habitats. The team, along with another team studying mosquitoes thought it would be a good idea to look for breeding habitats using drones. The team developed the research question, “How effective are drones in identifying potential mosquito breeding habitats surrounding schools in Medford, NJ?” The team began to make a plan, but in the middle of all of this, the team was invited to do a webinar with GLOBE. A 15-minute Google slide presentation about mosquitos and research was created and presented with other scientists from GLOBE.

After this, the research started. Mr. Tyler, a drone professional, was met at Memorial School. Steps in flying the drones were to first unpack the equipment and arrange the safety cones in a square around the drone lift off/landing area. Once the drone took-off, live video feed was presented on the touch screen device mounted on the radio system. When the drone was in the air around 200-300 feet high at Haines/Memorial, Kirby's Mill and the Board of Education, the team watched the drone and told Mr. Tyler where to fly it and what to look for. If a location was found that looked like it would collect water or already had collected water, a picture for later examination was taken. At Allen school, a smaller drone was used. This drone was programmed using four latitude and longitude points. The drone flew the pattern by itself. It took about 15 minutes to fly and take pictures at each location. Some team members got to put on special goggles that viewed everything through the camera of the drone.

A day after Mr. Tyler took the images, analyses of the images began. They were examined for low lying areas, flat roofs, and other objects that could collect water. Potential breeding sites were marked in different colors.



Image 1

Kai, Morgan, Gavin, Ethan and Mr. Tyler observe as the drone is preparing for take-off.



Image 2

From left to right, Morgan, Ethan, Mr. Tyler, Gavin and Kai monitoring the drones through the monitor on the controller.



Using drones to find Mosquito Breeding Habitats

Find a location or locations that may contain breeding sites

1. Find four coordinates around the location making a square. (Only necessary if using autopilot on a drone.)
2. Arrange a date with your team mates to fly the drone. Go to your site/sites on that date.
3. Once there, arrange a path of flight for the drone
4. Designate a take-off and landing spot for the drone. Make 7ft by 7ft square using traffic cones around the drone. (This is for safety!)
5. Once in the air look out for low flying planes and helicopters. If seen, land the drone in a safe location.
6. Fly the drone to a location where it can take a picture of the entire site (not for autopilot). Repeat from various locations and perspectives.
7. Safely land the drone after taking images.
8. Analyze the images. When analyzing images, look for the following on the building itself and in the surrounding area.
 - a. Any visible existing water
 - b. Flat roofs
 - c. Low lying areas
 - d. Any structure capable of collecting water

The final step of the research in Part One was to check and ensure our data from the Mosquito Habitat Mapper App was showing up on the GLOBE Visualization Tool.

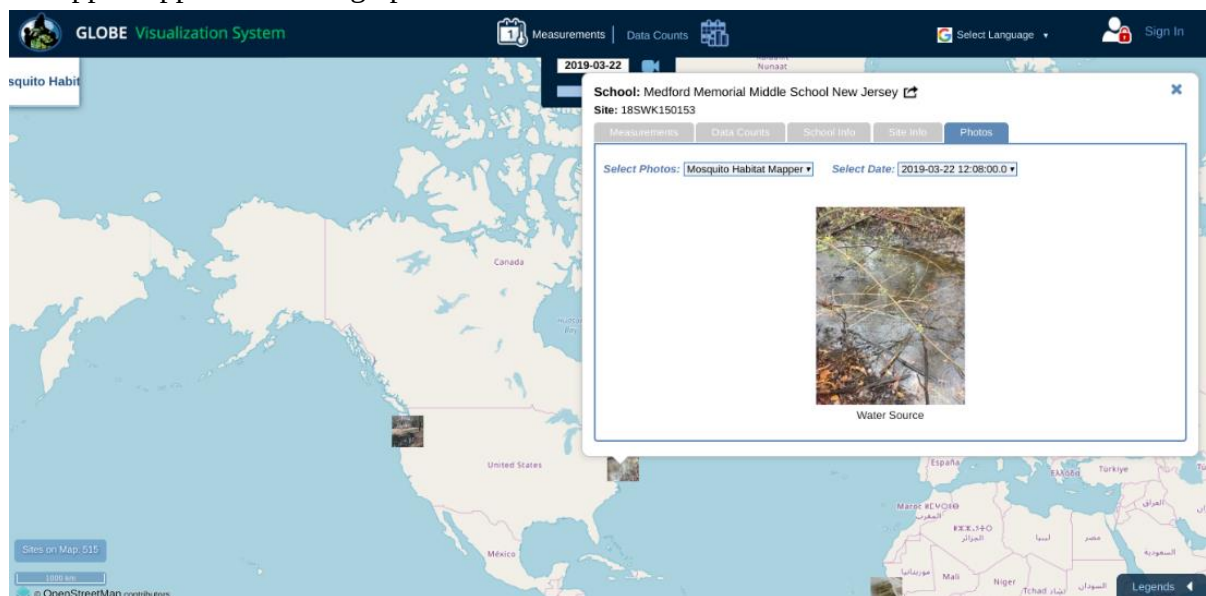


Image 3

This is our visualization page and just one of the days we found possible mosquito breeding grounds using the Mosquito Mapper.

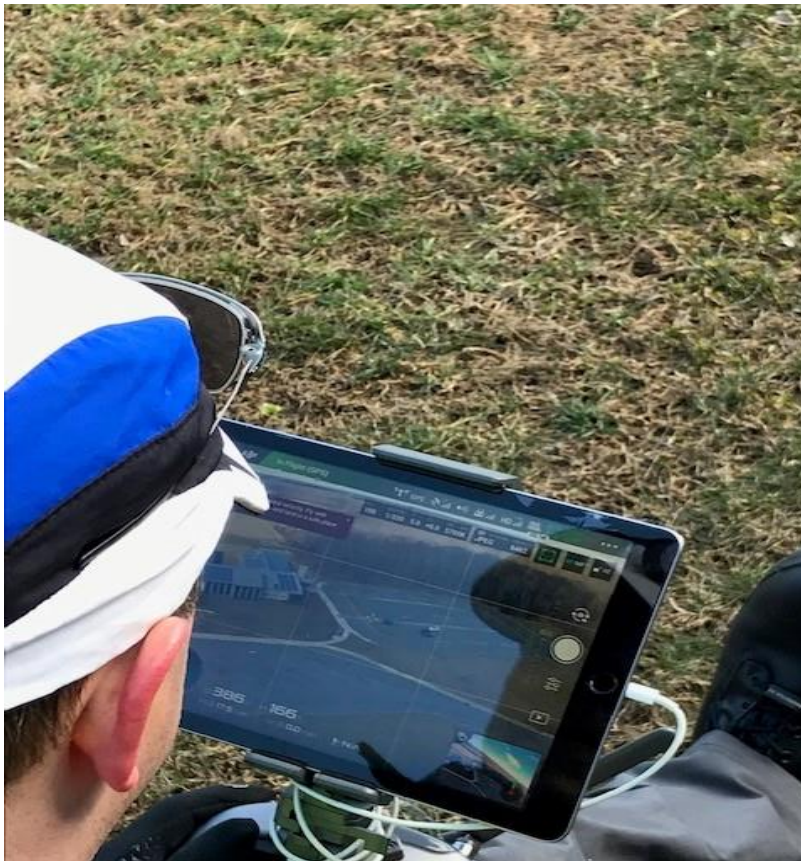


Image 4
Mr. Tyler monitoring the drone
footage through the touch screen
monitor at Kirby's Mill School



Image 5



Image 6

Kai and Laura identifying breeding sites with the GLOBE Mosquito Habitat Mapper.



Image 7

Kai viewing live drone footage through Mr. Tyler’s virtual reality headset at Allen Elementary School as Ethan and Morgan watch.

Results

Drones were a key tool that helped the team to further identify possible mosquito breeding habitats in several different types of locations. Below is a key to use when looking at the images.

Color Identification for images

Blue circle- swamps and small lake areas

Light yellow circle- tall woods area

Dark yellow circle- short woods area

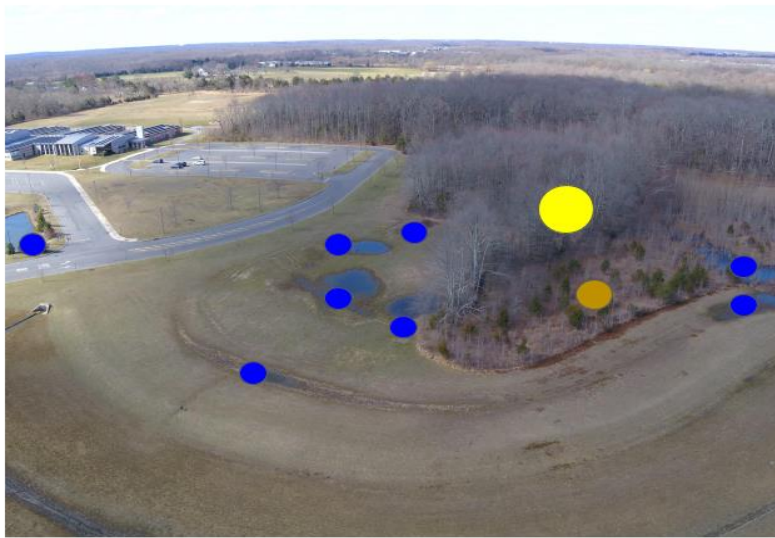
Purple circle- man made sandy areas

Red circle- gaga pits that could potentially hold water

Light green circle- playground areas that could potentially hold water

Dark pink circle- wet fields/potential wet fields

Orange circle- flat roofs



There are many ponds and swampy areas surrounding the trees near Kirby's Mill Elementary School. These ponds and swamps are good breeding sites for mosquitos, especially the culex because they like swampy dirty areas.

Image 8

Kirby's Mill Elementary School, 151 Hartford Rd, Medford, NJ 08055



At Kirby's Mill, there is a sand area in the back, a gaga pit, a playground area, and a large open field. These are ideal for collecting water, and great for mosquito breeding.

Image 9 Kirby's Mill Elementary School, 151 Hartford Rd, Medford, NJ 08055



The field behind Haines collects a lot of water after rain. The swampy area with trees by the parking lot would be a great spot for mosquitoes to breed as well.

Image 10
Haines Elementary School, 136 Main Street, Medford, NJ 08055



The flat roof of the Board of Education building is capable of collecting water, as well as the surrounding field. The trees next to the building most likely have a swampy area underneath, as have most of the other trees at Haines and Kirby's.

Image 11 Medford Township Board of Education, 137 Hartford Road, Medford, NJ 08055

Discussion

Drones are an effective way to identify potential mosquito breeding habitats. It is much easier and faster to locate breeding sites using a drone than it is to walk around for hours and hope to find a site. Drones can give anyone an advantage because some of the locations are not accessible from the ground, or clearly identifiable from the ground. The team was able to take images from five different locations. Counting driving time, the team only spent three hours with Mr. Tyler. Walking the same amount and type of property would have taken much more time and possibly have been dangerous.

However, as effective as the drones are, there are some limitations when using them. Even though there were no leaves on the trees because of the season, it was still difficult to see what was underneath the trees from the perspective of the drone. Another issue is timing the image taking so it is right after a rainfall. Some areas where rain might collect were not seen, because it hadn't rained in about four days. When pictures of possible breeding sites were taken with cell phones using the GLOBE Observer Mission Mosquito app, a close up image was acquired, but only of a smaller area. The app is best to use when looking for mosquito larvae. The Observer app helps to identify the location as an actual location where mosquitoes breed or not, while the drones only take pictures of potential sites.

The next step in research is to choose the most likely sites from each of the drone images and use the mosquito habitat mapper to identify the sites. Once at the location, larvae can be observed and sampled using the GLOBE observer app, and then the site will be eliminated.

Pros and Cons of the Use of Drones in Identifying Breeding Habitats

Pros	Cons
It is much easier than walking and searching	Some sites are below other objects and not clearly visible to drones.
It is more efficient	It is much more difficult to arrange drone flights with a group
Covers a greater area in each photo	

Things are seen in a more proportional way than from the ground	
It takes constant observations	

Conclusion

After examining the images, the team discovered that drones are helpful in identifying mosquito breeding habitats. They give many advantages such as seeing the overall picture of the land and locating the sites much more efficiently than walking around the location. Looking at each picture, the few difficulties of using drones are that they can be difficult to acquire and arrange a flight. It also can be difficult to tell what something in the photo is because it may be underneath another object or landform at times. Overall, with the use of drones taking constant observations of a greater area, they are very effective in identifying possible mosquito breeding sites. With the help of drones, scientists can easily locate mosquito breeding habitats in effort eliminate them and decrease the population of these dangerous animals.

Badges

- **Make an Impact**

The report clearly describes how a local issue led to the research questions or makes connections between local and global impacts. The students need to clearly describe or show how the research contributed to a positive impact on their community through making recommendations or taking action based on findings. (The entire Mosquito Habitat Mapper is making an impact on our local community and the World. We will present our information to the Medford BOE and recommend courses of action.)

- **Be a STEM Professional**

The report clearly describes collaboration with a STEM professional that enhanced the research methods, contributed to improved precision, and supported more sophisticated analyses and interpretations of results (Mr. Tyler, the professional drone pilot)

- **Be a STEM Storyteller**

The report describes or shows how the students shared the story of their research in a creative way. (Participating in the GLOBE Webinar by making PPT slides and giving the presentation.)

Bibliography/Citations

¹Mosquito, GLOBE Mission. *YouTube*, *YouTube*, 9 Nov. 2018,
www.youtube.com/watch?reload=9&v=sBqt9PxFSIA.

²Mosquito, GLOBE Mission. *YouTube*, *YouTube*, 6 Feb. 2019,
www.youtube.com/watch?v=MsHycC-vMxY&feature=youtu.be

³“Mission Mosquito.” #Language
www.globe.gov/web/mission-mosquito/overview.

Note: All images were taken by the research team (Laura, Kai, Ethan), Mrs. Gorman, or the drone pilot, Mr. Tyler.